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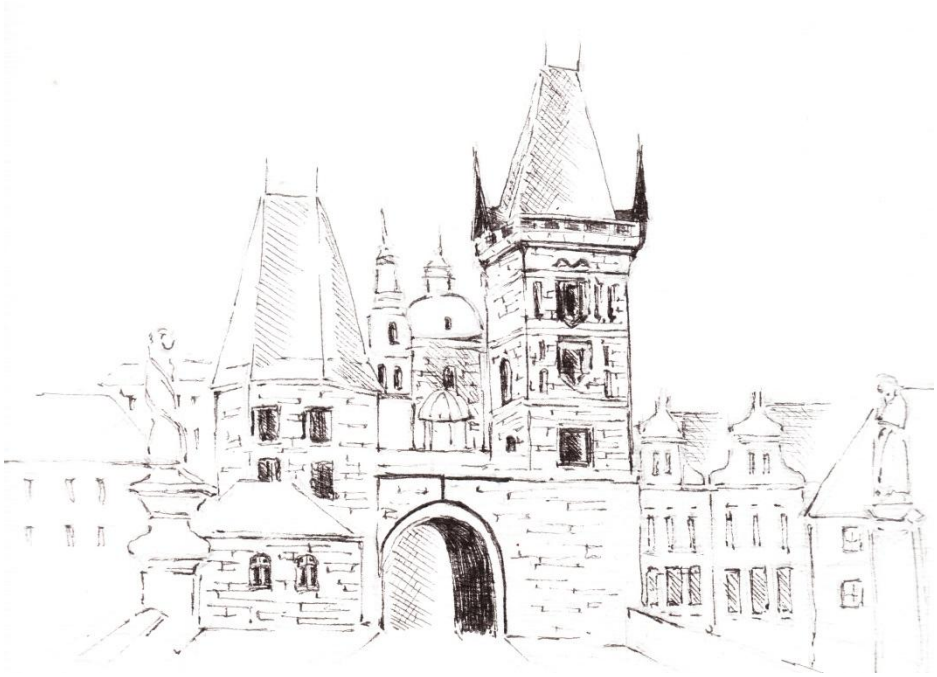

Prague - Janie Chroust 2013

Welcome to IDIMT 2013!

A hearty welcome to the 21st IDIMT Conference!

We are happy to welcome you for the 21st time at an IDIMT Conference. Looking into the audience I see the familiar faces of participants loyally returning year after year. We are a big family! For me the friendly atmosphere, and the ample discussion time – many other conferences unfortunately lack these characteristics – are the greatest assets.

Looking back at the history of the IDIMT Conferences[1] we notice changes for the better taking place every year. This year we are changing the location: We started off at Kubova Hut in 1993, then moved successively to Zadov, Ceske Budejovice and Jindrichuv Hradec. This year we have arrived in Prague at the well known University of Economics. We hope that the long academic tradition of Prague's universities will have a positive influence on our conference, too.

The historical academic aura of Prague together with the beauty of the historical buildings and sites will provide an excellent ambience for our conference.

For the first time we are not a stand-alone conference. We have arranged our conference parallel to the well-known CONFENIS 2013 conference. We hope that this will lead to further multidisciplinary dialogues.

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[1] Chroust, G. and Doucek, P. and Loesch, C.W. (eds.): 20 Years of IDIMT Conferences - Looking Back, Inst. for Systems Engineering and Automation, J. Kepler University Linz, Austria, Nr SEA-SR-35, Sept. 2012, ISBN 978-3-902457-35-6

The overall orientation of our conferences has not changed: it deals with current and future challenges in a world dependent on Information and Communication Technology, but each year we can observe a slight change in interest and direction.

During the initial conferences we discussed transitions of economies and social systems and their technical and managerial consequences. We then gradually advanced to considering the systemic aspects of a world dependent on Information Technology, also looking at challenges and problems. Soon economic topics caught the interest of the participants, followed by contributions concerning sociological and ethical aspects. Later reliability, vulnerability, disasters, and security became key topics. The influence of Social Media has entered the discussion this year.

This year's conference again is related to the topics of last year, but adapted and modified according to current trends:

- Smart ICT solution for business and public services
- Computer Based Innovation in SMEs
- Corporate Performance Management
- ICT Impact on Economy
- Social Media - the Good, the Bad, the Ugly
- Electronic Media in Crisis Situations
- Ethics and Social Responsibility in the Computer Age
- Security/Dependability of Cyber-physical Systems

Employing a blind review process we have accepted 33 submitted papers and 9 invited papers, resulting in an acceptance rate of 0.63. The authors come from 6 different countries (Austria, Czech Republic, Denmark, Germany, Slovakia, Ukraine).

Each session is organized by a Session Chairperson. Traditionally a session begins with a keynote, the other papers providing additional points of view. The papers are followed by intense discussions. We believe that the intense discussions are one of the attractions of the IDIMT-Conferences, due to the interdisciplinary exchange of thoughts.

The preparation and realization of IDIMT 2013 would not have been possible without the support of many organizations and persons. Therefore we would like to thank:

- the Czech Grant Agency for partially sponsoring the conference (GACR Grants P403/11/1899, P403/11/0574) and Internal Grant Agency (IGA) Grant F4/8/2013 (IG409013),
- the University of Economics Prague and the Johannes Kepler University Linz, which as partner universities provide the organizational infrastructure,
- Česká spořitelna, a.s. for financial support of the conference.

Our further thanks go to:

- Petr Doucek for chairing the Organizing Committee and organizing a beautiful evening event,
- Václav Oškrdal and Antonín Pavlíček who took over the work of arranging and assembling the selected papers into the proceedings, keeping contact with all involved parties, especially reminding the authors and performing all the other necessary administrative jobs,

- Lea Nedomová, Conference Secretary, for her support,
- all keynote speakers, speakers and contributors of papers,
- all Session Chairpersons for establishing contacts and soliciting contributors,
- all reviewers providing evaluation remarks and suggestions for improving the papers,
- the Trauner Verlag for acting as the publisher of our conference, and
- all other unnamed persons contributing to the success of this conference.

To a successful and interesting conference!

Gerhard Chroust, July 2013

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ELECTRONIC MEDIA IN CRISIS SITUATIONS

SOCIAL MEDIA IN CRISIS SITUATIONS

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Keywords

Disaster response, social media, blogs, phases, psychological effects, information management

Abstract

Adequate response to wide-spread crises is becoming a global necessity and a social responsibility in view of the seemingly growing number of regional disasters endangering a growing number of people and even our society. Adequate response is highly dependent on the availability of appropriate information with the right contents, at the right time, and in the right place. The organized information acquisition and dissemination by official institutions (essentially top down) is an established method. In the last decade an alternative approach has been introduced, which promises to cover many of the gaps and blind spots of the classical approach: Social Media. We discuss the available Social Media and their use in responding to disasters.

1. Motivation

Crisis situations (often man-made or at least triggered by human activities) appear to have grown in number, in scale and in their impact, together with an increased public awareness due to media coverage (Bolin and Standford, 1998; Altomonte, 2012). Adequate reaction/response to wide-spread crises is becoming of vital global necessity and a social responsibility in view of the seemingly growing number of occurrences. A key success factor for a timely, adequate, and effective handling of a crisis is the availability of appropriate information and the ability to process and distribute it effectively. Social Media are a new form of communication in a bottom-up way. They augment in many ways the classical 'official' information strategies during crises. In chapter 2 key aspects of crises are discussed, followed in chapter 3 by an analysis of Social Media. Chapter 4 discusses the usage of Social Median in crisis situations.

2. Key Aspects of Crises

2.1. Phases of a Crisis

From a stakeholder viewpoint we distinguish five phases of a crisis (Fig. 1). The length of the phases and their time evolution (Mrotzek and Ossimitz, 2008) depends on many circumstances, the transition from one phase to the next often being ill-defined. The only certainty is that when disaster strikes, it is too late to start preparing!

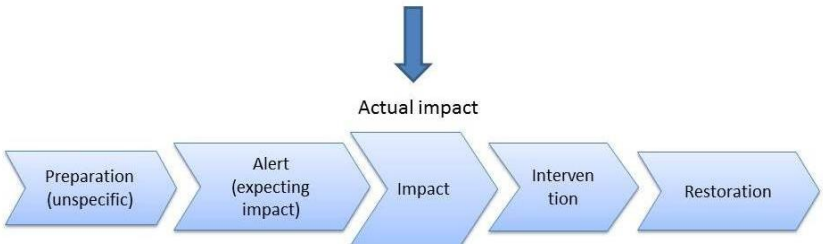

Fig. 1. Phases of a Disaster

Preparation Phase: The Preparation Phase takes place before any actual incident is incipient and considers potential hazards. Necessary data is collected, procedures and strategies are identified, recorded and trained (Sanders and Lake, 2005; Linnerooth-Bayer, 2006), necessary materials are stacked, organizational issues are discussed and decided (Chroust and Ossimitz, 2011; Reissberg, 2010).

Alert Phase: During the Alert Phase specific hazards are to be expected (perhaps more than one) and specific preparatory actions are started. However, it is still not certain that the crisis will materialize.

Impact Phase: The Impact Phase can vary from a very short time (e.g. an earth quake) to a lengthy period of time, e.g. a long lasting flood (Mrotzek and Ossimitz, 2008).

Reaction/Intervention Phase: The impact triggers remedial actions via an Intervention. This phase is responsible for quick first responses (e.g. 'First Responders') in order to contain and/or mitigate the damage and give first aid to all victims. It is successful if it manages to bring the damaged system into a temporarily acceptable state. Time is a critical factor for this phase.

Restoration Phase: After a 'settle-down' time the Restoration Phase can start. It needs long-term vision and planning. It aims at restoring the damaged system to a state which can be accepted as an adequate replacement of the original system. There is also an effort to implement improvements on all necessary levels which will avoid or at least mitigate future damages, including new safety standards and regulation, stacking necessary materials for the next crisis, etc.

2.2. Stakeholder

A disaster involves numerous differing stakeholders, most of them having varying information needs in relation to their status, their situation, and their tasks. A rough classification of stakeholders with respect to their involvement is given in (McEntire, 2007, chapter 2), but with the caveat that a person can have several roles at the same time!

Immediate victims: these are persons immediately affected by the disaster, being physically or men- tally injured, having lost relatives, and/or property. They are in need of immediate help.

Persons associated with victims: These have themselves not suffered damage, but are worried about victims they are associated with (relatives, friends).

First Responders: These are organized groups of persons (fire brigade, rescue services, medical personnel, technical support, etc.) on the scene of the disaster. They may even come from distant locations.

Voluntary helper: In the case of an emergency many people rush to the scene to help (Neal et al., 2012). Their interference ranges from usefulness to helplessness and to being an outright nuisance. Their willingness to help depends strongly on their social milieu (Barth, 2007; Barth and Flaig, 2013) and mobilization (section 4.2.).

Government officials: Persons who are in charge of the area, are responsible for policy, organization, and intervention in the disaster area.

Media: Media include reporters, camera teams, radio and television speakers, website-managers etc. They provide information to the public. They are keen on news and are at the same time a disturbing factor in crisis response (McEntire, 2007, chapter 72).

General public: The general public, local and distant, wants to be informed by media, by government officials and - today - also by social media. Today it is practically impossible to limit, restrict, and control the information reaching the outside world.

Sensors and actuators: Although they are not truly stakeholders, in many aspects they behave in the same way. Typically a wide-area survey of a situation e.g. the status of a flood, can be based on a combination of twitter messages, air reconnaissance, and measurements from sensors (Laursen, 2013; Hughes and Palen, 2009).

Another way of classifying stakeholders is to distinguish them by personality and gender, age, degree of handicaps, local vs. foreigner, different cultures (Hofstede and Hofstede, 2005), different milieu (Barth and Flaig, 2013), trained versus untrained helpers, social milieu (Wikipedia-english, 2013, sinus milieu), etc.

2.3. Information Needs

Today‘s technology has brought about a change in people’s attitudes, see (Haddow and Haddow, 2008): "We have to recognize that people today have a different expectation with respect to information and its availability. Spoilt by the ’normal’ operation of the internet people expect immediate availability of information and also instant communication facilities. Waiting hours for an official communiqué is often not accepted. Additionally social media provide a web of interconnections providing information and disinformation to a wide area of listeners."

Needed *information* (Haddow and Haddow, 2008) comes in different, sometimes overlapping forms:

direct information: This is information needed by a stakeholder in order to fulfil his/her task. With respect to the recipients we can distinguish:

mass information The same information is provided to everybody within a certain domain (e.g. general alarm).

mass customized information General information which is somewhat tailored to a specific group of people but can be derived from general information, e.g. hand gesturing for deaf people, language translations (Piller, 2006).

individualized information Information which is only meant for single persons or a very small group (e.g. for a person in a wheelchair stuck in a house, or for a squad of Fire Fighters).

indirect information Information needed to derive/create/define more specific information which finally (perhaps over several steps) becomes direct information (e.g. the evacuation maps in a hotel, photos/sketches of buildings, forecast of weather and storm direction).

global information Information which is valid (and useful) for a group or all stakeholders (e.g. Weather forecast) and enables general orientation

ancillary information Information which in itself is not directly useful but gives a general overall view and perhaps consolidation and assurance (speech from a high-ranking official, announcement of rescuers on their way, ...).

3. The Phenomenon of Social Media

3.1. Social Media - A new Paradigm

Traditional information management using standard Information and Communication Technologies (ICT) is able to handle the information described in section 2.3.. Modern technology has added considerable speed, storage amount and computing power, providing a ubiquitous communication potential which was unknown some 20 years ago. This takes place in ways not previously anticipated, e.g. pattern recognition, data mining, simulation, virtual reality, etc. (Chroust, 2012).

In the past information supply was mostly a top-down process - from official sources to the individual. Information in the other direction had also been channelled through official response centers (crisis centers) to be re-distributed from there. This obviously allows for those in power to obstruct, modify, and suppress undesired information in many ways.

In the last decade a completely new paradigmatic support medium has emerged: Social Media (Surowiecki, 2005; Grifantini, 2009; Leimeister, 2010; Miller, 2010; Hossfeld et al., 2012).

(Haddow and Haddow, 2008) states: "The emergence of new media-online news sites, e-mail, blogs, text messaging, cell phone photos, and the increasing role played by "first informers": witnesses who now have the ability to transmit information immediately from the event. [They] are redefining the roles of government and media. ... government's historical role as gatekeeper is now an anachronism. Traditional media's role as the sole conduit of reliable and officially sanctioned information has been eclipsed by the increasing use and influence of new media."

In (Fraustino et al., 2012) we find: Social media are interactive digital tools that feature content users may generate, manipulate, or influence. Social media are conducive to timely, interactive communication and foster dialogue and content exchange among message consumers and creators ... While many traditional media (such as newspapers and television) remain important disaster communication channels, traditional media primarily facilitate one-way information dissemination. Social media can create opportunities for two-way dialogue and interaction among organizations, the public, and individuals.

The term "Social media" refers to the means of interaction between people in which they create, share, and exchange information and ideas in virtual communities and networks. A. Kaplan and M. Haenlein (Kaplan and Haenlein, 2010) define social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content."

Furthermore, social media depends on mobile and web-based technologies for creating highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content. It introduces substantial and pervasive changes to communication between organizations, communities and individuals (Wikipedia-english, 2013, keyword 'Social Media').

3.2. Types of Social Media

In the last decade we saw a growing diversity of social media, offering different approaches and usage. Classification proves difficult due to the newness, the volatility of the definitions and also the fact that many of the available activities cover more than one area. Following (Kaplan and Haenlein, 2010) we identify eight categories of social media.

Collaborative Projects Numerous persons contribute towards a common 'artifact' in the widest sense of the word. Examples are Wikis for text-based content, Social Bookmarking (Recommender-

systems) which enable group-based collection and rating of Internet links or media content, similarly also to Co-creating which attempts to realize a mutual value for group-members.

Blogs A blog is a website that conveys the writer or group of writers' opinions or experiences. It can include text, pictures, and even video. Facebook and Twitter are its most prominent examples.

Content Communities The main objective of content communities is to share media content between users.

Crowd Sourcing (not included in (Kaplan and Haenlein, 2010)) In Crowd Sourcing a large number of users try to solve a problem / find a solution by combining their common knowledge ('swarm intelligence' (Miller, 2010)).

Social Networking Sites Social networking sites allow their users to connect by use of personal profiles containing diverse types of information including photos, video, audio. They usually feature instant messaging and email.

Indirect Swarm Collaboration (not included in (Kaplan and Haenlein, 2010)) Swarms may behave in a seemingly coordinated way yet without central control (Miller, 2010, p. 120-121), guided by very simple rules which the members of the swarm apply individually.

Virtual Game Worlds In a virtual game world users interact using a personal avatar in a three dimensional, near-realistic environment.

Virtual Social Worlds Virtual social worlds allow for an interaction in a three dimensional near-realistic platform using avatars in a way similar to real life.

4. Using Social Media in Crisis Situations

4.1. Information Exchange

Social media have become increasingly important in previous disasters with respect to communication possibilities. The table (Fig. 2) indicates in which phase the different types of social media have been helpful ("*") and exceedingly helpful ("**").

	Prepare	Alert	Impact	React	Restore
Collaborative Projects	*	**			*
Blogs	*	*	**	**	
Content Communities	*			*	*
Crowd Sourcing		**	**	**	*
Social Networking Sites	*				*
Indirect Swarm collab.			*	**	
Virtual Game Worlds	*	*	*	**	*
Virtual Social Worlds	*				*

Fig. 2. Relating Social Media to Disaster Phases

Collaborative Projects are especially helpful in pooling valuable advice before the expected disaster occurs. During restoration, again, the input of all stakeholders is valuable for the improvement of the new system and incorporation of the lessons learnt.

Blogs turn out to be very effective in supporting resilience with respect to disasters, especially during the "hot" phases of a disaster. Data indicate (Taylor et al., 2012) that the public relies on a mix of formal and informal information sources. Social media are often used to re-post or re-tweet

links from government websites felt to be of use to communities, thus acting as filters and amplifiers of 'official' information.

Surveillance is a major aspect in situational reconnaissance. Blogs can supply information without First Responders physically accessing the disaster area: One can rely on "First Informers", often also called "voluntweeters" (Fraustino et al., 2012).

Facebook and Twitter are also very effective in fund raising during the Reaction and Restoration Phase (Fraustino et al., 2012).

Content Communities will be most helpful in putting together necessary pieces of information for 'the case if'. The collection of facts used in the 2010 Haitian earthquake was greatly simplified by Ushahidi-Haiti, a crisis map created right after the earthquake by volunteers from Tufts University (Fraustino et al., 2012). Disaster survivors and volunteers were able to send incident reports via text messages and tweets. In less than two weeks, 2.500 incident reports were sent to the map.

Crowd Sourcing will be especially helpful in bringing together information from all parts of the affected area (Miller, 2010). It can also collect helpful advice from locals who are familiar with the location.

Social Networking Sites will be helpful in making people aware of one another with respect to their knowledge and abilities during the 'quieter' Preparation Phase and during Restoration.

Indirect Swarm collaboration can be useful in directing a larger group of people to go/run to safety in the right direction. A small number of persons must start doing the right thing. The obvious danger is that the behaviour of the crowd can easily be mislead or even lead to panic.

Virtual Game Worlds can be a valuable training instrument, especially for First Responders. In the reaction phase these allow experimenting with different reaction strategies. They are helpful for Restoration as they can envision different alternatives

Virtual Social Worlds In the Preparation and the Restoration Phase they allow people to train their social competence (Hampden-Turner and Trompenaars, 2000; Lindsey et al., 2003).

4.2. Motivation and Mobilization of Stakeholder

With respect to self-motivation (Fraustino et al., 2012) observes: During disasters, the public may use social media to organize emergency relief and ongoing assistance efforts from both near and afar. In fact, one research group dubbed those who surge to the forefront of digital and in-person disaster relief efforts as "voluntweeters". Research also showed the positive role of Facebook and Twitter in disaster relief fundraising. Research also reveals how social media can help identify and respond to urgent needs after disasters. A similar behaviour was described in (Neal et al., 2012).

There is also a contrasting view in (Kennedy, 2011) that the many people, both in real life and in the social media world tend to "stand- by and watch without taking any action". The "bystander effect" may explain the non-reaction by many: The more people witness a person in distress the less likely they are to do something to intervene and try to help.

4.3. Psychological Effects of Social Media

As a consequence this information exchange and the promotion of connectedness can enable Social Media to act as a source of psychological first aid in the early stages of disaster and can assist by supporting community resilience, e.g. when trapped by a disaster people feel helpless, completely at a loss, disoriented, and frightened. Victims turn to blogs for emotional release and support (Fraustino et al., 2012)

Being able to use a blog raises the hope for help and also effectively increases the chances of being detected and rescued.

"… disasters are often inherently tragic, prompting individuals to seek not only information but also human contact, conversation, and emotional care (Sutton et al., 2008). Social media are positioned to facilitate emotional support, allowing individuals to foster virtual communities and relationships, share information and feelings, and even demand resolution. Indeed, social media in general and blogs in particular are instrumental for providing emotional support during and after disasters" (Fraustino et al., 2012).

Being able to contact somebody (even an unknown person) gives a certain amount of assurance. (Mercer, 2012; Howell and Taylor, 2011) observe that social media can limit psychological damage during natural disasters, as observed by studies of use of Facebook and Twitter in Queensland, Australia, New Zealand und Japan. Keeping people active is a way of reducing the direct psychological stun effect, as experience in emergency situations has proven in the Impact and Intervention Phase. A person who is shocked and paralyzed by disaster can be reactivated by performing an active task of support for recovery. Involving all people in recovery actions increases resilience and activates the potential of resilience. The impact of disaster concerning psychological effects is possibly reduced.

4.4. Social Media - Acceptability

Information is only useful if available correctly at the right place in the right time and in the adequate form. Thus the provision of adequate reliable and robust communication channels must also be analyzed with the communication medium matching the type and importance of the information.

Many reasons exist as to why Social Media have received the kind of acceptance they have (Fraustino et al., 2012):

- Because of convenience
- Based on social norms
- Based on personal recommendations
- For humour and levity
- For information seeking
- For timely information
- For unfiltered information
- To determine disaster magnitude
- To check in with family and friends
- To self-mobilize
- To maintain a sense of community
- To seek emotional support and healing

Conversely, chief reasons why the public might not use social media for disaster communication are (Fraustino et al., 2012)

- privacy and security fears,

- accuracy concerns,
- access issues, and
- knowledge deficiencies.

Key requirements for the use of Social Media are:

Quality of channels: high-capacity, stable, and reliable channels that function even during disaster

Filtering of Information quality: qualified vs. non-qualified, reliable or unreliable information

Filtering of priorities: crisis related content vs. standard communication content

Coordinated actions for gathering of useful information aggregation of individual data, comparison and elimination of untrustworthy sources.

Trust in authorities Providing authentication of messages, preventing hoax and disinformation (McEntire, 2007).

Saving bandwidth It is a known fact know that during a crisis traffic especially via blog-devices in- creases up to the point of breakdown. Technical means for reducing band width requirements can be used, e.g. by speech-to-text conversion, coding (codes for standard incidents), reducing transmission quality, etc.

5. Summary

Crises have and will always a posed threat for our lives. The progress in Information and Communication Technologies (ICT) has revolutionized Crisis Management as in many other fields. The speed and the ubiquity of wide-area two-way communication is a completely new phenomenon which can be used in manifold ways to improve and accelerate the efficiency and effectiveness of Crisis Management.

We are now on the brink of an information revolution in crisis response. In former times possibilities were lacking which enabled the broad mass to become involved in disaster response. Government officials and disaster relief organizations are not too well trained in dealing with the public, especially via the new media. Mobile technologies and Social Media bring in a new perspective. The broad mass, the Crowd, is able to help in gathering and dissemination of information on site.

Social Media might also bring about change in the attitude of people, from a "they have to help" to a "we will help".

In this paper we have described - from the viewpoint of Social Media - needs and trends. It has to be understood that the technical communication media must keep pace with the abilities and the requirements of information interchange. The optimal utilization of the information processing capabilities and the communication facilities still prove considerable challenges both for technical and human factors experts.

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References

Altomonte, H. (2012). Japan's nuclear disaster: Its impact on electric power generation worldwide [in my view].Power and Energy Magazine, IEEE, 10(3):96 –94.

Barth, B. (2007). Der emotionale konsument: Brauchen wir eine andere marktforschung? In VMÖ, editor, Handbuch der Marktforschung. VMÖ, Wien 2007.

Barth, B. and Flaig, B. (2013). Was sind sinus-milieus®? - eine einführung in die sozialwissenschaftliche fundierung und praxisrelevanz eines gesellschaftsmodells. In Thomas, P. M. and Calmbach, M., editors, Jugendliche Lebenswelten. Berlin - Heidelberg 2013.

Bolin, R. and Standford, L. (1998). The Northridge Earthquake: Vulnerability and Disaster. Routledge, London 1998.

Chroust, G. (2012). ICT support for disaster management. In Doucek, P., Chroust, G., and Oskrdal, V., editors, IDIMT 2012 ICT-Support for Complex Systems, vol.38 Sept 2012, pages 13–23. Trauner Verlag Linz, 2012.

Chroust, G. and Ossimitz, G. (2011). A systemic view of interventions in regional disasters. In Doucek, P., Chroust, G., and Oskrdal, V., editors, IDIMT 2011 Interdisciplinarity in Complex Systems, vol.36 Sept 2011, pages 81 – 94. Trauner Verlag Linz, 2011.

Fraustino, J. D., Brooke, L., and J., Y. (2012). Social media use during disasters: A review of the knowledge base and gaps, final report. Technical report, Human Factors/Behavioral Sciences Division, U.S. Dept. of Homeland Security, 2012.

Grifantini, K. (2009). Can you trust crowd wisdom? Technology review (MIT), Sept 16, 2009.

Haddow, K. and Haddow, G. (2008). Disaster Communications in a Changing Media World. Butterworth- Heinemann Homeland Security, kindle-book, 2009.

Hampden-Turner, C. and Trompenaars, F. (2000). Building Cross-Cultural Competence - How to Create Wealth from Conflicting Values. Yale Univ. Press 2000.

Hofstede, G. and Hofstede, G. J. (2005). Cultures and Organizations - Software of the Mind. McGraw-Hill, NY 2005.

Hossfeld, T., Hirth, M., and Tran-Gia, P. (2012). Crowdsourcing. Informatik Spektrum, vol. 35 (2012) no. 3, pages 203–208.

Howell, G. V. J. and Taylor, M. (2011). When a crisis happens, who turns to facebook and why? Asia Pacific Public Relations Journal, 2011.

Hughes, A. and Palen, L. (2009). Twitter adoption and use in mass convergence and emergency events. In

J. Landgren, J. and Jul, S., editors, In Proceedings of the 6th International ISCRAM Conference, Gothenburg, Sweden, May 2009.

Kaplan, A. and Haenlein, M. (2010). Users of the world, unite! the challenges and opportunities of social media.Business Horizons vol. 53 (2010) no. 1 , also www.sciencedirect.com, pages 59–68.

Kennedy, B. P. (2011). Posting on disaster. http://www.psychologytoday.com/blog/the-digital- self/201101/posting-disaster.

Laursen, L. (2013). Robot to human: "trust me". IEEE Spectrum vol. 50 (March 2013), page 13. Leimeister, M. (2010). Kollektive intelligenz. Wirtschaftsinformatik, no 4 (2010), pages 239–242.

Lindsey, R. B., Robins, K. N., and Terrell, R. D. (2003). Cultural Proficiency: A Manual for School Leaders.Corwin Press 2003.

Linnerooth-Bayer, J. (2006). Planning for disasters. Options (IIASA), summer 2006, pages 18–19.

McEntire, D. (2007). Disaster Response and Recovery: Strategies and Tactics for Resilience. Wiley, USA 2007. Mercer, P. (2012). Social media eases psychological bruden of natural disasters. http.voanews.com/content/. Miller, P. (2010). Smart Swarm - Using Animal Behaviour to Change our World. FSC + HarperCollins, 2010.

Mrotzek, M. and Ossimitz, G. (2008). Catastrophe archetypes - using system dynamics to build an integrated systemic theory of catastrophes. In Chroust, G., Doucek, P., and Klas, J., editors, IDIMT-2008 - Managing the Unmanageable - 16th Interdisciplinary Information Management Talks, pages 3671–384. Verlag Trauner Linz, 2008.

Neal, R., Bell, S., and Wilby, J. (2012). Emergence in the disaster response to the june 2007 hull floods. In Bichler, R., Blachfellner, S., and Hofkirchner, W., editors, European Meeting on Cybernetics and Systems Research 2012 - Book of Abstracts, pages 85–87. Bertalanffy Center for the Study of Systems Sciences 2012.

Piller, F. (2006). Mass Customization: Ein wettbewerbsstrategisches Konzept im Konzept im Informationszeitalter.Deutscher Universitätverlag Wiesbaden, 2006.

Reissberg, A. C. (2010). A cybernetic approach to hurricane hazard management on O'Ahu, Hawaii. In Leonard, A., editor, ISSS 2010: Governance for a Resilient Planet, page (paper no. 1350). ISSS, 2010.

Sanders, R. L. and Lake, J. E. (2005). Training first responders to nuclear facilities using 3-d visualization techno- logy. In WSC '05: Proceedings of the 37th conference on Winter simulation, pages 914–918. Winter Simulation Conference.

Surowiecki, J. (2005). The Wisdom of Crowds. Anchor Books, Random House, New York 2005.

Sutton, J., Palen, L., and Shlovski, I. (2008). Back-channels on the front lines: Emerging use of social media in the 2007 southern california wildfires. In Proceedings of the 2008 ISCRAM Conference, Washington, DC, USA, May 2008.

Taylor, M., Wells, G., Howell, G., and Raphael, B. (2012). The role of social media as psychological first aid as a support to community resilience building. The Australian Journal fo Emergency Management, vol 27 (2012) no 1, pages 1324–1540.

Wikipedia-english (2013). Wikipedia, the free encyclopedia. http://en.wikipedia.org/wiki/.

EVIDENCE COLLECTION FOR CRITICAL INFRASTRUCTURE

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Data retention, critical infrastructure, evidence collection

Abstract

When critical infrastructure is attacked electronically, traces of the attack are often absent. Either because the systems involved do not store data themselves, any evidence involved was deleted by the attackers, or the malfunction destroys/deletes the data. To be able to identify the responsible party and/or find out how the intrusion took place a system of "tracer boxes" is suggested, which retains data for later analysis, without taking part in communication and being strictly separated from the systems themselves. The necessary properties of such a system are discussed and potential legal problems analysed.

1. Introduction

Critical infrastructure is more widespread than would at first be assumed: for instance without electrical power a lot of things won't work any more, from gasoline pumps to cash registers in shops. Yet it is difficult to protect, as such infrastructure might be widely distributed, yet interconnected. This is less a problem as such, but more when considering that today these elements are supervised, and often also controlled, from remote. Therefore it is essential to protect this communication. However, the protection itself is not the focus of this paper, as this is dealt with in detail very often (e.g. Ten/Manimaran/Liu 2010 and Cheminod/Durante/Valenzano 2013). Rather it assumes – as the past has already proven (Gorman/Yadron 2013) – that attacks on such infrastructure will occur (some of them even successful; Falliere/Murchu/Chien 2011), and then the problem exists of finding the culprit. Ideally there would be some evidence, but often it is enough (e.g. other countries are involved) to be able to pinpoint the attacker with reasonable confidence. In many cases not only the source of the attack is of interest, but also the "how": where the attacker broke into the system first, what the vulnerability was etc. (Sridhar/Hahn/Govindarasu 2012). This is especially important for the future to be able to patch any problems through software, regulations, procedures and so on. To a limited degree this could also be useful for an operator of such infrastructure to be able to present evidence that a malfunction was not caused by him or his employees, but was caused by external attackers (and hopefully despite adequate protection measures instituted by him! Ahmed et al 2012).

An example for such an attack (or it could have been a human error or a technical mistake; currently a lack of software updates is presumed) was when almost the Austrian power grid

collapsed – which might have caused the whole European power grid to collapse as well. The reason for this was a command intended for requesting usage information from natural gas customers in Bavaria, which somehow managed to get into a similar network for electricity. This caused an avalanche of responses, replies etc. which caused the central control system to no longer be reachable. The actual source of the command has not yet been identified (Berger 2013).

Another aspect will be investigated in this paper as well to a limited degree is, that if the infrastructure is really critical, a successful attack might destroy any collected evidence (e.g. no power for some time → data is lost; limited explosions/fires → computer is destroyed). So the aspect of retaining the data for further analysis, while simultaneously keeping it secret, is of interest too.

The basic idea of how to solve these problems is to introduce a large number of cheap data retentions systems, called "tracer boxes" at numerous points within the system. These collect data and store it in a ring buffer, so they can operate without any data extraction for a long time. In case of an incident overwriting old data is halted and the boxes collected for evaluation of their recorded data.

Some constraints must be set for this paper to be able to investigate this proposed system:

- Communication takes place using the Internet: This does not necessarily mean, that this is really a public network, but rather that the Internet protocols are employed and similar media used for communication. Physically the network might be (reasonably) separated from the "real" Internet, or employ virtual private networks (VPNs) to emulate a separate private network when using public communication facilities. Other communication mechanisms might also be monitored, but then the hardware might typically become expensive fast.
- Only computerized systems can be monitored: The tracer boxes only accept digital data and will not collect other sensor data themselves. They are completely passive and just record information passed to them, requiring cooperation by computer systems in sending them data if not monitoring a communication path.

1.1. Potential attacks/attacker profile

Retaining communication and status data will not prevent attacks, but this is not the aim. It is "merely" there to obtain evidence for later analysis. Therefore it must be discussed, which kinds of attacks (in a wide sense) can later be investigated. For example, although not a typical attack (but: insider attacks of disgruntled/terminated employees!) fatal misconfiguration will show up in communication protocols, and potentially also system logs (login of user and configuration change). Additionally the source of this communication can be pinpointed through the source address of the packets. If this is falsified, the wide distribution of boxes throughout the network will allow locating the actual point of entry of these packets with reasonable accuracy. Aligning the input to a system with its output (e.g. when a tracer box exists on both sides of a firewall) allows verifying its correct implementation or discovering incorrect configuration/malfunctions afterwards. Depending on the extent of logging of a system, problems might even be recreated if the systems state is known to a large degree: replaying the input should then lead to the same output, or allow deriving the previous state from it. Also, attacks designed to crash the system might destroy any useful data on the system itself, but would not affect a tracer box, which does not interpret the data at all. Similarly, successful hackers often clean log files to remove any traces – which is not possible here as well.

A potential problem with this approach is that attacks must be detected externally. Therefore the proposed system will not bring any results in the following circumstances: a system is hacked, but no further activity takes place. I.e., the critical infrastructure is only hacked to the degree "something could be done, but nothing has been done". If then a time elapses which is longer than the retention time, subsequent attacks will only show their "initiation" in the logged data (or nothing if some kind of scheduler within the system has be exploited), but not the actual intrusion. It should be noted however, that this is perhaps a low probability attack, except for foreign governments. Most other hackers would at least issue some commands with negative effect to verify/prove their ability to actually cause any effect and thereby risk discovery.

2. Introducing tracer boxes

Such tracer boxes would be placed at strategic points in the communication network and attached to important systems. Examples for this could be (ideally all simultaneously, not alternatively!):

- In front of a firewall and after it (both sides): What (kind of) traffic reaches the system, what has passed through it – in both directions. It therefore incorporates aspects of intrusion detection systems (outside → in) as well as data loss protection systems (inside → out).
- On each network segment: To later investigate the traffic on it for anomalies. This would typically be some form of Ethernet, but could also be any other bus system, i.e. not only the connection to the "PC" controlling the machine, but also the connection from the "PC" to the individual machines should be monitored. If this is a long segment (e.g. glassfiber connection between to plants several kilometres apart), a tracer box should be present on both ends, as manipulations could also take place between them. This applies especially to wireless communication paths, where it is easy to set up a rogue sender to inject additional data.
- Attached to each important control system: E.g. for each computerized machinery-control system a tracer box should be connected to it, receiving logging data and trace information.

Different from the system Kilpatrick et al 2006 propose the whole data will be stored, not only an excerpt based on "relevant portions of network packets" deemed important. Additionally we do away with a central storage, obviating thereby the need for a completely separated parallel communication network.

2.1. Requirements for tracer boxes

This results in a very large number of such systems in two main configurations: Listening in on communication (in whatever form), and monitoring a computerized system. However, most characteristics of tracer boxes for both systems would be very similar and would have to be:

1. **Completely passive**: Tracer boxes do not ask for information, but only receive data which is sent to them. In this way there is no danger that they influence the monitored systems in any way, even if they should malfunction. Additionally, as they do not receive any commands, the potential for attacking them is extremely limited: only malformed data could be used to "hack" them. This is comparatively easy to protect against, so there would not be any real danger of electronically infiltrate or subvert them. This could for example be realized even on a hardware basis by connecting them to networks, respectively the monitored computers, through a network tap. This is a device allowing data only to flow in

a single direction, i.e. signals can pass only from the network/system to the tracer box, but no wires exist for communication in the other direction.

2. **No data analysis**: Tracer boxes only store data, but do not analyse it, as e.g. proposed in Valli 2009. This reduces the complexity of the box, preventing the need for voluminous software systems which could easily crash (or being crashed through artificially constructed data!). Also there is no need for powerful CPUs, lots of RAM etc., keeping the size and price of such a device small. This has another aspect too: if the data is analysed, then this is only useful if some action ensues if an attack is detected. But this would mean initiating some kind of communication to the outside, with the associated problem that this might be faked. Additionally current intrusion detection systems similar to this suffer from a high rate of false positives. With a large number of such systems distributed through the critical infrastructure this could easily end in a management nightmare. An additional advantage is that the configuration of the device is minimized – there is no need for a learning phase or describing what data is acceptable and what not.
3. **Rolling data storage**: Data will be stored for limited time only. This presumes that an attack on a critical infrastructure will be detected "soon", e.g. within one week (but see above for delayed exploitation). For a coarse estimate of the storage required let's assume a fully loaded 100 MBit connection (unrealistic for infrastructure control!), where every bit is retained. This means: 100 MBit/s = 12,5 MByte/s = 1,08 TByte/day = 7,56 TByte/week. This is still a significant amount of data, but with 3 TB hard disks commercially available for a low price, this does not seem out of the question. If the data rate is reduced to 10 MBit/s (more realistic even for the boxes monitoring computers – these would have to generate this amount of logging data beside their normal work!), a single cheap and readily available 1 TB hard disk would be sufficient (or a smaller and more robust, but not so cheap, SSD).
4. **Stopping recording**: As there should be no possibility of contacting such systems through the network, there is also no possibility to tell them to stop recording/deleting old data. This must therefore be organized differently. Options for this include: when the power fails (this is obvious, but it might be extended to any other physical local sensor), when no data arrives (therefore old data should not be deleted when "too old", but only when new data arrives and no more storage space exists), on preconfigured data inputs (very dangerous, as these might potentially be faked to hide subsequent attacks!), when too much data arrives in too short a time (as this would reduce the retention period), or manually (a simple button on the outside is sufficient; as physical access is required this shouldn't be a security issue with respect to electronic attacks). Potentially any such stopping could simultaneously cut off the communication or stop the system being monitored, ensuring no loss of data, but creating a potential for DoS attacks.
5. **Liveness checks**: One difficulty is the necessary liveness check. Otherwise hard- or software problems would go unnoticed till the next inspection when someone physically checks its. This includes not only the state of health of the trace box, but also whether it has stopped recording (see above) and whether it has received data recently (to detect it being physically sabotaged by disrupting its communication link). This can be done in three ways: completely locally (e.g. a small display; would require regular physical inspection) as well as using the same or a different communication medium. If the same medium is used this violates the second principle (see above), of not sending data. Moreover it might interfere with the normal procedure (when can data be sent onto this channel if we do not actively participate in it?) and would also potentially alert an intruder to the existence of the device.

Introducing a different communication channel, e.g. a SMS, brings its own problems. For instance in case of a critical infrastructure failure the reliability of such alternative channels is not assured – but then the problem is apparent anyway. But this also means additional hardware in each device, more power consumption, and potentially additional communication costs. Moreover, a completely passive system is not necessarily possible there, other than with e.g. Ethernet/glassfiber cables. Still, a separate (one-way because of security!) communication channel would be very desirable. This should be combined with a unique identification to ensure the authenticity of this message and prevent injection of false notices. This can be done through some secret knowledge embedded within the tracer box, e.g. a pseudo random number generator similar to those in security tokens or the private key for an electronic signature. Note, that a challenge-response protocol is not possible because of the unidirectional communication, so only a single notice can be sent, which must be different every time (replay attacks!), and can be verified as genuine without disclosing the secret data.

6. **Information disclosure**: Potentially problematic could be that any regular liveness signal might disclose the position of a critical infrastructure component and allow mapping/discovering them. However, if someone is seriously interested in critical infrastructure, it is probably not too difficult to find them in a different way. Normally these are large physical structures and therefore easy to discover. What might be different is, that any individual such structure might be easy to find if someone is physically there, but a liveness signal could perhaps be used to map all of them even from a greater distance or allow homing in on them by automatic devices.
7. **Updates**: Related to the liveness check are updates of tracer boxes. This requires significant communication directly towards them, which subsequently modifies their behaviour. Because of security issues this should not be possible – another reason for keeping them very simple, as any updates will then require physical presence!
8. **Data extraction**: Similar as updates any data extraction mechanism using communication would require the tracer box to send out large amounts of data, initiated by a command. This violates the principles discussed above and should be impossible. Any access to the data is easily performed through physically gathering the boxes (with critical infrastructure a physical inspection will necessarily take place after a larger incident!) and opening them. Because of their simple and cheap construction and installation they can be easily replaced (minimal configuration – see above!).
9. **Encryption**: Data is stored on tracer boxes in encrypted form, so if they get lost, the data is not disclosed. As no analysis takes place on the box this is no problem. As soon as the data is received, it is encrypted with a public key and subsequently stored. Only on analysis an (external to the tracer box!) private key is used for decrypting the data. However a small problem exists here: to be able to correctly delete/overwrite old data the timestamp and the record delineation should remain unencrypted. This would still allow some communication analysis, identifying how many messages of which length arrived when/during which period. It might therefore be better to store data in larger chunks, which are only deleted as a whole. The drawback is internal fragmentation (the end of the chunk is potentially empty as the next message doesn't fit in) and that some analysis remains possible.
10. **Simple, cheap, and physically robust**: As a large number of tracer boxes are expected to be placed, their cost and upkeep is very important. Therefore they should be on the one hand very cheap, on the other very robust. This should be possible today, as because of the lack of performance required, very simple devices are sufficient. E.g. they can be cooled

passively (no fan) and need only a small power supply (and not necessarily main power; almost any supply might work). The main difficulty remaining is the data storage: hard disks are cheap, but not that robust (e.g. vibrations) and require more power, while flash storage is comparatively expensive, but needs very little power and is mechanically very robust (their limit on writing should not be a problem: If data is stored for a whole week, then 1000 write cycles would result in a minimum durability of almost 20 years!).

An important decision is what data to retain for later analysis. For network communication this is quite trivial: everything. This does not mean the content data only, but really everything, including packet headers, ARP/routing communication etc. Analysis might be rendered more difficult because of this wealth of data, but only this approach ensures that all necessary data exists – as it is impossible to predict how an attack would occur in detail. For computer system traces this is much more difficult. One approach would be to introduce a logging system into the main software (if not present already), which will send its data to the tracer box. This logger, other than typically the one on production systems, would be configured to log full debug information – which should be produced in plenty by the main software. This must be done efficiently, as a lot of data can be stored and received easily, but assembling (e.g. string concatenation) and transmitting it might tie up resources.

2.2. Advantages and problems of this approach

The biggest advantage of this approach is, that data for later investigations exists, and is separated from the hacked system and practically impossible to hack electronically (separation; simple, no commands at all, not reachable from the outside). So a hacker might be able to remove any traces from the logfiles of a system and stop the transmission of data to the tracer box, but this can only be done after the initial intrusion has been successfully logged and retained in the tracer box. The main disadvantage is the costs: as the system cannot be used for normal monitoring, this seems like a purely additional cost with no direct commercial benefit. However this can be relativized when comparing them to the black boxes of e.g. aeroplanes. These also bring no direct commercial benefit, still even airlines are interested in them as they might be used to avoid liability in case of accidents, or aeroplane manufacturers can use them for finding out about problems which would otherwise probably remain completely undetected. Despite this, they would probably not exist if there were no regulations that they must be installed in every aeroplane. Such a requirement might be considered for critical infrastructure too: such infrastructure installations is similarly (if not more) expensive, malfunctions are very dangerous, and although infrequent, difficult to investigate afterwards (the equivalent of physical destruction is deleted/absent data, which is even worse, as not even a remote possibility might exist for finding traces!).

Another difficulty for communication tracer boxes is encrypted transmission. Logging the encrypted data is relatively useless, as decryption might be impossible even if all the secret/private keys involved might be known (e.g. random numbers in Diffie-Hellman key agreement would have to be logged with a system tracer box, else knowledge of the keys won't help!). The alternative would be to configure the tracer boxes as transparent proxies, but then they would have to send data, perform complex logic, and store private information – all things they should never do! It would therefore be necessary to implement encryption offloaders in front of systems, where the tracer boxes would be between those two. This is however expensive and introduces an additional system to be potentially attacked. Therefore such systems are usually installed only for large web servers to reduce their load – which are not the target of tracer boxes. A possibility to reduce this problem is to refrain from using encryption (within a - apart from attackers – closed network not unreasonable or totally uncommon, for process control systems rather the normal configuration,

IBM 2007), or live with it. The latter option is not useless, as some traffic analysis remains possible after an incident and often not all traffic is encrypted (and sometimes systems might log enough data to allow decryption). The bulk of the collection would then however be shifted to system tracer boxes, where the computer sends logging data – although not in its raw form.

The biggest challenge poses the liveness signal. However it is very important unless proper functioning of the tracer boxes can be ensured differently. The danger of mapping attacks to discover critical infrastructure components is not necessarily that large (see above), and security of critical infrastructure should never rely on secrecy of their location (security by obscurity never works in the long run) – which anyway would help against physical attacks only, but not electronic ones. It could therefore be said, that the danger of electronic attacks is transformed into physical attacks.

2.3. Data evaluation

Gathering a lot of data is useless if there is no possibility of later searching, analysing, and evaluating it in a useful way. For the concept of tracer boxes to work therefore some documentation is needed: where exactly which (serial number etc.) box is located, so that collected data can be related to the systems it was sent to/from. This includes a description and inventory of the systems themselves, including their software revision at any point in time, which is much more problematic than the former!

While existing tools are suited to investigating single systems and can therefore be applied to tracer boxes as well, the additional advantage of their larger number and distribution can only be realized when the tools support this as well. Therefore some development is necessary in this area, which should focus on comparing traffic or logs from similar systems (e.g. one hundred similar transformer stations → what is the difference in traffic to them?), taking into account that these are not clones and some deviations therefore always exist (in the electrical example e.g. temperature, load, or load distribution etc. requiring specific commands).

2.4. Comparison to IDS/DLP systems

In its basic function intrusion detection systems and data loss prevention systems resemble such tracer boxes closely. However, some important differences exist:

- No analysis takes place. This reduces the hardware costs significantly and allows refraining from filtering, i.e. investigating only “interesting” traffic. Connected with this is therefore the lack of central administration and frequent updates of the clients/boxes.
- Integration possible/necessary: While especially DLP systems must copy with “unwilling” software, i.e. programs not designed for working together with it, tracer boxes need this, but only on a very low level. This means that introducing the required functionality is technically trivial and might even be done automatically in some cases, e.g. through aspect-oriented programming or modified libraries.
- No need for training or understanding the content: DLP systems must be able to analyse a variety of file formats to be able to inspect the content; often they also need large databases of documents or at least their hash values. Network IDS typically must be trained to find out about the “normal” flow of data/work processes. This is dangerous in regard to large incidents in critical infrastructure, as rare events will lead to false alarms, while actual incidents might result in a flood of them, bringing their own associated problem.

3. Conclusions

Tracer boxes are simple to build and implement and cheap to produce. Main costs associated with them are their installation and management (recording of where they are located, change management on the systems they watch, regular maintenance/replacement etc.). There are no significant legal problems associated with them, so their introduction should not be difficult. However, as there exist no obvious and immediate benefits by them for the companies involved, only indirect and uncertain (=in case of an attack) ones, they are unlikely to be introduced soon. Still it is worthwhile to think about them as similar systems already do exist in other areas: black boxes for aeroplanes, or archival requirements for E-Mails, which are similar to these tracer boxes from the software point of view (encryption/signature, storage only…). As both computerized infrastructure becomes increasingly widespread and therefore more vulnerable, and attacks on such infrastructure are receiving more attention and becoming more frequent (Keefe 2012), implementing a mandatory retention of data in this way seem desirable at least for some very important systems.

References

Ahmed, I., Obermeier, S., Naedele, M., Richard, G. (2012), SCADA Systems: Challenges for Forensic Investigators, IEEE Computer Vol. 45, No. 12,44

Berger, D., Chaos im Stromnetz durch verirrte Zählerabfrage (2103), http://www.heise.de/newsticker/meldung/Chaos-im-Stromnetz-durch-verirrte-Zaehlerabfrage-1865269.html (17.5.2013)

Cheminod, M., Durante, L., Valenzano, A. (2013), Review of Security Issues in Industrial Networks, IEEE Transactions on Industrial Informatis, Vol. 9, No. 1, 277

Falliere, N., Murchu, L., Chien, E. (2011), W32.Stuxnet Dossier, http://www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/w32_stuxnet_dossier.pdf (14.6.2013)

Gorman, S., Yadron, D. (2013), Iran Hacks Energy Firms, U.S. Says, http://online.wsj.com/article/SB10001424127887323336104578501601108021968.html (14.6.2013)

IBM Internet Security Systems (2007), A Strategic Approach to Protecting SCADA and Process Control Systems, http://www.iss.net/documents/whitepapers/SCADA.pdf (14.6.2013)

Keefe, M. (2012), Timeline: Critical infrastructure attacks increase steadily in past decade, http://www.computerworld.com/s/article/9233173/Timeline_Critical_infrastructure_attacks_increase_steadily_in_past_decade (14.6.2013)

Kilpatrick, T., Gonzalez, J., Chandia, R., Papa, M., Shenoi, S. (2006), An Architecture for SCADA Network Forensics, in: Olivier, M., Shensoi, S. (Eds.), Advances in Digital Forensics II, Boston: Springer 2006, 273

Sridhar, S., Hahn, A., Govindarasu, M. (2012), Cyber-Physical System Security for the Electric Power grid, Proceedings of the IEEE, Vo. 100, Bo. 1, 210

Ten, C., Manimaran, G., Liu, C. (2010), Cybersecurity for Critical Infrastructures: Attack and Defense Modeling, IEEE Transactions on Systems, Man, and Cybernetics – Part A: Systems and Humans, Vol. 40, No. 4, 853

Valli, C. (2009), SCADA Forensics with Snort IDS, Proceedings of WORLDCOMP2009, Security and Management 2009, 618

SOCIAL GPS APPLICATIONS AS AN INSTRUMENT OF EARLY WARNING IN TRAFFIC

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eCall, crashes, warning, information, Radio-Help, WAZE

Abstract

This paper aims to assess the current situation and to identify weaknesses and influence of planned or proposed solutions. The previously proposed solution was extended and the implementation of community navigation suggested. This should ensure faster response of the entire early warning system. Although financial savings associated with the implementation of the proposed solution are expected, this paper does not cover this dimension. The financial aspects will be a subject of further research.

1. Introduction

In the previous paper (Kubát, 2012), an improvement of current distribution of information in case of a traffic accident was proposed by our team. This paper endeavours to improve the already proposed solution. The extension is based on using a social GPS application which already works and helps drivers. But it works separately and independently on a NTIC (National Traffic Information Centre) (NTIC, 2013) and this paper outlines how it could be implemented into the already described system.

2. Currently used telematic methods

Currently the information about an accident or a problem has to be reported by a driver or a witness of the accident. It means a phone call to the emergency line 112. This report is then transferred to the NTIC. From NTIC it is distributed via following information channels: variable information boards, RDS-TMC and voice relations on some radio stations. Disadvantages of those particular methods were in detail discussed in previous paper. (Kubát, 2012) It can be briefly stated that the most important negative characteristics include the maintenance of variable information boards, the inability to work in bad weather conditions (heavy rain, blizzard, foggy weather and finally the delay which always appears. RDS-TMC and voice relations on radio stations can be missed by drivers.

There are some problems on the input as well. Today the information about a traffic accident is reported verbally to the emergency operations centres via mobile phones, either by those involved in accidents or their witnesses. However, this is associated with problems when attempting to better understand the given situation and determining adequate intervention (the exact position and direction of the vehicle, the scope of damage, elimination of repeated reports of the same accident, etc.). Speed of intervention is a key factor for its success, whereby any possible delays influence negatively the outcome of the entire rescue operation.

3. Short range planned method (eCall)

Project co-funded by the European Union aims to the creation of a system that enables automated reporting on accidents to the European-wide emergency line 112, including accurate information about its location. When the eCall device installed in a car detects an accident by means of sensors, it automatically sends a message to the nearest emergency centre, indicating the exact geographical location of the accident as well as other data. This system can be activated either manually by pressing a button on the dashboard by the vehicle passengers or automatically by the vehicle sensors triggered during an accident. After the system is activated, a connection with the nearest emergency call centre (PSAP) is established transmitting both sound and data flows. The sound connection enables vehicle passengers to communicate with professionally trained call operators while at the same time data channels are used to transmit data messages (MSD) to these operators. Each message contains 43 details about the accident, such as time, exact location, car identification, eCall system status (whether the eCall was activated manually or automatically) and information about possible service providers. Based on this information, the operator will liaise with the integrated emergency services to direct them to the exact accident location as well as provide them with an exact description of the accident's severity and the number of injured. (Vávra, J., 2010)

A manual use of the system can be useful when a traffic accident is witnessed (European Commission, 2010). eCall systems should be installed in all new cars, at the latest, by 2015 and possibly also installed in older cars.

Although this system brings a clear improvement of the current situation in terms of saving lives and providing quick health care during accidents, it does not provide a solution for distributing information about the accident to the drivers approaching the place of accident, i.e. who are potentially at danger. When using existing information channels, the acquired accident data could be made available in about 5-10 minutes via motorway information boards, RDS-TMC messaging and radio travel news. However, each of these distribution channels has specific limitations and based on current traffic density the above-mentioned reporting times are clearly insufficient. The next disadvantage is a fact, that according to the system specification, it cannot locate the car before the emergency message is activated. It means that after activating the message, the system starts searching for satellites therefore a delay is inevitable.

4. System for Automated Forewarning of Vehicle Crashes

For better and particularly early distribution of warning information, a system called System for Automated Forewarning of Vehicle Crashes (the System) (Kubát, 2012) can provide remarkable help. This system has a data connection to the receiver systems-vehicle emergency call (e.g. eCall). The principle consists of full automation of generation and transmission of all relevant information about the accident to vehicles moving in its vicinity. The process of warning is initiated by the crashed vehicle, which will send information about the accident using eCall immediately after the

collision happens together with the exact location of the accident. Information is received by the central office of the System which immediately generates data and / or voice information about the incident, including the positional code of the accident. Data will be sent via radio session and to car receivers as well. (Brunclík, 2010)

System receivers (mobile phones, navigation devices) must be equipped with a positional code comparator of an accident positional data generated by the positioning system receiver. If the comparator evaluates that the position code of an accident coincides with position code of the receiver and vehicle movement will be evaluated as being directed to the scene of the accident, it will be forced to activate the data reception and / or voice session. In practice, we may be able to automatically inform road users according to their current position and direction of the danger which is coming, almost immediately.

The transmitted relation of Radio-Help uses positional codes for identifying areas of compulsory data reception i.e. where the broadcast is directed. The receiver in the area is maintained in standby mode and capture broadcast on a fixed frequency. Then it compares its position according to GPS coordinates with areas included in the broadcast. If there is an agreement it activates forced broadcast reception session. After the broadcasting code ends receiver goes into standby mode again. Subscribers of Radio-Help that are outside the defined zone will not be disturbed by warning broadcast sessions.

The described process implies that it is possible to simultaneously transmit separate sessions to more areas. For the broadcast could be used longwave radio transmitters, which are currently in transition to shortwave broadcasts gradually lose its utility. In this case, would suffice to cover the whole CR only one central longwave transmitter.

More detailed information can be found in the previous paper (Kubát, 2012) or under the working title RADIO-H (Radio Help) (Skrbek, 2010, p. 138).

5. WAZE method

WAZE is a free social GPS application featuring turn-by-turn navigation. It means that the driver is led through every crossroad. WAZE is supported by Android, iPhone, Symbian, Windows Mobile. WAZE differs from traditional GPS navigation software as it is a community-driven application and learns from users' driving times to provide routing and real-time traffic updates. It gathers map data and other information from users who use the service. Additionally, people can report accidents, traffic jams, speed traps, police patrols. It can also update roads, landmarks, house numbers, etc.

WAZE is available for download and use anywhere in the world, but while some countries have a full basemap, other countries still require users to record the roads and edit the maps. Currently WAZE has a complete base map in the United States, Canada, United Kingdom, France, Germany, Italy, Netherlands, Belgium, Israel, South Africa, Ecuador, Chile and Panama.

In addition to turn-by-turn voice navigation, real-time traffic, and other location-specific alerts, WAZE simultaneously sends anonymous information, including users' speed and location, back to its database to improve the service as a whole. This crowd sourcing allows the WAZE community to report navigation and mapping errors and traffic accidents simply by running the app while driving.

According to WAZE, there were 20 million users in June 2012, who were doubled within a 6 month period. Over 3.2 billion miles had been driven by WAZE users.

For the purpose of early warning we will deal only with the alerts. The routing and navigating is not important for this paper. WAZE can be used for warning in both cases – car accidents and traffic problems. It will inform other users the fastest way (compared to previously described methods). On the other hand, it has some disadvantages. A smartphone is necessary (OS: iPhone, Android, Windows Mobile or Blackberry) and a data plan is needed (to eliminate expenses for mobile data). But even with a data plan there are areas with no signal. In case of an accident there is a delay described in next chapter.

A WAZE user has to be disciplined and not distract other users by sending useless messages just for obtaining more points in the WAZE system. Points serve for progress in WAZE user hierarchy. During the report of an event a driver is distracted too.

WAZE does not get information only from its users but from NTIC as well. The reverse flow of information is not possible at the moment. Reports from drivers are verified by other drivers but WAZE is still not reliable information source for NTIC. Of course, even a WAZE user has a duty to report the accident on line 112. In this case the other WAZE users are informed two times.

The idea is to allow information from WAZE report flow into NTIC which would then deal with it like with information from any other source. The data format of the information would have to be standardized. After the standardization the information could be processed flawlessly. It would ensure better awareness on the input. If the information is properly verified it could be processed by the Radio HELP system immediately without causing delay in NTIC. WAZE implementation would take effect in case of traffic problems that are not life-threatening. In those cases eCall is not activated and drivers are not obliged to inform NTIC about the problem.

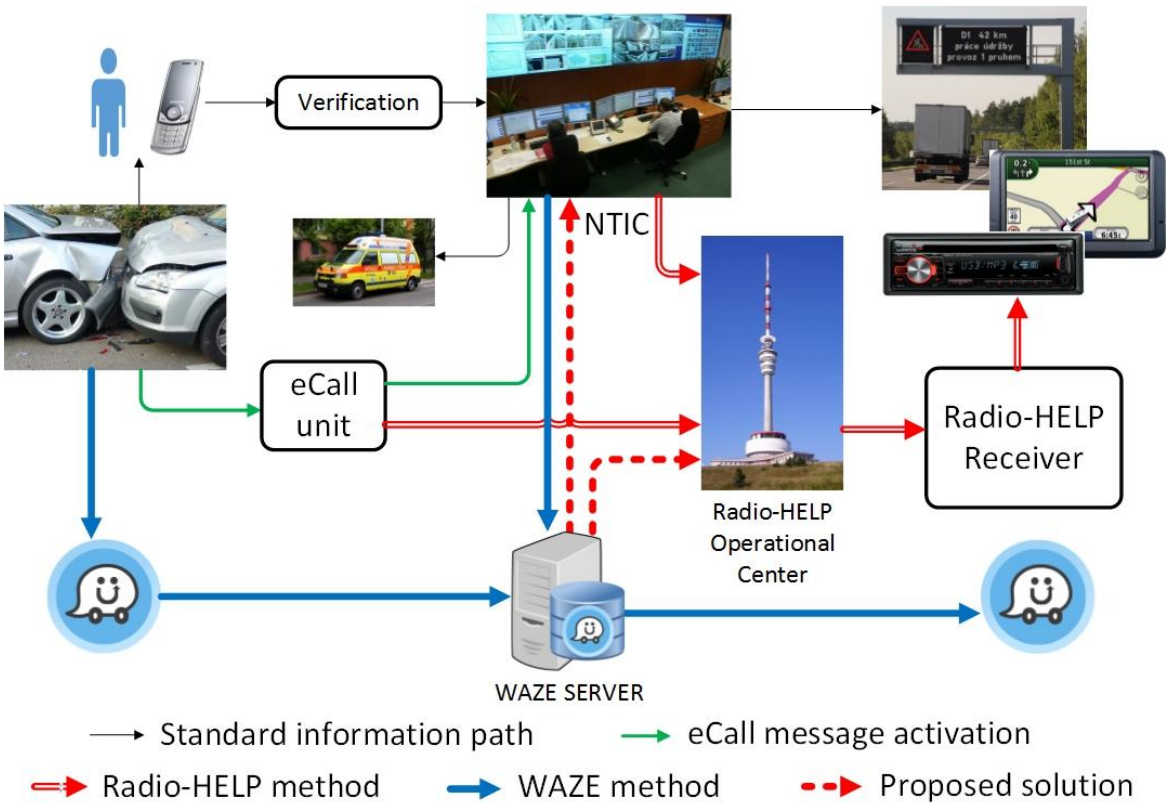

Fig. 1: Transmission and acquisition of information in the event of an accident with the use of eCall, Radio Help and WAZE (Author)

6. Comparing separate segments of each method

We could divide the entire process into three parts: input, processing data and output. We can group them together and compare their advantages and disadvantages. In the following summary good data coverage for WAZE is assumed.

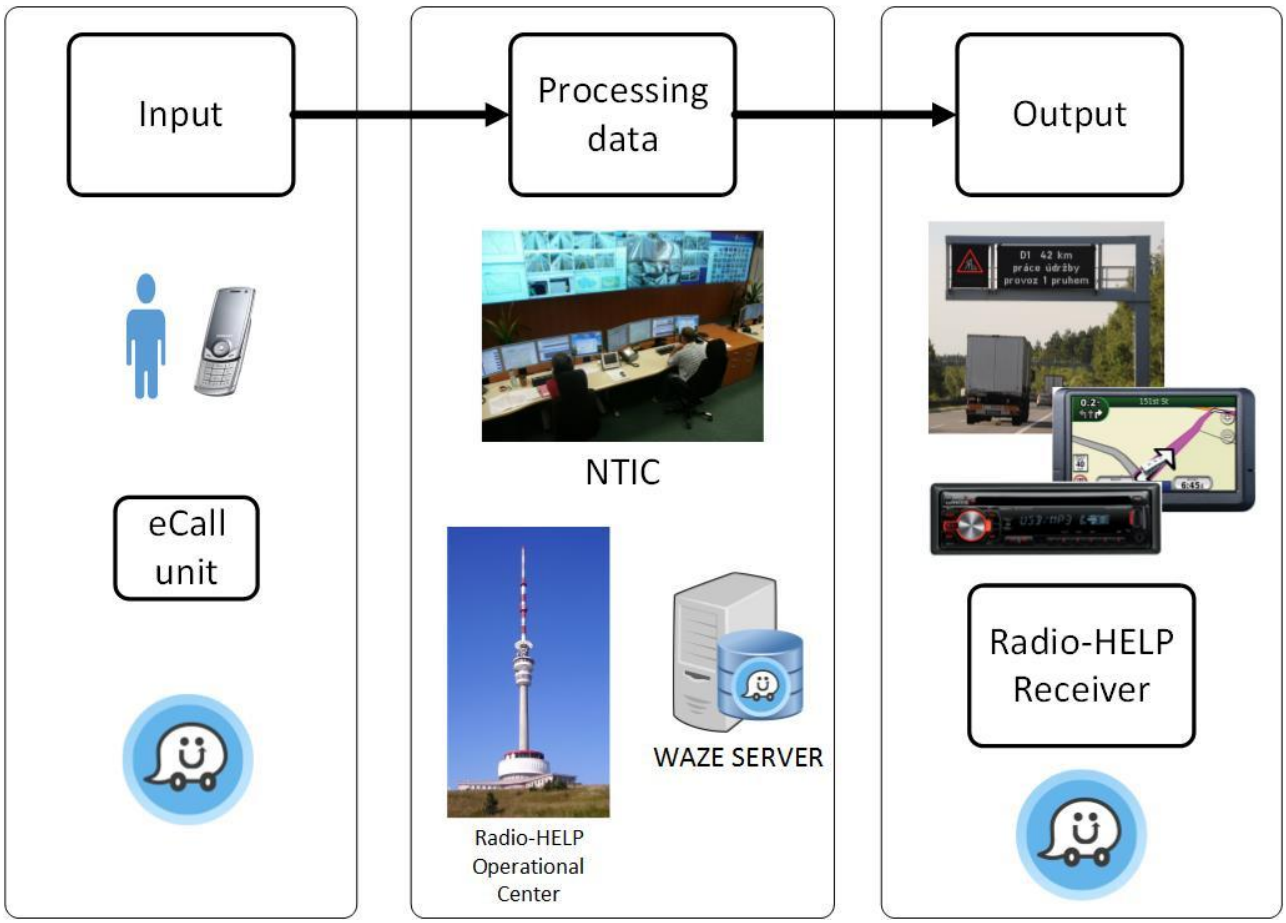

Fig. 2. The system divided into particular segments (Author)

The situations on input can be following:

- A participant or a witness will call emergency line (112) and announces the accident/traffic problem. Then NTIC will have to verify the message by sending police unit or fire department unit to check coordinates of the accident. A disadvantage of this method is an inevitable delay caused by the necessity of verification. The calls could also be compared to other calls. It would request waiting for next people to call the NTIC.
- eCall unit will automatically open a communication canal with an operator in the emergency centre (only in case of an accident). This method is the quickest one but it is switched on only in case of an accident and its implementation is not finished yet.
- WAZE user inputs information about an accident or a problem. After the accident is reported the information is forwarded to other users promptly. Besides disadvantages mentioned earlier there is a delay in special cases like a chain crash. There is no time to input the event so approaching drives have no chance to be informed. Even in usual (not chain) car accident the third driver will be warned (first driver crashes, second driver reports the accident and third driver get a notice).

There is no absolute winner. The best choice consists of combination of all methods.

Data processing:

- NTIC – quick response due to the number of reports. But there is a human factor causing delays.
- Radio-HELP – automated processing, but it requests standard data format on input, which is possible only in case of eCall or WAZE input (or other automated solution).
- WAZE server – no delay, a verification is done by other drivers (WAZE units)

After comparing the fastest input (eCall) and fastest data processing (Radio-HELP and WAZE), it was concluded that a combination of those two methods is not possible. eCall is automatic, but in current circumstances it needs a human worker to process information about an accident. On the contrary, Radio-Help and WAZE methods are processed automatically, but they need a human user to input the event.

Output – message for drivers:

- Output via standard methods (Variable information boards, RDS-TMC...) strongly depends on the quality and speed on previous two segments (input and data processing). There are exceptions (i.e. variable information boards in strong snow-fall) but in general this claim is correct.
- Radio-HELP receiver provides immediate information about the traffic problem. But at the moment it is only in a conceptual stage on which further work has to be done.
- WAZE interface (smartphone) provides voice alert and it is quick as well. Especially for traffic problems without eCall activation.

7. Summary

As a conclusion it can be seen that no one of the above methods is the best. However, it would be useful to incorporate WAZE into NTIC. The verification could be done via three times confirmed report from WAZE users. It would still be faster than sending there police or fire department unit to check it out. Although there are some obstacles, it should be quite simple to incorporate information from WAZE server into NTIC. The question is whether NTIC will be willing to adopt this solution. The broader spreading of smartphones and lower expenses for data plans could make things even easier.

Acknowledgement

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References

Brunclík, M., Skrbek, J. (2010). Systém automatizovaného kritického varování před místem dopravní nehody [online], [cit. 2012-5-10]. Available from WWW: http://spisy.upv.cz/Applications/2010/PPVCZ2010_0415A3.pdf

European Commission (2010). eCall – saving lives through in-vehicle communication technology [online], [cit. 2012-5-10]. Available from WWW: http://ec.europa.eu/information_society/doc/factsheets/049-ecall_july10_en.pdf

Kubát, D. , Kvíz, J. , Skrbek, J. a Žižka (2012), T. Distributing Emergency Traffic Information. In IDIMT 2012 – ICT Support for Complex Systems. 1. vyd. Linz: Johannes Kepler Universität, 2012. S. 33 – 39. ISBN 9783990330227.

Kubát, D., Kvíz, J., Skrbek, J., Žižka, T. Prevention of injuries by traffic accidents through the smart real-time location-based warning system. In VARAJAO, J., CRUZ-CUNHA, M., YETTON, P., RIJO, R. (edd). CENTERIS/HCist 2012 - Conference on ENTERprise Information Systems/International Conference on Health and Social Care Information Systems and Technologies. Vilamoura, SciKA, 2012. P 127. ISBN978-989-97433-1-1

NTIC - National Traffic Information Centre (2013), Available from WWW: http://www.dopravniinfo.cz/narodni-dopravni-informacni-centrum

Ředitelství silnic a dálnic ČR (2012). Proměnné dopravní značky (PDZ) a zařízení pro provozní informace (ZPI) [online], [cit. 2012-5-1] Available from WWW: http://portal.dopravniinfo.cz/promenne-dopravni-znacky-a-zarizeni-pro-provozni-informace

Skrbek, J. (2010). Informační služby ve specifických situacích, in Doucek, P. (ed.): Informační management, 129 – 146, Professional Publishing, Praha, 2010, ISBN 987-80-7431-010-2

Skrbek, J. (2009). New Possibilities of Information Services in Crisis Situations, proceedings of the 11th Anual International Conference „Present and Future of Crisis Management 2009“, part 22, 6 p., T-SOFT Prague, ISBN 978-80-254-5913-3

Vávra, J. (2010). Systém eCall v konfrontaci s alternativními systémy nouzového varování, DP-EF-KPE-2010-105, EF-TUL, Liberec.

ADVANCED EARLY WARNING SYSTEMS AND RADIO-HELP – STATE-OF-THE-ART

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Communication; emergency; alert; crisis; information; notification; Radio-Help; Katwarn, EAS, IPAWS, NL-Alert

Abstract

In autumn 2008 the principles of Radio-Help were firstly published. The idea of position-based forced broadcasting fulfils even current requirements for warning and notification of people in crisis and unusual situations. This contribution, related papers (Skrbek, 2009, 2011, 2012), (Skrbek & Kvíz, 2010) of previous IDIMT and other significant conferences, describes some wider and upgraded views on this topic. Currently it brings brief description of major newly introduced early warning and alert systems with a special stress on the US system of IPAWS (based on the forced broadcasting) and Dutch NL-Alert (usage of mobile networks). This paper also presents the current state of development and implementation of German system KATWARN. Finally are explained main differences and features of the original position based broadcasting system Radio-Help and above mentioned early warning and notification systems.

1. Introduction

To distribute a warning information - in cases like tsunami, floods, extensive fires, nature disasters, terrorist attracts, black-outs of energy etc.- is becoming with growing intensity one of the main roles of states and their governments. Limits for obtaining of early warning information are given not only through available technologies (with respect to responsive approaches to collection, selection and distribution of information), but also by possibilities and abilities of people to receive, understand and appropriately use delivered information.

“The big news story in August 2011 was the threat Hurricane Irene posed to the way of life of New Yorkers. If events happened to fall just "right," Manhattan and other low-lying regions might well be swamped, shutting down public transit systems, the New York Stock Exchange, food and water supply chains, and other niceties of urban life in New York City. Luckily, Irene ran out of steam before delivering such a life-changing blow, and the end result was a just bit worse than what would have been experienced from a very heavy summer storm. So the good people of Manhattan dodged a bullet, and the media hype beforehand simply amounted to a large dose of overreaction to the possible threats presented by Irene. But one day the bill really will come due, as it did in New

Orleans with Hurricane Katrina in 2005, showing that overreaction and near-paranoiac prudence are two sides of the same coin…" (Casti, 2012)

This prognosis became a reality within a year. Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, as well as the second-costliest hurricane in United States history. The storm became the largest Atlantic hurricane on record (as measured by diameter, with winds spanning 1,800 km) (Gunter, 2012). Preliminary estimates assess damage at nearly $75 billion, a total surpassed only by Hurricane Katrina. The severe and widespread damage the storm caused in the United States, together with its unusual merge with a frontal system, resulted in the nicknaming of the hurricane by the media and several organizations of the U.S. government as "Superstorm Sandy".

Disasters could happen not only due to natural influences. No less danger is a consequence of our complex and unstable infrastructure and the human nature. The underlying cause of extreme situations is directly attributable to the ever-increasing complexity of our global society (Casti, 2012). The current Euro-Atlantic civilisation is crucially dependent on energy, especially the electricity. One of the worst and most dramatic power failures plunged millions of Europeans into darkness in November 2006. The blackout, which originated in north-western Germany, also struck Paris and 15 French regions, and its effects were felt in Austria, Belgium, Italy and Spain. Even for these cases is necessary to find new unconventional and effective ways of providing necessary information to the population.

2. New and innovative ways of distribution of alert and warning information in the USA

The technological options available for crisis communication have expanded considerably in the last decade. Both state and rescue organizations are using television, establishing phone lines to respond to questions, but lately they also need to consider Internet resources. Organizational websites offer a highly accessible resource that provides various stakeholders with crisis information. Increasingly, social networking tools are also used to communicate and establish dialogues with stake holders. Whether using weblogs, Twitter, podcasts, YouTube, and e-mail messages, now there are so many new media options that are defined as crisis communication tools. As described in (Skrbek, 2010), (Skrbek 2011-2), in many situations the availability of new media are very limited. The following paragraphs describe main progress and approaches to the distribution of alert and warning information that were published and introduced in 2012. The topic of emergency management and especially effective notification of civilians in crisis situations becomes an important part of a significant government programs.

2.1. Integrated Public Alert and Warning System

The Integrated Public Alert and Warning System (IPAWS) is a multi-agency emergency population warning system in the United States. It is designed to provide rapid, reliable and effective communication to the public in case of major emergencies such as natural disasters and terrorist attacks.

During an emergency, alert and warning officials need to provide the public with life-saving information quickly. The IPAWS is a modernization and integration of the nation's alert and warning infrastructure and will save time when time matters most, protecting life and property.

As part of the Integrated Public Alert and Warning System, the US next generation of emergency alert and warning networks, the Department of Homeland Security's Federal Emergency

Management Agency (FEMA) and the Federal Communications Commission (FCC) announced in December 2009 the adoption of the design specifications for the development of a gateway interface that will enable wireless carriers to provide its customers with timely and accurate emergency alerts and warnings via their cell phones and other mobile devices.

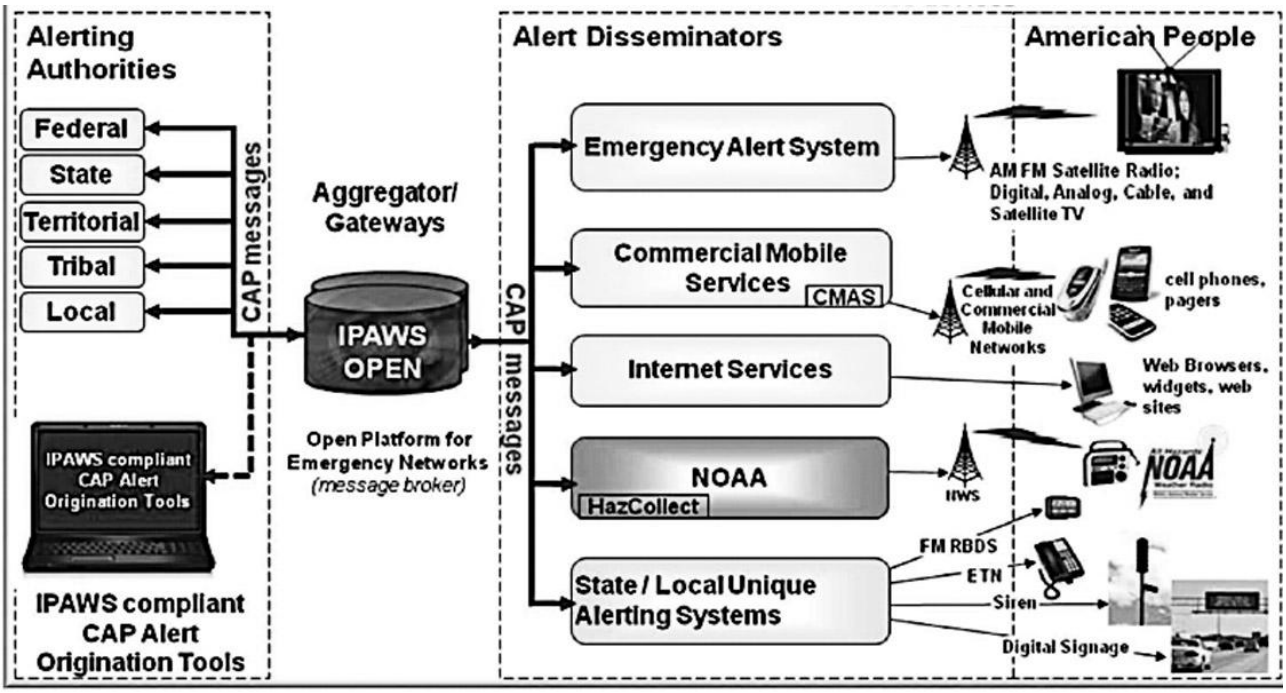

Fig. 1. Architectural organization of IPAWS

(http://www.fema.gov/pdf/emergency/ipaws/architecture_diagram.pdf, 2012)

A key part of IPAWS is its predecessor – the Emergency Alert System.

2.2. Emergency Alert System

The Emergency Alert System (EAS) is an US national public warning system that requires broadcasters, cable television systems, wireless cable systems, satellite digital audio radio service (SDARS) providers, and direct broadcast satellite (DBS) providers to provide the communications capability to the President to address the American public during a national emergency. The system also may be used by state and local authorities to deliver important emergency information, such as AMBER alerts and weather information targeted to specific areas.

Television and radio broadcasters, satellite radio and satellite television providers, as well as cable television and wireline video providers all participate in the system (collectively, EAS Participants). EAS Participants broadcast alerts and warnings to the American public regarding weather threats, child abductions, and many other types of emergencies. The EAS functions as one key component of a national alert and warning system that provides alerts over multiple communications platforms, including mobile communications devices.

An EAS alert is based on an audio protocol defined in the FCC's rules. In the EAS, an alert originator at the local, state, or national level inputs an EAS alert into the system using specific encoding equipment. Specially designated stations then broadcast this alert to the public in their listening areas. Other EAS Participants (television and other radio broadcasters, cable and wireline video service providers, radio and television satellite service providers, and others) monitor the specially-designated stations for EAS alerts. When these other EAS Participants receive the EAS

alert, they, in turn, broadcast it to the public in their listening areas. This group of EAS Participants may be monitored by other EAS Participants too far away to receive the EAS message from the first group of transmitting broadcasters. This next group of EAS Participants, in turn, broadcasts the alert to the public in the vicinity of their stations, as well as to any other stations that may be monitoring them.

The EAS alerting architecture is used by state and local emergency managers to send alerts to the public about emergencies and weather events. While the requirements for carrying a national-level EAS alert differ in some respects from state and local alerts, the national EAS test will test the underlying architecture that also supports state and local alerting. Ensuring that the EAS architecture functions properly will benefit emergency alerting at all levels of government.

The EAS provides the ability to send messages regionally or nationally (though it has never been activated at these levels). But a major disaster like an earthquake or tsunami could necessitate the use of the EAS on a regional or national basis to send life-saving information to the public.

2.3. Testing of the EAS

Local and state components of the EAS are tested on a weekly and monthly basis, respectively. Because it is not possible to anticipate what systems might be affected by an emergency, the EAS is built as a redundant, multi-platform alerting system. The EAS is designed to work when other methods of disseminating emergency alerts are unavailable. While there is no guarantee that any form of communications will withstand major disasters, various elements of the EAS are hardened to withstand such calamities. Moreover, the EAS uses technology that is widely accessible to the public. EAS is serving as a primary method for transmitting national emergency alerts and warnings for the foreseeable future.

During a national emergency, the facilities of all EAS participants must be reserved exclusively for distribution of Presidential Messages.

2.4. CMAS – Commercial Mobile Alert System

The Commercial Mobile Alert System (CMAS) is the second important part within IPAWS intended to provide emergency mangers and the President of the United States a means to send alerts and warnings to the public. Specifically, CMAS provides Federal, state, territorial, tribal and local government officials the ability to send 90 character geographically targeted text messages to the public regarding emergency alert and warning of imminent threats to life and property, Amber alerts, and Presidential emergency messages. The CMAS is a combined effort of the federal government and cellular providers to define a common standard for cellular alerts.

IPAWS, FEMA and FCC announced 7.12.2009 the adoption of the design specifications for the development of a gateway interface that will enable wireless carriers to provide its customers with timely and accurate emergency alerts and warnings via their cell phones and other mobile devices. (FCC 2009).

CMAS alert SMS messages cannot be broadcasted to an area smaller than a cell site. The area covered by a cell site varies according to population density, but it is too large for broadcasting alerts about small-scale emergencies.

Ngo and Wijensekera designed a system that allows receiving a message in smaller location (Ngo and Wijensekera 2011). When a mobile user launches Emergency Response Application (ERA), it updates the local repository and retrieves and displays the user’s current GPS location on a map on the mobile device. Under the default settings, the location update is triggered when the 60-second

time period has expired or the user has moved 50 meters from the last recorded location. GPS data is used to estimate the movement of the user assuming that the user carries the device all the time. Thus, a user headed towards the emergency location could be advised to leave the area immediately. The prototype system was implemented in Java. During an emergency, the emergency coordinator enters the event location on the map. Then enters all the necessary information about the emergency (alert type, event type, message, spreadable nature, affected area…). Then defines the radius of the affected area (Ngo and Wijensekera 2011).

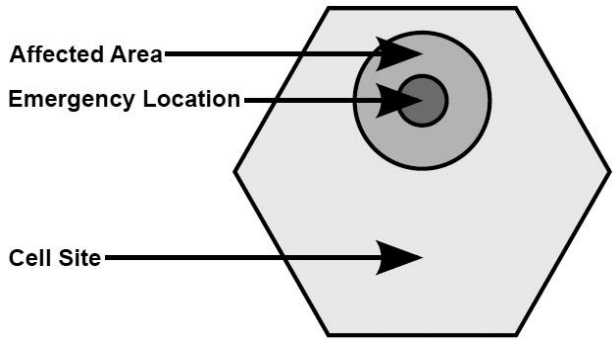

Fig. 2. Typical emergency scenario (Ngo and Wijensekera 2011, p. 143)

Both authors published in 2012 (Ngo and Wijensekera 2012) an enhancement to CMAS that provides more detailed information within the 90-character text using an encoding technique. The viability of the enhancement is demonstrated using a prototype that generates and broadcasts CMAS emergency alerts to Android phones, on which an emergency response application intercepts, decodes and displays the alerts to users.

3. European approach to alert and emergency notification

The following paragraphs describe three different technologies with the purpose of describing current European approaches to alert and emergency notification.

3.1. KATWARN

KATWARN is an innovative warning system that informs the affected groups of the population of incidents by SMS, email or via a smart phone application in addition to the general information provided by the police, fire brigade, and radio and provides them with concrete advice on appropriate conduct from the local authority.

The geographical positioning of the SMS transmission is based on postal codes of town residents. Additionally, as an option, the warning information would also be distributed by e-mail. Registration of KATWARN is realized by SMS. If you want to be warned in case of disaster, send your post-code to the KATWARN (number 0163-7558842). Then you get all appropriate alerts for your area.

New communication channels were presented at CeBIT 2013. Fraunhofer Institut develops systems and infrastructures that use mobile apps as an interface to the citizens and users. Using smartphones or tablets, KATWARN warns in case of catastrophic events or extreme weather situations. Shortly after the launch of the new channel of the KATWARN App, the user numbers of the system at the Apple Store rise to No. 1 for the category "free news"… The severe weather warnings are from the

Germany's National Meteorological Service (DWD) and inform about "extreme severe weather", the highest warning level.

The KATWARN App supports throughout Germany the statutory task of the DWD, to inform the public about official severe weather warnings and to alert. The KATWARN App also conducts warnings and instructions by local fire and rescue coordination centres in various German cities and counties. The KATWARN App is available for free from the Apple Store.

The warnings are emitted in the event of danger via the fire brigade and emergency control centers in collaboration with the competent disaster protection authorities. As an addition, the Deutsche Wetterdienst disseminates severe weather alerts (only the highest alert level "extreme weather") nationwide via KATWARN. Citizens have to register (free of charge) by sending an SMS stating their postcode to the system or by installing the smart phone application.

Not always the KATWARN warnings are unconditionally successful. During a chemical accident in Riederwald (Frankfurt) not all real or potentially affected people were warned. The SMS messages got people working 70 km away from Frankfurt. The tourists or workers from other regions got no SMS information about the imminent danger.

3.2. NL-Alert

This system launched in Nederland in 2012 allows the authorities to inform people in the direct vicinity of an emergency situation, by sending a text message to their cell phones (Jagtman at al., 2011). The message will describe the situation and advise people what to do at that very moment. All cell phones in the relevant area will receive these messages automatically, provided that the phone is switched on, the NL-Alert channel has been activated and the telephone has reception. The messages are not sent by texting but by means of cell broadcasting, which can be compared to a radio signal. They are sent by way of the cell phone providers' transmitter masts. As a result, NL-Alert will still be operating in the event of a network overload. It is not necessary to register and NL-Alert is free of charge and anonymous. Currently, NL-Alert already works on more than half of all mobile phones in the Netherlands.

The control room of the emergency services will send a message on an (imminent) disaster, such as major fires involving the release of toxic smoke, explosion hazards or flooding. Within seconds, cell phones in a specific area will pick up the message.

3.3. Radio-Help

The author of paper with his team designed the technical and media solution of position-based distribution of information called "Radio-Help", which shall be effective even in cases like long-term collapse of electric network, radio and television broadcasting, inoperable of mobile phones, landline phones and the Internet. One of the base functionalities of the system is the possibility of urgent (local and selective) notification in case of threats or crisis situations.

Position based distribution of information uses the synergy of widely applied technologies in different devices for reaching new quality. The technology of Radio-Help system is in detail described in (Skrbek 2011-1) and (Skrbek 2011-2). In principle the solution of targeted broadcast for a geographically defined area consists in a superposition of digital positional data to the transmitted information. The receiver of such a signal is equipped with a positioning system (GPS and/or Galileo). Broadcast targeting is performed by comparing the positional coordinates of the receiver (in the form of satellite positioning system) with the codes that are a part of the trigger partition in the beginning of each broadcasting session. When an external position code, which is

transmitted by an authorized transmitter, conforms to an internal position code of the receiver, the forced listening broadcast session is activated (i.e. the session targeted for listening in the defined area).

The Radio-Help broadcasting will cover not only holders of special Personal Communication Terminals (PCT's), but also the receiver of Radio-Help can be integrated into any audio and audio/video devices. For stationary A/V devices (radio, TV, etc.) it would be possible to set up a fixed positional code, based on the postal address of their users. The system significantly complements, extends and improves the current Early Warning System of central Rescue Services (Skrbek, 2012).

4. Conclusion

Radical change in the system for informing the population in crisis is not a question of discussion in terms of whether to carry it out, but only a question of how and when to decide on its implementation and where to allocate the necessary resources. The paper presents information about four different approaches to warning and informing the population in emergency situations.

Robust U.S. system (IPAWS) uses to transmit warning information through all available media, i.e. all transmission channels. Its application is based on U.S. laws and in European context is unfeasible. Early warning systems KATWARN as well as NL-Alert are originally based on SMS with later extension on Internet mobile applications. Their weaknesses include not entirely clear positioning of broadcast messages. The main problem of such systems is the loss of functionality in "simple cases" of failures of mobile networks. Experts say that, in the near future, due to a variety of reasons, civilization will be more regularly faced with such problems like black-outs of electricity lasting several days, local floods, heavy snow falls, terrorist attacks etc. All such situations, although very different in nature, have one common issue - how to ensure real-time dissemination of relevant information to the affected areas.

The Radio-Help might, in principle, fully meet the requirements of adequate, locally defined information spreading in all the above-mentioned situations.

The Radio-Help technology should - thanks to centrally coordinated broadcasting of warnings and instructions from protected transmitter - ensure the functionality of the system in majority situations. Recent reports from the top-management of the Czech Radio discuss the efforts to realize and implement a Radio-Help system in the Czech Republic environment.

Acknowledgement

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References

Blake, E. S., Kimberlain, T. B., Berg, R.J., Cangialosi, J.P., Beven II, J.L. (2013) National Hurricane Center. Tropical Cyclone Report: Hurricane Sandy - October 22 – 29, 2012. United States National Oceanic and Atmospheric Administration's National Weather Service. http://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf.

Casti, J. (2012) X-Events: The Collapse of Everything, HarperCollins; 1st edd., New York, 2012, ISBN: 0062088289

Coombs, W.T. (2012). Ongoing Crisis Communication: Planning, Managing and Responding, 3rd edd., Sage, Washington DC, 2012, ISBN 978-1-4129-8310-5

FCC Public Notice (2012) EB Docked No. 04-296, Federal Communication Commision, Washington, 2012, http://www.fcc.gov/document/reminder-eas-participants-june-30-2012-cap-deadlinel, 8.5.2013

FCC Public Notice (2013) FEMA and the FCC announce adoption of standards for wireless carriers to receive and deliver emergency alerts vie mobile devices, Federal Communication Commision, Washington, 2008, http://www.fcc.gov/document/fema-and-fcc-announce-adoption-standards-wireless-carriers-receive-and-deliver-emergency-al, 8.5.2013

Haddow, G.D., Bullock, J.A., Coppola, D.P. (2010). Introduction to emergency management, 4th edd., Butterworth-Heinemann, Oxford, 2010, ISBN 978-1-85617-959-1

Jagtman, H.M., Sillem, S., Ale, B.J.M. (2011) Bouwstenen voor alarmberichten in het kader van NL-Alert, TU Delft, 2011, ISBN 978-90-5638-256-8

Ngo, P., Wijesekera, D. (2011) Engancing the Usability of the Commercial Mobile Alert System, in International Conference on Critical Infrastructure Protection V., Springer, Berlin, 2011, ISBN 978-3-642-24864-1

Ngo, P., Wijesekera, D. (2012) Emergency Messages in the Commercial Mobile Alert System, in International Conference on Critical Infrastructure Protection, Springer, Berlin, 2012, ISBN 978-3-642-24864-1

Serna, J. (2012) Hurricane Sandy death toll climbs above 110, N.Y. hardest hit, Los Angeles Times, 3.11.2012, http://articles.latimes.com/2012/nov/03/nation/la-na-nn-hurricane-sandy-deaths-climb-20121103,

Skrbek, J. (2010). Informační služby ve specifických situacích. In DOUCEK, P. (ed.) Informační management. 1. vyd. Praha: Professional Publishing, 2010. S. 129 – 146. ISBN 987-80-7431-010-2

Skrbek, J., Kvíz, J. (2010) Critical Areas of Early Warning System. In IDIMT 2010: Information technology – Human Values, Innovation and Economy,18th Interdisciplinary Information Management Talks. 1. vyd. Linz: Trauner Verlag, 2010. S. 193 – 202. ISBN 978-38-5499-760-3.

Skrbek, J. (2011-1). Advanced Ways and Means of Civilian Notification in Crisis Situations . In KOCOUREK, A. (ed.). Proceedings of the 10th International konference: Liberec Economic Forum 2011. 1st edd. Liberec: Technical University of Liberec, 2011. P. 419 – 426. ISBN 978-80-7372-755-0

Skrbek, J. . (2011-2). Effective Notification of Civilians of Regional Emergencies – Illusion or Reality?. In DOUCEK, P., CHROUST, G., OŠKRDAL, V. (edd). IDIMT 2012: Interdisciplinarity in Complex Systems, 19th Interdisciplinary Information Management Talks. 1st edd. Linz: Trauner Verlag, 2011. P 111- 120. ISBN 978-3-85499-873-0

Skrbek, J. . (2012). Notification of Civilians of Regional Emergencies, Disasters, Crises and Unexpected Situations – an Agile Approach. In DOUCEK, P., CHROUST, G., OŠKRDAL, V. (edd). IDIMT 2012:ICT Support for Complex Systems, 20th Interdisciplinary Information Management Talks. 1st edd. Linz: Trauner Verlag, 2012. P 33 - 41. ISBN 978-3-99033-022-7

CROWDTASKING FOR CRISIS AND DISASTER MANAGEMENT – OPPORTUNITIES AND CHALLENGES

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Keywords

Crowdtasking, crowdsourcing, volunteer management

Abstract

Crowdtasking as defined in this paper is a new concept for managing qualified volunteers in order to obtain requested and specific information from them. This process takes place in the frame of an interactive communication process between a task manager and preselected volunteers from the crowd. Crowdtasking differs from existing crowdsourcing approaches. Crowdsourcing, a known and proven concept in many fields including crisis management can be defined as assigning tasks to a non-specified group of people. An alternative approach is to select specific volunteers qualified for specific crisis scenarios out of the crowd, depending on the crisis scenario and to communicate with them by using specifically designed user interfaces. For the development of advanced volunteer management solutions such approaches ensure obtaining highly reliable information for crisis managers without the need to analyse large amounts of unstructured data provided by an unspecific crowd. This paper sums up the current state of the art and experiences concerning the application of crowdsourcing for crisis and disaster management and – based on this background – finally describes the new concept called crowdtasking for the management of volunteers.

1. Introduction

One of the first attempts to define crowdsourcing was made by Brabham 2008. He defines crowdsourcing as an online, distributed problem – solving and production model suited to aggregate talent and leverage ingenuity, only enabled through the web. According to Wikipedia,

"crowd sourcing is the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers." Crowdsourcing is contrary to outsourcing where selected persons, groups or institutions are requested to perform specific services or to provide precisely specified information. Crowdsourcing allows a qualified crowd to participate in different tasks such as provision or validation of information, but also editing in case of request (Gao et al 2011). According to Chan 2013 crowdsourcing is defined as giving tasks that are traditionally performed by specific individuals to a group of people or a community to solve problems. Looking specifically at crisis management, Chan defines crowd sourcing as a mean to collect a variety of perspectives on challenges as well as solutions making an improvement of crisis management possible. He points out that crisis responses taking crowdsourced opinions into account would improve in quality compared to decisions not taking into account the output of the crowd. Boulos et al 2011 specifies crowdsourcing as procedure with the feature that specific applications are capitalizing on the power of the masses and relying on citizen participation in order to achieve their goals. It can be seen from the variety of definitions shown above, representing only a minority of existing definitions that crowdsourcing encompasses a whole range of meanings and the term has been used in an almost inflationary way. Starbird 2012 criticizes therefore that the term crowdsourcing is finally used both too vague and too narrow.

In the frame of this paper we understand crowdsourcing as a process allowing crisis managers to extract information or content from the crowd or to release services to the crowd without getting in an extended interactive communication process with the part of the crowd providing requested information.

There are already several examples of existing crowdsourcing approaches such as the platform Wikipedia, many of them including some type of quality assurance process. Wikipedia is a collaboratively edited, multilingual, free Internet encyclopaedia providing about 26 million articles. While writing this paper we searched also on Wikipedia for the terms crowdsourcing and crowdtasking and were confronted with the following message: "This article is written like a personal reflection or opinion essay rather than an encyclopaedic description of the subject. Please help improve it by rewriting it in an encyclopaedic style". Most of the articles of Wikipedia can be edited by anyone having access to the site; this can be seen as a delegation of tasks to a very large crowd.

In the field of disaster and risk management, crowdsourcing denotes the process of using large number of persons to collect disaster-relevant data via various communication channels such as social media platforms, thus fitting several small pieces of information quickly into a broader situational picture. Recent analysis of the management of crisis demonstrates that crowdsourcing has emerged as a promising method in crisis and disaster management. Regardless of the nature of an event, such as natural or man-made disasters, applying crowdsourcing has supported emergency response authority, emergency staff and last but not least, the population itself. Popular examples of successful applications of crowdsourcing in disaster management are the Haiti earthquake in 2010, the Lybia crisis in 2011 and recently the Boston marathon bombing in 2013.

The open source software development community is successfully applying a similar approach as the crowdsourcing paradigm for decades. Contributions of single developers around the globe continuously extend and improve a common software project. Due to the high amount of participators from different domains with diverse qualifications, the overall success of open source projects is comparable to proprietary projects (see Linux, Mozilla, Apache). Nevertheless, there are some important differences between crowdsourcing and open source. According to Brabham 2008,

problems solved or products developed by the crowd become the property of the crowdsourcing institution, e.g. a company. In contrast, open source products are available to everyone.

2. Examples of crowdsourcing solutions and their applications in the domain of crisis and disaster management

A growing number of reported use cases demonstrate the usability of the crowdsourcing within the domain of crisis- and disaster management (UN-Spider 2013). Crowdsourcing has some advantages compared to conventional relief methods. By using crowdsourced data, relief organizations are provided with real-time reports to identify and respond to urgent needs. Emergency agencies are able to prioritize on most affected areas and important issues on base of simple, often visual analysis. Furthermore, geo-tagged information from platforms and devices support the relief staff by locating specific user requests (Gao et al., 2011).

Possibly the most notable success story is the one of the International Network of Crisis Mappers (The Humanitarian Technology Network) – a large and very active international community of experts, policymakers, technologists, researchers, journalists, hackers and skilled volunteers engaged at the intersection between humanitarian crises, technology, crowdsourcing, and crisis mapping. Crisis Mappers uses a variety of crowdsourcing techniques to support crisis managers and traditional response organizations in crisis situations. The network sustains early warning and situation awareness for rapid response to complex humanitarian emergencies based on multiple approaches such as mobile and web – based applications, participatory maps or geospatial platforms.

In this chapter, we present some prominent examples of the available crowdsourcing solutions and their applications in the crisis management. We intend to give an insight in the domain, but do not claim to give a complete overview on existing solutions.

Sahana

The mission statement of the Sahana[2] Software Foundation is to save lives by providing information management solutions. The purpose is to enable organisations and communities to improve preparedness for and response to disasters. Sahana Software was developed by members of the Sri Lankan IT community in order to assist in the recovery of Sri Lanka after the 2004 earthquake and tsunami. The Sahana Software Foundation was finally founded in 2009 (Sahana 2013). Sahana is a Free and Open Source Software (FOSS) including web-based disaster management applications for inventory management, situation awareness and volunteer coordination. Moreover, registering of missing and found persons and request management or information sharing between different organisations are available as additional functionalities. The Sahana Foundation offers several software solutions, two examples are Eden (Emergency Development Environment) and Vesuvius.

Eden is an open source software platform especially built to help in disaster management. It provides a solution to manage organisations, people, projects, assets and inventory, to collect information through assessment and to provide situational awareness through maps. Eden can be downloaded from the web or flash drives and is designed to be used in environments with poor internet. Eden was used to manage a list of about 700 organisations helping the population after the 2010 earthquake in Haiti in order to provide opportunities for collaboration and coordination. The

[2] Sahana means relief in Sinhalese

Disaster Risk Reduction (DRR) project portal, based on Eden, is used to provide organisations to share knowledge on humanitarian projects they are engaged within the Asia Pacific region. Eden can be used to manage human resources, e.g. Portuguese volunteer firefighters use Eden to manage their various teams (e.g. tracking of experience, training and evaluations to manage credentials of volunteers). The resource mapping system of Eden is used by the International Federation of Red Cross and Red Crescent Societies (IFRC) to provide visibility on the assets of the organisations.

Vesuvius focuses on hospital selection and lost person finder capabilities. It is optimized for missing persons reporting in order to enhance family reunification by accepting reports, providing advanced search and filtering capabilities. Moreover, it provides tools assisting in local and remote hospital triage management. The US National Library of Medicine uses Vesuvius in order to improve disaster preparedness and response in family reunification and hospital triage. Vesuvius enables capture of photos and exchange of data across facilities for US-hospital focused catastrophic situations. The use of the Vesuvius people locator was supported for the Haiti earthquake (2010), Christchurch earthquake (2011) and the Japan Earthquake (2011).

Ushahidi

The name **Ushahidi** represents the people behind the so called platform. Ushahidi[3] is a non-profit company that provides several products with the purpose of democratizing information, increasing transparency and improving sharing of information. The Ushahidi platform is a free and open source tool for crowdsourcing information through different channels such as SMS, email, Twitter and the web. It is dedicated to information collection, visualization and interactive mapping. Prominent field of applications are monitoring of elections in India or Mexico or coordination of support activities in the aftermath of the Haiti earthquake. E.g., in Haiti the Ushahidi platform was set up two hours after the earthquake on the 12. of January 2010 by volunteers from the Tufts University in Massachusetts in order to enable relief organizations setting up a short message service short code phone number to spread free SMS text (Gao et al 2011). **Swift River** is another free and open source platform from Ushahidi, The purpose of Swift River is to extract information from massive amounts of crisis relevant data in order to provide a basis for actions. It enables filtering and verification of real time data from information sources such as SMS, Email or Twitter by applying semantic analysis and verification algorithms. **Crowdmap** makes it possible to crowdsource information from the Ushahidi platform. It allows setting up a specific deployment of the Ushahidi Platform without having to install dedicated web servers. Crowdmap can be used to map reports or information or to manage local resources. An example of an application of crowdmap is the Thailand Flood Information Map in response to the flooding in Thailand in summer 2011 causing more than 500 deaths and an estimated damage of 5.1 billion dollar (Boulos et al 2011).

Examples of other crowdsourcing solutions

OpenStreetMap (OSM) is a collaborative project with the objective to create a free editable map of the world. Driving forces behind this development have been limited availability of maps in many parts of the world and the availability of low cost portable satellite navigation devices. According to the OpenStreetMap homepage about 300.000 contributors worldwide provide data using GPS devices, aerial photography and other sources (OpenStreetMap 2013). In the aftermath of the Great East Japan Earthquake (Appleby 2013) open street map volunteers set up a road map of more than 500.000 roads in the area affected by the disaster. This work was supported by another crisis map named **Sisai.info** verifying, categorizing and mapping about 12.000 tweets and emails of

[3] Ushahidi means testimony in Sahili

the affected areas. Both platforms had the potential to close information gaps, but the degree of response by the first responders remained unclear. OpenStreetMap was also used to map roads, buildings and other infrastructure of Port-au-Prince within two days after the Haiti earthquake based on satellite images.

Another open source platform frequently used in crisis management is **GeoChat**, a collaboration tool allowing everybody to chat, report and get alerts on their phone (Geochat 2.013). It enables self-organizing group communications by allowing linkage of field, headquarters and local communities in real time and visualizing on a map. Examples of use of GeoChat are applications for Cambodia and Thailand with the purpose to respond to potential outbreaks of diseases (Boulos et al 2011). Among the several software products provided by the GeoVista Center, in particular **SensePlace** and **SensePlace2** are relevant for crisis management. SensePlace is designed to discover news stories or other documents important for user specified topics and places, extracting geo-tagging references to places. This results in a geo-historical context in order to interpret events. SensePlace2 retrieves place-time attributes from social media platforms, i.e. Twitter in order to support crisis management.

Challenges and limitations with the Usage of Social Media for crisis management

Even in the pre-twitter times, it was clear that "today's databases contain so much data that it becomes almost impossible to manually analyse them for valuable decision-making information" (Goebel and Street, 1999). The situation is much worse today: social media such as Twitter, Facebook or Flicker produce *a huge heap of unstructured data* in different formats. Only a small portion of this data heap is trustworthy and even a smaller portion is related to specific events or topics relevant to crisis management. This portion typically grows in crisis situations, with both affected and non-affected people often deciding to make their personal status information sites publicly available via social media. Unfortunately, the shared contents about status, experience and impressions of the affected population is often available in a non-comfortable way; hence decision makers have to deal with information which is inaccurate, fragmentary, redundant, complementary, affirmative, falsifying and/or contradictory (see Howe et al 2006). What crisis managers really need is a *validated overview of the prevailing conditions and developments in areas affected by crisis*. Based on their own experience such information helps them shaping their decisions. It is therefore necessary to assess the quality of the available data, and to extract the information relevant to decision makers. This is typically performed by combination of web crawlers and specifically designed filters. This extracted information is the basis for the development of knowledge dedicated to support decision makers or other managers. This knowledge generation process is illustrated in Fig. 1.

Fig. 1. Information generation processs – from Data to Knowledge

Advantages and shortcomings of crowdsourcing in crisis management

Some of the issues inherent to general purpose social media platforms have been already addressed by the crisis-management specific platforms introduced in this section. In particular, these

platforms often force the users to provide semi-structured information which is easier to interpret than the unstructured information. In addition, the ratio of the information related to crisis management to unrelated information is higher as unrelated posts are discouraged both by the platform and by the organizers. However, the disaster communication approach of existing crowdsourcing solutions remains a multi-directional and open-ended one, and relies on the use of a rather large but unknown crowd, which contributes in a more or less structured way to a broader picture of disaster situation and needs assessment.

Gao et al. (2011) identified some shortfalls of crowdsourcing supporting disaster relief actions:

1. Lack of interoperability between different relief organizations, the emergency staff and various volunteer groups respectively individually self-motivated volunteers leads to double-tracked mission efforts and causes an inefficiently usage of resources. Features facilitating the accord of coordination activities are absent.
2. Crowdsourced data don't contain all demanded and obligatory correct information. Geo-tagged reports are related to former visited places and mislead relief staff.
3. Crowdsourcing applications are not featured with access security. Sometimes critical information causes panic of population. In conflict areas an open access might have a detrimental effect on relief staff.

Looking specifically at volunteer management, crowdsourcing is not well suited for establishing structures which enable bindings between task managers and task workers, e.g. between relief organisations and volunteers. Therefore limited accountability exists and task managers cannot be sure that tasks will be done successfully. To address this shortage, we have developed an approach called crowdtasking which is designed to remedy the inadequacies of crowdsourcing for volunteer management in crisis and disaster management efforts.

3. Crowdtasking: - a new approach for volunteer management

The management of volunteers is a specific challenge of crisis- and disaster management, which cannot be well addressed by general purpose social media or even by the existing crowdsourcing solutions for crisis management which were presented in the previous section. This leads to the motivation to develop the new crowdtasking concept described further down.

To-date, the term crowdtasking has not been widely used in the literature. In the frame of the ENVIROFI project crowdtasking was used to denote a specialization of crowdsourcing where volunteers are asked to perform specific actions and report on the outcome. In ENVIROFI, the principle of crowdtasking was applied to the biodiversity domain, and part of the functionality implemented on a proof of concept level. However, the project has also anticipated the "Citizen-powered environmental crisis management" use case where the same principles are applied to crisis management (Granell et al 2012).

When analysing crowdsourcing and crowdtasking several aspects need to be considered:

- Compared to existing crowdsourcing approaches crowdtasking limits the access to the information generating process to a qualified, preselected and registered large group of individuals
- By specially designed user interfaces and quality assurance measures it is ensured that only crisis relevant information is generated and non-specific data is excluded

- In addition crowdtasking relies on a bi-directional communication process between a task manager and qualified members of the crowd

As illustrated in Fig. 2, the cyclical crowdtasking process consists of five functional units: The setting up of tasks by the task manager (e.g. a coordinator for volunteers' activities)

a. The selection of qualified parts of the crowd, that is of the volunteers that are on the right location, trusted and capable to perform the tasks at hand.

b. The distribution of information and tasks in case of events to pre-selected volunteers

c. Validation and storing of gathered information

d. Interactive communication between task manager and the preselected crowd, including the update of the situational development

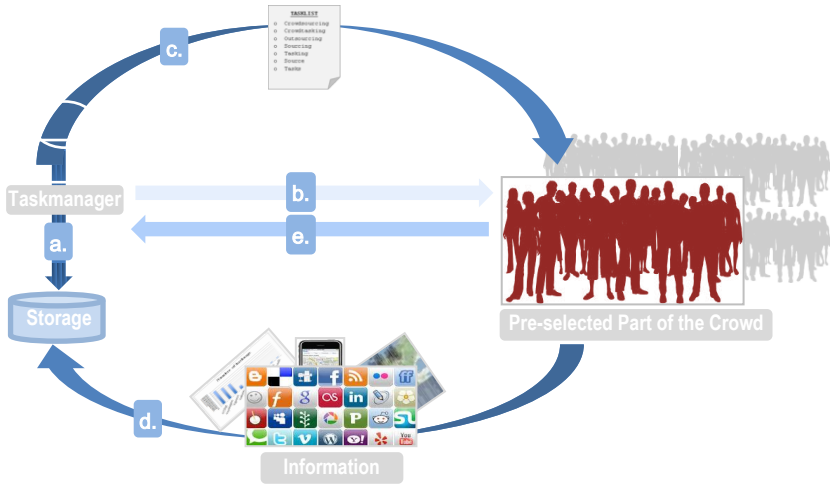

Fig. 2. Crowdtasking procedure – Interaction opportunities between task manager and a pre-selected part of the crowd

Crowdtasking, is therefore a closed-ended - two way disaster communication strategy with a pre-selected group of persons being directly applicable not only to response and recovery of the crisis management cycle, but also to the preparedness phase. Crowdtasking is not only contributing to a better situational awareness of the responders, but also to the strengthening of individual and community resilience. Summarizing

- Crowdtasking is a sub form of crowdsourcing as it uses a large number of persons to collect data and at the same time it has resemblance to the more closed-ended online volunteering approach (bi-directional communication aiming at performing tasks not using multi-directional communication channels like social media).
- Crowdtasking has a different area of focus than crowdsourcing:
  - a) to get trusted and detailed information for situational awareness and decision support in disaster response and
  - b) to instruct persons to perform simple tasks for helping themselves or neighbours in preparedness, response and recovery phases.
- It also addresses criticisms of crowdsourcing (addressing an unspecified, random crowd, replication of data, trust) by building upon existing volunteer management strategies in

disaster management and trusting on a pre-defined crowd of volunteers, facilitated by a structured communication concept

While crowdsourcing assists the quick acquiring of a broader (though less detailed and reliable) picture crowdtasking, by requesting answers to a-priori defined information categories, contributes to an enriched and more reliable picture of defined and measurable parameters of a disaster. Thus both, the more open crowdsourcing as well as the more structured crowdtasking are supplementary concepts.

4. Discussion and Conclusions

The disaster communication approach of existing crowdsourcing solutions is a multi-directional and open-ended one, relying on new communication channels provided by social media and the use of a rather large but unknown crowd, which contributes in a more or less structured way to a broader picture of disaster situation and needs assessment. Existing crowdsourcing approaches and the before described crowdtasking process have both their strengths and limits. In case of crowdsourcing the output from the crowd consists of rather unspecific data. There is need to analyse and filter these data in terms of relevance and credibility to obtain reliable information. Based on this information it is possible to derive knowledge suitable for decision making or other applications. Benefits from crowdsourcing approaches can be the quick response from large numbers of persons (assessing disaster impact, effectiveness of response), as well as the possible revelation of new knowledge due to the openness of the process (i.e. previously unknown and unaddressed needs for help). Challenges are the necessity to process, aggregate and validate large numbers of incoming data by using adequate techniques such as GDACS (GDACS 2013).

When looking at crowdtasking the advantage of the closed process is that there is little need to extract information from the data, because the pre-selection of specific groups out of the crowd on one hand and the well-defined tasks combined with the interactive communication process on the other ensures that only relevant and trusted information will be provided by the preselected members of the crowd. Stricter workflow and data model results in structured information that can be easily interpreted, visualized and used for decision making. Moreover, advanced crowdtasking processes can support: (1) user profiling; (2) profile-specific adaptation of the data presentation; (3) profile-specific adaptation of the tasking; as well as (4) data quality assessment by automated processes. As a consequence, the crowdtasking process is easier to control and expected to produce more reliable results than generic crowdsourcing.

The disadvantage of this approach is that crowdtasking relies on the prior and validated knowledge of the users profile and capabilities. Potential ad-hoc volunteers will often not be taken into account when distributing the tasks and may not receive some of the relevant data due to the focused and dedicated communication process. This disadvantage can, to some extent, be mitigated by combination of the technical and organisational measures. Most notably, the crisis management organisation in charge of the system should assure that the most important data is distributed to all users of the system and establish a method for quick validation of the (new) user's profiles in crisis situations.

When implementing a crowdtasking process it has to be ensured that legal and ethical obligations are enforced. Looking at legal aspects specific focus has to be set on liability and privacy aspects, e.g. who would be liable in case of crowd members providing false information leading to wrong decisions of crisis managers? Moreover, it has to be ensured that the requirements on the crowd are in line with their physical abilities, their qualifications and ethical requirements. If all these aspects

are considered in an adequate way, crowdtasking has a high potential to help improving nowadays disaster management.

References

Appleby, L. (2013). Connecting the last mile- the role of communications in the great east Japan earthquake. http://www.internews.org/research-publications/connecting-last-mile-role-communications-great-east-japan-earthquake

Boulos, K., Resch, B., Crowley, D., Breslin, J, Sohn, G., Burtner, R., Pike, W., Jezierski, E., Chuang, K. (2011). Crowdsourcing, citizen sensing and sensor web technologies for public and environmental health surveillance and crisis management: trends, OGC standards and application examples. International Journal of Health Geographics, 10:67

Brabham, D. (2008). Crowdsourcing as a model for problem solving – an introduction and cases. Convergence: The International Journal of Research into New Media Technologies, Vol 14 (1): 75 -90, DOI: 10.1177/1354856507084420

Chan, J.C. (2013). The role of social media in crisis preparedness, response and recovery, Vanguard, RAHS Programme Office (RPO), http://www.oecd.org/governance/risk/

Gao, H., Barbier, G., & Goolsby, R. (2011). Harnessing the Crowdsourcing Power of Social Media for Disaster Relief. IEEE Intelligent Systems, 26(3), 10–14.

GDACS (2013). http://www2012.wwwconference.org/proceedings/companion/p703.pdf, May 2013

Geochat (2013). http://insteed.org/technologies/geochat/, May 2013

Goebel, M., Street, F. (1999). A survey of data mining and knowledge discovery software tools, 1(1), 20–33.

Granell, C., Schade, S., Mazzetti, P., Giacomelli, A., Usländer, T., van der Schaaf, H., Havlik, D., Havlik, F., Berre, A., Schleidt, K., Pielorz, J., Gupta, M., Lorenzo, J. (2012). D6.2.3 Report on Community Consultation III, public deliverable of the ENFIROFI project, available online on http://www.envirofi.eu

Havlik, D., Egly, M., Huber, H., Kutschera, P., Falgenhauer, M., Cizek, M (2013) . Robust and trusted crowd-sourcing and crowd-tasking in the Future Internet in proceedings of ISESs

Howe, J. (2006). The rise of crowdsourcing. Wired, http://www.wired.com/wired/archive/14.06/crowds.html

OpenStreetMap (2013). http://www.openstreetmap.org, May 2013

Sahana (2013). http://sahanafoundation.org May 2013

Starbird, K. (2012). What "Crowdsourcing obscures: exposing the dynamics of connected crowd work during disaster. Proceedings of CoRR. Retrieved from http://arxiv.org/ftp/arxiv/papers/1204/1204.3342.pdf

UN-Spider (2013). http://www.un-spider.org/sites/default/files/NL_Crowdsourcing_online.pdf

Ushahidi (2013). http://www.ushahidi.com, May 2013

ICT IMPACT ON ECONOMY

MEASUREMENT OF ECONOMIC IMPACT OF ICT: FINDINGS, CHALLENGES, PERSPECTIVES

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Keywords

Impact of ICT on economy, productivity, econometric approach, national accounts, statistical data

Abstract

The aim of the paper is to present current situation at the measurement of economic impact of ICT. Keynote issues are stated, findings from recent years are summarized and the relationship between index approach and econometric approach is analysed. On the other hand, many issues rest for further research. Apart from other topics, the impact of current economic recession should be deeply analysed. Finally, the usability and interpretability of statistical data is discussed.

1. Introduction

Production and usage of information and communication technologies (ICT) play an important role in the economy and in the society as well and many researchers tried to quantify the influence of ICT both on the economic development and on the societal changes. Measurement of economic impact of ICT has become a topical issue and an object of analyses of economic analysts and the ICT experts. The interest of researchers increased in the time of economic recession starting in 2008. What is the role of ICT? Did ICT production and usage of it help to economic development? What is the impact of investment in ICT from macroeconomic point of view?

The aim of the paper is to present current situation at the measurement of economic impact of ICT, to present key findings recently achieved and think about challenges and perspectives for the further research related to this issue in the next years.

2. Data and Methodology Used in the Recent Research

The keynote source for methodology of the analysis has been set up by the Organisation for Economic Cooperation and Development (OECD), see OECD (2004). Authors/editors of this publication collected recent methodology approaches used in individual countries and gave theoretical background and practical guidelines to the researchers.

Many other authors have been inspired by those approaches and measurement of economic impact is systematically analysed. Pavlicek et al. (2011) described the position of ICT sector in the Czech national economy using the division of the economy to its industries. He analysed the gross value added of the industries and the effectiveness of the Czech ICT sector. Doucek (2011) focused on

the human capital in ICT – competitiveness and innovation potential in ICT. He described three groups of countries: those with highest literacy, highest GDP per capita and highest productivity. The intersection of these three groups consists of 4 countries (UK, Australia, USA and Canada) which have three common features: large interconnected economy, good education system and common used English language. He also analysed the number of students studied in ICT study programs and concluded that there is a possible lack of ICT teachers in ICT tertiary education. He is aware of the quality of university education and of the fact that best students will want to study abroad. Maryska and Doucek (2011) compared the Czech and Austrian education systems. Other approach to analyzing ICT impacts on economy is presented in (Kuncova, Doucek, 2011), where is presented the analysis of the Czech Republic ranking in Europe economic space according to internet services utilization.

Fischer and Vltavska (2011) presented the systematic approach to the measurement of economic impact of ICT. They described the system of national accounts as a useful data source for competitiveness analysis including the impact of ICT. They pointed out that the system of national accounts is the comprehensive system of the statistical data on the national economy which allows the analysis both of products and producers. Using data from the national accounts they analysed the share of ICT goods and services on the total output and the value added, differences in labour productivity between ICT and non-ICT industries, usage of ICT goods and services in the industries and compared the share of gross value added on total output between ICT and the total economy (Maryska, 2008). They also compare the share of compensation of employees on the gross value added. Fischer and Vltavska (2012) also deeply analysed the intermediate consumption of ICT products and its impact on the economy of the Czech industries.

There are also some analyses of the impact of ICT on the total factor productivity. Hanclová and Doucek (2012) used the econometric approach, Vltavska and Fischer (2010) used the index approach. Labour productivity in connection to the labour costs was analysed by Fischer and Vltavska (2009).

Doucek et al. (2012) presented the comprehensive view on the competitiveness of the Czech ICT sector. Co-authors of this monograph used demographic, social and economic point of view with the special attention to the tertiary education including ICT. Competitiveness of the tertiary education system has also been analysed by Fischer and Finardi (2010) mainly from the points of view of the rate of investment in tertiary education.

3. Key findings

The economic impact of ICT could be analysed from different points of view and using different data. The macro-economic impact we recommend to analyse using data from the system of national accounts. It is necessary to differ between ICT manufacturing and ICT services: ICT manufacturing has a very low share of value added to the gross output (approx. 2 %) so their impact on gross domestic product is very small. It also causes the objections of estimating the labour productivity and total factor productivity in ICT manufacturing due to the high sensitivity on small changes in gross value added and the number of employees. Fischer and Vltavska (2012) also found out that the share of intermediate consumption influences the economy of the non-ICT industries.

From the point of view of the human sources in ICT, Maryska and Doucek (2011) concluded that the Czech educational system is cheaper than the Austrian one. The Czech Republic has 1.35 time more students than Austria, but the Czech Republic spent on the tertiary education 1.05 % GDP

while Austria spent 1.60 % GDP. There is also a difference between the trends in the number of ICT graduates (in the Czech Republic is increasing, in Austria the number decreases).

For the analysis of the impact of ICT to the total factor productivity, it is possible to use both index approach and the econometric approach. These approaches are not competitive, but they are complementary. The advantage of the econometric approach is using all data in the time series while the index approach uses just the data at the beginning and at the end of corresponding time series. On the other hand, the econometric approach is sensitive to the sustainability of economic assumptions.

4. Challenges and Perspectives

As key challenges and perspectives we see the analysis of the impacts of the last economic recession in the Czech Republic. Although it started at the end of 2008, its impact has been recorded mainly in 2009 in the business sector and even in 2010 in the public sector due to the slower reaction of public budgets on the crisis. The influence of the recession should be analysed with some delay, because it is recommended to use the data from at least semi-definite sets of national accounts (Fischer and Sixta, 2009). Did the business sphere and the public sphere cut the expenses on ICT? Did the public sphere cut the expenses in education? Will be the future economic growth inhibited by the reduction of those types of investment? Also, the methodology of measurement of economic impact of ICT will be verified by the economic recession. Will the models estimate the relation between ICT level and economic growth correctly?

From the point of view of the human capital, the relation between the situation in tertiary education and the economy should be analysed. In 2013, about 400,000 students study at the tertiary education system. Is there any risk of the unemployment of the graduates? Will be the risk of unemployment different according to the study fields? In 2013, two big surveys are organized. REFLEX survey operated by Centre for Educational Policy is focused on employability of recent graduates including the level of wages achieved. On the other hand, EUROSTUDENT survey operated by the Ministry of Education, Youth and Sports is focused on the economic and social situation (including their jobs at study) of the current students. Some questions are also oriented to the visions of current students related to the future employment and future wage. Due to the relatively high number of respondents of both the surveys it could also be analysed the situation of graduates and students in ICT study fields.

5. Conclusion

In this paper we presented current situation of the measurement of economic impact of ICT to the Czech economy. Recently used methodology and key findings achieved are presented, both in the macro-economic level and from the point of view of the human capital development.

Challenges and perspectives are stated. Firstly, the influence of current economic recession should be deeply analysed. Secondly, two students' and graduates' surveys are operated. Using their results the current and future situation of ICT students and graduates could be analysed.

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References

Doucek, P. et al. (2012) Konkurenceschopnost českého ICT sektoru [Competitiveness of the Czech ICT sector]. Praha : Professional Publishing, 2012. 254 p. Text in Czech. ISBN 978-80-7431-077-5.

Doucek, P. (2011) Human Capital in ICT – Competitiveness and Innovation Potential in ICT. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz: Trauner Verlag universitat, 2011, s. 11–22. ISBN 978-3-85499-873-0.

Fischer, J. & Finardi, S. (2010) Czech Tertiary Education on the Way to Competitiveness. Jindřichův Hradec 08.09.2011 – 10.09.2011. In: IDIMT-2010. Linz: Trauner Verlag universität, 2010, p. 231–236. ISBN 978-3-85499-760-3.

Fischer, J. & Sixta, J. (2009) K propočtu souhrné produktivity faktorů [Towards the Measurement of Total Factor Productivity Index]. Politická ekonomie, 2009, vol. 57, no. 4, p. 544–554. Text in Czech. ISSN 0032-3233.

Fischer, J. & Vltavska, K. (2009) Labour productivity and labour costs ICT in the Czech republic. Jindřichův Hradec 09.09.2009 – 11.09.2009. In: IDIMT-2009 System and Humans – A Complex Relationship. Linz: Trauner Verlag universitat, 2009, s. 115–121. ISBN 978-3-85499-624-8.

Fischer, J. & Vltavska, K. (2011) National accounts as a useful data source for competitiveness analysis including the ICT impact. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz: Trauner Verlag universitat, 2011, s. 141–146. ISBN 78-3-85499-873-0.

Fischer, J. & Vltavska, K. (2012) Intermediate Consumption of ICT Products and Its Impact on Economy of the Czech Industries. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: IDIMT-2012. Linz: Trauner, 2012, s. 115–121. ISBN 978-3-99033-022-7.

Hanclová, J. & Doucek, P. (2012) The impact of ICT capital on labor productivity development in the sectors of the Czech economy. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: IDIMT-2012. Linz: Trauner Verlag universitat, 2012, s. 123–133. ISBN 978-3-99033-022-7.

Kuncova, M. & Doucek, P (2011). Comparison of the Cluster Analysis and the Methods of the Multi-criteria Evaluation of Alternatives Used to Create a Groups of Countries Similar in the Take up of the Internet Services. Janská Dolina 06.09.2011 – 09.09.2011. In: Mathematical Methods in Economics 2011 [CD-ROM]. Praha: PROFESSIONAL PUBLISHING, p. 419–424. ISBN 978-80-7431-058-4

Maryska, M (2008). Business Informatics in a Light of Costs, Profits and Gains. Jindřichův Hradec 10.09.2008 – 12.09.2008. In: IDIMT-2008 Managing the Unmanageable. Linz: Verlag Osterreich, 2008, s. 23–40. ISBN 978-3-85499-448-0

Maryska, M. & Doucek, P. (2011) Comparison of the Czech and Austria Education Systems. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz: Trauner Verlag universitat, 2011, s. 23–34. ISBN 978-3-85499-873-0.

OECD (2004): The Economic Impact of ICT. Measurement, Evidence and Implications. 303 p. OECD, Paris. ISBN 92-64-02103-5

Pavlícek, A., Kacín, R., Sigmund, T. & Hubacek, J. (2011) The Position of ICT Sector in the National Economy of Czech Republic. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz: Trauner Verlag universität, 2011, s. 147–156. ISBN 978-3-85499-873-0.

Vltavska, K. & Fischer, J. (2010) Labour Productivity and Total Factor productivity in the Czech ICT. Jindřichův Hradec 08.09.2010 – 10.09.2010. In: IDIMT-2010 Information Technology – Human Values, Innovation and Economy. Linz: Trauner, 2010, s. 251–257. ISBN 978-3-85499-760-3.

THE CZECH WAGE DISTRIBUTION IN THE CONTEXT OF ICT SECTOR

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Keywords

Log-normal distribution, log-logistic distribution, Meyer-Wise model, Singh-Maddala distribution

Abstract

Modelling of the wages in the economy presents very popular part of the economic research. It is caused mainly by the necessity of finding the best wage distribution as a prerequisite for the labour market modelling. The aim of this paper is to find the best fitted wage distribution for ICT sector and compare it with the results for the business sphere of Czech economy in the year 2011. Afterwards we examine the role of wage distribution in the process of economic modelling using the Meyer-Wise model. For the ICT sector Singh-Maddala distribution is the best fitted wage distribution in the economy where minimum wage exists. For Czech economy the log-logistic distribution presents the best option.

1. Introduction

Modelling of the wages in the economy presents very popular part of the economic research because of the findings of the well-fitted distribution as the necessary prerequisite for the modelling of the labour market. In the Czech Republic the log-normal distribution is usually used (Marek, 2010). However, this distribution does not present the best fitted distribution. Particularly, it is used because of its suitable theoretical qualities. This paper presents other best-fitted wage distributions for the ICT sector and business sphere (sector) of Czech economy with respect to its further use in the process of economic modelling. Besides log-normal distribution we employ log-logistic distribution and Singh-Maddala distribution using the micro data from the Average Earnings Information System (hereafter: ISPV) and evaluate fit between observed data and particular model. We will employ the Meyer-Wise model as the tool used to illustrate the role of the choosing the best-fitted wage distribution in economic models. Empirical studies on minimum wages are commonly based either on time series or panel data. The approach of Meyer-Wise model is different because the cross-sectional data are used to evaluate impact of minimum wage on

employment and wage distribution. Guy and Skott (2007) point out the relationship between ICT and income distribution in context of change supply and demand for low-paid employees due to technological changes in period from 1940 to 2000. We will concentrate on ICT sector defined in Doucek, Maryška et al (2012) and on the business sphere of Czech economy using the data from ISPV for the year 2011.

The remainder of the paper is organized as follows. In part 2 the data and methodology and wage distributions are clarified, in part 3 we present the results achieved for ICT sector and business sphere of Czech economy as well.

2. Methodology

In this section we present the Meyer-Wise model which is typically used to estimate the impact of the minimum wage on employment and wages comparing market wage rates that individuals would receive in the absence of the minimum wage with an actual wage distribution (Matějka & Duspivová, 2013).

2.1. Meyer-Wise Model

The purpose of Meyer-Wise (1983) model is measuring impact on employment and wages due to the existence of the minimum wage in an economy by comparing empirical and theoretical wage distributions. The basic idea of this model is illustrated in Fig. 1. Assume the economy where the minimum wage is not established and thus we do not expect interference in the wage distribution that is represented by the density f(W) (the solid line). Suppose the introduction of the minimum wage at level M to this economy, the initial density f(W) is switched to the new density represented by the dashed line h(w). The characteristic shape of this new distribution is caused by several effects. The minimum wage introduction creates spike which represents employees whose wage rose up to the minimum after introducing the minimum wage, but below the minimum wage is still some employees because they are employed in non-covered sectors or they are employed by not law-abiding employers. We can also mention the spill-over effect which can shifts the initial distribution to the right. A spill-over effect balances the differences in productivity of individual employees.

As for Czech Republic, the wage distribution in existence of the minimum wage is known. To be able to measure the impact of the minimum wage using Meyer-Wise model we need to know the wage distribution in the absence of the minimum wage. The minimum wage legislation has been enacted since the early 1990's and ISPV survey has been carried out since 1992, so the only option how to get the density function f(W) is to estimate hypothetical density function as a modification of the density function h(w). As Meyer and Wise (1983) we suppose that employees paid for particular level of wage above the minimum are unaffected by the minimum so we use the maximum likelihood method for estimating the distribution of wages from a sample of employees where the wages are truncated at 8 800 CZK (i.e. employees who are definitely not paid at the minimum on neither monthly nor hourly basis).

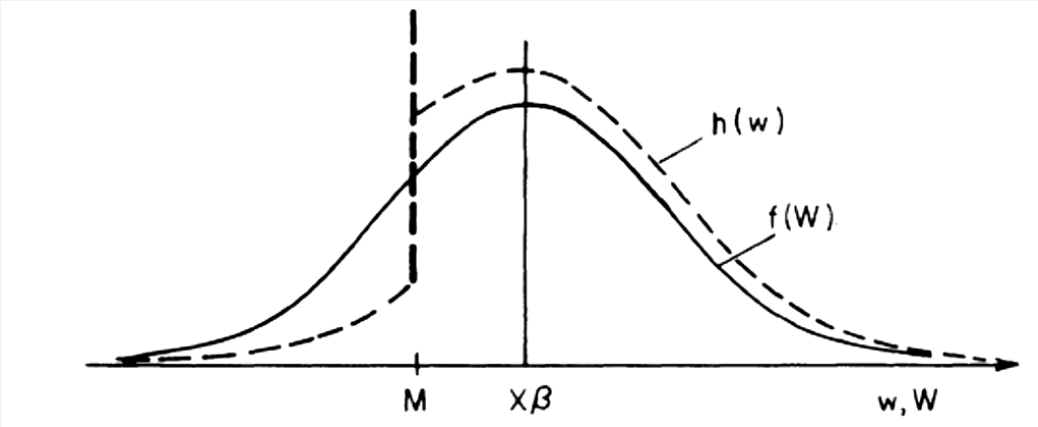

Fig. 1 Meyer-Wise Model; Source: Meyer-Wise (1983)

2.2. Wage Distributions

Singh-Maddala Distribution

The Singh-Maddala distribution (Singh & Maddala, 1976) comes from a generalization of the Beta distribution of the second order (Kleiber & Kotz, 2003). The Singh-Maddala distribution is often applied in the modelling of the household income in the USA. Probability density function for this distribution has the form:

$$f(y) = aqy^{a-1} / \left[b^{aq} \left\{ 1 + (y/b)^{a} \right\}^{1+q} \right], \tag{1}$$

where a, b, q, y > 0. Parameters a and b determine the shape of the distribution and q is the scale parameter.

Log-normal Distribution

The log-normal distribution is often used for its advantageous properties with respect to the normal distribution. This distribution was popularized by the French engineer Robert Gibrat (1931). The probability density function of the 3-parameter log-normal distribution is given by:

$$f(y) = \frac{1}{(y-\lambda)\sigma\sqrt{2\pi}} \exp\left\{ -\frac{[\ln(y-\lambda-\mu]^2}{2\sigma^2} \right\}, \tag{2}$$

where $0 \le \lambda \le y$, $-\infty < \mu < \infty$, σ > 0 are parameters of the probability density function, specifically μ is the expectation value, σ is the standard deviation and λ is the shift parameter. Density function (3) is defined for y > 0. Obviously if the parameter λ is set to zero, density function (2) becomes to the form of 2-parameter log-normal distribution.

Log-logistic Distribution

The log-logistic distribution (also known as the Fisk distribution) is a simplification of the Sing-Maddala distribution where the parameter q = 1. It is mostly used in survival analyses as a model for rapidly rising events which fall faster afterwards. The log-logistic distribution is very similar in shape to the log-normal distribution, but it is more suitable particularly for use in the analysis of survival data. The relevant probability density function is given by:

$$f(y) = ay^{a-1} / \left[b^{a} \left\{ 1 + (y/b)^{a} \right\}^{2} \right], \tag{3}$$

where a, b, y > 0.The parameter a determines the shape of the distribution and the parameter b specifies the scale of the distribution.

The maximum likelihood estimates and the related fits are evaluated by the Akaike information criterion (AIC) according to Yee & Wild (1996):

$$AIC = -\ln(L) + 2p, \tag{4}$$

where ln(L) is the logarithm of the likelihood and p is the number of estimated parameters in the maximum likelihood estimation method.

3. Results

3.1. ICT Sector

For the application of Meyer-Wise model it is crucial to find an appropriate hypothetical wage distribution which would represent the situation where the minimum wage does not exist. Singh-Maddala distribution was chosen as the best-fitting distribution based on the minimum value of AIC criterion (see Table 1 and Fig. 2 and 3). This distribution was subsequently used to fit the wages which are not affected by the minimum wage (i.e. wages higher than 8 800 CZK) and thus the hypothetical wage distribution without existence of the minimum wage was created. Descriptive statistics of Singh-Maddala distribution and its truncated modification are shown in the Table 2.

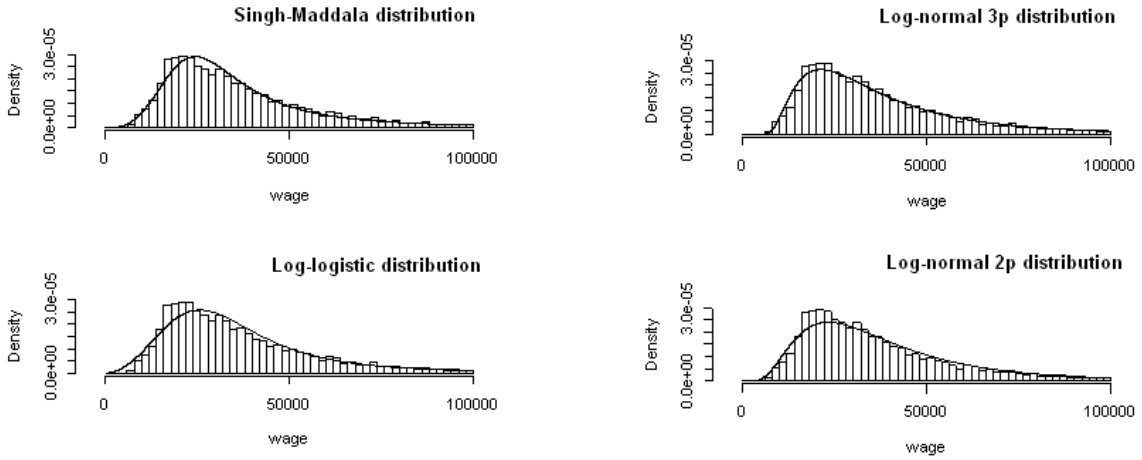

Fig. 2
Best-fitted wage distributions, ICT sector; Source: Computation of authors using ISPV (2011)

1) distribution	2) parameter estimates			3) log-likelihood	4) AIC
5) Singh-Maddala	6) a = 3.756	7) b = 25 319.7	8) q = 0.5849	9) -1 161 855	10) 2 323 716
11) 3-param. log-normal	12) μ = 10.215	13) σ = 0.717	14) λ = 4 918.58	15) -1 167 933	16) 2 335 872
17) log-logistic	18) a = 2.977	19) b = 32 476.69	20)	21) -1 169 210	22) 2 338 426
23) 2-param. log-normal	24) μ = 10.081	25) σ = 0.597	26)	27) -1 169 544	28) 2 339 094

Table 1 Best-fitted wage distributions, ICT sector; Source: Computation of authors using ISPV (2011)

distribution	n	E(X)	median
observations	103 337	40 872	31 889
Singh-Maddala	103 337	42 108	31 338
Singh-Maddala truncated	102 834	42 522	31 476

Table 2 Descriptive statistics of best fitting distribution (truncation at 8800 CZK); Source: Computation of authors using ISPV (2011)

Fig. 3 describes the comparison between observed wages (histogram), Singh-Maddala distribution (solid line) and truncated Singh-Maddala distribution (dashed line).

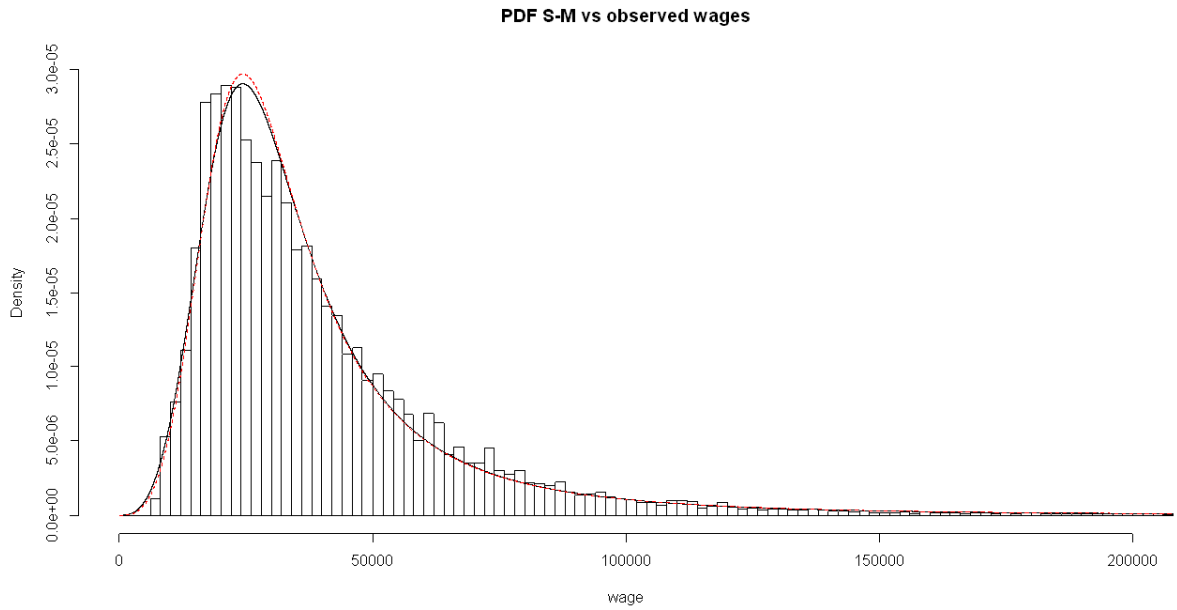

Fig. 3 Observed wages (ICT sector) – Singh-Maddala and truncated Singh-Maddala distributions; Source: Computation of authors using ISPV (2011)

The initial assumption that in ICT sector is no or negligible influence of the minimum wage was confirmed. Fig. 4 shows a gradual increase in the number of employees below the minimum wage (this is the positive effect of a hypothetical abolition of the minimum wage). It is apparent compensation of empirical and theoretical wage distribution in the situation near the minimum wage (spike), which is typical for economies where the minimum wage is established, in the other words the accompanying effect of the minimum wage is usually greater accumulation of low-income employees near the level of the minimum wage. The overall effect of the transition to a situation without the minimum wage is slightly positive (230 new employees, it is only 0.22% of total number of employees in ICT sector).

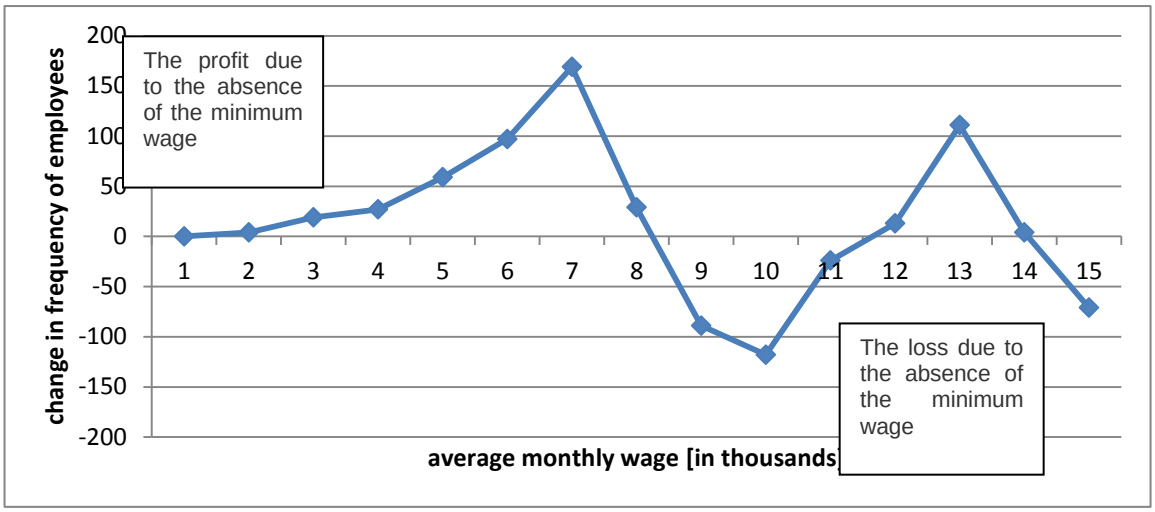

Fig. 4 Movement of Employment, ICT sector; Source: Computation of authors using ISPV (2011)

3.2. Business Sphere of Czech Economy

We tried to find out the appropriate wage distribution for the business sphere of Czech economy. A very satisfactory fit between observed data and model is provided by Sing-Maddala, log-logistic and log-normal distribution. However, it is necessary to choose the distribution that reflects the important part of wages the best possible way. It means that this distribution should not biased the area around the median of gross monthly wage (i.e. 21 224 CZK) where the most employees works.

On the basis of the considerations mentioned it is reasonable to assume that the best fitting wage distribution is log-logistic. This decision is justified by comparing two histograms (Fig. 5). The Meyer-Wise model was repeated for mentioned variants of appropriate wage distributions and it can be concluded that the total negative impact is retained, but the structure of employment especially in the lower end of the distribution is modified.

Comparing the results of Meyer-Wise model of Czech economy and results of the model for ICT sector it can be seen that modifications in employment in the whole business sphere are more consistent (see Fig. 6). Observed wages in business sphere are described by histogram with a very noticeable spike beyond the minimum wage. This spike can be interpreted as a forced accumulation of employees who would have worked for a wage less or equal to the minimum wage. Below the minimum wage is a distinct gradual increase in the number of employees, which is negative effect of the presence of the minimum wage, because 45 026 people are not employed. This increase is stopped due to the effect of the minimum wage and the compensation of the spike occurs. The overall effect of this hypothetical situation is significantly negative (77 668 employees would lose their jobs, which is 2.75% of employees in whole business sphere. Considering alternative Singh-Maddala distribution gives more significant 103 568 lost jobs, which is 3.67% of employees in whole business sphere.).

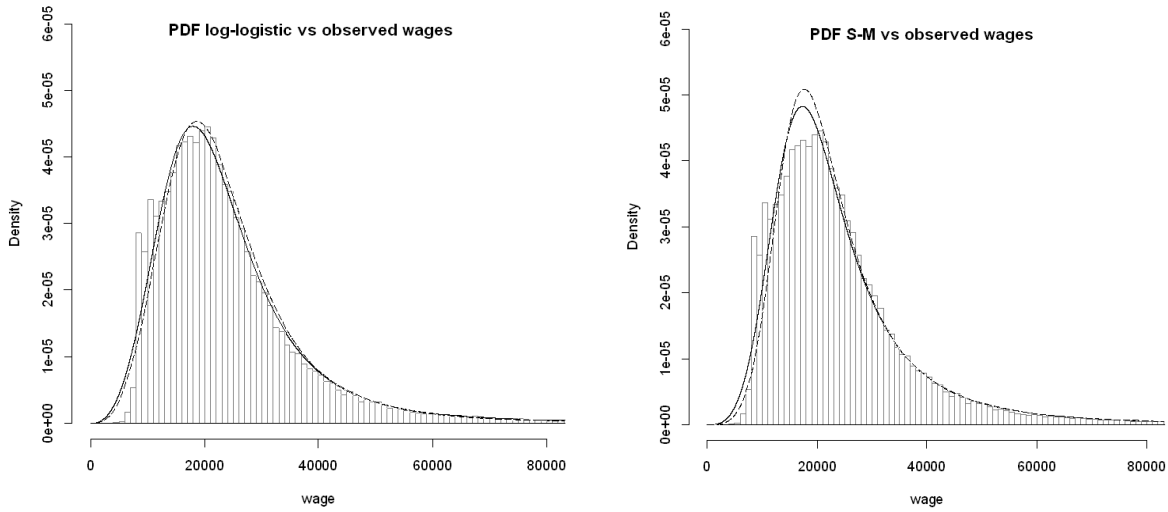

Fig. 5 Observed wages (business sphere, Czech economy) – Singh-Maddala and log-logistic distributions;

Source: Computation of authors using ISPV (2011)

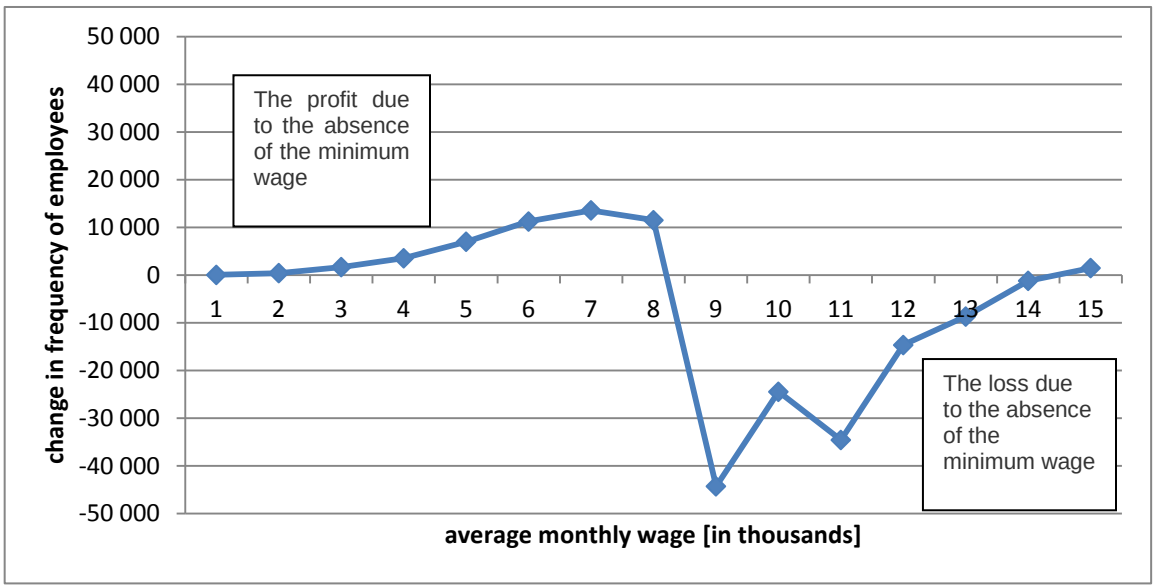

Fig. 6 Movement of Employment, business sphere, Czech economy

Source: Computation of authors using ISPV (2011)

4. Conclusion

This paper was devoted to the analysis of the best fitted wage distribution for Czech ICT sector and for the business sphere of Czech economy. We presented Meyer-Wise model as a tool employed to illustrate the role of the choosing the best-fitted wage distribution in economic models in the economy where the minimum wage exist. According to the model, we compare the distribution of wages that individuals would obtain in the absence of the minimum wage and the observed distribution. The difference represents the effect of the minimum wage on wages and employment

in the ICT sector and business sphere of Czech economy. We quantify the Meyer-Wise's model using the Singh-Maddala distribution (ICT sector) and log-logistic sector (business sphere of Czech economy).The role of the minimum wage in the ICT sector is not significant. The total positive change in employment is only 0.22%. Using the model for the business sphere of Czech economy brings significant conclusions. Due to the arguments of many authors on Meyer-Wise model we should take the results with caution.

Acknowledgement

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References

Akaike, H. (1974). A new look at the statistical model identification, IEEE Transactions on Automatic Control, 1974. 19 (6): 716–723, doi:10.1109/TAC.1974.1100705,MR 0423716

Doucek, P., Maryška, M., & kol. (2012). Konkurenceschopnost českého ICT sektoru [Competitiveness on the Czech ICT Sector]. 1. vyd. Praha: Professional publishing, 254 p. (Other authors: Fiala, T., Fischer, J., Hančlová, J., Langhamrová, J., Novotný, O., Vltavská, K., Voříšek, J.).

Gibrat, R. (1931). Les inegalites economiques. Paris: Sirey.

Guy, F., & Skott, P. (2007-11). Information and communications technologies, coordination and control, and the distribution of income. Working paper 2007-11.http://www.umass.edu/economics/publications/2007-11.pdf

ISPV. Informační systém o průměrném výdělku: 2011, IV. čtvrtletí, Mzdová sféra [Average Earnings Information System, 4th quarter, business sphere]. Ministerstvo práce a sociálních věcí, 2012.

Kleiber, C., & Kotz, S. (2003). Statistical size distributions in economics and actuarial sciences. New Jersey [US]: John Wiley & Sons Inc.

Marek, L. (2010). Analýza vývoje mezd v ČR v letech 1995-2008 [The Trend of Income Distributions in the Czech Republic in the Years 1995/2008 Analysis]. Politická ekonomie, 58 (2), 186-206.

Matějka, M., & Duspivová, K. (2013).The Czech Wage Distribution and the Minimum Wage Impact: An Empirical Analysis. Statistika. (in printing)

Meyer, R. H., &Wise, D. A. (1983).Discontinuous Distributions and Missing Persons: The Minimum Wage and Unemployed Youth. Econometrica, 51 (6), 1677-1698.

Singh, S. K., & Maddala, G. S. (1976).A Function for Size Distribution of Incomes. Econometrica, 44 (5), 963-970.

UNEMPLOYMENT OF GRADUATES OF IT STUDY PROGRAMMES IN THE CZECH REPUBLIC

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Keywords

IT graduates, registered unemployment rate, employability of graduates

Abstract

The aim of the paper is to analyse the situation of IT graduates at the labour market in the Czech Republic. Using administrative data from evidence of graduates (MSMT) and the evidence of unemployed graduates (MPSV) we compare the unemployment rates between individual study programmes, between bachelor and master study programmes and finally between IT and non-IT study programmes. Unemployment rate is higher for graduates of master programmes than for the bachelor ones and differs between individual study programmes. Surprisingly, unemployment rate for IT graduates is not different from the one for non-IT graduates. Relatively high unemployment rate occurred for graduates of bachelor IT programmes at higher education institutions where there is no continuing master programme. For further research we recommend to analyse the regional demand for IT professions in selected regions and also to take into account the differences in wages reached by graduates.

1. Introduction

Employment of graduates of public higher education institutions (HEIs) becomes an important issue in the Czech Republic from several points of view. Firstly, in time of the economic recession which is present in the Czech Republic since 2009 the total rate of unemployment increases. One of the threatened groups is the group of new graduates of HEIs who have little job experience. Secondly, the number of HEIs' students in the Czech Republic has rapidly grown in the recent decade (Fischer, Mazouch, and Finardi 2008) with the significant impact to the internal rate of return on investment in the tertiary education (Finardi, Fischer, and Mazouch 2012). Risk of unemployment should also have to be taken into account at the analysis of return ability on investment in education (Finardi & Fischer 2011). Thirdly, unemployment rate of graduates is a one of the so-called qualitative criterion of the funding scheme of public HEIs in the Czech Republic (Taušer & Žamberský 2012). Unemployment rate of graduates directly influences the level of budget of HEIs and is also an important criterion for setting up the limit of the number of students who will be paid by the Ministry of education, youth and sports (Finardi, 2010).

The situation of graduates in ICT sector is much better in comparison to other sectors from the point of view of wages received by employees (Doucek et al. 2012). In our opinion, it is necessary

to analyse not only the level of wages, which is just one side of the labour market, but also the employability. Only the employed people can use their innovation potential for the development of ICT (Doucek 2011; Hančlová & Doucek 2012).

For the analysis of graduates' employment there are a limited number of data sources. The Labour Force Sample Survey as a usual data source on employment and unemployment does not contain special data on (un)employment of graduates. We will use the administrative data on the number of unemployed graduates divided by the study programmes which are collected and processed by the Ministry of Labour and Social Affairs. These data will be combined by the number of graduates in IT study programmes which are collected by the Ministry of Education, Youth and Sports.

The aim of the paper is to compare the unemployment rate of graduates in the IT study programmes to the average rate of unemployment of all graduates and to verify the hypothesis of better employability of IT graduates contrary to non-IT graduates.

The paper is organised as follows. In the Data and Methodology section both the data sources and our methodological approach are described in detail. In section Results and Discussion we bring the comparison of the situation of IT graduates to others and discuss the interpretation obstacles of this comparison. Finally we conclude our results and put some recommendations.

2. Data and Methodology

We combine two main administrative data sources for our analysis. Firstly we use the data from the Ministry of Labour and Social Affairs on the number of unemployed graduates. These data are at a disposal in the division of study programmes (MPSV 2012). Secondly we use the data on the total number of graduates in public HEIs. These data are included in the data source for funding of public HEIs and are broken down by the study programmes.

Combining these data sources, we compute the registered unemployment rate of graduates in IT study programmes and compare it to the total registered unemployment rate of graduates. The advantage of both data sources used consists in their administrative character. Data on graduates are based on integrated information from matrices of students (SIMS); data on unemployed graduates are based on the evidence of the Labour Office. Because both data sources include all of the cases, no sampling error occurs and the results are accurate.

Data on graduates are related to the period from 1st November 2010 to 31st October 2011 and the number of unemployed graduates is as of 30th April 2012.

3. Results and Discussion

Registered unemployment rate of all IT graduates reaches 2 %. In this paper we would like to compare this unemployment rate with individual rates of study programmes and with individual registered unemployment rates of study programmes at individual public HEIs. For this analysis we take into account five study programmes: Applied Informatics, Informatics, Master Informatics, Electrical Engineering and Informatics and Information Technology. We concentrate on both degrees; bachelor and master. We do not analyze the results for PhD programmes which are specific.

	Bachelor	Master	Total
Applied Informatics	1.8	1.8	1.8
Electro Engineering and Informatics	2.7	2.6	2.6
Informatics	1.1	6.2	3.8
Information Technology	0.7	1.3	1.0
Masters Informatics	1.0	3.7	2.3

Table 1 Unemployment rate, study programme, %; Source: Computation of authors using MPSV and MSMT

Table 1 displays unemployment rate for each study programme. The lowest registered unemployment rate of bachelor students was achieved in the study programme Information Technologies 0.7 % (278 graduates and 2 unemployed). This study programme attains the lowest level of unemployment rate among master study programmes too (1.3 %). The highest registered unemployment rate was achieved at Electro Engineering and Informatics (bachelor degree) and Informatics (master degree) which is three times higher than the overall registered unemployment rate of IT graduates.

There are several study programmes with total employment of the graduates (e.g. Charles University – Informatics, University of South Bohemia – Applied Informatics, Palacky University – Informatics, etc.). We concentrate mainly on the study programmes with some unemployment rate of the IT graduates. From the results (see Table 2) of individual study programmes at the selected public HEIs one can find out that the unemployment rate among study programmes differs. One of the reasons is the number of graduated students and sensitivity on low values of nominator and denominator. In case there are 25 graduates and 2 of them are unemployed the unemployment rate is high. If there are over 100 graduates the unemployment rate reaches approximately 2 % (see University of Economics and Czech Technical University). The second reason of the differences is regional arrangement. The unemployment rate of the IT graduates is lower in the cities such as Praha and Brno (approximately 1 %). From the point of view of the comparison with the overall registered unemployment rate of IT graduates there are four public HEIs which significantly differ. The most significant different is achieved in the College of Polytechnics in Jihlava where the unemployment rate is eight times higher than the unemployment rate of all IT graduates. It could be caused by the absence of master degree and not willingness of employers to employ bachelors.

	Study Programme	University	Unemployment rate
Bachelor	Applied Informatics	Jan Evangelista Purkyne University	8.0
		Masaryk University	1.9
		University of Economics, Prague	1.4
	Electro Engineering and Informatics	College of Polytechnics, Jihlava	16.7
		Czech Technical University	1.3
		University of West Bohemia	2.7
	Informatics	Masaryk University	0.0
		University of Ostrava	5.9
	Information Technology	Brno University of Technology	0.8
		Technical University in Liberec	0.0
	Masters Informatics	Tomas Bata University	0.9

		University of West Bohemia	1.3
Master	Applied Informatics	Masaryk University	0.0
		University of Economics, Prague	2.4
	Electro Engineering and Informatics	Czech Technical University	3.2
		Technical University in Liberec	3.3
		University of West Bohemia	1.4
	Informatics	Masaryk University	7.7
		University of Ostrava	3.1
	Information Technology	Brno University of Technology	1.2
		VŠB - Technical University of Ostrava	1.4
	Masters Informatics	Tomas Bata University	4.6

Table 2 Unemployment rate, study programme, public HEIs, %; Source: Computation of authors using MPSV and MSMT

Using results in Table 3 we can compare level of unemployment between IT and non-IT graduates at the public HEIs which provide IT study programmes. For bachelors at 5 public HEIs the level of unemployment of IT graduates is lower than of non-IT graduates and at 6 public HEIs the situation is opposite. For master degree the situation is quite similar.

There is quite high unemployment of IT graduates at the College of Polytechnics in Jihlava and at the Jan Evangelista Purkyně University in Usti. It could be influence by the fact that there is no master IT programmes at those public HEIs. Although students can continue their studies at other HEIs, it is quite complicated do to the decreasing number of students who are paid by the MSMT. Also, it is necessary to deeply analyse the regional demand for IT professions in these two relatively specific regions.

	Bachelor IT	Bachelor non-IT	Master IT	Master non-IT
Brno University of Technology	0.8	1.0	1.2	3.0
College of Polytechnics, Jihlava	16.7	11.1	n/a	n/a
Czech Technical University	1.3	0.8	3.2	1.6
Jan Evangelista Purkyně University	8.0	3.5	n/a	4.7
Masaryk University	1.2	2.1	3.9	3.6
Technical University in Liberec	0.0	2.3	3.3	2.1
Tomas Bata University	0.9	4.3	4.6	5.2
University of Economics, Prague	1.4	0.3	2.4	2.3
University of Ostrava	2.5	2.0	3.1	4.8
University of West Bohemia	3.2	2.1	1.4	2.7
VŠB - Technical University of Ostrava	0.0	2.0	1.4	6.6

Table 3 Unemployment rate, study programmes, public HEIs, IT and non-IT, %; Source: Computation of authors using MPSV and MSMT

Generally, the hypothesis of better employability of IT graduates has not been verified. It could be caused by the fact the IT graduates can search for a good job for a longer time while graduates of e. g. humanities fast accept a job (including worse paid job).

4. Conclusion

In this paper we analysed one point of view on the situation of IT graduates at the labour market – employability. The hypothesis that there is significantly better employability of IT graduates contrary to non-IT graduates has not been verified, unemployment rates of both groups do not differ.

In general, the unemployment rate of bachelors (for both IT and non-IT graduates) is significantly lower than for masters. The reason consists in fact that many of bachelors continue their studies at master programmes and do not enter to the labour market (unemployment rate is related to all graduates including graduates who study in master programmes). The opposite situation is for bachelors at public HEIs where there is no subsequent master programme (Jihlava, Usti).

For further research, we recommend to make a complex analysis also taking into account the second point of view – differences in wages which graduates reach. It is possible to use for example results from REFLEX surveys.

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References

Doucek, P. et al. (2012) Konkurenceschopnost českého ICT sektoru [Competitiveness of the Czech ICT sector]. (2012). Praha : Professional Publishing, 254 p. Text in Czech.

Doucek, P. (2011) Human Capital in ICT – Competitiveness and Innovation Potential in ICT. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz : Trauner Verlag universitat, 2011, s. 11–22. ISBN 978-3-85499-873-0.

Finardi, S. (2010) Financování vysokých škol v ČR – vývoj a trendy [Financing of high schools in Czech Republic: progress and trends]. Praha 16.04.2010 – 17.04.2010. In: Teoretické a praktické aspekty veřejných financí [CD]. Praha : Nakladatelství Oeconomica, 13 p. Text in Czech. ISBN 978-80-245-1644-8.

Finardi, S., Fischer, J., & Mazouch, P. (2012) Odhad míry návratnosti investic do vysokoškolského vzdělání podle oborů, pohlaví a regionů [The estimation of internal rates of return on human capital investment differenced by study fields, sex and regions]. Politická ekonomie, 60 (5), 563–589. Text in Czech.

Finardi, S., & Fischer, J. (2011) Measuring Returns on Investments in Human Capital by Mincer Model and its Impact on Czech Higher Education System. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz : Trauner Verlag universität, 2011, p. 43–50. ISBN 978-3-85499-873-0.

Fischer, J., Mazouch, P., & Finardi, S. (2008) Rising of educational attainment in transitive european countries: Is not the catching up too rapid? Radenci 10.11.2008 – 12.11.2008. In: Medgeneracijska solidarnost-IZZIV za sodobne družbe. [online] Radenci : Statistični urad Republiky Slovenije, 2008, p. 1–7.

Hančlová, J., & Doucek, P. (2012) The impact of ICT capital on labor productivity development in the sectors of the Czech economy. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: IDIMT-2012. Linz : Trauner Verlag universitat, 2012, s. 123–133. ISBN 978-3-99033-022-7.

MPSV: Pololetní statistiky absolventů škol a mladistvých v evidenci ÚP. [Half-year statistics of graduates and young people in the evidence of the Employment Office]. http://portal.mpsv.cz/sz/stat/abs/polo. Cit. 2013-04-29.

Taušer, J., & Žamberský, P. (2012) Kvalitativní kritéria ve financování veřejných vysokých škol a jejich dopad na Vysokou školu ekonomickou v Praze [Qualitative Criteria in Financing of Public Universities in the Czech Republic and Their Impact on the University of Economics, Prague]. Acta Oeconomica Pragensia, 20 (4), 74–88. Text in Czech.

METHODOLOGY OF IMPLEMENTATION OF INFORMATION SYSTEM FOR THE MANAGEMENT OF THE PROCESS OF INVESTMENT ACTIVITY (MISP)

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Keywords

Corporate information system, methodology of enterprise information system, a process approach and project outputs, and the project management information support activities.

Abstract

This paper deals with the issue of corporate information systems and methodology of implementation of information system of the enterprise within the framework of enterprise projects. These projects and their control is defined to refer to high value-added knowledge components, high quality and reliability of their implementation, customer satisfaction with their use and, above all, their relation to the implementation of corporate information strategies. Fulfilment of the required outputs can only be achieved by developing and using logic procedural support, deployment, project management methodology, the introduction of the information system for the management of the process of investment activities (MISP). The contribution is fully disassembled procedural methodology on the example of the implementation of the procedural system for phase control requirements on investment measures in the Třinecké železárny, a.s..

1. Introduction and hypothesis

Information processes in the enterprise cannot run erratically, without a clearly established methodology and the use of the methodology of the introduction of the information system of enterprise projects (ISP), without a clear solid procedural setting and methodological background. This way the logical arrangement of the sequential steps, ideas, activities and project processes for projects ISP are included in the concept of the methodology development and project management ISP. The methodology can be applied not only at a general level, but especially in manufacturing companies for the management of the process of investment activities (MISP).

The procedural way of thinking is a public information system output and result in a solution of a specific project information system (or multiple projects). The methodology of development of information systems shows that this is a very formalized process a custom implementation of the information system to the final use of the target user groups-public. The theory of project management provides a public information system project in the general framework for the derivation of methodological recommendations specific to the role of the system support a custom deployment of information system.

2. Information system in a manufacturing enterprise

Information system in the manufacturing enterprise must be able to do automatically or by user request activity as acquisition, authentication, processing, data storage, information back-up and knowledge save, as well as creating the required files data, information and knowledge, or meta-knowledge, for analyzing operation, control, coordination, communication and visualization in real time (Wolf, 2002).

From the above mentioned, a corporate information system may consider only business data, information and knowledge at the same time. Practically, this depends on the type of the ISP, which is realized, or that we're exploring. The purpose of the use of information technologies within the ISP is the total rationalisation of management, decision-making and administrative activities.

An enterprise information system is built through project management. The basic definition of project access is according to V. Němec (Němec, 2003) identification of a project to provide design-time implementation of the innovation, such as the start and end dates. The project is a unique process consisting of a series of coordinated and controlled activities with start and end dates, undertaken to achieve the objective, which meets the specific requirements, including the limits of time, cost and resources.

In accordance with V. Němec (Němec, 2003) we can find advanced project definition as a unique and unique set of activities. The project is an effort to bring about a change, which is carried out a series of activities leading to the creation of the product, or the development and implementation of specific technologies. The target state is achieved within a limited time, in the context of limited resources and costs and to achieve the desired quality parameters.

The importance of the concept of the project in the context of business information system is summarised as follows:

unique activities scheme in the enterprise to advance established and clearly defined the objectives of the implementation of the corporate information system, that has the specified start and end, which requires cooperation between different professions, it joins their capacity and their efforts and uses (or consumes) to create a target output of information, material, money, competences and skills of the participating people.

From a procedural point of view it can be concluded that the project is a single transform of inputs (information, environment, material, money, competences and skills of the participating people) to outputs (target products), with the help of development activities that are organized into stages, steps, coordinated management activities (Chlapek & Chocholatý, 2004).

Projects of information system deal with their own development of an information system or its parts. The issue of assessing the effectiveness of the projects IS to a large extent is a matter not only of the needs of users IS (user groups) and their efficient satisfaction, but also a matter of expectations.

3. The methodology of project management information system in enterprises

For the definition of the concept of its own methods of creation of the project IS we would use a lot of approaches. According Mikulecký, Hynek and Lenharčík (2002) summary of the processes, methods, techniques, and tools that can be used for the development and introduction of the IS. The definition is a very good framework for content characterization of methodologies.

3.1. Methods of creation of the information system of enterprise project

Methodology of Information Systems is a recommended summary of the stages, approaches, policies, procedures, rules, documents, controls, methods, techniques and instruments for the creator of the IS, which covers the entire life cycle of the ISP. It determines who, when, what and why to do during the development and operation of the ISP.

An integrated approach to projects IS is based on the principles of system integration, which seeks to address the issue of the effectiveness of a number of information projects. The goal of system integration by J. Voříšek (Voříšek, 1993) is to create a permanent maintenance of the integrated information system, which combines the potential of information technology to the maximum available support information the objectives of the project.

If we understand the ISP as a system of rules, regulations and management methods in a particular project (i.e. systems of regular meetings, informal meetings of leaders and rank-and-file workers), we emphasize the implementation of custom information system management aspect.

3.2. Dynamic structure of the MISP methodology

In the construction of procedural methodology MISP has often been an often discussed topic, whether and in what importance to integrate the time factor into the basic procedural framework of this methodology. Indeed, the classical project approach is based on the magical triangle, where time is imperative concept, which competes with the scope, project risks, project cost and quality with a view to reconciling these variables and factors. Time of the project is therefore an external aspect, which is the system of work of the project team are entered, and is a part of a custom solution (through the requirements of investors).

In the methodology of the MISP process management requires a different perspective respecting the time frame of the project. The project time, however, is not only the external characteristic, but it becomes an internal project factor, internal project metrics. Its role is not an imperative; it becomes an internal regulator of the owner of the processes and limited condition of the quality of the project outputs. In compliance with the procedure for implementation of the project management process IS processed in the methodology of the MISP, it can be concluded that the right combination of all procedural and project dimensions (the organization of the project, people involved in the implementation of project activities and project technology) it is possible to achieve significantly higher levels of performance and efficiency of each part of the project processes, even the resulting project characteristics and performance metrics.

The dynamic structure of the MISP constitutes the basic concept of iterative development with its phases, iterations and milestones, as well as the factors that govern this process. These include satisfying the information needs of the contracting authority, risk reduction, incremental and saturating development. The methodology recommends that these iterative phases of information systems projects are not too long. There are two fundamental reasons. The project IS the development of technologies is relatively fast forward, so the longer cycles cause the danger of the

use of obsolete technologies or development environment. Another reason is the motivation of the participants. Researchers must be professional throughout the project development IS strongly encouraged-to keep the motivation in the longer period of time is very difficult.

Dynamic structure and dynamic view of the methodology of the MISP is five-phase complex, when partial processes in the individual phases together form one whole, which result is a process output. The key is in the MISP methodology to secure all the activities of the owners of each process and, of course, according to basic process philosophy very carefully to examine the quality of the outputs of the partial processes.

4. Application of methodology for the introduction of the information system for process management of investment activities in the Třinecké železárny, a.s.

In order to increase the level of investment projects management process has been by the management of the Třinecké železárny, a.s. in 2006 decided to impose Investment controlling. To address this issue was running a project for the construction of the information system for the promotion of investment activities. The project did not start on the Greenfield, individual parts of project management through the ISP have been secured in the ironworks, but the covering system has been lacked that would link the individual elements. In the course of making objective concept of scope of the project was broadened to include management of repair and maintenance. The mission of the project was to

- streamline the process of managing investment projects, repair and maintenance via introduction of the registration as a rapid and accurate sources of information,
- obtain the tools to facilitate the decision-making process during the planning and implementation of investment projects, allowing the control of resources and implementation schedules,
- facilitate statistical calculations and economic evaluation of investment.

In the first phase, which was to prepare a project, the implementation team defined the requirements for future functionality of the information system; it was based on the existing investment management process, complete with suggestions for the rationalization and enhancement, which arose during the discussions. At the time, when the requirements have been defined, stepped into the debate by an external consultant to assess the requirements with regard to the possibility of the implemented quality system. Some elements had to be redefined but some other elements have been dropped and, on the recommendation of the consultant on the other hand added.

Project outputs have been defined so as to ensure the following field of investment management process:

- The process of entering and request approval for the investment measures (PIO) - functionality allows you to enter the necessary information on the technical, material and financial aspect of the request and keep track of its status. Requirements are then used to construct the investment plan.
- The process of management of investment budget - allows you to set up individual items of investment programmes (budgets) and update them in the form of appendices and the recovery. The system allows monitoring of available resources.

- The process of updating the expected effect of the current year - evidence of the expected effect on projects, where recent months costs represent the resources posted the fact, planned investment spending for the next months are entered manually.
- Depreciation simulation process - it is possible to interlacing of assets and data cards in each of the SPP elements (SPP-structured element of the project, the foot-stone of the information system).
- The process of information management - sending of important information and warnings about the need for response in the standard decision-making process by electronic mail.
- The process of reporting – generating and sending of reports about investment activity to responsible persons according to their requirements.
- Documentation management process - distribution and archiving of business and technical documentation related to investment activities.

The outputs of the first phase were initiated in the second stage – setting of target concept. This document contained the analytically processed user requests and defined the scope and form of the acceptance tests. Target concept was written so that it can be productive during the preparation of operation quickly and easily converted into user manuals.

In the third-stage - realisation of the project, IT department was under the direction of consultant carried out adaptation of implemented information system according to the requirements of the target concept. This phase revealed certain inaccuracies and errors of the target concept and so it needed to be edited and then be approved by the implementation team.

Preparation of the operation included a link system with information systems for financial accounting, controlling, asset management, materials management, maintenance and operation. The system was still running in a test mode, so that in case of any problems, have not been affected by the productive modules, with which it has been traversed. The test series was carried out and end-user training was done. Testing phase came to an end at the time when the system and users have been ready to go into operation.

Phase fifth – productive operation and support system of the tilting test mode to productive. The first three months, when the real projects were targeted, data validation was carried out, to check the functioning of the system and under the customs specifications were programmed for more reports. After the end of the trial period, the project was terminated.

4.1. The request management process for investment measures (PIO)

The following text contains the procedural system for phase control requirements on investment measures in accordance with the methodology of the MISP. Each individual claim is entered by manufacturing operations, other employees of the investment department, department of technology and research as well as marketing. The system allows you to enter the necessary information on the technical, material and financial aspect of the requirement so as to serve as a basis for future investment plan in both the long and short term horizon. Individual requests can be forwarded to each state (status) and thus enable their aggregation according to the needs of the contracting authority. You can also connect to the request documents that explain the relevant request closer (drawing, photography, a documentary about the purpose of the investment, etc.).

In each step of the process control requirements on investment measures, it was necessary to establish the role, i.e. who has permission to perform this step, the input status of the request, indicating its condition before making the step and the output status, indicating the status of a

request for the execution of the step. In order to ensure the correct procedure is to make a concrete step only when the requirement is in the appropriate state i.e. the appropriate status is done. Output status may acquire more options according to the result of the step. Some of the steps do not change the status of the request, but set the values into the fields. The following table lists the descriptions of procedural activities, roles, input and output statuses.

	Specification	**Role**	**Input status**	**Output status**	**Comments**
1	Setup of PIO	Promoter of PIO	open	for approval	
2	Approval of PIO	Approver of PIO	for approval	Enable unable	
	Approval of PIO agrees with the requirement and passes it on investment department.				
3	Acceptance of PIO	Head of IV (investment department) Zone: Point of view of IV	enable	accepted Open	return for completion
	Head of investment department accepts or returns for completion. Monthly the head establishes the list of received and discussed (according to the data for the deferred actions) requirements which will be submitted for discussion. For consideration they will be submitted to all the requirements of an approved operation with the opinion of the investment department. The management meeting rejects or decides to postpone the processing of technical information.				
4	Approval of processing for technical report	Head of IV Zone: date of postponing action head of project	accepted	Technical report postponed rejected	Accepted monthly by the management meeting
	Head of investment department shall appoint a project manager for the actions that have been approved for processing technical reports. For postponed actions will be listed the date of consideration (determined by the management meeting).				
5	Proposal for including in 5-year-plan	Head of IV Zone: Proposal for including in 5-year- prospect – yes, no	fixed status		
	Head of IV prepares a list the requirements for inclusion in the 5-year-old perspective, which he shall submit to the management for approval.				
6	Acceptance of inclusion in 5-year-plan	Head of IV Zone: strategy plan	fixed status		acceptance of inclusion in 5-year-plan
	The management meeting approves x disapproves inclusion of PIO in 5-year-plan				
7	Report prepare to discussion	Technician of IV	TZ (technical report)	Technical report enables to Technical-economic	

		appendix: report Project team(s) (expectation of implementation)	enable: Head of IV, head of operation, controlling, human resources manager	council (TER)	
8	Discusses in Technical-economic council (TER)	Head of IV Zone: project	Report passes to TER	termination of action project	
10	setup of project	Technician of IV	project	project – development	
11	implementation of PIO	assumed from the project	project - development	project – implementation	
12	postponing of PIO	assumed from the project	project - development	postponed	
13	termination of PIO	assumed from the project	project – development	termination of action	
14	executed of PIO	assumed from the project	project – development	action executed	

Table 1: Description of processing procedures for management of investment

5. Conclusion

Over a period of more than six years of productive operation system built using procedural methodology of the MISP, it can be concluded that the expectations which have been inserted into it, have been come through. The system is further developed, and formed additional follow-up implementation projects. In the field of investment requirements there is compared to the target of such a practice, the first request will be discussed with all interested parties and then you refer to the system requirements accepted, thus minimizing the failure to approve the requests or return them to replenish at the stage prior to the processing of technical reports. The projects are in the system often following only from a financial perspective. Practice has shown that the substantive proceedings are much more flexible and more efficient by using standardized instruments defined in the dynamic structure of the methodology of the MISP. We can say that even in this project was reflected the general approach of the Třinecké železárny to newly imposed systems — from introducing mindlessly and automatically all the system has to offer, but choose only those units that will yield the desired effects and adapt them to the real environment.

References

Chlapek,D., Řepa V., & Stanovská I., (2005) : Vývoj informačních systémů, Oeconomica, Praha 2005, ISBN 80-245-0977

McNurlin, B.C. (1998) : Information Systems Management in Practice. Prentice Hall, 1998

Němec, V. (2003) : Projektový management. Grada, Praha 2003, ISBN 80-247-0392-0

Nora, S., & Minc, A. (1978): L'information de la societe. Paris: Rapport M. le President de la Republique, 1978

Wolf, P.(2003): The Experiences of the Procedural Management. In ICCC´2002. Proceedings of 3th International Carpathian Control Conference. Ostrava-Beskydy, Czech Republic. Ostrava: VŠB – TU Ostrava, May 27-30, 2002. s.623-628. ISBN 80-248-0089-6.

Wolf, P. (2005):. IS/IT Supports Process Management. ICEE 2005, In International Conference on Engineering Education. Gliwice, Poland: July 25-29, 2005. ISSN 1562-3580

Řepa, V. (1999): Analýza a návrh informačních systémů. Ekopress, Praha 1999, ISBN 80-86119-13-0

Řepa, V. (2005): Procesní řízení a modelování. Grada, a.s. Praha 2006, ISBN 80-247-1281

COMPUTER BASED INNOVATION IN SMES

ICT AND INNOVATIONS IN CONTEXT OF THE SUSTAINABLE DEVELOPMENT

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Keywords

ICT, innovation, sustainable development, green IT, virtualization, SME

Abstract

The paper deals with the aspects of ICT innovation in sustainable development. It specifies the relevant context of corporate social responsibility and Green IT. Important foreign surveys and findings are compared and main ICT innovation trends declared. Both these aspects are then applied in survey done among the Czech SME companies. The main results of this survey are described finally.

1. Sustainable Development and Corporate Social Responsibility

Sustainable development is associated with a large variety of terms which are very similar to each other (Kovalenko, 2013). We can meet for example with corporate conscience, corporate responsibility, corporate citizenship, social performance, corporate social responsibility or sustainable responsible business (Basl, Gala, 2009). The most common term is corporate social responsibility (CSR).

As well as sustainable development, CSR does not just focus on one issue, but is more of a holistic approach to business decisions and practices (Doucek, 2011). That means every move that company makes should be economically, socially and environmentally sustainable. ISO 26000[4] Guidance Standard on Social Responsibility, defines that CSR shall cover environmental issues (such as biodiversity, climate change, resource efficiency, life-cycle assessment and pollution prevention), and combating bribery and corruption. Community involvement and development, the integration of disabled persons, and consumer interests, including privacy, are also part of the CSR agenda.

Next important issues are also human and worker rights, incl. safe workplace and elimination of all forms of forces labour, limitation of discrimination and freedom of association.

Nevertheless, most of the companies are willing to implement into their business strategy the CSR policy in terms of mitigating the potential social and environmental impacts of their operations, and in reducing their carbon footprint. While working on the challenging problems which will help

[4] ISO 26000:2010 is the recognized international standard for CSR.

society, businesses will have a great feeling of doing good and that will bring the respect from their customers and consumers.

2. Sustainable Development and ICT Innovation – Green ICT Trends

While the department of CSR in the enterprise is concentrating on all issues of sustainable development, related to their businesses: environmental, social and economical, the target of Green IT is to find solutions and prevent environmental issues.

Most of the time, the concept of Green IT is represented in a close relation with the sustainable development, therefore it can be defined as environmentally sustainable computing. According to (Walsh, 2011) sustainable IT manufacturing refers to methods of producing products in a way that does not harm the environment. It encompasses everything from reducing the amount of harmful chemicals used to making them more energy efficient and packaging them with recycled materials. In the article of (IEEE, 2008), Murugesan defines the field of green computing as "the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems – such as monitors, printers, storage devices, and networking and communications systems – efficiently and effectively with minimal or no impact on the environment."

Today sustainability issues are increasingly becoming an important consideration for businesses. Understanding the impact and benefits of implementing a Green IT strategy should be essential for every business. And, the main target is to achieve environmental and financial savings by empowering employees to take action on energy, waste, water and travel.

Speaking about Green ICT and social responsibility we could find inspiration of best practices in countries of northern Europe naturally. Many Finish firms for instance prefer virtualization and paper less administration done by ICT innovation. On the other hand these projects are still not coordinated and the primary impulse is not environmental impact. (Tenhunen, 2011)

Best practices generally can bring inspiration (Appasami, 2011). It can show how to use computer better by the end user, how to use full potential of servers and computer centers. The special topic is effective cooling of hardware and virtualization, memory sharing or multitasking.

The impact on the third developing countries and their environment and work force is also important (Berthon, 2010). The question of ecological elimination is many times still open (smart phones, photovoltaic etc.).

The key step in the way towards sustainability support is implementation of environmental more friendly technique and technology especially into enterprise architecture of information system (Velte, 2008). The successful green project can bring the reduction of electricity power consumption, usage of virtualization, green ICT management.

The last trend in ICT innovation are also attractive topics for analyzing if and also how they can contribute to green ICT and CSR development. Sustainable ICTs and management systems for Green computing (Hu, 2012) bring the environmental impact of smart phones and photovoltaic elements, incl. their recycling. But there are not only benefits of ICT, green ICT innovation in companies and generally in society. There is also some “dark side” of green ICT (Venkatraman, 2011) in trends like virtualization or cloud computing. ICT is not a goal but the path and tool only. There are necessary steps in changes of firm culture, in firm legislative and national and international laws that should be accepted and follow by companies, employees. Many managers responsible for data centers do not even know the price their companies pay for electricity power (Johnson, 2008).

There is not only usage if ICT in a company. The environmental impact must be follow during the whole lifecycle of IT. The important aspects are electronic waste, transport, digital content (OECD, 2010; Kunstova, 2010).

The importance of Green IT aspects is reflected in a form of suitable frameworks and procedures. The systematic auditing is the tool for increasing effectiveness of the processes described by some authors (Ambtman, 2011; Maryska, 2008; Novotny, 2009).

3. Current Main ICT Innovation Trends

The ICT innovations are stronger and stronger oriented on trends known as Green IT. The most practical applications of Green IT are mainly:

- Dematerialization.
- Virtualization.
- Cloud Computing, SaaS.
- Tele-working.

The next possible forms of Green IT can be – Data Centre Cooling Remote Client Management, Suspend/ Hibernate Power Distribution, Server Energy, Storage Energy, Client Energy etc.

Dematerialization is further way how IT can contribute to more effective way how companies operate. Dematerialization of suitable real products or activities can eliminate amount of greenhouse gases that are produce during traditional form of production. The virtual forms like electronic documents, tele-working, videoconferences, e-commerce, on-line media are good known examples. The study of The Climate Group shows that thanks to dematerialization can be volume of CO_2 reduced till 2020 about 500 Mt (this amount is equal to that generated by whole branch in 2002).

Virtualization is the current trend in IT infrastructure when there is necessary to deal with software is not able to use hardware in an optimal way. Virtualization increases the hardware flexibility. It means finally that the important factors are improved (efficiency, accessibility, utilization, maintenance). Good example can be more virtual servers on one physical server. This trend is still not fully reflected with license politics of some providers. The long term horizon should calculate also with traditional difficulties like security and reliability (Virtualization, 2003-2013).

Cloud computing is maybe the most known trend lately. The Cloud Computing is able to offer access to shared configurable sources (network, servers, data storage, applications and services) any time from any place. This cloud computing services are widely available and flexible. The fast growth of smart phone and tablet popularity is another reason for using of cloud computing model mainly in smaller firms that needn't built own computer centers with own IT specialists. The application Software as a Service approach can be also good measured and can offer suitable model when firm pays only for that what was used.

Tele-working is way of application of ICT in companies that can have the most significant positive influence on reduction of greenhouse gas emission. This model supports the possibility when an employee can regularly work some day at home instead to travel to work. Tele-working is also an important factor of business continuity when in some emergency situation (like after hurricane period) employees can work from home although the office must be closed or they are not accessible by transport. The known disadvantage is less human interactivity.

4. Sustainability Support by ICT Innovation in SMEs

Many authors bring examples of Green IT implementations that caused benefits. But they mostly prefer big companies (for instance Velte, 2008; Van Osch, 2010). Van Osch presents good examples from automotive industry where he compares three significant companies – General Motors, Toyota a Daimler. The result, he presents, is that the penetration of environmental oriented innovation is very difficult and nearly not possible without social and legislative support. Clark (Clark, 2009) is one of the authors who concentrates on the Asian market and preparation of Asian firms for adoption of Green IT. He formulates conclusion that only 15 % of firms in this region prepare Green IT projects. Other details for the Czech Republic are presented for example in (Basl, Doucek, 2012; Buchalcevova, Gala, 2012).

From the European perspective there is crucial sector of Small and Medium Enterprises (SMEs) and their abilities to adopt green ICT, resp. CSR and sustainability perspectives in their business activities. Information and Communications Technologies (ICT), Small and Medium Enterprises (SMEs) and innovation – these three terms and their combination conceal within them the great expectations of the current stagnating economy, which is balancing on the brink of the abyss of a global crisis. In present-day Europe the proportion of SMEs in the total number of enterprises represents around 80 % and roughly 75 % of jobs.

This article presents two surveys dealing with innovations and the innovation potential of SMEs in the Czech Republic.

4.1. Survey A - SME expenditure in further investments and innovation in ICT

The aim of the investigation was, in particular:

- To ascertain the present situation in the segment of SMEs concerning expenditure on enterprise ICT and plans for further investments and innovations in ICT.
- To ascertain the level of interest in new trends and their utilization for the management of enterprise ICT such as cloud services and virtualization.
- To identify possible interest in the employment of mobile equipment.

Main findings

Server infrastructure

Almost 60 per cent use a maximum of 3 servers. One third of firms have all servers less than three years old. In the firms with the smallest turnovers there is the largest share of completely renovated infrastructures and also of infrastructures over three years old as a unit. This circumstance seems to show that in the smaller companies the renovation of ICT is not realized in a planned manner. The use of blade servers is minimal, with the representatives of only 4 % of companies stating that they used these servers. The dominant platform for working with data is the Microsoft SQL Server (59 %), but in the larger SMEs use of the SAP program is increasing. For two thirds of SMEs failure of services means financial loss and roughly half of them also have some idea of the level of this loss.

Interest in savings on ICT and the introduction of new technology

Of the technologies aimed at saving firms' costs, the SMEs are most interested in backing-up (84 %) and administration (70 %). For virtualization and cloud solutions it is generally the case that only companies with larger ICT are interested in this problem. Only 6 % of SMEs are considering

the introduction of cloud services in the next 12 months and 14 % are considering the introduction of tablet PCs. At present 29 % of them use tablets (most frequently larger companies). Further details of present situation and impact of ICT on the whole economy in the Czech Republic is detailed described in (Hanclova, Doucek, 2012) and in (Doucek, Fischer, Novotny, 2012).

Investments and company IT solutions

For the coming year companies have only limited budgets for expenditure on ICT. Roughly one fifth of them are not planning any investment in ICT in the coming year, but for only a small proportion of them are this due to recent investments in ICT. As far as concerns the level of investment two thirds of firms are planning to invest a sum of less than 1 million CZK in ICT in the next 12 months. Higher expenditure is planned by larger companies and firms where ICT is managed by internal employees (partly or completely).

From other investigations we know that in the sphere of expenditure there is pressure on finances and reduction of costs. This means there is scope for technology, which gives firms the opportunity to deal with these pressures.

4.2. Survey B - ICT innovation based on main green principles in SMEs

The aim of this investigation was, in particular, to ascertain the present situation in the segment of SMEs concerning penetration of the main ICT innovation green trends like dematerialization, virtualization, cloud computing and tele-working (Vojtesek, 2013).

The identification of the orientation on the electricity power consumption and its reduction was the next part of the survey. Last but not least how SMEs are prepared for Green IT and if Green IT project are planned.

The following main hypotheses were formulated before the survey:

- Companies know the term Green IT but they are not active in it.
- Companies applying Green IT principles do it because of cost reduction mainly.
- Companies mostly apply some of green ICT principles although they do not use this term.
- Majority of companies monitors the electricity consumption and try to reduce it.

The number of companies that were asked for reply was 110 and 37 firms sent filled forms back (35 companies were from the interval SME). The survey was done in March 2013 (Vojtesek, 2013).

4.2.1. Dematerialization – Electronic invoicing

The electronic invoicing is applied very often among surveyed companies. This form of dematerialization is applied by nearly 75 % of companies. The reason is that it doesn't demand sophisticated hardware and legislative rules. The companies save time and reduce cost. The only one response said they do not use now and do not plan to apply it in the future.

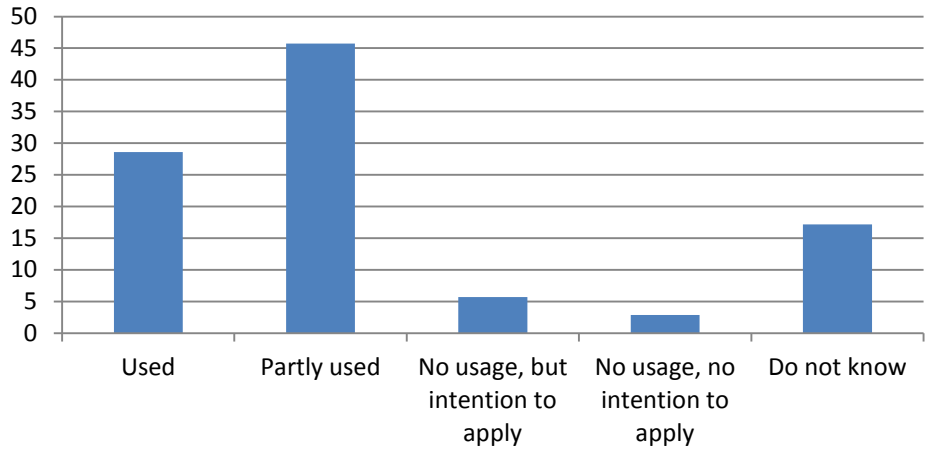


Fig. 1. Electronic invoicing; Source: (Vojtesek, 2013)

4.2.2. Virtualization

Virtualization is applied in more than half of surveyed companies (55 % exactly). This result is very positive and it is a little unexpected at the same time. Generally the virtualization is used by big companies where there are own servers and many end stations. Therefore virtualization can bring them financial effects. The application of virtualization in SMEs is good news.

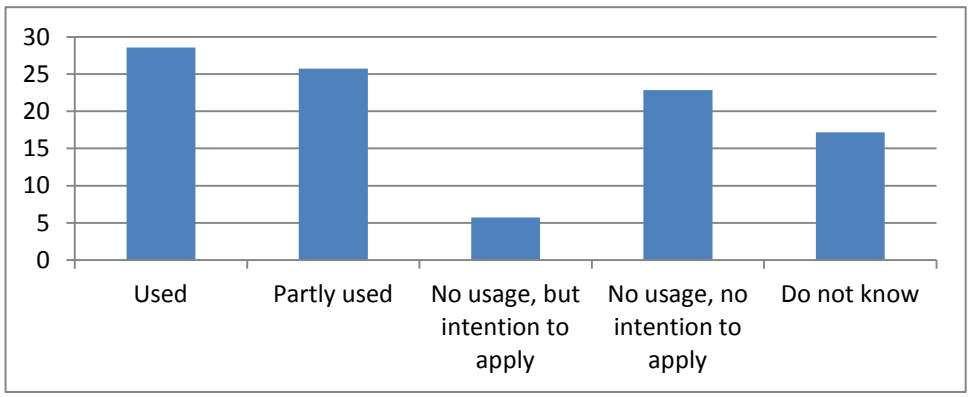


Fig. 2. Virtualization; Source: (Vojtesek, 2013)

4.2.3. Cloud Computing, Software as a Service

The cloud computing is the way how the software has been offered recently. It is applied in 31 % asked companies. There are 29 % companies at the same time that do not use it and do not plan to apply in the future. These results are symbolic because it symbolize one half companies excited about cloud computing and the other one doesn't believe it.

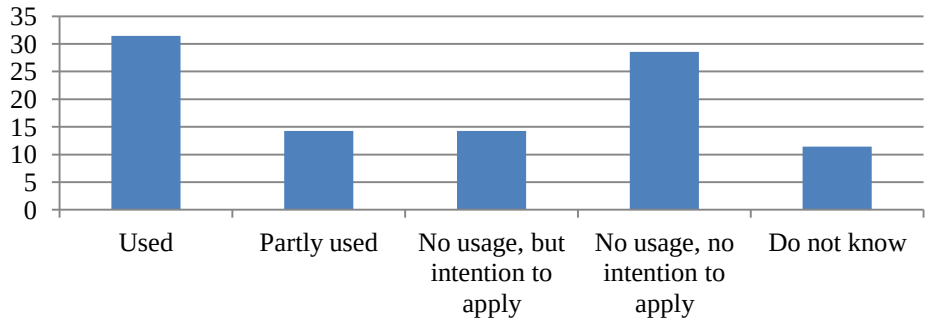
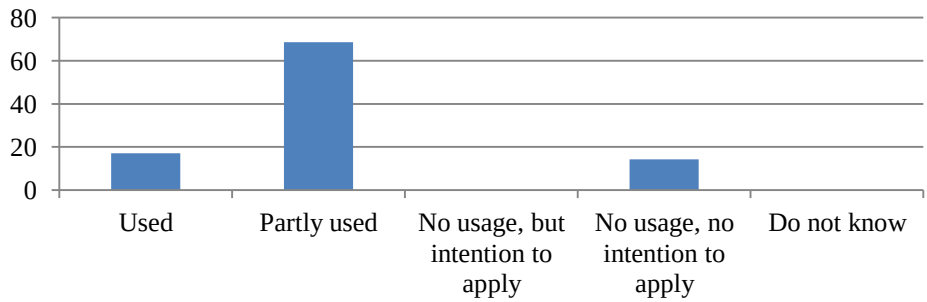


Fig. 3. Cloud Computing – Software as a Service Source: (Vojtesek, 2013)

4.2.4. Tele-working

This form of working from home is applied by nearly 70 % companies. The fact that tele-working



is possible in 86 % companies is really good result.

Fig. 4. Tele-working; Source: (Vojtesek, 2013)

4.2.5. Tele - and video conferences

The similar positive result shows usage of tele and video conferences. The higher benefits are naturally when companies are located different in long way destination. More than half companies (54 %) partly use this form of communication. It only confirms that fast internet and applications like Skype are available for all users.

5. Conclusion

The survey in the Czech SME companies confirms the similar results known from survey from other countries from Europe and Asia. The companies are not yet very active in the field of sustainability and Green IT. They mostly do not know the term Green IT and there is therefore large space for education and training. On the other many companies use practically last innovative ICT trends helping them to reach green aspects – mainly virtualization, cloud and dematerialization. Majority of companies also analyses the electricity power consumption with the tendency to use IT effectively to reduce the cost.

References

Appasami, G. & Suresh, J. (2011). Optimization of Operating Systems towards Green Computing. International Journal of Combinatorial Optimization Problems & Informatics [online]. 2011, 2, issue 3, pp. 39-51 [cit. 2012-12-11].

Ambtman, L. (2011). Green IT Auditing. Amsterdam, 2011.: http://www.e-jobs-observatory.eu/sites/e-jobs-observatory.eu/files/Thesis%20Green%20IT%20Auditing.pdf. Doctoral thesis.Vrije Universitei.

Basl, J. & Doucek, P. (2012) ICT and Innovations in Context of the Sustainable Development in Europe. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: 20th IDIMT-2012. Linz: Trauner Verlag universitat, 2012, p. 153–161. ISBN 978-3-99033-022-7

Basl, J. & Gala, L. (2009) The Role of ICT in Business Innovation. Jindřichův Hradec 09.09.2009 – 11.09.2009. In: 17th IDIMT-2012. Linz: Trauner Verlag universitat, 2009, p. 67–75. ISBN 978-3-85499-624-8

Berthon,P. et al. (2010). Get the most out of green IT. Industrial management [online]. 2010, ann. 52, issue 5, pp. 14-18 [cit. 2012-12-11]. ISSN 0019-8471.

Buchalcevova, A. & Gala, L. (2012) Drivers and Inhibitors of Green ICT Diffusion: a Survey in the Czech SMEs. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: IDIMT-2012. Linz: Trauner Verlag universitat, 2012, s. 163–170. ISBN 978-3-99033-022-7

Clark, R. (2009). The green IT bandwagon rolls on. Enterprise Innovation [online]. 2009, 5, issue 6, pp. 42-43 [cit. 2012-12-11].

Cmunt, V. (2013).Trends of Enterprise Information Systems, Diploma work, University of Economics, Prague, 2013.

Doucek, P., Fischer, J. & Novotny, O. (2012) Impact of ICT on National Economies – Open Issues. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: 20th IDIMT-2012. Linz: Trauner Verlag universitat, 2012, p. 111–114. ISBN 978-3-99033-022-7

Doucek, P. (2011) Human Capital in ICT – Competitiveness and Innovation Potential in ICT. Jindřichův Hradec 07.09.2011 – 09.09.2011. In: IDIMT-2011. Linz: Trauner Verlag universitat, 2011, s. 11–22. ISBN 978-3-85499-873-0

Hanclova, J. & Doucek, P. (2012) The Impact of the ICT Capital on Labor Productivity Development in the Sectors of the Czech Economy. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: 20th IDIMT-2012. Linz: Trauner Verlag universitat, 2012, p. 123–133. ISBN 978-3-99033-022-7

Hu, W. C. & Kaabouch, N. (2012). Sustainable ICTs and management systems for green computing. Hershey, PA: Information Science Reference, 2012, xxvi, 467 p. ISBN 14-666-1841-8.

IEEE (2008) Murugesan, San. Harnessing Green IT: Principles and Practices. In: IEEE Xplore [Online]. 2008 [cit. 2013-04-08]. http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=4446673&contentType=Journls +% 26+Magazines&searchWithin%3DSearch_Index_Terms%3A.QT.green+IT.QT.

Johnson, J.T. (2008. Is 'green IT' real? ... As real as your bottom line. Network world [online]. 2008, ann. 25, nr. 37, p. 24 [cit. 2012-12-11]. ISSN 0887-7661. EBSCOhost

Kovalenko, I. (2013). Analysis of CSR for the world class ICT companies from Green IT perspective, Diploma work, University of Economics, Prague, 2013.

Kunstova, R. (2010) Enterprise Content Management and Innovation. Jindřichův Hradec 08.09.2010 – 10.09.2010. In: IDIMT-2010 Information Technology – Human Values, Innovation and Economy. Linz: Trauner, 2010, p. 49–56. ISBN 978-3-85499-760-3

Maryska, M (2008). Business Informatics in a Light of Costs, Profits and Gains. Jindřichův Hradec 10.09.2008 – 12.09.2008. In: IDIMT-2008 Managing the Unmanageable. Linz: Verlag Osterreich, 2008, s. 23–40. ISBN 978-3-85499-448-0

Novotny, O (2009). ICT performance reference model in the context of corporate performance management. Jindřichův Hradec 09.09.2009 – 11.09.2009. In: IDIMT-2009 System and Humans – A Complex Relationship. Linz: Trauner, 2009, s. 13–16. ISBN 978-3-85499-624-8

OECD (2010). Greener and Smarter: ICTs, the Environment and Climate Change. OECD [online]. 2010 [cit. 2012-12-11]. http://www.oecd.org/site/stitff/45983022.pdf.

Tenhunen, M. (2011). Conceptualizing and Measuring Green IT Readiness in Finnish Companies. Application Area: Electronic Invoice. Aalto, 2011. Avaliable at: http://epub.lib.aalto.fi/fi/ethesis/pdf/12505/hse_ethesis_12505.pdf. Diploma work. Aalto University School of Economics.

Van Osch, W., Rohnsack, W. R. & Avital, M. (2010). From Green IT to sustainable value: The Path –Dependent Costruction of Sustainable Innovation. In: Academy of Management annual meeting proceedings [online]. 2010 [cit. 2012-12-11]. ISSN 2151-6561.

Velte, A. & Velte, T. (2008). Green IT: reduce your information system's environmental impact while adding to the bottom line. New York: McGraw-Hill, 2008. ISBN 00-715-9923-1.

Venkatraman, S. (2011). The Dark Green Side of Information Technology. International Journal of Business Insights & Transformation [online]. 2011, ann.. 3, S3, p. 96-106 [cit. 2012-12-11].

Virtualization, (2003-2013) Virtualization Industry Challenges: Report 2008. Virtualization.info [online]. © 2003-2013 [cit. 2012-12-5]. http://virtualization.info/en/challenges/

Vojtěšek, C. (2013). Analysis of SME from the perspective of sustainability application (Analýza malých a středních podniků z pohledu uplatnění principů udržitelnosti), Diploma work, University of Economics, Prague, 2013.

Walsh, K. (2011). What is sustainable IT?. In: CIO: Environmentally Sustainable IT Definition nd Solutions [Online]. 2007 ttp://www.cio.com/article/149651/Environmentally_Sustainable_IT_Definition_and_Solutions

GREEN ICT MATURITY ASSESSMENT IN CZECH SMES

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Keywords

Green ICT, maturity model, self-assessment, small and medium-sized enterprises, SMEs

Abstract

With regard to an increasing interest in Green ICT worldwide, we have designed a Green ICT maturity model for SMEs and performed a maturity assessment in Czech small and medium-sized enterprises that utilize ICTs. This assessment represents a first step in the process towards an improvement in the Green ICT area. This paper contains description of the Green ICT maturity model and presents selected results of the assessment.

1. Introduction

As stated in the Global Information Technology (2013), „Information and communication technologies (ICT) has evolved into a key enabling infrastructure across industries while proving to be a powerful driver of enhanced living conditions and opportunities around the globe". ICTs affect the environment from two different perspectives. On one side, they cause environmental problems at each stage of their lifecycle from manufacturing to usage and disposal. On the other side, ICTs can be seen as a tool in addressing the environmental problems. With support of ICT we are able to calculate carbon footprint, deploy computerised models to increase energy efficiency and reduce greenhouse gas emissions.

Recent changes in the environment, economy and technology substantially drive an adoption of Green ICT practices across the world as stated in the surveys (Fujitsu 2010), (Rowe 2011). According to Chitra (2011), among the main factors escalating an interest in Green ICT are primarily a rapid growth of Internet, increasing cooling requirements, increasing energy costs and restrictions on energy supply access, lower server utilization rates and ICT impacts on the environment. San Murugesan (2010) adds also "growing consumer interest in green solutions and practices, higher expectations by the public on enterprises' environmental responsibilities, and the emergence of stricter environmental compliance requirements". According to Loeser et al. (2011), Green ICT contributes to gaining a competitive advantage not only by cost savings (through direct usage of Green ICT or an improved utilization efficiency of other business resources) but also through a possibility to differentiate from competition. This is a key factor for businesses that do not belong to the group of Innovators and /or Early adopters of innovation (Basl & Gala, 2009).

However, a level of diffusion of Green ICT practices in various countries differs significantly. The results of a survey conducted in 2011 and focused on usage of Green ICT practices in SMEs in the

Czech Republic that do use ICTs indicate that there exists a great potential among businesses to improve (Buchalcevova & Gala, 2012).

The aim of this paper is to present the Green ICT maturity assessment in Czech SMEs that utilize ICTs (not provide ICT services). Following first an introduction of Green ICT, a design of the Green ICT maturity model is presented. In the third section, the results of the maturity assessment are analysed. Lastly, a conclusion and future work are discussed.

2. Green ICT maturity model design

A first step in the process towards any improvement efforts in organisations is to carry out a current state analysis. According to Jokela et al. (2006), a current state analysis is put into practice as a capability maturity assessment, where Capability maturity models (CMM) serve as a tool to its implementation. The best-known maturity model is the CMM for software (Paulk et al.1995). In addition, other software engineering maturity models have been developed and further proposed for a range of other problem areas. Some of them are mentioned in Jokela et al. (2006). In our case, two groups of maturity models can be distinguished, i.e. maturity models directly aimed at Green ICT and maturity models aimed at other problem domains than Green ICT. Based on a literature review and internet search, the following maturity models were detected in the Green ICT area:

- G- readiness (Molla et al. 2011)
- Green ICT Capability Maturity Model (Philipson 2010)
- Sustainable ICT- Capability Maturity Framework (Donnellan et al. 2011)
- Green IT Maturity Assessment Program (Accenture 2010)
- Green ICT scorecard (McGregor 2008)
- UK Government Green ICT Maturity Model (HMG CIO Council Green ICT Delivery Unit 2012)

These models were analyzed to be later utilized for the Green ICT assessment in Czech SMEs. An in-depth description of maturity models analysis goes beyond the scope of this paper. However, after a deep analysis we found out that these maturity models cannot be utilized for the maturity assessment in SMEs that use ICTs. This fact is grounded in the following reasons: a detailed description of models is not publicly accessible; models are concentrated rather on IT providers and large companies or government institutions than on SMEs. Therefore, we decided to design our own Green ICT maturity model. Green ICT maturity model was created in these steps:

1. Definition of Green ICT areas
2. Definition of maturity levels
3. Formulation of questions
4. Formulation of possible answers
5. Assigning weights to the defined questions
6. Specifying the rule for maturity level calculation

Green ICT areas were defined based on the researched maturity models, their adjustment and completion. Proposed areas were then verified in order to be relevant for SMEs that use ICTs.

Finally, 16 Green ICT areas were defined grouped into Green of ICT and Green by ICT area groups according to (Basl & Doucek 2012). Green ICT areas are graphically illustrated in Fig. 1.

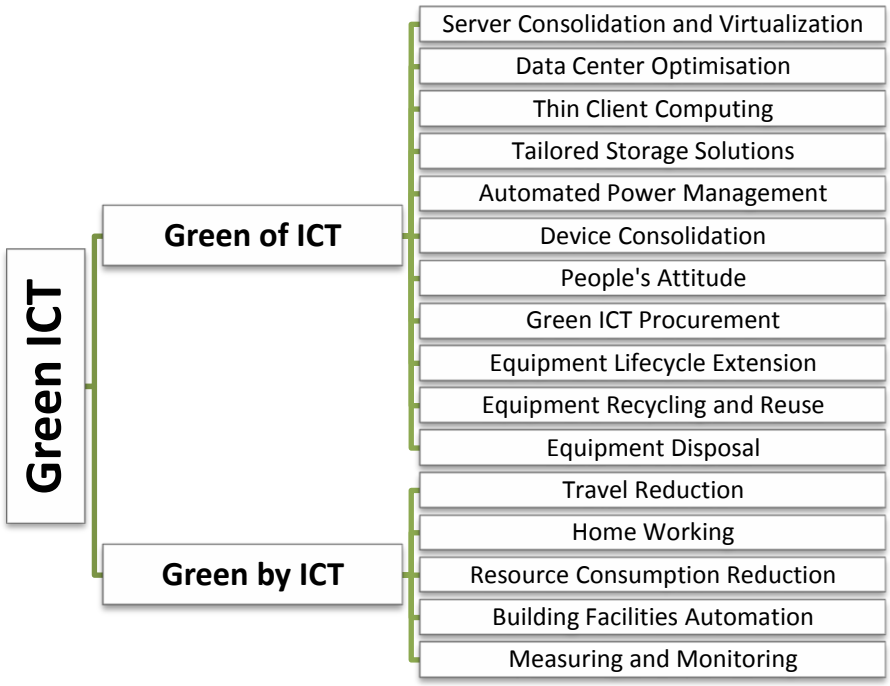

Fig. 1 Green ICT areas for SMEs

We defined 6 maturity levels presented in Fig. 2 while adopting the specification of maturity levels according to the Green ICT framework developed by the Connection Research in collaboration with the RMIT University (Philipson 2010).

Fig. 2 Maturity levels of the Green ICT maturity model based on (Philipson 2010)

One or more questions were defined for each Green ICT area. By answering these questions a maturity level of the enterprise can be measured. Considering the relevance of the entire form to be answered and the adequate number of questions, it was necessary to find a suitable compromise. As a result, we defined 31 questions that are listed in Table 1.

1	Does your company have an initiative in place to optimize the number of servers through consolidation and virtualization?
2	Does your company have an initiative in place to optimize data centers?
3	Does your company have an initiative in place to use thin clients?
4	Does your company have an initiative in place to optimize data storage through consolidation and virtualization?
5	Does your company reduce the volume of enterprise data by eliminating its duplicity (redundancy) and its compression?
6	Does your company have an initiative in place to move less often used data to backup disks?
7	Is all IT equipment in your company controlled by a central power management system?
8	Does your company have an initiative in place to set monitors and disks automatically to "power down" to a low power state when not used 15 minutes or less?
9	Does your company have an initiative in place to set computers automatically "power down" to a low power state when not used 30 minutes or less?
10	Does your company have an initiative in place to consolidate office equipment (such as printers) in ratio of 10 / 1 (employee /device)?
11	Does your company have an initiative in place to consolidate personal devices (such as laptops) in ratio of 1 / 1 (employee / device)?
12	Does your company have rules for motivating employees in Green ICT?
13	Does your company provide a feedback to employees on the impact of established green initiatives?
14	Do employees turn off their computers when not in use? Do they unplug their laptops and phone chargers when not in use?
15	Do employees turn off/sleep their computers instead of using screensavers?
16	Does your company have an initiative in place to set printers to duplex and greyscale print by default?
17	Do employees delete useless files and e-mails from their computers?
18	Does your company have an initiative in place to buy "greener" ICT equipment when buying a new one? (Based on EPEAT, Energy Star or EU energy labels rating)?
19	Does your company have an initiative in place to extend ICT equipment lifecycle, if its replacement isn't necessary (so that financial resources can be better used in another Green ICT initiative)?
20	Does your company have an initiative in place to repair broken ICT equipment if its replacement isn't

	necessary (so that financial resources can be better used in another Green ICT initiative)?
21	Does your company have an initiative in place to donate, recycle or reuse unused ICT equipment?
22	Does your company dispose ICTs in compliance with environmental regulations, including the EU Restriction of Hazardous Substance (RoHS) Directive and the Waste Electrical and Electronic Equipment (WEEE) Directive?
23	Does your company have an initiative in place to limit travelling of employees by using audio / video conferences, on-line meetings or telepresence?
24	Does your company support working from home office?
25	Does your company have an initiative in place to reduce resource consumption (e.g. paper) by using ICT technologies?
26	Does your company have an initiative in place to send electronic invoices instead of paper ones?
27	Does your company have an initiative in place to send payslips by e-mail instead of printing them?
28	Does your company have an initiative in place to fax/receive fax to e-mail instead of a printer?
29	Is temperature in offices controlled by a building control system, and is your company continuously improving the energy efficiency of the heating system?
30	Does your company monitor energy consumption and energy savings by ICT?
31	Does your company calculate company carbon footprint by ICT?

Table 1 Green ICT indicators - questions

In order to obtain more information about the enterprise, two additional questions were supplemented to the self-assessment form:

32: How many employees does your company have?

33: In which business field is your company active?

Questions number 1 – 22 are from the Green of ICT area, questions number 23 – 31 are from the Green by ICT area.

Moving to the next step in the Green ICT maturity model design, possible answers for the above stated questions were formulated. Then, specific weights were assigned to the questions based on Saaty's method of multi-criteria options evaluation. The final step of designing the Green ICT maturity model consisted in specifying the rule for maturity level calculation. We calculated maturity level for the Green of ICT area, Green by ICT area and for the whole enterprise.

3. Model implementation and results analysis

In order to verify our model, an interactive website with a self-assessment form was created accessible at the link http://Zelene-IT.cz. After answering all the questions, actual results are

immediately presented to the users in a form of a graph, so they are able to view a Green ICT maturity level of their company directly. Moreover, the users can also take a look at the average results of all already assessed enterprises compare their company to other organizations.

Target group of SMEs was selected based on the database of companies which obtained support for their ICT innovation within the Operational Programme "Enterprises and Innovations" (2010). We picked these companies due to a previous successful cooperation. The programme also designated a basic separation of the population thanks to its focus on small and medium companies in defined activity areas, i.e. CZ-NACE C10 - C33 (with the exception of 12 and 19). Basic contact information was found for each identified subject in the sample. Subsequently, the companies were asked by email to fill in an electronic self-assessment form. Firstly, a survey request e-mail was sent to 384 enterprises on October 18th, 2012. Although 368 e-mails were delivered, only 15 companies filled in the self-assessment form. Therefore, a "reminder" e-mail was sent on October 30th, 2012. Overall, 67 self-assessment forms were filled in. Most companies stated they have 50 to 249 employees; none of them have more than 250 (Fig. 3).

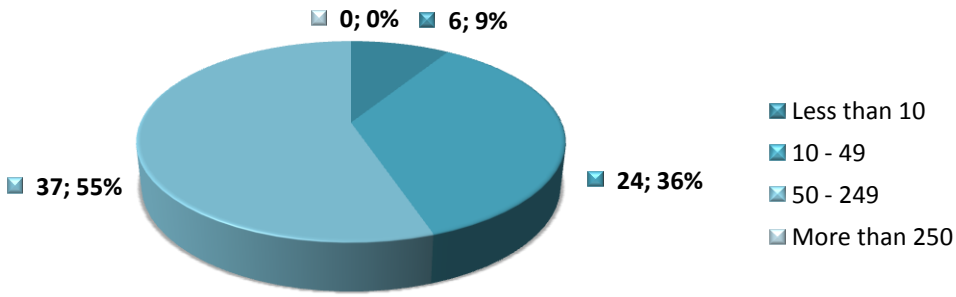

Fig. 3 Company size

The overall result of the Green ICT maturity assessment represents the average Green ICT maturity. The assessed enterprises reached a value of 1.88 which reaches to maturity level 2, i.e. SMEs in the Czech Republic are striving to utilize the opportunities of Green ICT. Taking a closer look at the particular areas, the Green of ICT area (1.91) and Green by ICT area (1.8), the enterprises lead the way in the Green of ICT area.

However, maturity of particular Green ICT areas is not that balanced. Fig. 4 shows the results. Third maturity level was nearly achieved in two areas. The highest score was reached in the "Equipment Disposal" area, with a value of 2.91 followed by the "Equipment Recycling and Reuse" area, with a value of 2.65. On the opposite side is found the "Measuring and Monitoring" area (value 1.04) followed by the "Automated Power Management" area (value 1.29) and "Thin Client Computing" area (value 1.46).

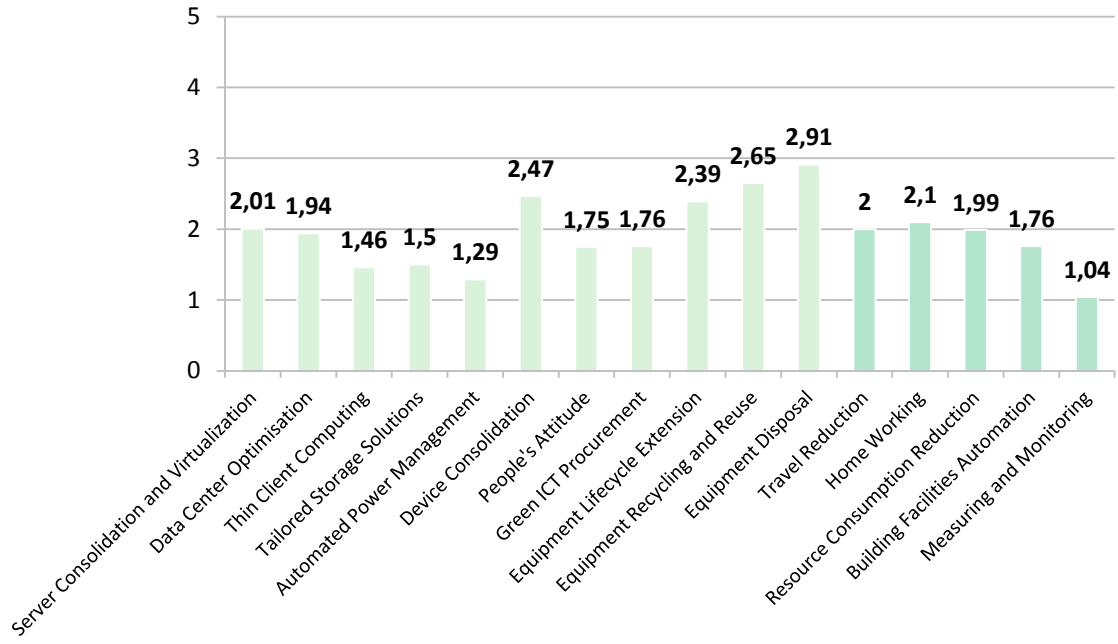

Fig. 4 Average Green ICT maturity of each area

4. Conclusion

This paper presents the Green ICT maturity model for small and medium-sized enterprises that utilize ICTs, its design, implementation and selected results of the assessment in the Czech Republic. The Green ICT area does not receive enough attention in the Czech Republic and there is a lack of Czech written literature that would support this area among enterprises and explain the benefits of various Green ICT initiatives. Therefore, we do believe that the designed maturity model will support the Green ICT expansion in the Czech Republic and that this model may become the starting point for the implementation of Green ICT practices in small and medium-sized enterprises.

Acknowledgment

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References

Accenture (2010) Assessing Green IT Maturity among Korean Companies http://eng.nia.or.kr/english/bbs/board_view.asp?BoardID=20111222161116261 1&id=9354&Order=301&Flag=100 Accessed 2012-10-20

Basl, J, Doucek, P.(2012) ICT and Innovations in Context of the Sustainable Development in Europe. Jindřichův Hradec 12.09.2012 – 14.09.2012. In: IDIMT-2012. Linz : Trauner Verlag universitat, 2012, s. 153–162. ISBN 978-3-99033-022-7.)

Basl, J., Gala, L. (2009). The role of ICT in business innovation. In Doucek P; Chroust G; Oskrdal V (Ed.), IDIMT-2009 (pp. 67-75). Linz: Trauner Verlag universitat.

Buchalcevova A, Gala L (2012) Drivers and Inhibitors of Green ICT Diffusion: a Survey in the Czech SMEs. In: IDIMT-2012. Trauner Verlag universitat, Linz, pp. 163–170

Chitra S (2011) Adopting Green ICT in Business. In: Unhelkar B (eds) Handbook of Research on Green ICT. IGI Global, pp 643-651

Donnellan B, Sheridan Ch, Curry E (2011) A Capability Maturity Framework for Sustainable Information and Communication Technology. IT Professional. 1 (2): 33-40

Fujitsu (2010) Green IT: The Global Benchmark : A Report On Sustainable It In The USA, UK, Australia and India. https://www-s.fujitsu.com/au/whitepapers/greenit_global_benchmark.html. Accessed 2012-06-11

Global Information Technology (2013) World Economic Forum, http://www.weforum.org/issues/global-information-technology

HMG CIO Council Green ICT Delivery Unit (2012) UK HM Government Green ICT Maturity Model http://www.cabinetoffice.gov.uk/sites/default/files/resources/HMG-Green-ICT-Maturity-Model-v2-29-02-12-in-XLS-Format.xls Accessed 2012-10-15

Jokela T, Siponen M, Hirasawa N, Earthy J (2006) A survey of usability capability maturity models: implications for practice and research. Behaviour & Information Technology. 25(3):263-282

Loeser F, Erek K, Schmidt N, Zarnekow R, Kolbe L (2011) Aligning Green IT with Environmental Strategies: Development of a Conceptual Framework that Leverages Sustainability and Firm Competitiveness. In: Proc 17th AMCIS. Detroit, Michigan, USA. Paper 222 http://aisel.aisnet.org/amcis2011_submissions/222/ Accessed 2012-08-15

McGregor C (2008) UK GOV Where are we? Cabinet Office CIO / CTO Council Green ICT Delivery Unit http://cdn.netamia.com/itst/ict2009/catalina_mcgregor-207-1243496899.pdf Ac-cessed 2012-09-20

Molla A, Cooper V, Pittayachawan S (2011) The Green IT Readiness (G-Readiness) of Organizations: An Exploratory Analysis of a Construct and Instrument. Communications of the Association for Information Systems, 29(1):68 - 96

Murugesan, S. (2010). Strategies for Greening Enterprise IT. In: Unhelkar, Bhuvan. Handbook of Research on Green ICT. IGI Global. 2010. ISBN: 9781616928346

Operational Programme Enterprises and Innovation (2010). Ministry of Industry and Trade of the Czech Republic. Retrieved from http://www.mpo.cz/cz/podpora-podnikani/oppi/

Paulk M, Weber C, Garcia S, Chrissis M, Bush M (1995) The Capability Maturity Model: Guidelines for Improving the Software Process. Addison-Wesley

Philipson G (2010 A Comprehensive and Practical Green ICT Framework. In: Unhelkar B (eds) Handbook of Research on Green ICT. IGI Global, pp 131-145

Rowe A (2011). ICT sustainability: The global benchmark 2011. Fujitsu. https://www-s.fujitsu.com/global/solutions/sustainability/Fujitsu-ICT-Sustainability-TheGlobalBenchmark2011-Report.html Accessed 2012-08-11

INNOVATION IN USE CASE DERIVING

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Keywords

Enterprise ontology, innovation, DEMO methodology, business process modelling, use case

Abstract

Innovations play a crucial role in enterprise development. One of the aims of innovations is devising a process innovation which represents the way of software development as a service. A use case is a construct for the definition of the behaviour of an information system. Despite the usefulness of the use cases application in requirements elicitation and in business process modelling, the problem of identifying use cases still remains. The presented approach compares possibilities of different business modelling techniques for identifying use cases. The main stress is placed on utilizing DEMO (Design & Engineering Methodology for Organizations) and its possibilities for use cases deriving. The paper discusses and compares the achieved results in an illustrative example.

1. Introduction

Innovations can be understood as a broad platform for rapid progressive changes in the economy, based mainly on the ability to use ICT tools, which thus become a critical factor in the success of the entire economy (Basl, Doucek, 2012). Innovation of the information system development focuses on better comprehension of the customer's requirements, which are formalized by use case models. It is possible to consider these types of innovations to rank as a process innovation type. A use case is defined by (Jacobcon, 1992) as a description of the complete course of events initiated by an actor and of the interaction between the actor and the system. A use case can be comprehended like this: "It is one case of information system utilizing" (Skrabalek et al., 2012). The development of the Use Case Model is in fact information system modelling in the point of view of its possible utilization. By system is meant an information system or computer application, and by actor is meant a particular role of the user(s) of the system. Use cases are mostly applied in

engineering methods that are based on the UML. The strong point of these methods is that once the use cases are identified, the development of the software application goes on easily. The weak point of this approach is the identification of use cases itself. Some of the possible methodologies stress the actor approach or more precisely the actor role approach. The main principle of this approach is to find out all the actor roles within the environment of the system that will need to utilize the information system or communicate with the system or transfer some information to the system. The other approach that to some extent improve the previous approach is the process approach, which emphasizes the business process and asks additional questions, e.g. who will use the system. All these approaches represent so called best practice approach. It means that the approach can bring remarkable results mostly depending on the experience of the user. Another drawback concerns the fact that this approach is not supported by complete methodology covering also the construction view of the issue.

There is still the most serious problem which is connected with human perceiving business processes as some kind of information processes, see (Dietz, 2003; Kozel, 2012). The UML itself is primarily an information system modelling language and not a language that is suitable for business process modelling. In addition, an information system is basically a system in the category of rational systems, whereas a business process is a system in the category of social systems.

A use case should satisfy the following requirements:

- it should have the right granularity or level of detail, which means that actions which are atomic from the business point of view have to be found;
- it should be complete, i.e. it should contain everything that is necessary and it should not contain anything that is irrelevant.

These strict requirements are mostly difficult to fulfil by many business modelling approaches. One of those that satisfies these requirements is DEMO (Design & Engineering Methodology for Organizations) methodology (Dietz, 2006), which was developed particularly for the purpose of modelling essential business processes completely abstract from their implementation.

The outline of this paper is as follows. Section 2 provides a short introduction into DEMO methodology, especially into aspect models that are utilized. In section 3, Construction and Process DEMO models of illustrative example are presented and described. From this model a set of use cases is derived in section 4, which thus creates a starting point for the development of information systems. Section 5 discusses the proposed approach. Section 6 contains a conclusion and the aims of future research.

2. Demo Methodology

DEMO (Design & Engineering Methodology for Organizations) methodology was developed by Dietz and described in (Dietz, 2006). According to this methodology, an organization is composed of people (social individuals) that perform two kinds of acts, *production* acts and *coordination* acts. By performing production acts, people fulfil the aims of the organization. A production act can be either material or immaterial. By the material production act we mean some tangible act such as a manufacturing or transportation act. By the immaterial act we mean some intangible act such as approving an insurance claim or delivering a judgment. By performing coordination acts human beings enter into and comply with commitments. They initiate and coordinate the production acts. To abstract from the particular subject that performs the action, the notion of *actor role* is introduced. A subject in his/her fulfilment of an actor role is called an actor.

The result of successfully performing a production act is a *production fact*. An example of a production fact may be that a payment has been paid or an offered service was accepted. All realization issues are fully abstracted out. Only the facts themselves are relevant, not how they are achieved. The result of successfully performing a *coordination act* is a *coordination fact*. Examples of coordination acts are *requesting* and *promising* a production fact.

The diagram in Fig. 1 shows the standard transaction pattern. It contains two actor roles, the initiator and the executor and coordination and production acts between them. Each transaction starts with the *request* coordination act made by the initiator. In reply to the *request*, the executor performs either *promise* or *decline* coordination acts. In short, the *decline* means the end of transaction. The *promise* goes on in *production act,* which resulted in the *production fact*. The production fact is *stated* to the initiator, who can either *accept* it or *reject* it. The standard transaction pattern omits four cancellation patterns that make it possible to revoke an act and to model real conditions completely. The transaction itself can be expressed in more condense way, see Fig.2.

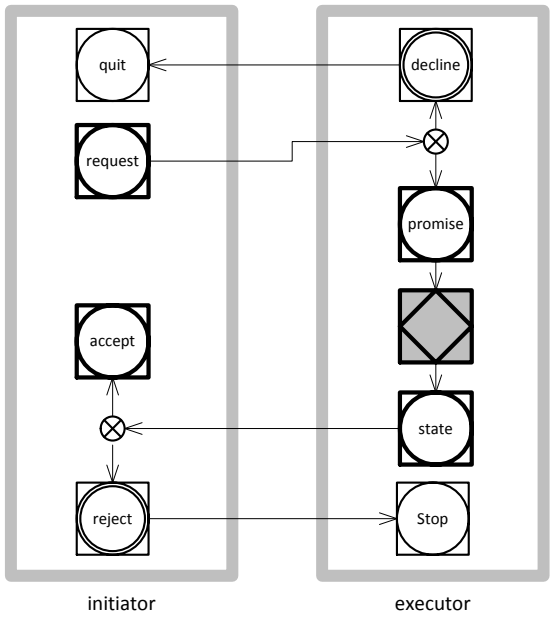

Fig. 1 The standard pattern of a transaction (Process Model)

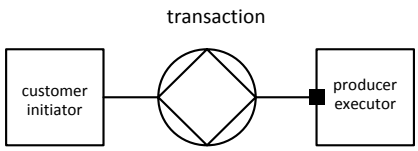

Fig. 2 Transaction – basic building block (Construction Model)

The diagram in Fig. 2 shows the relation between the initiator (the relation is indicated by the plain line) and the executor (the relation is indicated by the dot at the executor). The DEMO methodology provides four mutually integrated aspect models. From the point of view of use cases, the Construction and the Process Models are only used. The purpose of the Construction Model is to identify the actor roles and transactions. The task of the Process Model is to show how transactions are casually and conditionally related. The Process Model has a crucial position in use

case modelling. The basic unit for declaring the business process is the notion of transaction. Transaction represents the basic building block between two social subjects. Apart from the basic states of *request*, *promise*, *production*, *state* and *accept* it also contains the other states that address erroneous states such as *decline*, *refuse* and the states which come from cancellation. The business process in the DEMO methodology is defined as a set of enclosing transactions with the definite result (fact).

3. The Business Domain Model of an Internet Provider

The following text contains an excerpt of the whole application description:

Anyone who wants to be connected to the Internet with maintenance of this service has to be registered with the Internet provider and pay a regular payment once a year. To be registered, one has to fill in the entrance form at the office of the provider. From the beginning of the registration, the customer can extend the Internet connection by the additional TV connection or by the additional telephone connection. The additional connection is performed by an external supplier. Then the applicant receives an invoice that has to be paid.

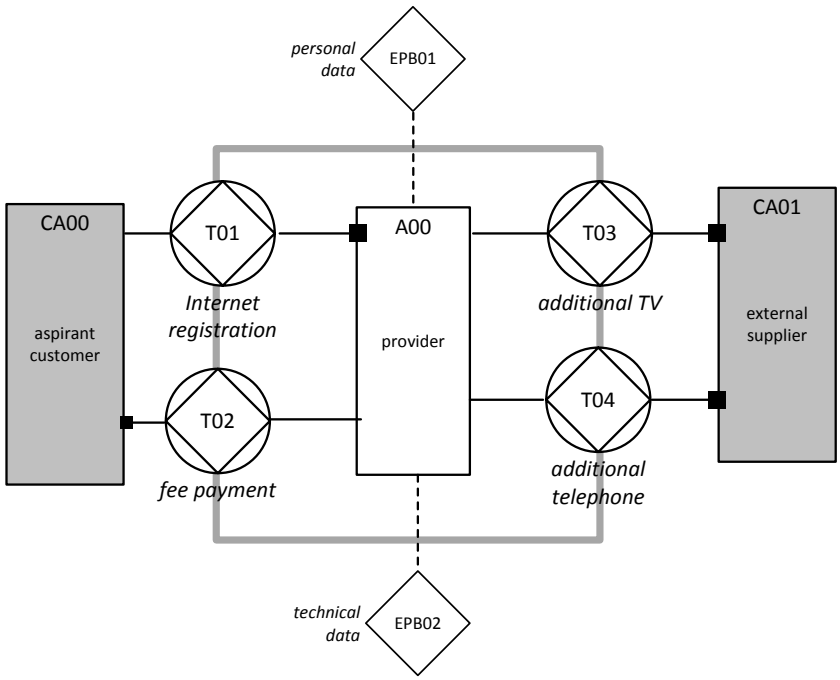

Fig. 3 Construction model corresponding to the task

The DEMO analysis of this example brings about four essential transaction types because four production event types have been identified. They are: *applicant registration*, *fee payment*, *additional TV* and *additional telephone*. The diagram in Fig. 3 shows the actor roles, transactions and the relations between transactions and actor roles.

The diagram in Fig. 4 shows the process model that corresponds with the construction model in Fig. 3. Each transaction type is composed of four coordination acts – represented by a circle placed in a box and one production act - represented by a diamond placed in a box. Abbreviations are utilized for coordination acts: *rq*, *pm*, *st*, *ac* stands for *request*, *promise*, *state* and *accept* respectively. For the sake of simplicity, only the success parts of transactions are illustrated.

The dotted lines in the diagram express waiting and the symbol of cardinality '0..1' represents the possibility that the situation may or may not happen. In reality it means that the aspirant customer can ask the additional TV connection or the additional telephone connection. Each transaction contains just one production act.

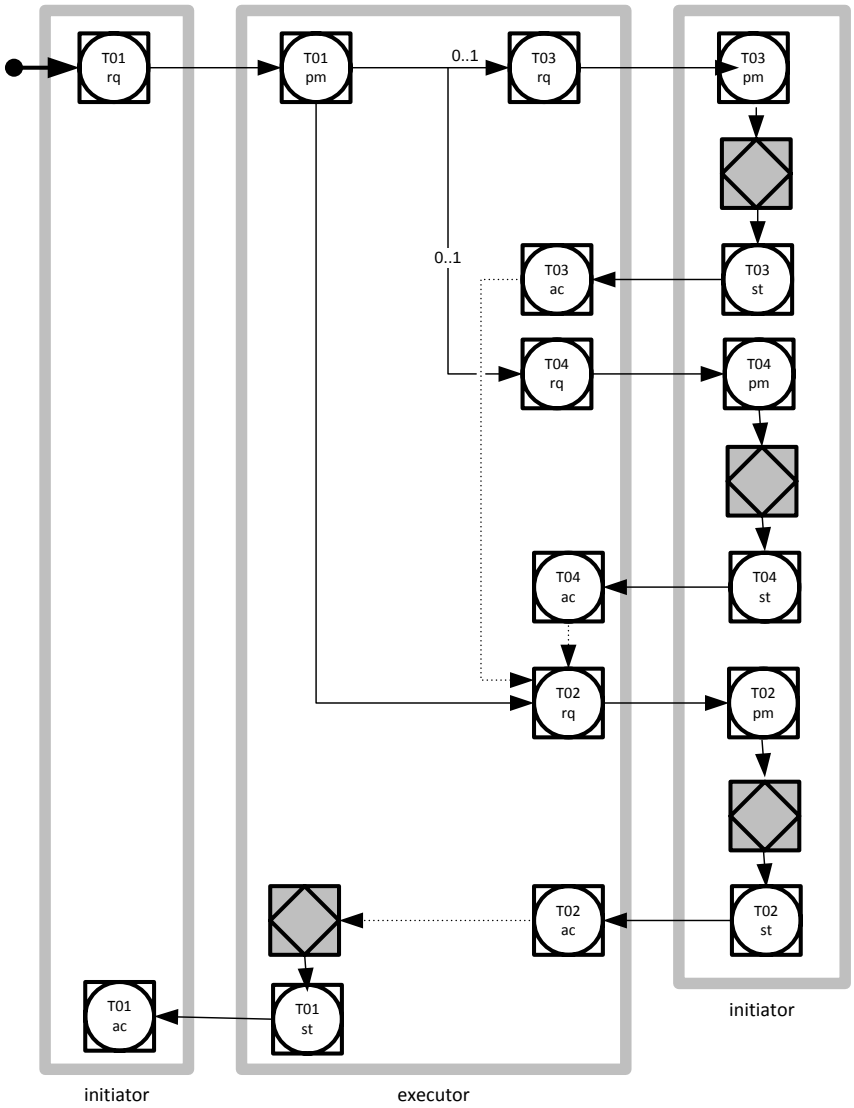

Fig. 4 Process Model corresponding to the task

4. Deriving Use Cases for an Internet Provider

Use cases are derived in a two-step procedure (Dietz 2003). The first step is a straight transformation from the Process Model. The use case contains three actors and four *business components* that correspond to the transactions in Fig. 4. Between the actors and the business components are interactions that have the following meaning: the aspirant customer activates the component T01 by request. The component then prompts the provider for making the promise or the decline. In the case of the promise, the component prompts the provider to perform the state

act. If this has occurred, the aspirant customer is prompted to either accept or reject. If he agrees with the accept, the component registers him as a new customer.

Similarly, three more transaction types may be described. However, the first step does not capture the relations between the business components themselves. They can express the relation of including or the relation of extending. They are the topic of the second step.

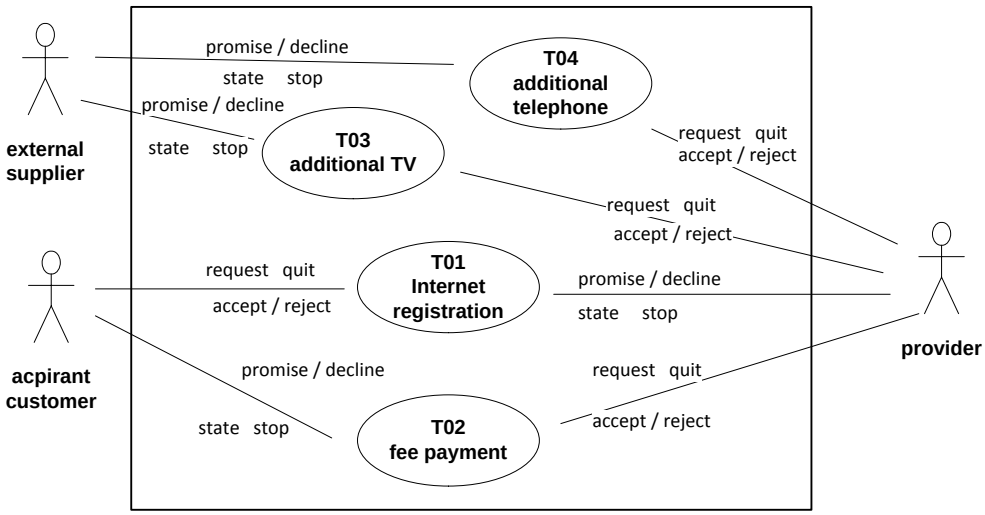

Fig. 5 First step in developing Use case

The second step has to take into account the kind of relationships between the business components. According to the UML rules, T02 component is included in T01 component and T03 and T04 components extend T01 component. The diagram in Fig. 6 shows informational components that are added. These two informational components correspond with the external *fact banks* in Fig. 3. They are connected with the business components by include relationships.

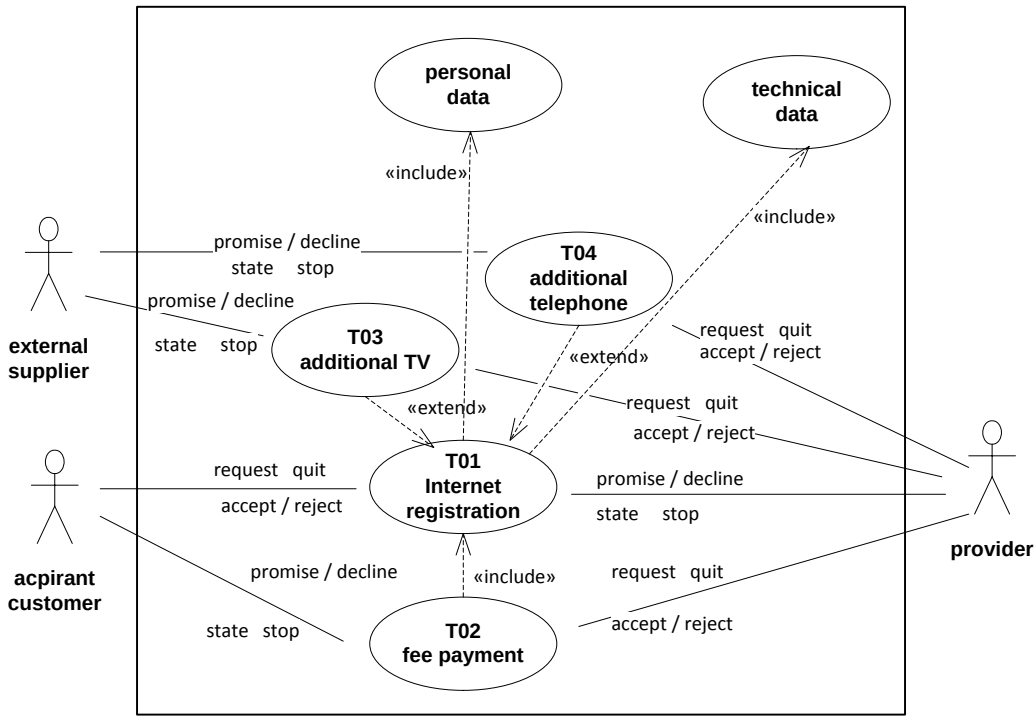

Fig. 6 Second step in developing Use case

The use case in Fig. 6 appears to be a very appropriate point for the development of a supporting system.

5. Discussion

The traditional approach to requirement elicitations is to use the so called waiter's strategy when the substantial stress is laid on the customer's requirements. Naturally, the customer's view and understanding the issue is really important but it is not the only one. Firstly, using a well elaborated theory supported by appropriate methodology can filter the most essential (ontological) model completely independent of implementation (Ministr, Števko, 2010). Secondly, it can reveal missing bindings and discrepancies in the design. In particular, in use case examples it can help to identify all use cases and their mutual bindings. The above describe procedure can be also utilized for Petri net models, see (Zacek, Hunka, 2011).

6. Conclusions

The paper shows the possibilities of the DEMO methodology to be used in the problem of requirements elicitation for the derivation of use cases. The paper shortly introduces two aspect models of the methodology that offers another approach, which differs from the traditional approaches to identifying use cases. The whole procedure was demonstrated on a rather simple example. The major problem of traditional tools and approaches in this area is a misconception that a business process is a kind of information process. Instead, it is a system in social and rational categories. For use case derivation the construction model and the process model were use. Because the DEMO methodology abstracts completely from the way in which the principal model of an organization is created, one can use a modern information and communication technology to implement its successful application. The DEMO methodology provides guidelines to identifying actor roles, transactions and relations between them.

References

Basl, J., Doucek, P. (2012) ICT and Innovations in Context of the Sustainable Development in Europe. Jindřichův Hradec 12.09.2012 - 14.09.2012. In: IDIMT-2012 - ICT Support for Complex Systems – Human Values. Linz: Trauner, 153-162, ISBN 978-3-99033-022-7. WOS:000315973000016

Hu, Y., Wood, J. F., Smith, V., & Westbrook, N. (2004) Friendships through IM: Examining the relationship between instant messaging and intimacy. Journal of Computer-Mediated Communication, 10(1), 38-48.

Dietz, J.L.G., (2006) Enterprise Ontology Theory and Methodology. 1 st edt. Springer-Verlang 2006

Dietz, J.L.G. (2003) Deriving Use Case from Business Process Models. In: Conceptual Modeling, ed by Song, Liddle, Ling, Scheuermann. Lecture Notes in Computer Science 2813 (Springer-Verlang 2003)

Jacobson, I. (1992) Object-Oriented Software Engineering – A Use case Driven Approach. 1 st edt. 552 p. Addition Wesley Professional NZ (1992)

Kozel, R. et al. (2012) The Cooperation of Teachers and Students on facebook. Jindřichův Hradec 12.09.2012 - 14.09.2012. In: IDIMT-2012 - ICT Support for Complex Systems – Human Values. Linz: Trauner, 277-286, ISBN 978-3-99033-022-7. WOS:000315973000029

Ministr, J., Števko, M. (2010) Human Resources Requirements for Professional Management of ITSCM Process. Jindřichův Hradec 08.08-2010 – 10.09.2010. In: IDIMT-2010 Information Technology – Human Values, Innovation and Economy. Linz: Trauner, 57-64, ISBN 978-3-85499-760-3. WOS:000288345500006

Skrabalek, J. et al. (2012) Inner Architecture of Social Networking System. Spindleruv Mlyn 21.01.2012 – 27.01.2012. In: SOFSEM 2012: Theory and Practice of Computer Science. Berlin: Springer-Verlag, 530-541, ISBN 978-3-642-27659-0. WOS:000307258500043

Zacek, J., Hunka, F. (2011) Object Model Synchronization Based on Petri Net. Brno 15.06.2011 – 17.06.2011. In: 17th International Conference on Soft Computing MENDEL 2011, Book Series: Mendel 523-527, ISBN: 978-80-214-4302-0. WOS:000302647900080

THE INNOVATION OF THE INFORMATION SYSTEM IN CONTEXT OF INVESTMENT OPTIONS OF SMES IN THE CZECH-POLISH BORDER REGION

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Keywords

Cloud computing, software as a service, software characteristics, information system

Abstract

The strategy that incorporates leveraging of modern information technology in the information system became an integral part of business strategies of many companies and institutions. The aim of the paper is to present evaluation questionnaire survey results that dealt with assessment of attitudes of Czech and Polish SMEs to cloud based forms of software acquisition. Their incorporation in current and future plans of information system's updates with respect to influence of specific software characteristics on their plans is also assessed. The knowledge of the notion cloud computing and its possible benefits and drawbacks are also analyzed. The results show findings of the survey's analysis that showed implications on the impact of company size and knowledge of the term cloud computing as well as results indicating influence of software factors as well amount of surveyed companies that are planning or using the on-demand distribution model of software acquisition.

1. Introduction

The existence of today's companies or institutions becomes threatened if it is unable to adapt to rapidly changing conditions. Functions of the information system (IS) and the management system are intertwined and mutually permeate and they have common purpose of ensuring a stable behaviour of firms and institutions. The strategy of modern information and communication technology (ICT) implementation became an integral part of their business strategies. The

information is perceived by today's management of companies as a key to creation of added-value in execution of their business processes, along with innovations that are also important drivers of change in the organization (Němec & Zapletal, 2012). Decisions and actions made by today's companies often heavily depend on the usage of IS/ICT. It is perceived as the key differentiator of competitive advantage is more often finding innovative utilization of available options. Rozehnal (2012) states that a change in thinking is needed and a constant search for innovation, driven by the need to understand the importance of ICT in business, also drives companies to explore other options of IS/ICT acquisition.

In this context, today's another distinctive trend is the transition of many ICT firms to provision of ICT tools as a service. In terms of this innovative approach the client buys a service in order to transfer risks and substantial portion of costs on the service provider (SaaS – software as a service). According to Tvrdíková & Koubek (2011) SMEs (small and medium enterprises) represent 99% of all active companies in the European Union and therefore this paper focuses on the assessment of Czech and Polish border region SMEs' and their attitude to the cloud computing and its viable characteristics. Poland has become viable and strong business partner over recent years. It offers interesting business opportunities not only to Czech but to all companies in the Europe and eventually in the rest of the Western and Eastern world.

Cloud computing, i.e. sharing of hardware and software using network connection, changes ingrained methods and business models in the world of ICT. On one side it allows more effective use of computing and other resources of data centers and service vendors. On the other side it allows fulfilment of user requirements concerning speed of deployment of their offered services with desired quality and availability for a transparent price. In a cloud based system the user accesses just the presentation layer. The storage, servers, applications and desktops are separated from the physical enterprise information infrastructure – the virtualization allows for higher efficiency and flexibility of ICT usage while lowering its costs.

Cloud computing benefits (Hagel, Brown, Davison, 2010):

- Applications as services, provided from centralized data center through the network.
- The users don't have to know the technologies or manage their operations – only web browser is needed to access the applications on the server (no special hardware requirements are placed on the user).
- High scalability (dynamically scalable resources) and elasticity.
- Price – lower, the provider leases to more users (multitenancy).
- Changes the software to a service – the consumer pays not for the license but for the intensity of the software usage (the computing power becomes commodity which is bought and scaled to needs).

Limiting factors of the cloud computing:

- Possible risk of losing stable operation through the Internet – reliability.
- Higher costs of large data volumes transfer.
- Concerns about the safety of sensitive data and data at all.
- Lack of control.

The aim of the paper is to present evaluation questionnaire survey results that dealt with assessment of attitudes of Czech and Polish SMEs to cloud based forms of software acquisition. Their

incorporation in current and future plans of information system's updates with respect to influence of specific software characteristics on their plans is also assessed. The knowledge of the notion cloud computing and its possible benefits and drawbacks are also analyzed.

2. Methodology and data

As a reference of similar results can serve the Edge Strategies's SMB Cloud Adoption Study (Kazarian, Hanlon, 2011). The study assessed visions and key factors of cloud adoption in a large sample of 3258 SMEs (about 200 from each of 16 countries in the world) with a 3 year prediction of future situation. Findings suggest that most SMEs will remain hybrid in the way that they will still combine paid on-demand services with traditionally acquisitioned on-premise software (36% of SMEs will pay for 4+ services). The study however indicates that the number of paid services will increase in total. Also the mean number of paid services will be slightly higher in medium than in small and micro companies. Another finding indicates that the number of employees that will leverage paid services to support their workload will increase. This fact also indicates that the awareness of cloud as a term will be higher. This is however conditional according to what type of manager is in charge of decisions concerning ICT. The emphasis is placed on the influence of decision makers that have closer relationship with ICT related topics (the study indicates strong preference of rather internal ICT familiar recommender and influencer role than a clean-cut business or ICT based decision maker). In our paper we are interested in similar factors of cloud adoption and attitudes of surveyed companies in our data sample to this topic.

The results of the paper are based on findings of a research project CZ.3.22/3.3.04/12.02994 that was focused on collecting information on the usage of ICT tools for the support of decision making of small and medium firms in the Czech-Polish border region, using a questionnaire survey. The outcome of the project was 160 replies from both Czech (CZ – 100 replies) and Polish (PL – 60 replies) firms, all replies were from members of middle and top management of surveyed SMEs.

According to the collected data the paper first presents findings concerning differences between CZ and PL firms in terms of their current and future preferences of software acquisition methods according to their size. Special interest was in results of their plans on using the SaaS model, which is closely connected with the cloud computing term and their knowledge of it.

Secondly the paper presents findings concerning differences between CZ and PL firms in terms of their perception of factors of software characteristics in context of their current and future attitude to use the SaaS as a method of software acquisition. The ANOVA (analysis of variance) method was then used to specify factors that have the most significant influence on the current and future preferred method of software acquisition (on a required significance level of $p < 0.05$; due to a limited size of data sample the method assessed all cases regardless of region or company size specification).

As a third result the paper presents findings of the analysis of correlation between the knowledge of the term "cloud computing" and size of a company with differentiation between the CZ and the PL region. The Spearman coefficient computation was used to specify significant value of correlation (also on a required significance level of $p < 0.05$). The result however does not specify the role of the respondent in the company of respective size and it serves mostly as a general indicator.

3. Results and discussion

3.1. Approaches to update of information system and information technologies of SMEs

The way of self-developing the company's IS is often economically disadvantageous and in many cases almost impossible for SMEs. The implementation team should contain specialists that need to be constantly educated. Therefore today it is a much rarer case of acquiring IS by the company since it is also economically disadvantageous to have such team working just for the needs of one company (and especially for SMEs). On the contrary buying application from different vendors brings complications when the company wants to create truly integrated information system. These aforementioned drawbacks of traditional software acquisition methods (on-premise approach) led many firms and institutions to the decision of acquiring IS/ICT as a service. In this case the company can firstly take advantage of services of a General Contractor (quickest realization and professional implementation of each IS's component although the company then commits to a high degree of dependence on Contractor's abilities, reliability and stability). Secondly the company has the opportunity of fully acquiring the IS/ICT as a service – outsourcing the whole IS/ICT and its operations or leverage the cloud computing based solutions, especially the SaaS distribution model (on-demand model).

As for first results of the survey there were determined frequencies of responses panelled by region label and size of a respondents' company. They were then divided into groups according to their statement if they are aware of the term cloud computing. After that there were frequencies of responses determined according to respondents' current and future preference of a software delivery method. Table 1 show these results (the results for Knowledge of the term cloud computing="Yes" are sums of results from total of 3 categories that concerned any level knowledge of the cloud computing term).

Region	Size by number of workers	Knowledge of the term cloud computing	Current preference		Future preference	
			on-premise	on-demand	on-premise	on-demand
CZ	1-9	No	22	7	21	8
		Yes	13	4	12	5
	10-49	No	9	2	6	5
		Yes	16	4	13	7
	50-249	No	6	0	6	0
		Yes	8	4	6	6
PL	1-9	No	9	2	10	1
		Yes	9	1	8	1
	10-49	No	9	2	8	2
		Yes	6	2	6	2
	50-249	No	2	0	2	0
		Yes	12	1	12	1

Table 1 Frequencies of responses according to specific preference of software delivery model

The results show minor decreases in total current on-premise installation numbers in favour of the on-demand model. The results in the table also show that even if there are cases where the on-demand delivery model is currently leveraged, these cases still show some evidence of unawareness of the cloud computing term. Since the cloud computing is closely related to the SaaS software distribution model the SaaS vendor can purposely shield their customers from this term to reduce their confusion (in terms of technical characteristics of their software delivery services).

3.2. Required characteristics of the software

Current requirements placed on the software equipment of IS (Hagel, Brown, Davison, 2010)):

- *Portability* – ability to work in different ICT environments (F1).
- *Reliability and robustness* – absence of malfunctions and system's user fault tolerance (F2).
- *Scalability and flexibility* – ease of making changes and ability to react on changes in the outer world (F3).
- *Support for upgrade and updates* – continual development of the software and maintaining updates (F4).
- *Ease of use* (F5).
- *Vendor support services* – installation, quality documentation, continuous maintenance, consultations, training (F6).
- *Low operational and acquisition costs* – cost of maintenance, support, license fees etc. (F7).

We used these factors to measure the perception of software characteristics according to current of future usage of on-demand model of IS/ICT and region of the respondent. Table 2 shows median values of responses from the Likert scale of <0; 4>. The value 0 represents insignificant factor, 1 equals less significant, 2 means significant, 3 represents more significant and 4 represents a most significant factor.

Region	**Current/future use of on-demand model**	**Valid cases**	**Perception of software characteristics (median)**						
			F1	F2	F3	F4	F5	F6	F7
CZ	Current	19	2	4	2,5	3	2	2	3
	Future	26	2	4	2	3	2	2	3
PL	Current	11	2	3	2	3	3	2	3
	Future	14	2	3	2,5	3	3	2	3

Table 2 Perception of factors when on-demand model is currently used or assumed as viable in the future

The lower count of responses (layered by region and current/future use) shows rather average perception of each factor. There is no especially noticeable difference between respondents that are currently using or plan to use SaaS delivered IS/ICT in the future even in the limited data sample. Further there was an assessment made whether there is any statistically significant factor that influences use of current and future method of software delivery. Table 3 shows results of ANOVA test for current preferred method of software acquisition. The results show significant influence of factor F6 (Vendor support services) although the resulting model is not very representative due to only 18% of explained variability in current preferred method of software acquisition (R = 0.189). Nevertheless the influence is statistically significant so there can be taken an assumption that

currently used software delivery model is influenced by a level of vendor support services to a certain degree (table 1 shows that there is higher count of respondents using the on-premise model).

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	0.876	1	0.876	5.468	0.021*
Residual	23.717	148	0.160		
Total	24.593	149			
Predictors: F6 Vendor support services; R = 0,189, significant on p < 0.05 level					
Dependent: E1 Current preferred method of software acquisition					

Table 3 Results of ANOVA test of relationship between perception of software characteristics and method of current software acquisition

Table 4 shows results of ANOVA test for future preferred method of software acquisition. The results show significant influence of factor F1 (Portability) although the resulting model is also not very representative due to only 19% of explained variability in future preferred method of software acquisition (R = 0.194). Nevertheless the influence is also statistically significant so there can be taken an assumption that future planed software delivery model is influenced by a degree of portability (although table 1 shows that there is higher count of respondents still planning the on-premise model, there portability is a typical parameter of on-premise software installations).

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	1.081	1	1.081	5.660	0.019*
Residual	27.501	144	0.191		
Total	28.582	145			
Predictors: F1 Portability; R = 0.194, significant on p < 0.05 level					
Dependent: E2 Future preferred method of software acquisition					

Table 4 Results of ANOVA test of relationship between perception of software characteristics and method of future software acquisition

3.3. The awareness of SME's management of the term cloud computing

The problem of SMEs is usually availability of capital for large investment in IS/ICT. This problem still persists even in larger companies – the priority of difficult investments in IS/ICT are not always a top priority for the management of companies. One of occasional reasons is however also the unawareness of management and employees of companies and institutions of quality IS/ICT means' benefits. Along goes also lack of knowledge of possibilities of acquiring them with relatively lower costs. It is therefore imperative to raise awareness of managers in this topic as it is also imperative to search for easier ways of new technologies' application. This can help to solve the problem of transferring new technologies to practical use – the probably easiest way is to leverage technologies accessed through the cloud computing.

According to Qureshi, Kamal (2011) a significant amount of company owners, managers and end users are aware of this term but the most of them still do not trust it or have no idea what this term means. Therefore we analyzed correlation between firm size and knowledge of the term cloud computing in our data sample. Fig. 1 shows difference in knowledge of this term where more CZ firms with 1-9 workers are still unaware of the cloud computing in context with PL firms (although

there are less replies in the data sample that represent Polish firms). Collectively there is no noticeably distinctive difference evident from the results mainly due to lower count of replies. Nevertheless the information that there is still higher amount of respondents of various size that are unaware of the meaning of cloud computing is relevant. According to table 1 some of them are however currently using the on-demand model for their IS/ICT tools. This could imply that the unawareness could conceal some possible other aspects of cloud computing. This includes using and sharing virtual storage space or portability of specific services etc. (so not only as a platform for on-demand delivery of the software). Possible ways of quantifying the knowledge of a specific term and then increasing it is presented in Ministr, Ševko (2010). On the contrary this fact could also imply that firms may not seek the knowledge of the possibilities that the cloud can bring them. The reason could be that there is a question whether they would benefit from it or not after all (if their productivity of their business processes will be any better after switching to or supplement them with cloud services – this is however a viable research question for further research). According to table 5 there is a weak statistically significant correlation between firm size and knowledge of the term cloud computing. Further expansion of the data sample would bring better results concerning a more precise correlation coefficient value more relevant to the real situation.

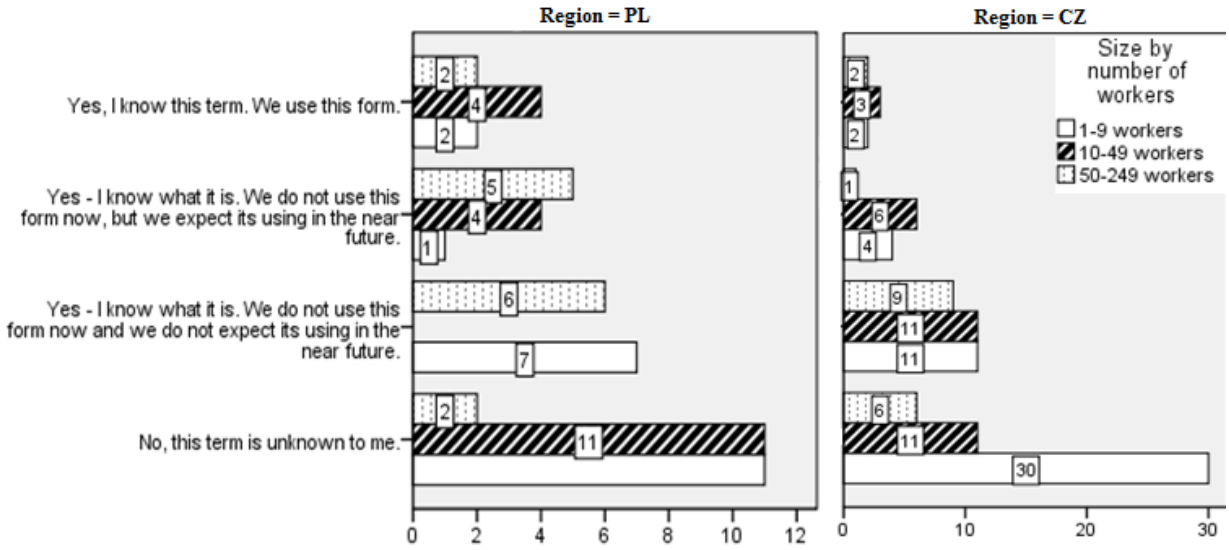

Fig. 1 Knowledge of cloud computing term according to firm size – Czech and Polish respondents

Region	Valid cases	Spearman coefficient ($p < 0.05$)
CZ	96	0.258 (approx. sig. 0.011)
PL	55	0.290 (approx. sig. 0.032)

Table 5 Correlation between size of a company (by number of workers) and their knowledge of the term cloud computing (Spearman's coefficient)

4. Conclusion

The aim of the paper was to present evaluation questionnaire survey results that dealt with assessment of attitudes of Czech and Polish SMEs to cloud based forms of software acquisition. The paper also dealt with their incorporation in current and future plans of information system's update with respect to influence of specific software characteristics on their plans. Also the knowledge of the notion cloud computing and its possible benefits and drawbacks were assessed

according to the methodology. The cloud computing poses viable solution for this problem while bringing the software as a service software distribution model. The results show evidence of some changes in thinking of SMEs in the Czech-Polish border region in favour of usage of the SaaS distribution model. The lack of knowledge of cloud computing is still apparent. The data sample should be further expanded so that new relationships can be discovered and other already determined further validated. Despite this fact there were some minor results that the knowledge of the term cloud computing is related to company size. Also the influence of software characteristics on the preferred method of software acquisition was also evident in our results, although the explanatory power was not very high. However despite the limitations of the data sample, our results correspond to some degree with overall findings of the Edge Strategies's study concerning adoption of cloud based applications, performed in several countries worldwide.

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References

Hagel, J., Brown, J. S. & Davison. L. (2010). The Power of Pull: How Small Moves, Smartly Made, Can Set Big Things in Motion. Basic Books, New York. ISBN 978-0465019359.

Kazarian, B. & Hanlon, B. (2011). SMB Cloud Adoption Study 2010: What Will be the Impact of Cloud Services on SMBs in the next 3 years? Global Report, Edge Strategies. http://www.microsoft.com/en-us/news/presskits/telecom/docs/SMBStudy_032011.pdf.

Ministr, J. & Števko, M. (2010). Human Resources Requirements for Professional Management of ITSM Process. In: IDIMT 2010 Information Technology – Human values, Innovation and Economy (pp.57-64). Jindřichův Hradec: Trauner Verlag, Linz.

Němec, R. & Zapletal, F. (2012). The Perception of User Satisfaction in Context of Business Intelligence Systems' Success Assessment. IDIMT-2012 : ICT Support for Complex Systems (pp. 203-211). Jindřichův Hradec: Trauner Verlag, Linz,

Qureshi, S. & Kamal, M. (2011). Role of Cloud Computing Interventions for Micro-Enterprise Growth: Implications for Global Development. In: Proceedings of the Fourth Annual SIG GlobDev Workshop: Fourth Annual SIG GlobDev Workshop (pp. 1-25). Shanghai: SIG GlobDev, Routledge.

Rozehnal, P. (2012). Trends in Management of Companies Caused by the Impact of ICT. IDIMT 2012 - ICT Support for Complex Systems. (pp. 135-142) Jindřichův Hradec: Trauner Verlag, Linz.

Tvrdíková, m. & Koubek, O. (2011) The Use of Cloud Computing (SaaS) for Small and Medium Enterprises to Improve the Quality of their Information Systems. IDIMT-2011 : Interdisciplinarity in Complex Systems (pp. 389-391). Jindřichův Hradec: Trauner Verlag, Linz.

ASPECTS OF APPROACH TO APPLICATION IS/IT IN SMES

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Keywords

Information system, Information Technology, SMEs, Implementation

Abstract

In this paper some aspects of the creation of recommendation for the approach to the application of information technologies (IT) in the segment of small and medium enterprises (SMEs) are discussed. The motivation comes from a number of studies that analyse the influences of individual factors and their actuation at IT application, but insufficient number of possible solutions to this application. SMEs due to their characteristics are facing a number of problems that through the process of IT implementation have become problematic. This paper also includes some conclusions from personal research on the application of IT in SMEs in Czech-Polish border region, which was implemented in 2012.

1. Introduction

Information technologies (IT) are understood as one of the sources of development of potential of economic entities. The vast majority of these entities fall into the category of small and medium enterprises (SMEs). SMEs are specific among other due to their size and the number of employees. This specifics influence the application of information systems or information technologies (IS/IT). There are available many studies that analyse the key factors of IS/IT application in SMEs, but they are missing specific recommendations for their application; and, therefore, increase the level of use of technologies. This is a logical consequence, because the determination of a solution due to the variability of possibilities is very difficult. Nevertheless, this area has to be discussed in order to achieve the phase of designing specific solutions besides the analysis of the state. The existing methodologies are often cumbersome and complicated for deployment in SMEs.

At the end of 2012, together with the colleagues from Poland, we implemented the research of using IT technologies in the segment of SMEs. The aim is to map the current level of use of IS/IT in the Euroregion Silesia, which is geographically situated in the parts of the Moravian-Silesian Region in the Czech Republic and on the Polish side in the areas of the Silesian and Opole Duchy. Solutions should also include the recommendations for IS/IT application in the companies. The aim of this paper is to summarize the direction of the solution and presentation of the selected results of the survey. The technological development entails increasing possibilities of IS/IT application and

with it connected changes in the management of companies (Rozehnal, 2012). It is necessary that also in the concerned segment the technologies get pushed through more markedly.

2. Literature Research

There is a series of studies available where individual authors define the relevant aspects of the implementation of IS/IT in SMEs. The firms in this segment exhibit the typical features that distinguish them from larger companies. Authors Antlová (2009) or Plumb and Zamfir (2008) summarize the basic differences. Here are the selected differences in relation to the focus of the paper:

- SMEs have fewer resources for implementation of ICT
- the owner plays an important role and generally the organizational structure is flat
- SMEs use ICT often only as an operational tool, not as a strategic advantage
- short-term planning, rather accidental
- the way of functioning, competition in the market, often with focus on the local market

Economic factors

Economic factors create an important part of the implementation of IS/IT. In the literature, the authors differ in conception. Alam and Noor (2009) or Premkumar and Roberts (1998) mention the importance of understanding the benefits. Continuity in understanding of the benefits of IS/IT, in conjunction with the Internet network is stated by authors Fulantelli and Allegra (2003), when they emphasize access to new markets and development of communication. Soja (2008) points out the problems in the implementation of IS/IT and the consequent problems with inadequate benefits that do not fulfil the original expectations.

In opposition to these benefits, many authors point at the costs of application of IS/IT like Alam and Noor (2009) or Olszak and Ziemba (2012). In connection with costs the issues related to the acquisition of technologies with a high importance of IS / IT application for SMEs with the possibility of fatal consequences in case of an unsuccessful implementation are discussed.

Strategy

Estrin et al. (2003) state a negative perception of the economic substance of influence of IT in view of management is the tendency to view software as an expense rather than as a strategic asset. This view of perception technologies is associated with the images of exercisability within the functioning of the company. Antlová (2009) or Plumb and Zamfir (2008) state in relation to SMEs rather a haphazard planning of short-term character.

Organizational factors and human resources

The decisive factor in this context is the size of the organization, which in many cases limits the options, especially of the human potential. Therefore, the role of managers of the company (often of the owner of organization) is getting into the foreground (Milne & Mathys, 2009; Soja, 2008; Premkumar & Roberts, 1998). Subsequently, the problems discussed are associated with the significance of key persons such as the business (Enzenhofer & Chafer, 2001), narrow perception of technologies (Soja, 2008), the concentration of the key knowledge (Valkokari & Helander, 2007). People as the main factor for the application of the IS/IT in various forms appear in most of the aspects. Their importance as a key factor is mentioned by Doucek (2009).

External factors

Factors coming from the external environment influence the application of IS/IT in both the positive and negative direction. The necessity of IS/IT application by reason of retaining in the supplier-customer chain, observation of legislative demands, compatibility with the systems in parent organizations. Through these influences, a company can be markedly shifted forward, but can also be shifted to bankruptcy. These factors are discussed by (Achrol & Kotler, 1999; Arendt, 2008).

Technologies

The technologies themselves are a factor that plays a role in many directions. Basl and Doucek (2012) mention the importance of innovations, while Lucchetti and Sterlacchini (2004) state the importance of this branch and its technological demands. The current technological trends and their great diversity offer new opportunities for the application along with the substantial change in application factors. Possibilities of application of technologies of cloud computing in SMEs were summarized by Tvrdíková and Koubek (2011). The authors point to new trends in the utilization of IT to achieve business goals. Racek & Ministr (2012) document the use in the sphere of crisis management, while the utilization of social networks was discussed by Pochyla (2012) and Martinik (2012) points to the possibilities of using multimedia. There is a huge amount of similar examples with regards to the technological possibilities.

3. Recommendation of approach to application - implementing of IS / IT

In the introductory stage of formation of the recommendation of an approach were delimited important aspects that must be respected. Briefly, it was stated in the chapter above. Those aspects were extended by adding the findings from a personal academic survey. The overview of the initial situation was supplemented by using this information. Model 90's, by Michael S. Scott-Morton (Scott-Morton, 1991), which defines the critical success factors of IT implementation, was used as another input element.

Key factors influencing the process of IT applications that have been identified by analysing the available literature are as follows:

Human resources - particularly in connection with the level of computer literacy of staff, availability of IT specialists and the ability of managers/owners to appreciate the potential of technologies and to try to utilize this potential. Organization - especially in the context of process analysis, size of the organization, number of employees and their roles, etc. Technologies - are important for the target segment in connection with the simplicity of deployment, availability and financial requirements, security and application possibilities, etc. External environment - in the context of the compatibility of systems with customers, suppliers and the necessity of an application of systems that is used in parent organizations. Economic opportunities – they limit the situation due to the price demands (acquisition, management of IS/IT). Strategy - the problem is to understand information technologies as an opportunity that can bring positive further development for the company.

All factors discussed above are ultimately associated with people. Our **own survey** was strongly focused on the facts that concern the human potential of companies. We have data from 160 respondents (100 in CZE, 60 in PL) in our survey who were divided up according to the classification of economic activities (CZ-NACE). The distribution is shown in Table 1. The respondents were elected on the basis of geographical terms and criteria of belonging to SMEs. In connection with the survey we will at least mention the selected conclusions from the field of

personnel ensuring administration and operation of ICT. In connection with the personnel staffing of operation, the respondents were questioned about the ensuring by human resources. Offered variants of answers: 1) the employees of the company, who are not IT specialists (primarily they have other duties within their work time), 2) the employees of the company - IT specialists, 3) external workers - outsourcing and 4) the last variant - other ways of ensuring (arbitrary answer). For a better evaluation of the importance of individual variants, it was enabled to rate each variants on one of five levels (insignificant, little significant, significant, more significant, the most significant). Our goal was that we would not eliminate any variants in the decision making of respondents since we assumed that in the segment of SMEs most cases would concern various combinations of the coverage of operations of IT with human resources. Respondents could consider the importance of individual forms of securing and at the same time express their extent of involvement.

A	B	C	D	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	Total
1	3	13	4	17	20	3	6	1	5	11	4	11	11	4	5	40	1	160

Table 1

Our initial assumptions were proved through the investigations. Most respondents took advantage of the opportunity to evaluate the importance of each variant in the company. It is evident that the combination of multiple sources is important in the majority of entities for administration of IS/IT. Leastways important is the application of at least 2 forms of ensuring for more than 50 % of entities. For more details see Table 2. The results show the growing importance of a combination of multiple forms of ensuring the operations of IT with growing size of the company (in terms of number of employees).

Number of employees	1-9	10-49	50-250
2 sources	41,5	41,9	58,3
3 sources	9,8	16,1	25,0
In total, at least 2 sources	51,2	58,1	83,3

Table 2 (Results are given in %)

In order to evaluate the significance of forms of ensuring the administration of IT in individual entities (i.e. employees who do not belong to IT staff; employees belonging to specialists IT and external form of the administration), the scale of importance of sources was aggregated by merging of more significant and the most significant (or insignificant and little significant). So further was the evaluation simplified into insignificant, significant and most significant. The results were not stated in any special way to ensure arbitrary answers. Therefore this form of answer did not affect the results. In Table 3 are indicated the variants of results which in some of forms were above the limit 10%.

For companies with a staff of 1-9 is the most distinctive the application - nearly 32% - a combination of the use of external IT administration and workers who do not belong to specialists IT (IT non-experts). Very distinctive - with more than 27% - is the use of only external form of IT management. The firms with 10-49 employees also tend to distinctly utilize their own employees, who are not IT experts, in combination with external specialists, but the extent of ensuring this is more evenly and widely distributed amongst a combination of all three defined ways of management from the perspective of resources. For medium-sized companies (50-249 employees) an increase in their own IT specialists can be seen. The firms primarily do not rely as much on their own IT non-experts.

Number of employees	**1 - 9**	**10 - 49**	**50 - 250**
Own IT non-experts + external specialists	31,8	21,9	18,2
Only external specialists	27,3	12,5	9,1
Own IT non-experts	11, 4	12,5	0
Own IT non-experts + own IT specialists	11,4	6,3	18,2
Own IT specialists	2,3	15,6	18,2
Equally all forms	9,1	18,8	27,3

Table 3 (Results are given in %)

The stated results with further conclusions of the survey (to present the complete results within this paper is impossible) warn us of the need for a different perception of the needs of companies in the segment of SMEs. This applies in particular to micro-firms with a number of employees up to 10. In this segment the perception of IT and its application is often very different. This concerns most of the factors listed in chapter 2. In the case of smaller and medium-size businesses there is an apparent effort for the optimal administration of IS/IT - a combination of sources, also in connection with limited resources.

MIT 90's model (Scott-Morton, 1991) defines as the critical success factors inside the organization as follows: strategy, people and their roles, structure, technology and processes. Model is inspiring for us because the factors accepted by this model correlate with the most frequently indicated factors of IT application also in the present and because it simplifies the situation of perception of IT application. The simplicity, in our view, is crucial for application of the recommendations in practice. After considering the above aspects we come to the key question: how to simplify the process of implementation of IT in companies so this process is easier for the companies and what are the key points of this process. I assume that it concerns the following elements:

Form of application of IT. The harmonization between the business strategy and IT strategy. Understanding of the potential of IT. The process of implementing IT into business management.

In practice, it can be traced essentially through two approaches of IT application. The first is based on the knowledge of processes and needs of the firm that are satisfied through the chosen IS/IT solution. The choice of technology is subordinate to the requirements of the company that have been found during the analyses. Approaches to the analyses in the case of SMEs are discussed by Ursic et al. (2005) or Chang et al. (2006). The other approach is based on the application of IS / IT solutions and customization of business processes. It is based on the fact that the producers of software solutions use "the best" in their solutions and therefore in principle these systems should correctly solve the given type of problem (typically, for example, ERP systems and their modules) (Pajk et al., 2013).

From the perspective of the needs of SMEs, the execution of process analysis and the complicated survey of needs of organizations are questionable. When we talk about the need for a simple solution, the choice of a recommendation is based second stated approaches. It means on the effort to use the properties of software tools, and on this basis, considered and redefined their own business processes. But how to bridge the gap between the choice of technology and change in the organization. Pajk (2013) addresses this situation by applying the reference models that 1) are based on best practice and 2) are re-usable, versatile. (Fettke & Loos, 2003; Scheer, 1998). Still remains the question of the availability of these reference models and the way of their expression (Notation, description, togetherness), because the way of their expression should respect the simplicity, openness and compatibility. The need or application of the defining of functionality of

the system and its description is also growing in connection with the tendencies of application "IT as a service" where it is necessary to define the service interface. Here the software producers themselves should understand the possibility of application and the justness of these models. If in this way the applicability of IS/IT in practice is increased, then the producers surely would not be loss-making.

Then the recommendations for the application of IS/IT could be based on an easier assessment of the effect of the application of technologies within the company and in a broader sense also for defining the strategy of the company or its modification with a new application of IS/IT. This could positively affect a better option of consideration of the benefits of technology or of the approach in the context of the current solution in the company. Then the phase of IS/IT application with a "planned" impact on other factors in the organization would follow, i.e. the change in management of processes, corporate structure, and the role of human potential. The procedure is expressed in Fig. 1.

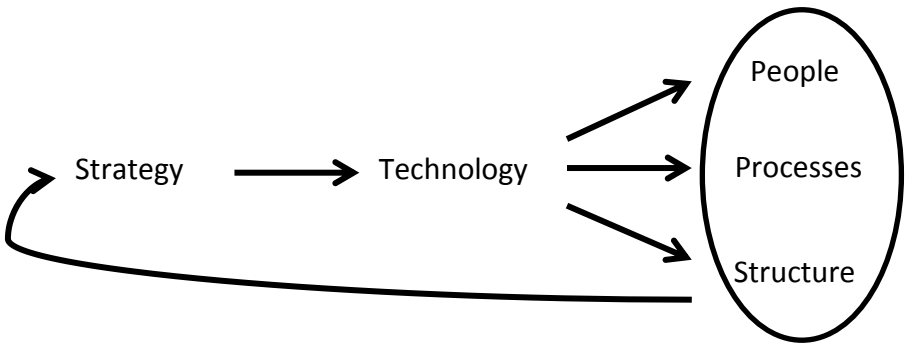

Fig. 1

4. Conclusion

This paper describes part of the results of the project "Application software for decision-making support in small businesses in the Czech-Polish border region" that inter alia should result in a recommendation that simplifies the approach to the application of IT in the companies of SMEs segment. Some conclusions from the carried out survey and directions of recommendations were published.

In this area there a series of studies available that focuses on mapping the main factors within the implementation of IS/IT. Although the authors tend to see the issues from different perspectives, the factors they discuss are essentially identical. Examples of different perspectives are documented by Olszak and Ziemba (2012), who show the factors in connection with the area of business intelligence, Looi (2004) deals with implementation of e-commerce, while Valkokari and Helander (2007) examine the issue of knowledge management systems.

The key factors include the human potential of these companies (this applies very strongly to the abilities of key executives or owners). From our own research, we can say that the effort of companies to optimize the administration of IS/IT by means of combination of forms of personnel ensuring (staffing) is evident. In the case of the companies with up to 9 workers we documented the inability to employ their own IT specialists. These companies often solve the situation in the form of outsourcing (or in combination with their own IT non-experts). It is clear that companies are realizing the importance of IS/IT and are actively trying to improve their situations. It is also evident that in most cases the companies want to have at least a partial effect on the application of

technology through their own employees. This is reflected in the combined use of their own and external personnel, especially in larger companies. This confirms our assumption that the potential of use of IS/IT and principles of their operation must be understandable for companies.

We have defined the basic thesis which would help SMEs companies to solve application IS/IT. The simplicity and speed of benefits of given solutions are important for the application. As a possible form of assistance we see the application of the reference models of software that would serve as guidance for future deployment. The possibility of the application of these models, their availability in the market, description and compatibility are the questions of further research.

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References

Achrol, R., S. & Kotler, P. (1999). Marketing in the Network Economy. Journal of Marketing. 63. 146-163.

Alam, S.S. & Noor, M.K.M. (2009) ICT Adoption in Small and Medium Enterprises: an Empirical Evidence of Service Sectors in Malaysia. International Journal of Business and Management, 4(2), 112-125.

Antlová, K. (2009) Motivation and barriers of ICT adoption in Small and Medium-sized Enterprises. E + M Ekonomie a management. 12(2), 140-155.

Arendt, L. (2008) Barriers to ICT adoption in SMEs: how to bridge the digital divide? Journal of Systems and Information Technology, 10(2), 93 – 108. doi:10.1108/13287260810897738

Basl, J., & Doucek, P. (2012) ICT Innovation in Context of the Sustainable Development in Europe. Jindrichuv Hradec 12.9.2012 – 14.9.2012. In IDIMT-2012: ICT Support for Complex Systems. Linz:Verlag Osterreich, 2012, 153-161, WOS:000315973000016

Chang L., Levy M, Powell P (2006) Process re-engineering success in small and medium-sized enterprises. In Proceedings of the Fourteenth European Conference on Information Systems (Ljungberg J, Andersson M eds.), 2006. 223-234, Goteborg.

Doucek, P. (2009). ICT Human Capital – Research and Development. Jindrichuv Hradec 9.9.2009 – 11.9.2009. In IDIMT-2009 System and Humans: A Complex Relationships. Linz: Universitatsverlag, 2009. 83–94, WOS:000273266300009

Enzenhofer, W., & Chroust, G. (2001). Best practice approaches in know-how and technology transfer methods for manufacturing SMEs. In Proceedings of the 27th EUROMICRO Conference. CA: IEEE

Estrin, L., Foreman, J. T., & Garcia, S. (2003). Overcoming barriers to technology adoption in small manufacturing enterprises (SMEs). Technical Report. Pittsburgh: Software Engineering Institute. 2003

Feetke, P., & Loos, P. (2003) Classification of reference models: a methodology and its application. Information Systems and e-Business Management, 1 (1), 35-53

Fulantelli, G., & Allegra, M. (2003) Small company attitude towards ICT based solutions: some key-elements to improve it. Journal of Educational Technology & Society. 6(1). Retrieved from http://www.ifets.info/

Looi, H.C. (2004) A Model of Factors Influencing Electronic Commerce Adoption among Small and Medium Enterprises in Brunei Darussalam. International Journal of Information Technology. 10(1). Retrieved from http://www.intjit.org/

Lucchetti, R., & Sterlacchini A. (2004) The adoption of ICT among SMEs: evidence from an Italian survey. Small Business Economics, 23(2), 151-168.

Martinik, I. (2012) Current Trends in the Area of Progressive Technologies for Recording, Publication, Adaptation and Management of Rich-media Presentations. Lodz 24.9.2012 – 26.9.2012. In 2012 International Conference on E-

Learning and E-Technologies in Education (ICEEE). Lodz: Technical University, 2012, 180-185. WOS:000310434700035

Milne, D., & Mathys, L.,W. (2009) ICT Adoption and Development of E-business among SMEs in South Africa. In ISBE Conference, Liverpool, 2009.

Olszak, C., M., & Ziemba E. (2012) Critical success factors for implementing business intelligence systems in small and medium enterprises on the example of upper Silesia. Interdisciplinary. Journal of Information, Knowledge, and Management. 7, 129-150.

Pajk, D., Stemberger, I., & Kovačič, A. (2013) The Use of Reference Models in Business Process Renovation. Business Systems Research, 1 (1-2), 30-38

Plumb, I. & Zamfir, A. (2008) Use of ICT in SMEs Management Within the Sector of Services. Annals of Faculty of Economics. 4(1). 481-487. Retrived from http://econpapers.repec.org/article/orajournl/

Pochyla, M. (2012) Future of Intranets and Social Networks in the Enterprise. Jindrichuv Hradec 12.9.2012 – 14.9.2012. In IDIMT-2012: ICT Support for Complex Systems. Linz:Verlag Osterreich, 2012, 305-312. WOS:000315973000032

Premkumar, G., & Roberts, M. (1998) Adoption of New Information Technologies in Rural Small Businesses. The International Journal of Management Science. 27(4), 467-484. doi:10.1016/S0305-0483(98)00071-1

Racek, J. & Ministr, J. (2012) ICT Support for Emergency Management. Jindrichuv Hradec 12.9.2012 – 14.9.2012. In IDIMT-2012: ICT Support for Complex Systems. Linz:Verlag Osterreich, 2012, 41-48, WOS:000315973000004

Rozehnal, P. (2012) Trends in Management of Companies Caused by the Impact of ICT. Jindrichuv Hradec 12.9.2012 – 14.9.2012. In IDIMT-2012: ICT Support for Complex Systems. Linz:Verlag Osterreich, 2012, 135-142. WOS:000315973000014

Scheer, A. W. (1998) Business Process Engineering Study Edition: Reference Models for Industrial Enterprises (1st edition). Springer-Verlag Berlin and Heidelberg, ISBN 978-3540638674

Scott-Morton, M. S. (1991). The Corporation of the 1990s: Information Technology and Organisational Transformation. London: Oxford University Press, 1991. ISBN 978-0195063585

Soja, P. (2008) Difficulties in Enterprise System Implementation in Emerging Economies: Insights from an Exploratory Study in Poland. Information Technology for Development. Special Issue: IT Investments in Emerging Economies. 14(1), 31–51. doi:10.1002/itdj.20086

Ursic, D. Anteric, S. Mulej, M. (2005). Business Process Re-engineering in Practice - A medium-sized Slovenian Company in Difficulties, Systemic Practice and Action Research, 18,1, 89-117

Tvrdikova, M & Koubek, O. (2011) The Use of Cloud Computing (Saas) for Small and Medium Enterprises to Improve the Quality of Their Information Systems. Jindrichuv Hradec 7.9.2011 – 9.9.2011. In IDIMT-2011: Interdisciplinarity in Complex Systems. Linz:Verlag Osterreich, 2011, 389-390. WOS:000299185000041

Valkokari, K., & Helander, (2007) N. Knowledge management in different types of strategic SMEs network. Management Research News, 30(7), 597-608. doi: 10.1108/01409170710773724

THE USE OF ICT TOOLS AS INNOVATIONS IN SMES IN THE CZECH-POLISH BORDER AREAS

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Small and medium enterprises, innovation, the Czech-Polish border areas, ICT tools, management levels, current and future ICT using, Somer's statistic.

Abstract

The paper presents a comparison of the factors of innovation ICT tools in small and medium enterprises (SMEs) in the Czech-Polish border area. Processed comparison is based on the analysis of current state of factors and their trends that determine the innovation of ICT tools in SMEs. Data for comparison of individual factors have been obtained on questionnaire survey conducted in 2012. The evaluation of the factors is based on asymmetric dependence testing. The results confirm the increasing trend in the use of Management Information Systems tools and Business Intelligence tools. And even a higher growth of usage of these tools is expected in future in Czech enterprises. Among the most important groups of factors influencing the future use of ICT tools are the current level of their use, as well as number of employees and turnover, flexibility and possibility of ITC tools upgrade, and maintenance forms of ICT use by level of complexity of ICT tools.

1. Introduction

Innovations in general represent a broad platform for rapid progressive changes in the economy based mainly on the ability to use ICT tools. Thus these tools become the critical success factors of the entire economy (Basl & Doucek, 2012). The selection of the factors that influences innovations in SMEs is based on the theoretical works (Soja, 2011; Olszak &Ziemba, 2004; Nemec & Zapletal, 2012). The authors divided the chosen factors of ICT tools innovations, into 4 basic

categories which are comparable for both countries (the Czech Republic and Poland). The chosen categories are as follows:

- The current and future use of ICT tools in SMEs, according to the level (area) of their using (Simple Office ICT tools, ICT tools for Sub-process analyses, Comprehensive ICT tools of Management Information Systems and ICT tools for Business Intelligence).
- The required properties of the considered ICT tools innovations in SMEs.
- The way of maintenance of ICT tools as factors of innovation in SMEs.
- The characteristics of the companies according OECD report (OECD, 2004).

The aims of processing of these factor categories are:

- identifying the significant factors of ICT tools as factors of innovation in SMEs in individual countries;
- determining the trends of the significant factors and
- identifying the main differences between maintenance and implementation of ICT tools innovations in SMEs in the Czech and Polish border areas.

Basic hypothesis of this paper is based on the fact that there are certain differences between the existing and planned innovations in using the ICT despite a fact that both researched regions are closely linked due to the frequent mutual cooperation (Basl & Doucek, 2012; Hanclova et al., 2010; Rozehnal & Tvrdíková, 2012).

The paper is divided into five main sections. The first section is focused on delimitation of the object of investigation and determination of research hypotheses. The second section specifies the methods used for the evaluation of asymmetric dependence of ordinal variables and the concept of the questionnaire survey. The third part includes empirical analysis and comparison of results. The fourth section summarizes the obtained results and it answers to the research hypotheses.

2. Data and methodology

In this part of the paper we specify the methodology for investigating the relationship between two categorical variables with ordinal scales. They capture not only the strength of the association but also its direction. In the next part, the concept of the questionnaire survey will be presented.

2.1. An asymmetric Somer's statistic

We consider the ordinal measures of association based on the difference between the number of concordant pairs (C) and the number of discordant pairs (D). They are calculated for all distinct pairs of observations. Assessment of the number of C and D is defined in paper Hanclova (2008).

With regard to existing pairs with the same value of the quantity, the intensity of the dependency between focused variables is decreased. We can use an **asymmetric Somer's statistic** of Y dependency on X that is calculated as follows:

$$d_{Y/X} = \frac{C-D}{C+D+T_Y} = \frac{2(C-D)}{n^2 - \sum_i n_{i+}^2}, \tag{1}$$

where T_Y is a number of pairs tied on Y, but with a different value of X. n_{i+} defines absolute marginal frequencies of rows in the contingency table of variables X and Y. This Somer's statistic ranges from -1 to 1. Values close to an absolute value of 1 indicate a strong relationship between the two variables and values close to 0 indicate little or no relationship between the variables.

The null hypothesis was tested that there is no association between the variables using the chi-square statistic. If H_0 is rejected, the pattern of the relationship was interpreted by computing the percentages in the direction of the independent variable, across the dependent variable. The strength of the association was determined using the magnitude. The direction of the relationship was described using the sign of the test statistic (Hanclova and Doucek, 2011). Testing for the asymmetric dependence of pair ordinal variables was implemented in the software IBM SPSS Statistics 21.

2.2. Concept and structure of the survey

Stated hypotheses will be empirically assessed using the questionnaire survey to identify, analyse and evaluate the usage of ICT tools as innovation factors in SMEs in the Czech-Polish border areas. Main aim was to examine determinants influencing ICT tools using as means of innovation.

The questionnaire was divided into 7 interlinked parts: **A** and **B** (current and future utilization of ICT tools), **D** (data sources to support decision-making process), **M** (modules used within the information system), **F** (software features decisive for ICT choice), **G** (the way of ICT maintenance), and **I** (identification of the company and respondent).

We distinguish four levels of use of ICT tools:

- First level is **Simple Office ICT tools (L1).** This level contains use of word processors, spread sheets, database systems and software for making presentations and software supporting a group work and compression or antivirus programs.
- Second level includes **ICT tools of for the Sub-Process Analysis in SMEs (L2).** There are ICT to support simple processes in the operative management level of the company (production and storage, purchase and sale, logistics, human resources, billing, inventory, accounting, tax accounting, banking etc.).
- The third level contains **comprehensive ICT tools of Management Information Systems (L3).** These tools are used especially at the tactical level of management, and they are part of the Management Information Systems (MIS). For example, it is comprehensive economical software that the use of periodic and provided operational systems.
- Finally, the fourth level is integrated **Business Intelligence solution** (**L4**).

For these four levels we investigate **intensity of their usage in current and future time** (variables **A1-A4 and in the future B1-B4**). The intensity of utilization of ICT tools was divided into 3 categories: 1 (never - very rarely), 2 (sometimes - often) and 3 (very often - always).

The third group of **determinants F** were such features which the company took into account when choosing software (SW) to support a decision-making process (**F1** = portability, **F2** = reliability and durability, **F3** = scalability and flexibility, **F4** = support or development. upgrade options**, F5** = ease of ICT use, **F6** = customer support services offered by the supplier, **F7** = low operating costs, and other). These features were assessed on a scale as follows: 0 (unimportant), 1 (low important), 2 (important), 3 (more important), and 4 (the most important).

The group **G** monitored how **ICT maintenance is provided in a company** with possible answers 0 (no) or 1 (yes) for these options: **G1** = own employees (not ICT specialists), **G2** = own employees (IT specialists), and **G3** = external ICT specialists (outsourcing).

In the last part of the questionnaire (**I**) we observed a **company profile**: **I1** = size according to number of employees, **I2** = amount of revenue, and **I3** = ownership structure of the company.

All data were obtained using the questionnaire survey which was distributed via email or by post to the SMEs in two rounds (September-October, November-December 2012). In the Czech part of the border region, 5 767 questionnaires were sent with a rate of return 1.73% (i.e. **100 questionnaires**) and in the Poland we distributed 3 806 questionnaires with the rate of return 1.54% (i.e. **60 questionnaires**).

3. Empirical results

3.1. Empirical distribution of different levels of ICT tools use in the surveyed regions

In the first part of the analysis we focused on the distribution of relative frequencies (in %) for the current (A1-A4) and future (B1-B4) usage of ICT tools as factors of innovation in SMEs in the Czech-Polish border in the second half of year 2012. The three categories of frequency of ICT tools use are distinguished (category 1 = ICT used rarely, category 2 = ICT used often and category 3 = ICT used regularly).The results are shown in Fig. 1.

In the Czech border area, the first level of ICT tools is used most often - Simple Office ICT tools are used in 97% of SMEs , followed by the second level (supporting the management of the Sub-Process) used in 93% of SMEs. The third level - Comprehensive ICT tools of Management Information System are used only in 62% of companies and ICT tools Business Intelligence are supported in 42% of SMEs. In the Polish border area, ICT tools of L1/L2/L3/L4 levels are used in 97% / 93% / 56% / 28% of SMEs. The first two levels are comparable between the surveyed regions, but the use of integrated MIS and BI are significantly higher in the Czech border area by about 6% and 14%.

In terms of future development in ICT tools use in both border areas, the survey showed the following facts. The first level (Simple Office ICT tools) is expected to keep the same level of use, but the second level (ICT tools of for the Sub-Process Analysis in SMEs) is assumed to stagnate in the Polish region and only slight increase of 3% is expected in the Czech SMEs. On the other hand, it is planned to increase in ICT use for L3 (a comprehensive MIS) by 10.2% respectively 5.6% in the Czech resp. Polish SMEs. This trend is also assumed for Business Intelligence tools (by 18.4% in the Czech SMEs and only by 8.3% in the Polish SMEs).

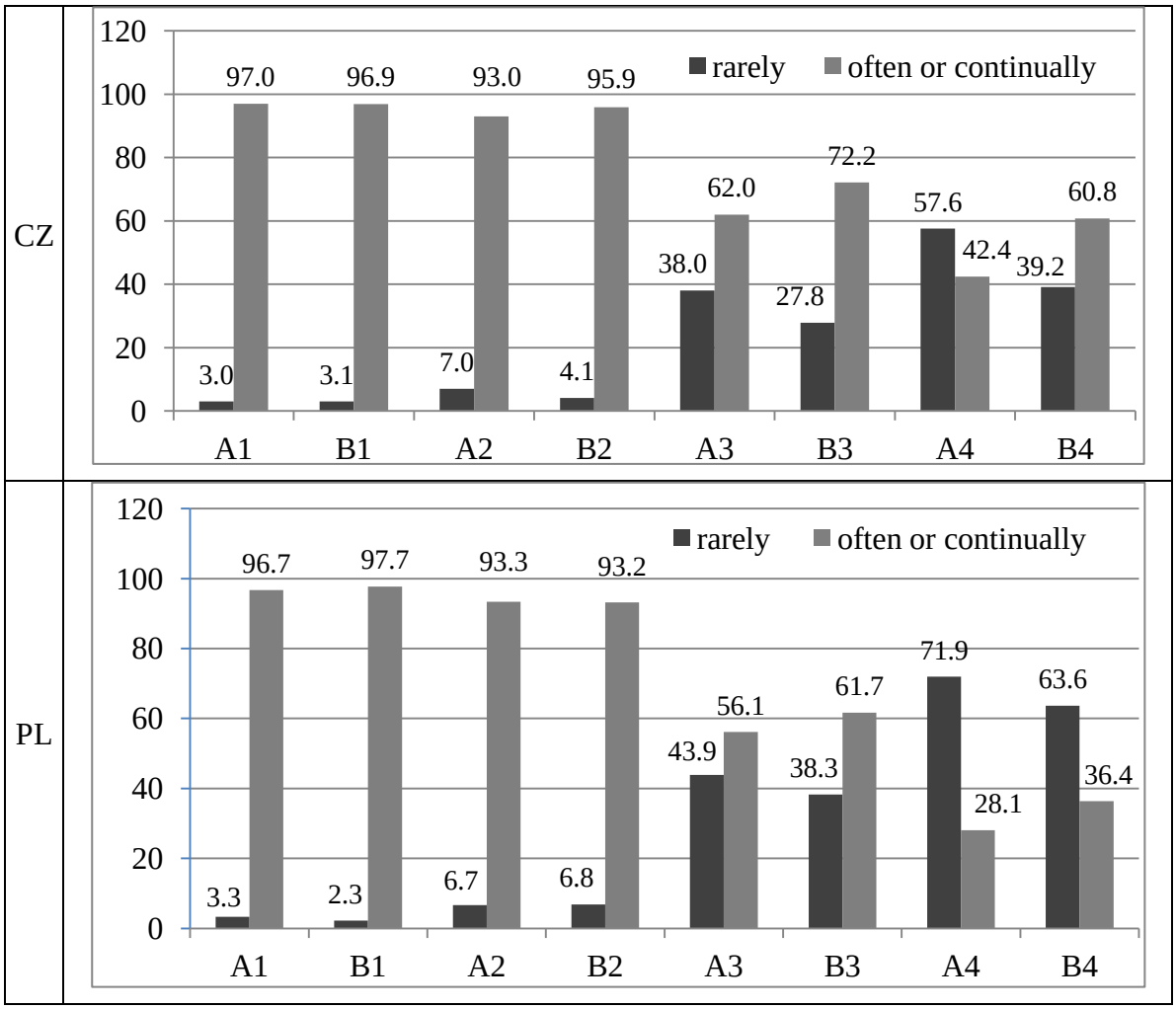

Fig. 1: Empirical distribution of the use of ICT tools in the surveyed regions

3.2. The effect of the determinants on the future use of ICT tools in the Czech and Polish SMEs

The second part of the empirical analysis follows the examination of paired asymmetric dependence of future use of ICT tools (ordinal variables B1-B4) on the following groups of factors: current use (A1 - A4), requirements on the properties of ICT tools at their purchase (F1 - F7), form of ICT tools maintenance in SMEs (G1 - G3), the specification of SMEs in terms of company size according to the number of staff, turnover level and ownership structure (I1-I3).

Table 1 summarizes the results for future use of ICT tools at the level of L1- L4 for Czech SMEs. Values of the Somer's statistic indicate the level of asymmetric influence of determinants on the future use of ICT tools that were statistically significant at 1% (***), 5% (**) or 10%.

The strongest factor group is the current intensity level of ICT tools use, which ranges in the interval <0.76, 0.89> for Czech region and <0.65, 0.91> for Polish border area according to the levels L1-L4. Furthermore, it was also found that future more intensive usage of Business Intelligence solutions already requires experiences with Comprehensive ICT tools of MIS (value of the Somer's statistic 0.42 for Czech area resp. 0.70 for Poland, which shows a moderate resp. strong positive correlation with regard to the potential interval <-1; 1>).

As the most important determinant from the group of factors F1-F4 appears F3 (scalability and flexibility), but it's only for the simple office ICT tools (L1) or ICT tools for Supporting the Sub-process analysis of SMEs (L2). The factor F4 (support for software development) operates with a relatively low but significant intensity around 0.16 through the all levels of ICT tools use in Czech SMEs. However, this effect is quite different in Poland where only F3 operates at L1 and L2. There is also factor F2 (reliability and durability) which is important in the Czech border region at the L1 and L2 levels around 0.16.

The most important factor from a group of ICT security (G1-G3) is factor G1 (ICT service's by own staff, no ICT specialists) with a combination of G3 (outsourcing) in Czech companies at the level of L1-L3. At the highest level (L4), Czech firms already prefer G2 over G1. It means that ICT services are covered preferably by own staff - ICT specialists. The situation is a bit different in Polish SMEs where the ICT maintenance services done by own ICT specialists (G2) are especially preferred.

	Czech SMEs				**Polish SMEs**			
factor\level	**B1_CZ**	**B2_CZ**	**B3_CZ**	**B4_CZ**	**B1_PL**	**B2_PL**	**B3_PL**	**B4_PL**
A1	0.89***	0.26***	0.40***	0.33***	0.65***	0.39***		
A2	0.38***	0.79***	0.42***	0.29**	0.33***	0.67***		0.26**
A3	0.23***	0.22***	0.87***	0.42***	0.23**	0.32***	0.81***	0.70***
A4	0.16**	0.16**	0.55***	0.76***		0.32**	0.53***	0.91***
F1							0.42***	0.20*
F2	0.16**	0.15**					0.22*	
F3	0.22***	0.24***			0.24**	0.21*		
F4	0.17**	0.18***	0.16*	0.16*	0.28***	0.21*		
G1	0.17**		0.15*				0.27*	
G2				0.16*		0.18*	0.32**	0.16*
G3	0.18**	0.12*		0.21**				
I1	0.13*		0.29**	0.26***	0.31**	0.25**	0.37***	0.34***
I2			0.29***	0.26**	0.32*		0.54***	0.63*

Table 1: Somer's test statistics for the use of ICT tools B1 – B4 in the Czech and Polish border areas

The last group of investigated factors contains the characteristics of the companies I1-I3. The determinant of ownership structure (I3) was not played an important and significant role. The number of employees (I1) was significant factor with growing dependence at the level L1-L4 in Czech SMEs (from 0.13 to 0.26), and with relatively stable dependencies from 0.25 to 0.37 in Polish companies. Amount of revenue (I2) is significant for future use of ICT tools at the level of L3 and L4 (MIS and BI) in the Czech companies. The same factor worked from the L1 to L4 in the Polish border area.

4. Conclusions

The main aim of this paper was to investigate the research hypotheses formulated in the introduction.

In terms of intensity and development of current and future use of ICT tools as a factor of innovation, it can be concluded that often or regularly use of ICT tools is the most important according to an empirical survey of 160 SMEs at the level L1 - Simple office ICT tools (around 97% of companies) and also at the level L2 (ICT tools for the sub-process analysis in SMEs) around 93%. These intensities are expected to remain at the same level in the future. Comprehensive ICT tools are currently used by 62% in Czech and 56% Polish companies. These values are planned to grow with half the intensity for the Polish region (6%) in comparison with the Czech SMEs. Business Intelligence tools are currently used by 42% of Czech SMEs and only by 28% of Polish companies. Even the future trends confirm the rapid growth particularly for the Czech SMEs by 18%.

Due to the identification of the main determinants of future use of ICT tools as a factor innovation at the level L1-L4, we can conclude that the most important group of factors is the current level of use of ICT tools especially at the same ICT level. Then it is the number of employees and firm's turnovers - these factors play a more important role with increasing ICT tools level especially in the Czech border area.

The most important properties of ICT tools which are usually required are especially flexibility and support for development, reliability and durability at the level of Simple Office ICT tools or the Sub-Process Analysis in SMEs. The portability is an important factor for ICT tools at higher levels (MIS and BI) in Polish border area. Investigated companies are going to take into account cooperation of ICT security maintenance by their own staff (not ICT specialists) together with its outsourcing form in future. SMEs prefer to have their own employees with ICT expertise for the ensuring the operation of Management Information systems and Business Intelligence tools, particularly in the Polish companies. Probably, the reason may be the safety of information technology in turbulent and competitive environment and related fear of outsourcing.

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References

Basl, J., Doucek, P. (2012). ICT and Innovations in Context of the Sustainable Development in Europe. In IDIMT-2012 - ICT Support for Complex Systems – Human Values. Linz: Trauner, 153-162, ISBN 978-3-99033-022-7, WOS:000315973000016

Hanclova, J., Doucek, P. (2011). Education and ICT Sector in the EU (Panel-National Application). In Proceedings of the 8th International Conference Efficiency and Responsibility in Education 2011. Prague: Czech University of Life Sciences Prague. Faculty of Economics and Management, 84-92, ISBN 978-80-213-2183-0, WOS 000300799300010

Hanclova, J., Lukacik, M., Szomolanyi, K. (2010). A VEC Model of the Czech and Slovak Economies. In Proceedings of 28th International Conference on Mathematical Methods in Economics 2010. České Budějovice: University of South Bohemia, 208-213, ISBN 978-80-7394-218-2, WOS 000287979900036

Hanclova, J. (2008). Comparative properties of structural macroeconomic modelling. In Proceedings of International Conference Quantitative Methods in Economics (Multiple Criteria Decision Making XIV), Bratislava: Iura Edition, 70-75, ISBN 978-80-8078-217-7, WOS 000288044800008

Ministr, J., Števko, M. (2010). Human Resources Requirements for Professional Management of ITSCM Process. Jindřichův Hradec. In IDIMT-2010 Information Technology – Human Values, Innovation and Economy. Linz : Trauner, 57-64, ISBN 978-3-85499-760-3, WOS:000288345500006

Nemec, R. & Zapletal, F. (2012). The Perception of User Satisfaction in Context of Business Intelligence Systems' Success Assesment. In IDIMT-2012 - ICT Support for Complex Systems – Human Values. Linz: Trauner, 203-211, ISBN 978-3-99033-022-7, WOS:000315973000022

OECD. (2012). EU SMEs in 2012: at the crossroads. Annual report on small and medium-sized enterprises in the EU, Retrieved from http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/supporting-documents/2012/annual-report_en.pdf

Olszak, C.,M., Ziemba E. (2004). Business intelligence systems as a new generation of decision support systems, In International Conference on Politics and Information Systems: Technologies and Applications, Orlando FL: Int Inst Informatics & Systemics, 172-177, ISBN 980-6560-21-3, WOS:000228205600033

Rozehnal, P., Tvrdíková, M. (2012). Cooperation of Academic and Commercial Sphere during the Implementation of BI by the Means of SaaS. Cavdat. In Proceedings of the ITI 2012 - 2012 34th International Conference on Information Technology Interfaces (ITI). New York: IEE. 59-64, ISBN 978-953-7138-24-0, WOS:000312658700012

Soja, P. (2011). Examining Determinants of Enterprise System Adoptions in Transition Economies: Insights From Polish Adopters. Information Systems Management, 28(3), 192-210, WOS:000299960000003

SOCIAL MEDIA – THE GOOD, THE BAD, THE UGLY

SOCIAL MEDIA – THE GOOD, THE BAD, THE UGLY

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Social media, crowdsourscing, crowdfunding, privacy, mental obesity, addiction

Abstract

The paper describes both positive and negative aspects of social media. It defines what social media are, how social media can be used for information discovery, how they work as a crowdsourcing tool, how they work as a news source or how helpful can be social media in education. Article also addresses possibilities of crowdfunding. On the other hand, it also deals with the problems, which are present with social media: social media and teenagers, relationship problems, loss of privacy, mental obesity and social media addiction.

1. Introduction

What is social media? Facebook? YouTube? Twitter? WordPress? Foursqare? Wikipedia? Amazon? On-line games? All or none of above? Are social media good or bad? Why? Those are the questions this conference section and its keynote paper try to answer.

As social media continue to evolve and develop, their use change and expand, so does the definition of social media (Xiang & Gretzel, 2010). In general, the term social media relates to the technology and platforms that enable the interactive web's[5] content creation, collaboration and exchange by public participants. Wikipedia, itself being one of the leading social media reference source, defines Social media as "media for social interaction, using highly accessible and scalable communication techniques. Social media is the use of web-based and mobile technologies to turn communication into interactive dialogue." While Social Media is the platform/tool, the act of connecting on social media platforms is called social networking. (Kaplan & Haenlein, 2010)

The interaction can be achieved on many different platforms that enable user to engage, to participate in, comment on and create content as means of communicating with their social graph, other users and the public. There are following main social media characteristics (Cohen, 2011):

- Social media encompass wide variety of content formats including hypertext, video, photographs, audio, PDF. Social media usually allow multiple-content-format alternatives.

[5] Term web is here understood as a network, not just world-wide-web. Social media lately reached out of WWW and their principles are being used on other platforms, such as mobile applications and games.

- Social media allow interactions to cross one or more platforms through social sharing, e-mail and RSS feeds. Content is being re-used, re-mixed, re-created.
- Social media allow different levels of engagement. Participants can create, comment or just lurk on social media networks.
- Social media enhance speed and breadth of information dissemination.
- Social media allow one-to-one, one-to-many, many-to-one and many-to-many communications. Wide range many-to-many communication is a newest form, which is unique for social media, it was unachievable before.
- Social media enable communication to take place both in real time or asynchronously over time.
- Social media is device indifferent. It can take place via a computer (including laptops and netbooks), tablets (including iPads, iTouch and others) and mobile phones (particularly smartphones);
- Social media extend engagement by creating real-time on-line events, extending on-line interactions offline, or augmenting live events on-line.

2. The good

While there are inherent risks and potential threats in on-line social networking (see chapter 3 a 4), let's start with potential benefits. Social media can provide opportunities for new relationships, as well as strengthening existing relationships, improve social capital and enlarge collective awareness – social networks facilitate open communication, leading to enhanced information discovery and delivery. Social media can be used for collective thinking (harnessing wisdom of the crowds) and also can be very useful tool to support democracy and public awareness. Lastly, social networks can be successfully used in educational process (Pavlicek, 2013).

2.1. Social media and relationships

It is quite iconical, that social media, as we know it, started in 1995 with server clasmates.com as a tool to map and keep existing social relationships of former alumni. Same development can be traced in Czech Republic, where the similar server was called spoluzaci.cz and Russia with the site odnoklassniki.ru. Later on situation developed and social networks were used to keep in touch with family members, friends, acquaintances. It became much easier to stay in touch with wider family circle through the use of on-line social networking. By sharing updates, photos, videos, and messages, family members can stay connected even if they live across the country—or the world. And of course, it is no necessary to just stay in the boundaries of current social network; social networking can lead to expanding the connections, meeting new people and improving social capital.

2.2. Social media and information discovery

Shining example how social media are used for information sharing and discovery is Wikipedia – free collaboratively edited, multilingual, internet encyclopedia. Its 30 million articles were written collaboratively by volunteers all around the world. Wikipedia is the largest and the most popular general reference work humankind ever created, ranking as 7th most visited website (as of Alexa.com in June 2013), and having an estimated 365 million readers worldwide.

Wikipedia abandoned former expert-driven style of encyclopedia building and relies on on-line collaboration and interaction of millions of unacademic authors. Wikipedia is based on open-source software (Oskrdal, 2009), therefore not just its content, but also its technology is open for general public to use.

The open nature of Wikipedia has led to various concerns, such as the quality of writing, the amount of vandalism and the accuracy of information. However, investigation of Nature (Giles, 2005) magazine proved that the science articles they compared came close to the level of accuracy of Encyclopædia Britannica and had a similar rate of "serious errors".

Wikipedia has also been praised as a news source due to articles related to breaking news often being rapidly updated. It turns out, that traditional print media (newspapers, magazines) are being replaced by on-line media and social media as a source of information about the word. As proved by original survey (Ischia, Pavlicek, 2012), behavior and habits of social networks users have changed. Newspaper and magazines use social media as a crowdsourcing networks.

2.3. Social media as a crowdsourcing tool

Brabham (2008) defines crowdsourcing as an on-line, distributed problem-solving and production model – the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an on-line community, rather than from traditional employees or suppliers. Wired magazine in its June 2006 issue have summarized term crowdsourcing as follows: "Simply defined, crowdsourcing represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer-production (when the job is performed collaboratively), but is also often undertaken by sole individuals. The crucial prerequisite is the use of the open call format and the large network of potential laborers."

Frequent question is, what motivates the crowd to collaborate. Intrinsic motivations usually use the fun and enjoyment that the contributor experiences through participation, social contact or intellectual stimulation. There could be also community-based motivations, such as community identification. Very powerful form of social motivation is prestige or status.

Extrinsic motivations for participation could be based on immediate or delayed payoffs. Either through monetary payments given to those who complete tasks or through benefits that can be used to generate future advantages, such as training skills and being noticed by potential employers. There are also social motivations, such as the rewards of behaving pro-socially, but most often, participants have altruistic motivation.

Current major approaches to the crowdsourcing are: crowdvoting, wisdom of the crowd, crowdfunding, microwork, crowdsearching, creative crowdsourcing and sometimes even inducement prize contests.

Examples of successfully crowdsourced projects are:

- reCAPTCHA uses CAPTCHA to help digitize the text of books while protecting websites from bots attempting to access restricted areas. Humans are presented images of the book, and asked to provide the corresponding text. Twenty years of The New York Times have already been digitized in this way.
- Facebook has used crowdsourcing since 2008 to create different language versions of its site. The company claims this method offers the advantage of providing site versions that are more compatible with local cultures.

- OpenStreetMap is a free editable map of the world, which had over 100,000 signed up contributors. Creation and maintenance of geospatial data is a labor intensive task which is expensive using traditional approaches, and crowdsourcing is also being used by commercial companies in this area including Google and TomTom.
- Wikipedia is often cited as a successful example of crowdsourcing, despite objections by its co-founder Jimmy Wales to the term.
- X-Prize is an innovation incentive prize using crowdsourcing mechanisms in order to tackle grand challenges that are considered failing as free markets.

2.4. Social media and Crowdfunding

Crowdfunding is the process of funding projects by a multitude of people contributing a small amount in order to attain a certain monetary goal. It is the collective effort of individuals who network and pool their money, usually on-line, to support efforts initiated by other people or organizations. Terms crowd-sourced fundraising or crowd financing are sometimes used as well.

Crowdfunding usually asks from small amounts of capital from a large number of individuals in order to finance a new business venture. Crowdfunding makes use of the easy accessibility of vast networks of friends, family and colleagues through social media to get the word out about a new business and attract investors. Crowdfunding has the potential to increase entrepreneurship by expanding the pool of investors from whom funds can be raised beyond the traditional circle of owners, relatives and venture capitalists.

Unlike funds from venture capitalists or angel investors, the money raised through crowdfunding doesn't necessarily buy the lender a share, and there is no guarantee that it will be repaid if the venture is successful. Instead, individuals are asked to make micro investments or donations to causes and ventures they believe in, thus allowing the work to be completed.

Crowdfunding is becoming a common financing method for citizen journalists, social entrepreneurs, activists, open-source software projects, artists, charities and so on. Theoretically, it lies just between investing and donating, but the amounts are generally small enough that few people expect to see a return from money given to crowdfunded projects. Crowdfunded projects usually take the form of social improvement projects or not-for-profit activities, but some crowdfunding sites are building a framework, where crowdfunding of for-profit ventures can come with an equity stake with potential payoff if the business succeeds.

The biggest website for funding creative projects is Kickstarter. It has raised over $100 million, despite its all-or-nothing model which requires project to reach the proposed monetary goal in order to acquire the money. In the Czech Republic is the most popular crowdfunding platform server HitHit.com, focused on the financing of new ideas, creative projects, publishing music albums, making movies, producing innovative products or design, software development, mobile applications etc. They have raised over 2 million CZK so far, including publication of the book for the famous Czech blogger and Twitter influencer Miloš Čermák.

2.5. Social media as a news source

Social media is replacing traditional journalism as a news source, since people are using Twitter, Facebook and other social media sources to learn about what's happening in the world. Traditional news outlets become increasingly less relevant to the digital generation. Over 50 % of users in USA have learned about some breaking news via social media rather than official news sources.

But the new media allow not just passive, but also active role: killing of Osama Bin Laden, the Hudson River plane landing, LAX airplane crash, Boston marathon massacre — these are just a few of many major news stories ordinary citizens published on Twitter first. Professional journalists use Twitter all the time to announce news quickly before writing up full articles. On-line news now generates more revenue than print newspapers.

But the trend toward internet and social media-based news – and the accompanying rush to be first to report a story – also comes with pitfalls. About a half of news consumers who have received "breaking news" via social media, found out later it was erroneously reported.

2.5.1. Facebook and Twitter difference

As a survey The State of the New Media 2012 (Mitchell, 2013) points out, on Facebook, the news come mostly through family and friends. On Twitter, people tend to get news from a broader mix of recommenders.

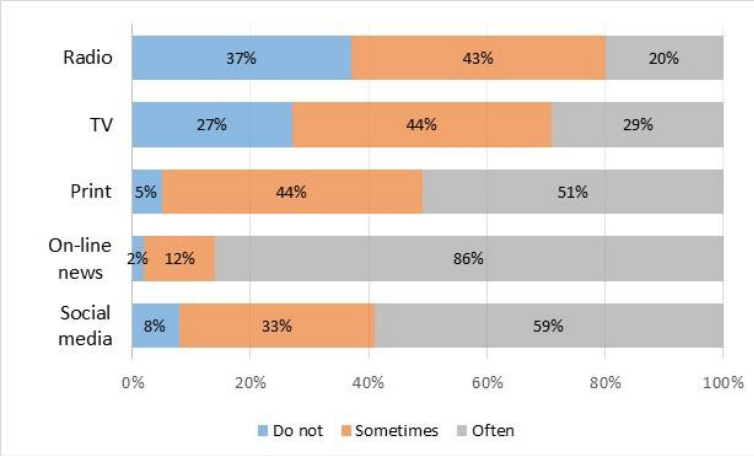
When asked who sends you most of the news stories you read or watch via Facebook, 70% respondents said friends and family. Another 13% get most of their recommendations from news organizations or individual journalists. And 10% said most of the news they looked at from social media came from non-news entities that recommend news stories.

Among Twitter news followers, there is much more of a mix: 36% say they get most of their links from friends and family and while 27% do so from news organizations This group was also almost twice as likely (18% on Twitter vs. 10% on Facebook) to look at news recommended to them by non-news organizations. A greater portion on Twitter, were unsure where most of the news recommendations come from or chose not to answer (19%).

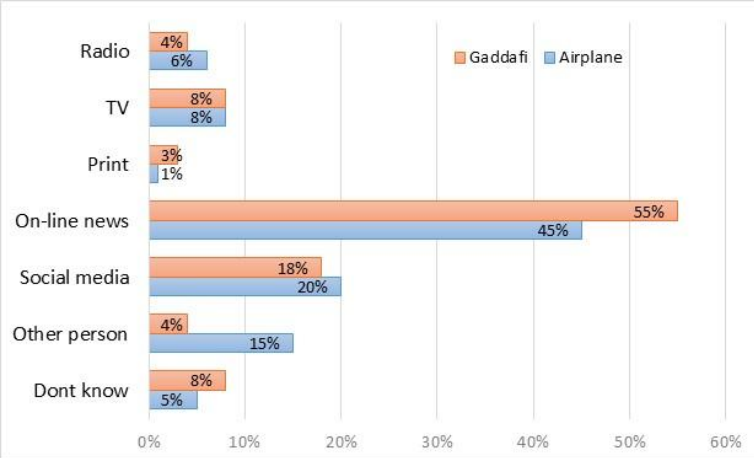
Another finding is that the rise of social media recommendations at this point does not appear to be coming at the expense of people going directly to news sites or searching for news topics they are interested in. Instead, social media news consumption is supplemental. This expanded behavior also explains, why smartphones and tablets do not appear to be replacing computers as much as providing additional ways to get news.

For example, 71% of those who ever follow news links on Facebook also get news by going directly to a news organization’s website or app. Among Twitter news followers, 76% also go to home pages or use apps from a news organization. Similarly 65% of Facebook news users get news via key word search, as do 69% of Twitter news users.

Similar research, focused on print media market, on-line news and social media, have been done also by the author of this paper (Ischia, Pavlicek, 2012). We studied behavior and habits of social networks users and analyzed how Czech newspaper and magazines use social networks. The results proved, that even in Czech Republic people shift to on-line news and social media to get their news (see Graph 1), which was confirmed when we asked them where they learned about the death of Muammar Gaddafi and Yaroslavl airplane crash (see Graph 2).



Graph 1: Where do you get the news from? Source: Ischia, Pavlicek (2012)



Graph 2: How did you learn about recent news? Source: Ischia, Pavlicek (2012)

2.6. Social media in education

Social networking is becoming increasingly important in schools as well – Facebook, Moodle, Digg and other sites are often used by teachers to communicate with students or for out-of-classroom discussions. Some universities have even social media sites just for students, typical example being borec.vse.cz at University of Economics, Prague, even thou such ad-hoc projects are being replaced by universal social site like Facebook (official Facebook page of my faculty has over two thousand likes, almost half of its students and faculty members).

Youth can further explore topics that they're interested in through on-line social networking. By making connections with other people who have the same interests, students can learn and exchange knowledge with others they may not have had the opportunity to interact with.

Teachers can take advantage of students' social networking abilities to create class blogs, discussion forums or videos. By collaborating with other students and teachers through on-line social networking, students are able to build stronger school communities.

Because social networking – like everything else on-line – is rapidly evolving, students can become more familiar with new and emerging technologies, as well as increase their media literacy through exposure to many different types of on-line media that are shared by their friends (Doucek, et al. 2012).

Students can use social networking to augment their real-world relationships, helping them learn to communicate in many different ways. Social networking is becoming an increasingly important method of communicating in schools and the workplace.

3. The bad

On the other side, social media can be also negative; it can lead to excessive loss of privacy or become even addictive, especially when users are lacking balance in their lives. Excessive texting, tweeting or chatting to the exclusion of other activities like exercise, seeing their friends in person and getting out of the house was observed mainly in teenagers.

3.1. Social media and teenagers

Teenagers are usually early adopters of new technologies and at the same time tend to fell for it. Here are possible troubles of such behavior, as seen by Barbara Greenberg (2013):

- Excessive teen users of ICT technologies are losing the ability to learn about and read social cues. They cannot learn to read non-verbal behavior properly if most of their interacting goes on in the virtual world.
- Part of learning to be a good friend, co-worker, partner is to learn how to cooperate with others. This is not a skill learned on-line.
- On-line activity can lead to exclusive and cliquey behavior.
- Young users have a problem how to deal with free time without staring at screen.
- Social media tend to create excessive drama. This is because positive messages are read as more neutral than they are intended to be; neutral messages are read as more negative as they are intended to be and one can only imagine what happens with messages that are intended to be negative.
- Excessive social media usage can lead to sleep-deprivation due to long hours of the night texting.
- Teens need to learn to be present in the moment. Too often teenagers have eyes on their smartphones when they are in the company of their peers. They lose the ability to interact mindfully in the moment.
- Teenagers are more aggressive and sexual when they feel anonymous and are communicating electronically. Things can get out of hand very quickly with both cyber-bullying and sexuality.

3.2. Loss of privacy

Moreover, direct consequence of social media is loss of privacy in our lives. People tend to overshare information, since it is the essence of social media. Mark Zuckerberg, founder of Facebook, claims that the loss of privacy is a social norm that we have acquired recently and that it is only normal for everyone to know everything what others are doing. At least such was his response to complaints about some privacy features removed from Facebook. City, gender and profile picture information were private before – now these demographics are considered to be public information and are shared with everyone (iCare Consulting, 2011).

But social media can be also a way to spread gossip, harmful misinformation, and further abuse. There is no way to really check for what is happening with a photo or video, except through user voting and reports. Employers have recently started checking their employees and candidate employees Facebook pages for opinions, habits and other subjects that could make them reconsider hiring or continue employment (Huffingtonpost, 2011). This means that personal data leaks are all the more dangerous.

Employers' looking through their employee's pages or data also has a negative impact as they will have access to the most intimate personal data, what their friends are like. Not only are employees responsible for keeping their opinions out of their statuses, they are also judged by who they are friends with, needing to clean up or delete friends' comments and posts on their pages. (Bohmova, Malinova, 2013)

If a major exploit is ever found that allowed anyone to see anything posted or otherwise told on any media site, it would have huge repercussions for both the users and the network's good status. Privacy is shrinking together with inhibition against sharing even the most private things, which is leading to a whole market based on user data.

And even if the tight private settings in social media profile would prevent friends, employers and general public to access user's data, the owner of the social media site still has access to them anyway. This is the real reason, why Facebook is so valuable, why Google tries so hard to promote his own social network G+ and why Twitter was able to operate for 5 years with loss – the real value of social media lies in the ability to scan and monitor social capital of their users and use it for targeted advertisement. Big brother is watching you.

4. The ugly

And things can get even worse than pictured in previous chapter. A study by Relationships Victoria (2011) has found that social media can cause problems in some relationships, can lead to mental obesity and addiction.

4.1. Relationship problems

Sixty percent of Facebook users list themselves as being in some sort of relationship. 37 % are listed as single, 31 % married, 24 % "in a relationship," 5 % engaged, and 3 % claim "it's complicated." Facebook has changed dating for the worse. Facebook causes people in relationships to overanalyze their partner's on-line activity, fuel jealousy, and every relationship mistake is kept on record and public.

Sociologists and psychologists have been exploring the impact of social networking on real-world relationships, especially marriage, and some have questioned whether excessive use of social media could play a role in divorce. However Wall Street Journal (Bialik, 2011) debunked reports that 1 in 5 marriages were ruined by Facebook, noting that there appeared to be no scientific evidence supporting such data.

Once upon a time, breaking up with someone over the phone or email was considered rude. Now, changing one's relationship status on social media has become common way to end a relationship. A quarter of Facebook users reported, that found out their relationships were over by seeing it on Facebook first. Good rule of thumb therefore should be: couples should always evaluate what they post in cyberspace and how much of their relationships they really want exposed to the public and do not air out "dirty laundry".

4.2. Mental obesity

Polgar (2012) claims that all the inane information we ingest on a daily basis is making it harder to concentrate, be reflective, and think critically. In other words, our smart phones are making us stupid.

Digital era (full text search engines + fast and limitless internet) gave us the ability to research anything and everything, with so little effort. So general assumption is that it would increase our ability to learn but, actually, it does just the opposite. This avalanche of knowledge has made us constantly consume rather than digest information. Polgar points out that he has students who can't begin writing research papers because they can't stop researching. They think "the next article will be better" or they get distracted and off track. The process of learning has gone from fine dining to fast food. It's all super-sized and empty calories, therefore he comes with the term "mental obesity" – as an analogy that access to endless information is like overeating. It turns out, that overexposure to high volumes of useless information could even impact on the level of happiness. Symptoms of mental obesity could be likened to anxiety, depression and stress.

Polgar says, that "…We communicate through texts, share our lives in 140 characters or less on Twitter, and have "friends" on Facebook we have never met. Shallow doesn't even begin to cover how students relate to one another. Critical thinking has become collateral damage of the age of information. We have become so scatterbrained, it's a wonder we can even find our iPads or remember our passwords…".

4.3. Social media addiction

Although there's no official medical recognition of social media addiction as a disease or disorder, still, the cluster of behaviors associated with heavy or excessive use of social media has become the subject of much discussion and research.

Addiction is defined as compulsive behavior with negative effects. Addicts feel compelled to do certain activities so often that they become a harmful habit, which then interferes with other important activities such as work, school or family.

In that context, a social media addict could be considered someone with a compulsion to use social media to excess – constantly checking Facebook status updates or "stalking" people's profiles, tweeting all the time, etc...

Harvard University researchers Diana Tamir and Jason Mitchell (2012) actually took MRI brain scan to see what happens when people talk about themselves, which is a key part of what people do in social media. They found that self-disclosure communication stimulates the brain's pleasure centers much like sex and food do.

Researchers at Chicago University (Hofmann et al, 2012) concluded that social media addiction can be stronger than addiction to some mild drugs, following an experiment in which they recorded the cravings of several hundred people for several weeks. Media cravings ranked ahead of cravings for cigarettes and alcohol.

Sherry Turkle, a researcher at the MIT in her book, Alone Together: Why We Expect More from Technology and Less from Each Other chronicles some of the negative impacts of constantly being connected by technology, which paradoxically can leave people feeling more alone.

Excessive use of social media may simply be the latest form of "Internet Addiction Disorder," a phenomenon first mentioned in the 1990s when internet use started to spread. Even back then,

people theorized that heavy use of the internet might impair performance at work, in school and in family relationships.

Social media addict fears disconnection, switching off social media is a terrifying ordeal, get anxious when not using social media. Addiction can be developed to Twitter, Facebook, LinkedIn and Instagram, or generally any on-line service - addicts even say they rely on social media to stay connected with friends and family.

4.3.1. Addiction in South Korea

One of the worst examples of such addiction was recorded in South Korea, where a couple let their baby starve to death, while they played on-line game bringing up a VIRTUAL child (Daily Mail, 2011). South Korea – nation considered one of the world's most technologically wired – admits to have 2 million “internet addicts” (out of 50 million citizens). The South Korean government admits that 1 in 5 of their high school students are addicted to mobile phones and smartphones, while defining addiction as "spending more than seven hours a day using the phone and experiencing symptoms such as anxiety, insomnia and depression when cut off from the device." The government had to come with plans to provide nationwide counseling programs for teenagers by the end of year 2013, to help them deal with their addictions.

5. Conclusion

The paper summarized both positive and negative aspects of social media. It is not easy to come with straightforward conclusion, saying that social media are good or that they are bad and should be banned or controlled. There are definitely positive aspects, which enrich our live and make it easier, comfortable and more interesting. Social media can really help not just individuals, but also in creating more open, democratic and participative society. The possibility is right there.

However, on the other hand, this new phenomenon brings up some very serious issues and opens questions we have not found answers for, yet. Mental obesity, social media addiction, loss of privacy, cyber-bullying, those are all problems, which we have to deal with. As with every new technology, we just have to learn, how to live with it and make the best out of it, because, once the technology is invented, it is here to stay.

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References

Bohmova, L. & Malinova L. (2013). Facebook User’s Privacy in Recruitment Process In: IDIMT-2013 Information Technology, Human Values, Innovation and Economy. Linz: Trauner Verlag, 2013

Bialik, C. (2011). Irreconcilable Claim: Facebook Causes 1 in 5 Divorces. The Wall Street Journal, March 12, 2011, http://online.wsj.com/article/SB10001424052748703597804576194563288753204.html

Brabham, Daren (2008). "Crowdsourcing as a Model for Problem Solving: An Introduction and Cases", Convergence: The International Journal of Research into New Media Technologies 14 (1): 75–90

Businesswire.com (2010). Social Shopping Study Reveals Changes in Consumers’ Online Shopping Habits and Usage of Customer Reviews (on-line, accessed June 2013) http://www.businesswire.com/news/home /20100503005110/en/2010-Social-Shopping-Study-Reveals-Consumers%E2%80%99-Online

Cohen, H. (2011). 30 Social Media Definitions (on-line, accessed June 2013) http://heidicohen.com/social-media-definition/,

Daily Mail (2010). South Korean couple let their baby starve to death (as they played online game bringing up a VIRTUAL child). (on-line, accessed June 2013) http://www.dailymail.co.uk/news/article-1282217/South-Korean-couple-let-baby-starve-death-played-online-game-bringing-VIRTUAL-child.html#ixzz2aPTgoONY

Doucek, P. Maryška, M. & Novotny, O. Requirements on the competence of ICT managers and their coverage by the educational system – experience in the Czech Republic. Journal of Business Economics and Management [online], 2012, roč. 0, č. 0, s. 1–24. ISSN 1611-1699. URL: http://www.tandfonline.com/doi/pdf/10.3846/16111699.2012.658436.

Giles, J. (2005). Internet encyclopedias go head to head. Nature 438 (7070): 900–901. Bibcode: 2005Natur.438..900G. doi: 10.1038/438900a. PMID 16355180.

Greenberg, B. (2013). 8 Problems with Teens and Social Media, (on-line, accessed June 2013) http://www.huffingtonpost.com/barbara-greenberg/8-problems-with-teens-social-media_b_3472816.html

Hofmann, W. Baumeister, R. F., Foerster, G., & Vohs, K. (2012). Everyday temptations: An experience sampling study of desire, conflict, and self-control, Journal of Personality and Social Psychology, 102, 1318-1335. Available at https://csom.umn.edu/marketinginstitute/research/documents/Vohs_EverydayTemptations_2012.pdf

Huffingtonpost.com (2011) 13 Controversial Facebook Firings (on-line, accessed June 2013) http://www.huffingtonpost.com/2011/10/17/facebook-firings_n_1003789.html

iCare Consulting (2011). Social Media And The Loss Of Privacy (on-line, accessed June 2013) http://www.icareconsulting.com/home/tech-blog/2011/10/06/9-social-media-and-the-loss-of-privacy-.html

Ischia, M., & Pavlicek, A. (2012). Tištěná média v prostředí sociálních sítí. ProInflow, 2012, vol 4, num. 1, pp. 1–9. ISSN 1804-2406. (on-line, accessed June 2013) http://pro.inflow.cz/tistena-media-v-prostredi-socialnich-siti.

Kaplan A. M. & Haenlein M. (2010)., Users of the world, unite! The challenges and opportunities of Social Media, Business Horizons, Volume 53, Issue 1, January–February 2010, Pages 59-68, ISSN 0007-6813, http://dx.doi.org/10.1016/j.bushor.2009.09.003. Available at http://www.sciencedirect.com/science/article/pii/S0007681309001232

Mitchell A., & Rosenstiel, T. (2012). What Facebook and Twitter Mean for News, The State of the News Media 2012, (on-line, accessed June 2013) http://stateofthemedia.org/2012/mobile-devices-and-news-consumption-some-good-signs-for-journalism/what-facebook-and-twitter-mean-for-news/

Oskrdal, V. (2009). Sharing Knowledge: Using Opens Source Methodologies in IT Projects. In: IDIMT-2009 System and Humans – A Complex Relationship. Linz: Trauner Verlag universitat, 2009, pp. 399–408. ISBN 978-3-85499-624-8.

Pavlicek, A. (2013). Possibilities of social networks in education. SMIS 2013, Strategic Management and its Support by Information Systems, in print

Polgar, D. R. (2012) Wisdom in the Age of Twitter, Amazon Kindle book (e-book), ASIN: B009EZ4J18

Tamir, D. I. & Mitchell J.P. (2012). Disclosing information about the self is intrinsically rewarding, PNAS, vol 109, no 21, DOI: 10.1073/pnas.1202129109, available at http://wjh.harvard.edu/~dtamir/Tamir-PNAS-2012.pdf

Xiang Z. & Gretzel U. (2010). Role of social media in online travel information search, Tourism Management, Volume 31, Issue 2, April 2010, Pages 179-188, ISSN 0261-5177, http://dx.doi.org/10.1016/j.tourman.2009.02.016. (Available at http://www.sciencedirect.com/science/article/pii/S0261517709000387)

ESCAPIST MOTIVES FOR PLAYING FACEBOOK GAMES: FINE-TUNING CONSTRUCTS

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Facebook games, escapism, quantitative research

Abstract

Facebook games became a phenomenon. There are no longer only big players like Zynga with multitude of games but even smaller ones like Bratislava-base Pixel Federation with TrainStation, Emporea, and Diggy's Adventure. Escapist motives are an important reason for playing Facebook games. The aim of this paper is to analyze if it is possible to create more than one construct from existing statements used for escapist constructs used in previously published papers, and to estimate internal consistency of the identified constructs.

1. Introduction

Facebook games are not a domain of only young and predominantly male players. Actually, middle-aged players constitute the majority Facebook game players. (This may be by design, since these people are more likely to have some extra money to pay for virtual goods.) And some Facebook games are played mostly by female players, e.g. 65% of Farmville 2 players are women (this may be caused by intentional design and marketing).

There are multiple factors why people play Facebook games. Escapism seems to be one of the most important reasons. The concept of escapism assumes two comparable contexts for our normal daily life and its associated mundane activities such as: work, studies and activities that escape it, such as reading a book, watching movies or playing games (Warmelink, Harteveld, Mayer, 2009).

Escapist motives are the strongest factors leading to on-line game addition (Xu, Turel, Yuan, 2012). Okazaki, Skapa and Grande (2008) found escapist motives to have a significant and positive impact on perceived fun in mobile games. Therefore, this papers focuses specifically on escapist motives in Facebook gaming.

The aim of this paper is to test whether it is possible to create more than one construct for escapism based on scales used by Warmelink, Harteveld, Mayer (2009) and Okazaki, Skapa and Grande (2008).

The paper is structured as follows: The second section describes the research methodology and data. The third section presents the data analysis and a discussion of results. The fourth section discusses conclusions and directions for future research.

2. Data and methodology

Data were collected using an e-online questionnaire. KwikSurveys.com was used because of the connotation. The author believes that it is better to imply that filling in the survey takes only a short time (that is certainly true for a questionnaire with 11 questions) than to imply that respondents are survey monkeys.

The survey was carried out in spring semester 2012. KwikSurveys.com was hacked then in early July 2012, and all surveys were deleted. Therefore, it is not possible to provide a working link to the on-line questionnaire anymore.

There were 93 respondents (62 from Slovakia and 31 from Denmark). Respondents were students from the University of Economics Bratislava, IT University of Copenhagen, and Aarhus University. The rational for using students in the survey was the fact that majority of similar studies are conducted on students, so it is necessary to test scales also on students.

The questionnaire contained 11 questions. The first nine of them were statements. So the survey fulfils Nunnally and Bernstein's (1994) rule of thumb that states that the minimal number of observations required is 10 times the number of statements.

Respondents were asked "To what extent do you agree with the following statements?" on 1-5 Likert scale (1 = strongly agree, 5 = strongly disagree). The first five statements were:

1. People play Facebook games in order to get away from it all.

2. Playing Facebook games makes people feel that they are in another world.

3. When people play Facebook games, they get so involved that they forget everything else.

4. While people play Facebook games, they truly feel that they are escaping from reality.

5. In general, people think that Facebook gaming is a good way to change their mood.

These five statements were based on Okazaki, Skapa and Grande's (2008) statements (who claimed to had adapted them from (Mathwick, Malhotra, Rigdon, 2001) and (Voss, Spangenberg, Grohmann, 2003):

- Playing mobile games gets me away from it all.
- Playing mobile games makes me feel that I am in another world.
- When I play mobile games, I get so involved that I forget everything else.
- While I play mobile games, I truly feel that I am escaping from reality.
- In general, mobile gaming is a good way to change my mood.

Okazaki, Skapa and Grande (2008), eventually, did not use the first and the last statements in the escapist construct in their paper.

The remaining four statements were:

6. Facebook games help people to „take a break“ from daily activities.

7. Facebook games help people to vent pain, stress, or frustration.

8. Facebook games help people to feel good.

9. Facebook games allow people to experience an alternative reality.

These four statements were based on Sudzina and Razmerita's (2012) statements (which had been based on (Warmelink, Harteveld, Mayer, 2009)):

- They helped me to „take a break“ from daily activities.
- They helped me to vent pain, stress, or frustration.
- They helped me to feel good.
- They allowed me to experience an alternative reality.

The reason for modifying statements in this study was the fact that the original statements implied that the user currently plays (or at least played in the past) games. But according to Sudzina and Razmerita's (2012) findings, as of early 2011, over 40% of students never had played Facebook games. Therefore, it is important to design statements which could be used also for non-players.

The penultimate question of the questionnaire was gender. There were 49 men and 44 women in the sample.

The final question was "Do you play Facebook games?". The options were

- Yes, I do.
- I did but I do not anymore.
- I never did.

In the sample, there were 14 respondents who currently played Facebook games, 45 respondents who used to play Facebook games but did not play at the time when the survey was carried out, and 34 respondents never played Facebook games. The percentage of respondents, who never played games as of early 2012, 36.6%, was lower than Sudzina and Razmerita's (2012) 40.9% as of early 2011. On one hand, it could be expected that some additional people, who never played Facebook games, tried them out in the year in between the surveys. On the other hand, this difference is not statistically significant.

Principal component analysis with Varimax rotation is used to identify constructs in the next section. Cronbach's alpha is used to evaluate internal consistency of the constructs. Pearson product-moment correlation coefficients are used to measure correlations.

3. Results and discussion

The correlation matrix of the questionnaire statements is provided in Table 1. Due to length of statements, statements are mentioned only using their order number from the previous section.

Statement	1	2	3	4	5	6	7	8	9
1	1.000	0.400	0.347	0.600	0.271	0.347	0.271	0.288	0.412
2	0.400	1.000	0.380	0.582	0.084	0.135	0.231	0.136	0.373
3	0.347	0.380	1.000	0.456	0.238	0.261	0.357	0.080	0.373
4	0.600	0.582	0.456	1.000	0.286	0.260	0.329	0.198	0.410
5	0.271	0.084	0.238	0.286	1.000	0.545	0.584	0.548	0.508
6	0.347	0.135	0.261	0.260	0.545	1.000	0.523	0.446	0.319
7	0.271	0.231	0.357	0.329	0.584	0.523	1.000	0.322	0.408
8	0.288	0.136	0.080	0.198	0.548	0.446	0.322	1.000	0.313
9	0.412	0.373	0.373	0.410	0.508	0.319	0.408	0.313	1.000

Table 1: Correlation matrix of questionnaire statements

Despite original concerns about two groups of statements because of similarity of wording, correlations are not, actually, too high.

The first group of statement was about escaping reality to an alternative world:

2. Playing Facebook games makes people feel that they are in another world.

4. While people play Facebook games, they truly feel that they are escaping from reality.

9. Facebook games allow people to experience an alternative reality.

The correlation between the 2nd and the 4th statements is 0.582, the correlation between the 2nd and the 9th statements is 0.373, and the correlation between the 4th and the 9th statements is 0.410.

The second group of statement was about changing mood from bad to good:

5. In general, people think that Facebook gaming is a good way to change their mood.

7. Facebook games help people to vent pain, stress, or frustration.

8. Facebook games help people to feel good.

The correlation between the 5th and the 7the statements is 0.584, the correlation between the 5the and the 8th statements is 0.548, and the correlation between the 7th and the 8the constructs is 0.322.

It is worth mentioning that correlations differ for current and past players between this survey and Sudzina and Razmerita's (2012) survey. The biggest difference is between the following statements:

8. Facebook games help people to feel good. / They helped me to feel good.

9. Facebook games allow people to experience an alternative reality. / They allowed me to experience an alternative reality.

In this survey, the correlation for current and past players is 0.442 while it was only 0.034 in Sudzina and Razmerita's (2012) survey. The second biggest difference is 0.216 vs. 0.030. It is hard to reckon to what extent it is due randomness, change in time or different wording.

Cronbach's alpha for the correlation matrix (Table 1) is 0.829. So it may appear that it makes sense to use all nine statements as one construct. But Bartlett's Test (Phi = 0.373, Log(Det|R|) = -3.248, Bartlett Test = 286.39, DF=36, p-value) shows that it makes sense to create more than one construct from the nine statements. Table 2 contains Eigen values.

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	3.810	42.334	42.334
2	1.555	17.278	59.612
3	0.813	9.035	68.647
4	0.676	7.509	76.156
5	0.570	6.328	82.484
6	0.525	5.838	88.321
7	0.444	4.938	93.259
8	0.351	3.903	97.162
9	0.255	2.838	100.000

Table 2: Total variance explained

There are two Eigen values higher than 1.0 in Table 2, so it makes sense to create two constructs from the nine statements. Table 3 shows to what extent are the statements correlated to either of the constructs

Statement	Component	
	1	2
1	0.249	0.696
2	-0.021	0.805
3	0.178	0.660
4	0.167	0.836
5	0.870	0.118
6	0.745	0.176
7	0.702	0.281
8	0.732	0.038
9	0.494	0.515

Table 3: Rotated component matrix

The first construct consists of statements 5-8:

5. In general, people think that Facebook gaming is a good way to change their mood.

6. Facebook games help people to „take a break“ from daily activities.

7. Facebook games help people to vent pain, stress, or frustration.

8. Facebook games help people to feel good.

For the first construct, Cronbach's alpha 0.793 is for all respondents, 0.734 for current and past players, and 0.822 for non-players.

It is worth mentioning here that if there were far more statements in the study, it is possible to expect that the 6th statement would not belong to the first (neither to the second) construct. Griffiths (2010) mentions two independent underlying motives for playing games - killing time, and

escaping from existing problems. The 6th statement is, actually, about killing time, while all the remaining eight statements are rather about escaping from existing problems.

The second construct consists of statements 1-4 and 9:

1. People play Facebook games in order to get away from it all.

2. Playing Facebook games makes people feel that they are in another world.

3. When people play Facebook games, they get so involved that they forget everything else.

4. While people play Facebook games, they truly feel that they are escaping from reality.

9. Facebook games allow people to experience an alternative reality.

For the second construct, Cronbach's alpha 0.789 is for all respondents, 0.758 for current and past players, and 0.806 for non-players.

Since the 9th statements are almost equally correlated also to the fist construct, it may make sense to leave it out in order to make the two constructs as independent as possible.

For the second construct consisting only of statements 1-4, Cronbach's alpha 0.770 is for all respondents, 0.788 for current and past players, and 0.796 for non-players.

To sum up, Cronbach's alpha of the identified constructs is above 0.7 regardless whether the statements are administered to current and past players or non-players, so these constructs are suitable for partial least squares and structural equations models.

4. Conclusions

The aim of this paper was to check if it is possible to create more than one construct for escapism based on scales used by Warmelink, Harteveld, Mayer (2009) and Okazaki, Skapa and Grande (2008) with the application for Facebook gaming. Respondents included current players, former players, and non-players. The reason for inclusion of respondents with varying experience with Facebook gaming was two-fold: (1) often, there is a need to use the same research instrument for all respondents (e.g. because it is administered on paper), and (2) many researchers include even non-players in their partial least square/structural equation models.

Based on the analysis, two escapist constructs with Cronbach's alphas over 0.7 were identified in this study. The first construct is mostly related to mood and consists of the following statements:

- In general, people think that Facebook gaming is a good way to change their mood.
- Facebook games help people to „take a break“ from daily activities.
- Facebook games help people to vent pain, stress, or frustration.
- Facebook games help people to feel good.

The second construct is mostly related to escaping reality and consists of the following statements:

- People play Facebook games in order to get away from it all.
- Playing Facebook games makes people feel that they are in another world.
- When people play Facebook games, they get so involved that they forget everything else.
- While people play Facebook games, they truly feel that they are escaping from reality.

- Facebook games allow people to experience an alternative reality.

It may be advisable to leave out the last statement in case as high independence as possible of the constructs is desired.

With regards to the future research, it would make sense to replicate the research and add other escapist statements based e.g. on (Xu, Turel, Yuan, 2012) or (Lee, Lee, Choi, 2012). Xu, Turel and Yuan's (2012) statements are:

- I usually play games so I can avoid thinking about some of real-life problems or worries.
- I usually play games in order to relax from the day's work or study stress.
- I often use game playing to escape from real world problems.
- I often use game playing to alleviate my depression.

Preferably, they should be rephrased - "people" should be used instead of "I" - so the wording is as similar to the existing nine statements as possible. It is probable that Xu, Turel and Yuan's (2012) second and fourth statements will highly correlate with the first construct because they refer to mood. It is possible that Xu, Turel and Yuan's (2012) first and third statements will correlate with the second construct because they refer to escaping reality. It is hard to estimate what effect omitting „usually" and „often" would have on the answers.

Lee, Lee and Choi's (2012) statements are:

- Because playing it gives me something to occupy my time
- When I have nothing better to do
- When I am bored
- Because playing it passes the time away
- So I can get away from what I am doing
- So I can forget about school, work or other things

They are formulated in a different manner than previously mentioned statements, so some changes in wording will be required. Since these statements refer also to other things than just mood change and escaping reality, it is possible that an additional construct related to Griffiths' (2010) "killing time" may arise.

It is worth to mention that there exist also articles that include escapist statements but it is not clearly stated which of statements are related to escapism, such as in (Floros, Siomos, 2012).

References

Floros, G., & Siomos, K. (2012). Patterns of choices on video game genres and internet addiction. Cyberpsychology Behavior and Social Networking, 15(8), 417-424.

Griffiths, M.D. (2010). The role of context in online gaming excess and addiction: Some case study evidence. International Journal of Mental Health and Addiction, 8(1), 119-125.

Lee, J., Lee, M., & Choi, I.H. (2012). Social network games uncovered: motivations and their attitudinal and behavioral outcomes. Cyberpsychology Behavior and Social Networking, 15(12), 643-648.

Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: conceptualization, measurement and application in the catalogue and Internet shopping environment. Journal of Retailing, 77(1), 39-56.

Nunnally, J.C., & Bernstein, I.H. (1994). Psychometric Theory, 3rd edition, McGraw-Hill, New York, ISBN 0-07-0478849-X

Okazaki, S., Skapa, R., & Grande, I. (2008). Capturing global youth: Mobile gaming in the U. S., Spain, and the Czech Republic. Journal of Computer-Mediated Communication, 13(4), 827-855.

Sudzina, F., & Razmerita, L. (2012). Escapist motives for playing on-line games: Preliminary results from an exploratory survey. In 25th Bled eConference eDependability: Reliable and Trustworthy eStructures, eProcesses, eOperations and eServices for the Future. Bled, 497-511, ISBN 978-961-232-256-4

Voss, K.E., Spangenberg, E.R., & Grohmann, B. (2003). Measuring the hedonic and utilitarian dimensions of consumer attitude. Journal of Marketing Research, 40(3), 310-320.

Warmelink, H., Harteveld, C., & Mayer, I. (2009). Press Enter or Escape to Play: Deconstructing Escapism in Multiplayer Gaming. In Proceedings of DiGRA 2009: Breaking New Ground: Innovation in Games, Play, Practice and Theory. Brunel University, London.

Xu, Z., Turel, O., & Yuan, Y. (2012). Online game addiction among adolescents: Motivation and prevention factors. European Journal of Information Systems 21(3), 321-340.

FACEBOOK USER'S PRIVACY IN RECRUITMENT PROCESS

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Facebook privacy, information on Facebook, recruiting process, social networks, human resources

Abstract

The paper is focused on the important topic of sharing information with all Facebook users. In our research we went through user profiles and collected data that they provide. We have found out surprising facts. One of them is that users are not aware of possible information abuse. In this paper we focus on information that can be used during recruitment process. The paper explores the kind of data the people present in their profile in Facebook as public information. Another focus of the paper is the use of this public information by the recruiters. The objective is to find out how the data presented publicly in the Facebook profile can influence the recruitment process and the decision about hiring new employees.

1. Introduction

Facebook is the largest social network with over a billion users, making it world's biggest database. In the Czech Republic there are more than 3 million users of Facebook, almost 61% of internet users in the country (Vance, 2012).

Traditionally, a recruiter's options for seeking new candidates have been newspaper ads, purchasing database from external sources, using on-line job boards, or asking hiring professionals to headhunt the appropriate candidates. Social media websites like Facebook and LinkedIn have come to the labour market, and are growing more and more in the area of recruitment. There are frequent situations, when the employer has to make decision. (Doucek, Maryška, Novotný, 2012) For example: Having in the final round of interviews four candidates with very similar professional experience. The employer could use social media to check the profiles of candidates. The recruiter can find out if they are responsible and loyal persons, if they said correct information during interviews, how other people react on their comments or if they are friendly etc. There are many aspects that can be discovered, in the recruiting process on social media. If the user of social networks knows how to work with them, they could be very helpful when looking for a new job. On the other hand, social networks can be also very dangerous for their users. (Sunshine, 2011)

The effort of using social networks in recruitment process is still increasing. In 2009, 45% of employers reported in the survey of CareerBuilder[6] that they use social networking sites to screen potential employees. In comparison to 2008, there were participating only 22% of employers. (Haefner, 2009)

This article summarizes what information people publish about themselves in Facebook as public (for other Facebook users - not friends of friend). And how HR can use this information in the process of recruiting.

2. Research/methods

In the first phase of research we went through 1400 Facebook profiles of users from different Facebook groups. We were focused on information which is public for other Facebook users (not friends of friend). The data were collected by students of courses focused on New Media. More than 20 students were involved in the research. They collected the data based on the selected Facebook groups. The Facebook groups were chosen from different areas in order to keep variety in the dataset. The age of Facebook users in the research was between 18 and 36 from users who have information about the age visible. The research was focused on the users from the Czech Republic. Students during the research used structured Excel file to fill in the publicly visible information in Facebook. With the term "publicly" we understand that is available to all Facebook users. We were interested in the responses on questions, which shows the table below.

1. Can you see more photos not only profile picture?	
2. Is the user profile open to the public (= if you don´t have him/her in Friends)	
3. Can you see posts on the Wall?	
4. Can you see how many friends he/she has?	
5. How many friends does the person have? (number)	
6. Can you see the page that user likes and liked in the past?	
7. If it is available list first three (no duplicates) favorite activities of user in area:	a. Music
	b. Books
	c. Films
	d. Television
	e. Games
	f. Sportsmen
	g. Sport
	h. Activities
	i. Interests
8. If it is available fill in:	a. Where does user live?
	b. Where is user from?
	c. Nationality
	d. When was user born?
	e. Is user in relationship?
	f. Education
	g. Work
	h. Relatives (who)

Table 1: Structure of the questionnaire (Authors, 2013)

[6]More than 2,600 hiring managers participated in the survey.

The second phase of our research was a block of expert structured interviews with top managers of recruitment companies, including Mr. Pavel Hájek, the director of leading personal agency Jobs21.

3. Discussion

3.1. Statistics

We analyzed statistical sample n=1408 Facebook profiles. In Table 2 are correlations for our statistical sample. We focused on public photos, wall information, likes, relationship status, education and work.

3.1.1. Correlations

Within our qualitative research we focused on Spearman's correlation coefficient. As shown in the table below, there are no significant correlations between our parameters. From these results we can say that there is a weak direct dependence between photos and wall visibility. The second and third weak direct dependence are between Relationship status and Education and Work visibility. The last weak direct dependence is between Education and Work visibility.

	Photo	**Wall**	Likes	Relationship	**Education**	**Work**
Photo	1	0,365	0,066	0,110	0,120	0,083
Wall	**0,365**	1	0,127	0,158	0,101	0,105
Likes	0,066	0,127	1	0,117	0,089	0,045
Relationship	0,110	0,158	0,117	1	0,242	0,274
Education	0,120	0,101	0,089	**0,242**	1	0,325
Work	0,083	0,105	0,045	**0,274**	**0,325**	1

Table 2: Correlations of users' publicly visible information (Authors, 2013)

In the terms of our research, we conclude, that from 1400 respondents 62,1% have their profile open for public. These 62% share mostly information about their education, photos and pages that they like. Hardly ever they share information about their relation. For the HR specialists are primarily interesting photos and the groups that people like. That information is sufficient and very useful for the process of recruitment. It can help to decide, whether invite the candidate for personal interview or not.

The content observed	**Yes**
Visibility of education	91,5 %
Visibility of user's photos	62,5 %
Visibility of Liked pages	61,3 %
Visibility of employer	56,9 %
Visibility of list of friends	51,2 %
Visibility of relationship status	29,1 %

Table 3: Questionnaire results (Authors, 2013)

3.1.2. Number of friends

In our sample n=1408 Facebook users, only 705 users have published the number of their Facebook friends. We found out that our average user has on **average 398,5** friends. There is **standard deviation 324,4** and **median 327.**

In the dataset we have normal distribution as can be seen in the histogram below. The peak of normal distribution lies in range 200 and 400. (see Fig. 1)

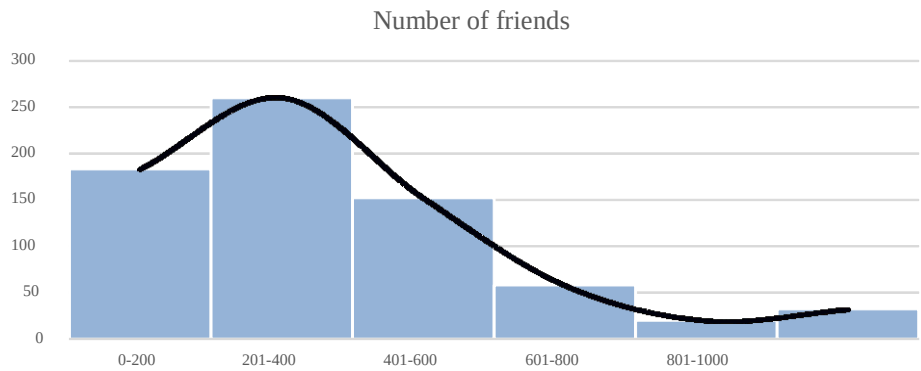

Fig.1: Histogram the Number of friends with normal distribution (Authors, 2013)

Fig. 1 shows that HR specialists see the social surroundings of approximately every second candidate. It is very probable in the number of "friends" that there will be someone from his current or previous job. HR specialist can use them as a reference on the candidate.

3.2. How is the situation seen by HR?

It turns out, that HR specialist regularly use the public information on candidates' Facebook profiles Haefner (2009) proves, that 18% of employers said they found content on social networking sites that encouraged them to hire the candidate.

Recently we could observe the trend and the effort of HR to find new people in social networks, mostly in Facebook. Recruiters are looking for the information about the candidates, who sent CV and applied for a job. The demand for some of interesting positions is enormous. It is impossible to interview personally each candidate. Regarding that fact is necessary to invite for the interview only the most suitable candidates. The choice is made due to a lot of aspects: personal profile, data in the CV, application letter, recommendations from the previous job etc. Facebook screen could be very useful to help the recruiter with the decision of hiring new employee, especially when the difference between the candidates is very narrow.

"HR specialists in Jobs21 are mainly interested in the photos that candidate present in Facebook. We check the candidate's public photos, and then we also screen the candidate's wall." (Hájek, 2013) If the comments are vulgar or critical to the previous employer, it definitely influences the recruitment process. Finally, membership in the groups in Facebook could give HR information about the focus of the person. For example if the recruiters look for the sales manager for the fashion shop, they can find out that fashion is more than only a job for the candidate. Even if in his free time he talks about fashion in specialized groups for fashion fans and professionals. That is a fact that gives extra point to the candidate.

Very revealing is also candidate's music taste. People don't realize it, and the favourite music bands are frequently publicly shared. To prove this point, we focused on first three items, which were visible on users´ profiles. We went through almost 650 entries to prepare snapshot of music

mixture, which our respondents liked most (see Fig. 2) HR specialist can anticipate the candidate's lifestyle, based on the information from the candidate's profile. He can for example find out, if the candidate is focused on one style or fan of many styles.

Fig. 2: Personal preferences of Facebook users in music area (Authors, 2013)

From interviews with top managers of recruitment companies in the Czech Republic we observe a growing interest about the social networks during the process of recruitment. The results of the research indicate that a few candidates were hired due to Facebook screening. The reasons were: creativity observed, high quality communication skills, very good knowledge and interest in the area of position offered, good references from other people in Facebook – could indicate if the person is favourite in the group of people and suitable for a teamwork. The idea of growing importance of social networks in HR is also supported by numerous surveys made in the past years.

3.3. Sharing of content on social networks

The Facebook privacy and information sharing is an increasingly discussed topic. A few years ago privacy wasn't a big point and only a small number of users secured their Facebook profiles. (Pavlíček, Rosický, 2006) Nowadays increasing quantity of people think about the privacy of Facebook and more people think about the possibility of screening their profile during looking for a new job. But majority of job seekers still are doing the opposite and are not mindful at all of the content they're posting online. 45% of employers reported they have found content on social networking sites that caused them not to hire the candidate, see Table 4 (Haefner, 2009):

Candidate posted provocative or inappropriate photographs or information	53%
Candidate posted content about himself drinking or using drugs	44%
Candidate bad-mouthed his/her previous employer, co-workers or clients	35%
Candidate showed poor communication skills	29%
Candidate made discriminatory comments	26%
Candidate lied about qualifications	24%
Candidate shared confidential information from previous employer	20%

Table 4: Why employers disregard candidates after screening online (Haefner, 2009)

Fig. 3 shows that more than 50 % of users have their Wall publicly accessible. This information is very useful for recruiters. They are able to follow user's posts, to see user's or friend's comments, etc. Due to wall information are the recruiters able to imagine the personality of user.

The first rule when you start with social networking is: **not to public your photos**. In our research we found out that more than 70 % of users (no matter in which interval of quantity of friends) published more than profile picture to other Facebook users. (Sengupta, 2013)

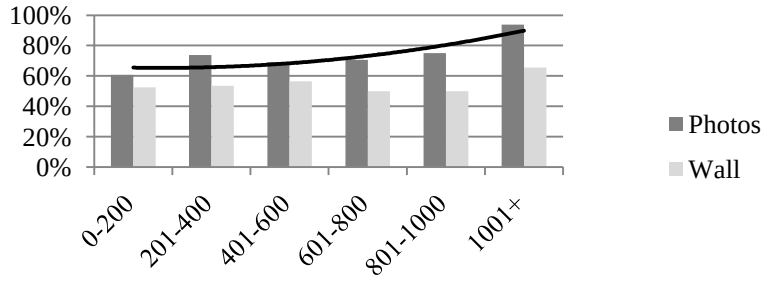

Fig. 3: User's privacy by public Wall and Photos (Authors, 2013)

There is an increasing trend of publishing photos in correlation to number of friends (see Fig. 3). The higher number of friends is the higher percentage of users shared publicly their photos. There is an obvious fact that users with more than 1000 Facebook friends tend to share more information.

In this kind of photos is hidden a threat. Photos are very often added by other users, who tagged user on their photos. The user loses the control of this kind of photos and shares them unconsciously with the rest of Facebook user, which means also with recruiters. (Harvey, Soltren, 2005)

In 2012 we made a survey, see Fig.4. The questionnaire answered 354 HR from the Czech Republic. We analyzed their view on social networks in the process of recruitment.

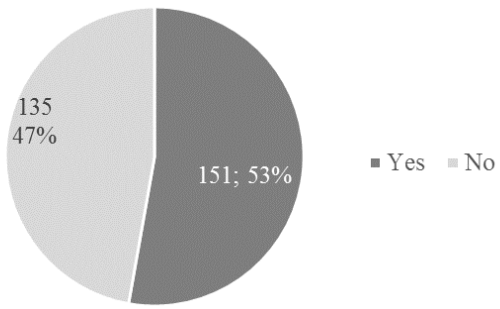

Fig. 4: Do you view the candidate profile on the social network? (Authors, 2012)

The research also indicated that 99% of HR professionals who screen the candidate's profile see the future of social network in recruitment, whether as one of the possible alternatives or to support other methods.

Those who watch the candidate's profile on Facebook are 65% who use actively social networks also personally (daily or at least once a week.)

There are numerous advantages that HR specialists see in using Facebook during the recruitment. One of them is the possibility of viewing the candidate's profile - "digital footprint". (Pavlíček, 2010) Another is a facilitation of recognition of a false CV (easy comparison of professional information in CV with the personal information on the Facebook profile).

We asked Ing. Kamila Riegerová HR specialist in the company AutoCont about the final decision of hiring a new employee. If two final candidates seem to be very similar in a professional way, what influences the decision of hiring one of the finalists? "I use social networks, but I also use the internet. Based on experience with searching, one of the first links appears Facebook and LinkedIn,

so logically HR uses them a lot. Most recruiters are currently using social networks to determine additional information about the candidates. For example, Facebook offers many public photos of people, which can change point of view in the eyes of recruiters, even though the interview with the candidate seemed seriously." (Riegerová, 2011)

4. Conclusion

The social networks are becoming extremely influent in recruitment area. From the data that we have collected and analyzed we could conclude that there is a significant gap between employers and potential employees.

Employers represented by HR specialist discovered very quickly the new space for facilitating the recruitment process. They are using the social networks, for example Facebook, to evaluate better the potential candidates and to choose the best employees. It is clearly shown by the statistic of CareerBuilder (Hafner, 2009) that indicates the numbers of hired and non-hired people influenced by screening social networks. Almost one fifth of the employers inform that social networks content encouraged them to hire the candidate. On the other side more than 45% of employers inform that due to screening internet profile of the candidate, they decide not to hire the person.

On the other hand, job seekers are not well prepared for the new trend. Majority of the people who are looking for a new job do not pay appropriate attention to their internet profile.

Facebook users carelessly publish a lot of personal information. More than 60% show their photos and around 50% of Facebook users, have their wall open for all Facebook users a similar percentage of users show the list of their friends publicly. There is confirmed dependency: The more friends they have the more content they share with all Facebook users. The most frequent information that recruiter could find is the education. Due to our research, more than 90% of Facebook users have the information about their education publicly accessible. There could be two reasons, first is that people do not see education as a delicate kind of information, second is that users could be proud of their previous studies, no matter what level had they reached.

People will not change their behaviour or life-style, but they will see more importance in maintaining the good image in the terms of internet presentation. Candidates would hide the problematic photos, comments and other information, or even they could public in future kind of information that will make up their profile.

We observe the recent situation of HR, using social networks as a "golden era for recruiters". They are step forward in comparison with the job seekers and they could fully benefit from the using the social networks.

Number of Facebook users in the Czech Republic will not grow significantly yet. But the number of people, who will see the importance in making up their own profile in Facebook, would rise quickly. It will lead in the closing the gap between employers and employees. People will hide more their profiles and make them more attractive for the recruiters, so finally the screening in the Facebook profile could become worthless. On the other hand there could by space for Facebook, to sell the publicly hidden information to the recruiters, as the LinkedIn already does.

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References

Doucek, P.; Maryška, M.; Novotný; O. (2012). Requirements of Companies on the Knowledge ICT Specialists for the ICT Administrator Role. 4th World Conference on Educational Sciences (WCES), Univ. Barcelona, Barcelona, Spain; WOS:000314465904105.

Haefner, R. (2009). More Employers Screening Candidates via Social Networking Sites [online]. Available on: http://www.careerbuilder.com/Article/CB-1337-Interview-Tips-More-Employers-Screening-Candidates-via-Social-Networking-Sites?ArticleID=1337&cbRecursionCnt=1

Hájek, P.. Osobní rozhovor. Praha, 10. 3. 2013.

Harvey, J.; Soltren Jose Hiram (2005). Facebook: Threats to Privacy. MIT [online]. Available on: http://groups.csail.mit.edu/mac/classes/6.805/student-papers/fall05-papers/facebook.pdf

McKeon, M. (2010). The Evolution of Privacy on Facebook [online]. Available on: http://mattmckeon.com/facebook-privacy/

Pavlíček, A. (2010). Human Resources in ICT – Information and Technological Literacy as the Qualification Prerequisites. 18th Interdisciplinary Information Management Talks, Jindrichuv Hradec, Czech Republic; WOS:000288345500016.

Pavlíček, A.; Rosický, A. (2006). Information and Internet Change Society: Emerging Constitution of the Social Systems, Internet Society II: Advances in Education, Commerce & Governance, 2nd International Conference on the Internet Society, New Forest, England; WOS:000240047700020.

Riegerová, K.. Osobní rozhovor. Praha, 31. 5. 2011.

Sengupta, S. (2013). Staying Private on the New Facebook [online]. Available on: http://www.nytimes.com/2013/02/07/technology/personaltech/protecting-your-privacy-on-the-new-facebook.html?_r=0

Sunshine, J. (2011). How Companies Use Facebook To Hire And Fire Employees (INFOGRAPHIC) [online]. Available on http://www.huffingtonpost.com/2011/08/04/new-infographic-shows-how-companies-target-unemployed_n_918816.html

Vance, A. (2012). Facebook: The Making of 1 Billion Users. Bloomberg Businessweek Technology [online]. Available on: http://www.businessweek.com/articles/2012-10-04/facebook-the-making-of-1-billion-users

INTERACTION OF SOCIAL MEDIA AND ITS USE IN MARKETING MANAGEMENT

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Keywords

Social media, marketing, management, interaction

Abstract

After introductory presentation of the problem and research in the field of interest (using social media in marketing management) this paper is focused on two important objectives for the company's marketing management in the internet environment. The first one is an application of social media in the marketing management; so that company will be able to record interaction user's services in relation to marketing activities of the company. The second one is the introduction of interactions that occur across social media and the use of this phenomenon in the management of marketing activities. Based on our own research, we propose a default mix of social media, suitable for (global) companies focused on the end customer. The initial mix together with the linking and integration of social media into content of websites gives basic platform for monitoring the users´ interactions in various services in light of the current marketing activities of the company. In conclusion, we discuss the current trends in this area, but also the problems faced by small and medium enterprises in the context of this paper.

1. Introduction

Consequences of the massive application of internet services in the socio-economic environment are an important trend in contemporary perspective on marketing (especially in case of commercial subjects). Higher demands are placed on the management of marketing activities in the internet environment, primarily in the areas of communication and distribution, which further determines the pricing strategy. These are mainly companies focused on end customers that offer their services or products there, where the potential customers are – physically or virtually. The issue of management of marketing activities is even more complex, because the activities not only in the physical world have to be managed, but also to be harmonized with those in the internet environment and vice versa. However, this paper is focused only on activities in the internet environment as the currently important phenomenon.

The internet environment in today's breadth and consequences is a young and very specific area originally created by man, yet so complicated, that the emergence phenomena known from the field of complex systems occur there. At the level of interaction the environment is formed by both

humans and softbots (software robots). In order to facilitate our view of internet environment, we use a particular decomposition – each internet service will be seen as a peculiar world with its own rules and options. These rules also determine for example communications in the service, distribution and pricing strategy, including the actual product mix suitable for this service. Obviously not all internet services are suitable for the application of the full range of marketing mix; some are for example only for promotion. Especially with social media it comes to interactions of their content, which means that one event leads to users´ interaction across different social media.

As it is apparent from the current research by Gartner Company (2013), five most important reasons for investing in social media are:

- Strengthen relationship with customer
- Enhance brand awareness or brand preference
- Share information and ideas with customers, suppliers and partners
- Establish interactive relationship with customers
- Increase my organization's revenue through new products or customers

The current problem with achieving these objectives is illustrated by the statement of Gartner Research Director A. Sarner (2013) when he says: "While investments and growth in social marketing is assured during the next two years, the ultimate success of social will depend on how well marketers can accelerate through the inevitable social expectation bust and make social marketing projects more than just 'engagement' objectives and then actually tie social activities to clear and measurable business objectives. Far too many companies are still following the hype of 'social' and have created or participated in social media without a plan."

Every organization needs a unique plan (due to their specific internal and external factors). The aim of this paper is to present a generally applicable approach using available internet services (tools), particularly social media at the level of integration and subsequent interactions toward synergistic effects. The result is the initial platform over which can be built an individual marketing strategy or provided appropriate data for the successful management of other marketing activities on the internet.

2. Marketing management and social media

Social media became a widely used instrument in the field of marketing and it gains an increasing interest of educational institutions and research studies (a modern trend is the social media marketing). However, the individual services (for example Facebook, Twitter, Google+, YouTube, LinkedIn, Flickr, Yelp, Foursquare, etc.) should be seen from their interaction point of view, not as separately as it is unfortunately often practiced and taught. To use them effectively in order to achieve the objectives of the organization it is necessary to manage them in this (systemic) point of view. This is a challenge for marketing management as a practical application and management of marketing techniques, resources and activities in companies. Lots of authors mention the marketing management before social media boom, and they explain the need to manage the marketing and its processes (for example: Wierenga & Bruggen, 1997; Webster, 2002).

Concerning the media coverage and computerization (Mizik & Jacobson, 2007), the role and importance of social media (in this area) are increasingly examining. Linking of social media, creating attractive content and proactive care for end customers lead to good corporate image,

increase the brand awareness and leads to higher turnover (Andzulis et al., 2012). As an example, the marketing campaigns on social networks should be mentioned, which affect a large number of potential customers, because mainly (ICT-based) social networks are the significant modern phenomenon of today (see Andzulis et al., 2012; Keller & Fay, 2012), in which Facebook (and the „value of a fans“) is now a frequently discussed topic (see Lipsman et al., 2012 or LaPointe, 2012). Social media marketing provides to companies a way of connection with their customers. However, organizations must protect their information as well as closely watch comments and concerns on the social media they use, because numerous online marketing mishap examples occur today.

The involvement of social networks into strategic marketing company delivers clear measurable results (LaPointe, 2012), which may be used effectively. This effectivity depends on the ability of holistic view and interpretation skills (meaning and importance of data, respectively information), not only on knowledge of the tool itself. It's about the ability to use these tools (including their interconnection) and to know “where” and “why” to use them, not only “how” to use them. (Garrigos-Simon et al., 2012) Moreover, the internet environment (as an important medial platform) as such puts new challenges for marketers (more precisely for marketing management), as discussed below.

3. Integration of social media and promotion

The starting point of any commercial subject in the internet environment is its web presentation (can be understood as its virtual reflection or identity). This web site should be well searchable via global search engine and it should be filled with detailed content of individual activities of the company. Before the rise of social media, there were two most used approaches to the promotion of the website, which have been used till today. The first focuses on the search engine through which a person usually finds and accesses other websites. Such techniques include:

- *Search engine optimization* – modifying website for softbots and further processing by search engines in order to achieve a better positions when searching for specific terms
- *Search engine marketing* – direct payment to search engine provider for better placement of reference when searching for specific terms

The second approach includes all kinds of Display advertising, especially banner advertising, where an event is arranged for which a client pay (best known is pay-per-click, etc.). At the level of direct customer relationships there are other methods such as e-mail marketing. Principally it comes to draw the attention of the user and then, if the link is relevant for him; redirects him to the relevant land page or web page of the company. A major drawback of this approach began for example a problem of banner blindness (Owens et al., 2011), or reducing the proportion of conversion of the accessing users and those that will turn into a real customer. Originally simple approaches have to be modified over the years, so that they can be better evaluated with emphasis on measurability (Contextual advertising, Behavioural targeting and other).

In contrast with this social media differently should be used in a different way, despite the fact that some of the older principles and approaches have been in some cases retained (e.g. banner advertising on Facebook). In this perspective, the aim of the company targeting on the end customers is to be there, where the potential customers spend their free time, and then to choose a suitable way to present itself there (attracting attention). (Garrigos-Simon et al., 2012) In the realization of communication campaign through social media the size of the potential audience is of a great importance. Therefore, it may be questionable whether it makes sense for start-up company to use social media if it does not have an initial audience. There still is an argument that every

company should participate in the selected social media of global nature, because the media can be seen as a common communication channel (like e-mail) – or as a standalone world from which the users do not like to go away. The fundamental approach to promotion in this area is to attract, spark the discussion, share user's messages with other users and across services (social media) – or rather to create a buzz, which makes the company or its products visible. (Kabani, 2010, p. 7)

In order to responsibly prepare a marketing strategy and then to manage marketing activities, it is necessary to create an initial mix of social media (most commonly used) and to acquire data about users´ interactions in the services for further evaluation. In this way, we will get initial feedback and on this basis we are able to manage other marketing activities. Only a creating the profile on the selected social media, it is not sufficient, the companies need to link profiles on the social media with website of company to ensure quick two-way passage. In addition to linking the website with social media at link-level it is also appropriate their integration into the content of company website in order to share this content through various media (generally sharing through any media, including those which company does not use). Only such a modified website and profiles created in the world's most widely used social media allows the measuring of user's interaction and getting feedback which is necessary for the subsequent management of marketing activities.

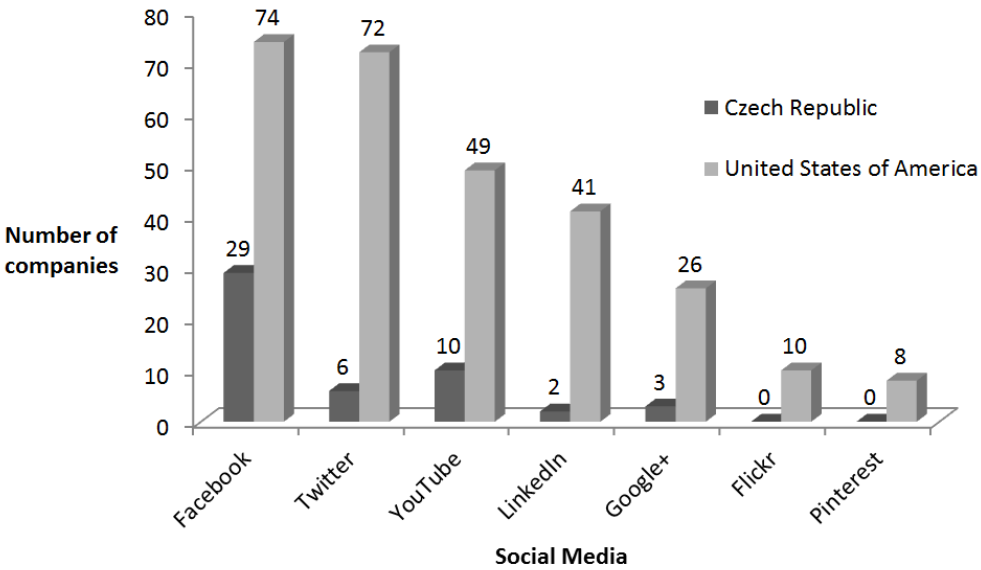

Fig. 1: Number of companies from top 100 company charts in USA and Czech Republic, which actively use social media and integrated them to their websites.

To be able to decide which social media should be chosen for the initial mix of social media, we focused on the 100 leading companies (USA, Czech Republic) and the social media they use. The aim was to make a comparison between the top one hundred most important companies in the United States according to the ranking of the "Fortune 500" of 2012 and the Czech Republic according to the ranking of the "Czech Top 100" in 2012. We wondered what social media were used by these companies, respectively which references go from their websites to social media profiles. The main difference in the ratio between the individual services of the destination was found primarily in approach to services such as Twitter, Google+ and LinkedIn, which is due to their limited use among the population in the Czech Republic, in contrast to the USA. It should also be noted that some companies in these ranks have built their business on B2B and completely ignore social media as a communication channel. Similar studies have been made in the past (e.g.

Svoboda, 2010). However it should be emphasized the need for their continual repetition due to changing trends of prioritizing of social media by people.

Besides the social media mentioned in Fig 1, we noted that the companies use other tools (mostly Delicious, Digg or StumbleUpon) in their activities and creating buzz at greater extent. Based on this survey, we may recommend companies to include Facebook, Twitter, LinkedIn[7] and Google+ into the default mix of social media. In the case of YouTube, Flickr and Pinterest, it is left to the discretion of the company if it is able to continuously create multimedia content.

4. Interaction and Social Media

In the previous section we introduced a procedure of linking and integrating social media to company website, including presentation of the recommended initial mix of social media. In this section, we aim to present interactions occurring at the level of social media, websites and users of those services. This synergistic interaction creates buzz, which we are able to analyse further and apply these results in the marketing management, thanks to analytical tools at various levels (web, social media, and aggregation of social media). Without this approach the companies according to Nichols (2013) are not able to compete effectively (companies have higher marketing costs) and in the internet environment they lose an important competitive advantage, which is gradually becoming the standard.

The following figure illustrates the linking and integration of social media with the company's website. With analytical tools that can be divided into three types, we get the view on the interaction of users (people and softbots). The first type is a web statistics of company website to which it is frequently used Google Analytics with other Google products aimed at advertising (AdWords, AdSense). The second type is statistics provided by the appropriate social media (where the company has a profile) or a third party that offers advanced statistics (e.g. in the case of Twitter). The third type is aggregated statistics – for example obtained when sharing via AddThis service. We get an overview of sharing the content across hundreds of social media. In case there is a large amount of interaction in a social media that company does not directly use, the company may begin to focus on them.

A related issue is a matter of security of data (at the level of own and non-shared statistics) and the possible misuse by other companies. The topic is more substantial, because for collect of necessary data is use third party services. Although it is very tempting, in our opinion it is important decentralization of tools (use the selected tool only to a certain level of interaction) especially for large companies, where it is inappropriate to use only tools of one company (such as Google or Adobe), due to the risk of misuse within competitive intelligence of this third party. If we make decentralization of tools, so only a marketing specialist with access to all tools can put together relevant picture and therefore the safety management shifts to the internal level of security under the corporate governance of company.

[7] LinkedIn is more suitable for enhancing the reputation in the field of human resources and B2B contacts, i.e. not just for marketing activities towards end customers. From a global point of view it cannot be overlooked.

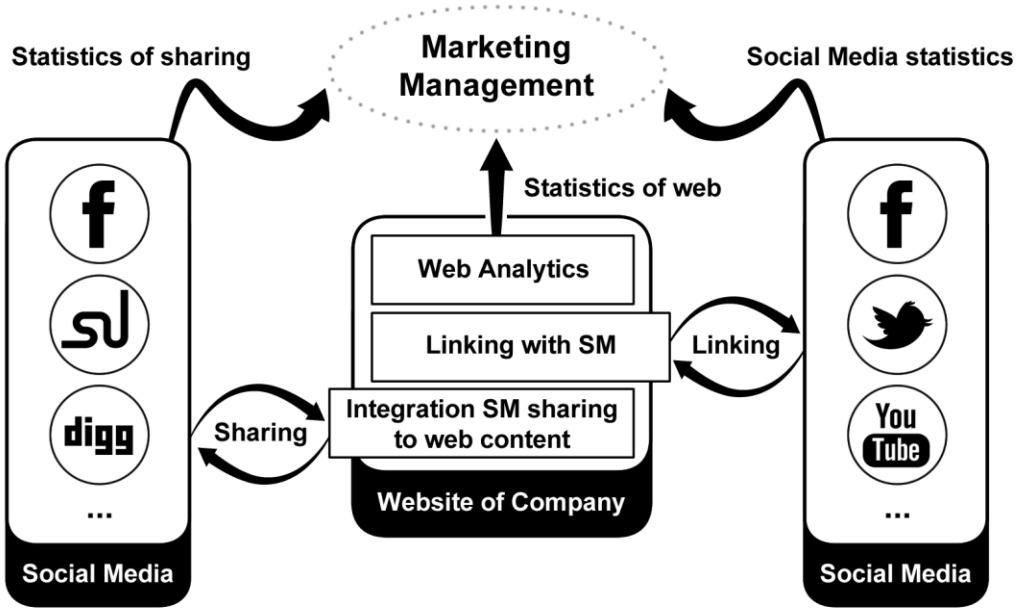

Fig. 2: Linking and integrating social media into websites and use of analytical tools for marketing management (feedback based on interactions).

In addition to these analytical tools, which are directly provided by internet services, a company can directly use application programming interface (API), which is made available by usually globally oriented social media. The company is able to target its interest only to certain data relevant to its needs for evaluation of users´ interactions. From the perspective of current trends, Big data seems to be a promising area for the purposes of marketing management (Chen et al., 2012), but there are currently no tools available for use by small and medium-sized companies. Respectively, their qualitative added value for these companies while using established analytical tools is now debatable.

Social media can be used from a marketing perspective also for other purposes than just for promotion. As an example, we mention Facebook service – that can be used for promotion (company profile, advertising), distribution (Facebook App, Parse – cross-platform services and tools) or competitive intelligence. Similarly, we can use some analytical tools to measure or obtain information not only in the field of self-promotion, but also distribution and monitoring of competitors. Yet the most important and most commonly used general approach to the given analytical instruments is a feedback for marketing communication, where it is important to fan the flame of positive discussion (Castronovo & Huang, 2012) and sharing (commercial) information among potential customers (audience).

Above, we dealt with view of the data acquisition methods for the analysis of interactions in the internet environment and using social media; in the next subsection it will be presented a practical demonstration of user´ interaction, a possibility of its measurement and subsequent management of communication activities.

4.1. User's interaction and identification of hubs

When looking at what is happening in the environment of internet services, we are most interested in users´ interactions that take place in this environment, and practically form it. The above mentioned approach opens up a new perspective. While it still is a true that while evaluating the

success of communication campaigns we are interested in the last (final) action, such purchase or click, in this approach we are interested in user interactions in the background; i.e. how a person or softbot got to the last event and if we can identify in this process the important places (servers, profiles, websites) which help to that activity. Marketing specialist can focus on these hubs and support them appropriately to increase the success of the campaign.

As an example we choose the following scenario: Within the communication of public relations the product reviews on specialized information portals will be published in sequence. These portals also use microblog Twitter, where tweets appear about new reviews. At the end of the review there will be a link to the Twitter account of contracting authority. According to the date of publishing the review, subsequent promotion via Twitter and the number of retweets, we are able to identify which portals have the greatest credit for the creation of so-called followers on Twitter account of contracting authority, respectively create enough buzz – a positive feedback. With these portals we can further enhance the cooperation, because through them we can reach a wide audience and also we address the people, who follow the contracting authority's Twitter profile thanks to a review. This way important communication hubs can be identified which accelerate communication in environment of internet services - not only within individual services, but also across them.

5. Conclusion

In the introduction to this paper, we described the current problem and the challenge in the field of marketing management of commercial subjects in the internet environment in the context of high impact internet services on socio-economic environment. We introduced a resource-available use of internet tools suitable for analysis as a starting point for decisions about marketing activities. Emphasis was put on measuring (realization) of interactions at the level of social media, and shows the possibility of use the information obtained.

In the third part we introduced our own comparative research on using social media by large companies in the USA and the Czech Republic. Based on it, we identified initial mix of social media (Facebook, Twitter, LinkedIn and Google+), where a company focused on end customers should be actively present. In addition, different trends were identified in using of social media in both countries. It should be stressed that the findings of our research and its result toward to initial mix are time limited. There are changing trends in the use of internet services (including social media) by people in time. It is necessary to monitor these trends and in 2-3 years intervals repeat similar research to update the initial mix. Also, a procedure was introduced (schema) for linking and integrating social media to company website to measure the interactions in this environment. Only by using a proactive approach to identify user interaction, company will be able to reallocate its resources adequately and effectively manage marketing not only in the internet environment.

Despite of this, the current situation and developments in this area is very overwhelming. There already are available qualitatively new technologies based on big data processing, which only large companies can currently afford. This trend at general level is highlighted by W. Nichols, CEO of MarketShare: "Many of the world's biggest multinationals are now deploying analytics 2.0, a set of capabilities that can chew through terabytes of data and hundreds of variables in real time. It allows these companies to create an ultra-high-definition picture of their marketing performance, run scenarios, and change ad strategies on the fly." (Nichols, 2013) It is a reality for large companies but just a future for the small ones. It is therefore appropriate for smaller and medium-sized companies to constantly modify their analytical capabilities in accordance with (financially and temporally) services available on the internet. Also for this reason we see this type of paper as a

benefit for small and medium-sized companies to the current view of the issue of the marketing management on the internet.

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References

Andzulis, J., Panagopoulos, N. G., & Rapp, A. (2012). A Review of Social Media and Implications for the Sales Process. Journal Of Personal Selling & Sales Management, 32(3), 305-316, ISSN 0885-3134.

Castronovo, C. & Huang, L. (2012) Social Media in an Alternative Marketing Communication Model. Journal of Marketing Development and Competitiveness, 6(1), 117-131, ISSN 2155-2843.

Chen, H. C., Chiang, R. H. L., Storey, V. C. (2012) Business intelligence and analytics: From big data to big impact. MIS Quarterly, 36(4), 1165-1188, ISSN 0276-7783.

Garrigos-Simon, F., Rafael, L. A., & Teresa Barberá Ribera. (2012). Social networks and web 3.0: Their impact on the management and marketing of organizations. Management Decision, 50(10), 1880-1890, ISSN 0025-1747.

Gartner (2013) Social Marketing in 2013. [cited May 1, 2013]. Available from: http://www.gartner.com/newsroom/id/2309616

Kabani, S. H. (2010) The zen of social media marketing: an easier way to build credibility, generate buzz, and increase revenue. Jackson, Perseus Distribution, 186 p. ISBN 19-352-5173-2.

Keller, E., & Fay, B. (2012). Word-of-Mouth Advocacy: A New Key to Advertising Effectiveness. Journal Of Advertising Research, 52(4), 459-464. doi:10.2501/JAR-52-4-459-464

LaPointe, P. (2012). Measuring Facebook's Impact on Marketing. Journal Of Advertising Research, 52(3), 286-287. doi:10.2501/JAR-52-3-286-287

Lipsman, A., Mud, G., Rich, M., & Bruich, S. (2012). The Power of "Like": How Brands Reach (and Influence) Fans Through Social-Media Marketing. Journal of Advertising Research, 52(1), 40-52. doi:10.2501/JAR-52-1-040-052

Mizik, N., & Jacobson, R. (2007). Myopic marketing management: Evidence of the phenomenon and its long-term performance consequences in the SEO context. Marketing Science, 26(3), 361-379,448,447, ISSN 1526-548X.

Nichols, W. (2013) Advertising Analytics 2.0 Advertising touch points no longer work in isolation. If your company doesn't analyze how they interact dynamically, it will be left behind. Harvard Business Review, 91(3), ISSN 0017-8012.

Owens, J. W., Chaparro, B. S. & Palmer, E. M. (2011) Text Advertising Blindness: The New Banner Blindness?. Journal of Usability Studies, 6(3), 172-197, ISSN 1931-3357.

Sarner, A. (2013) Social Marketing in 2013. [cited May 2, 2013]. Available from: http://blogs.gartner.com/adam-sarner/2013/01/15/social-marketing-in-2013/

Svoboda, J. (2010) Sociální média: Fortune Global TOP 100 vs. Czech TOP 100. [cited June 15, 2013]. Available from: http://www.tyinternety.cz/2010/02/24/clanek/socialni-media-fortune-global-top-100-vs-czech-top-100/

Webster, F. E. (2002). Marketing management in changing times. Marketing Management, 11(1), 18-23, ISSN 1061-3846.

Wierenga, B., & van Bruggen, G.,H. (1997). The integration of marketing problem-solving modes and marketing management support systems. Journal of Marketing, 61(3), 21-37, ISSN 1547-7185.

MEASURING THE EFFECTS OF USING SOCIAL MEDIA IN THE MARKETING COMMUNICATIONS OF THE COMPANY: PRESENTATION OF RESEARCH RESULTS

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Keywords

Twitter, microblogging, marketing communication, social media

Abstract

The paper is focused on the issue of evaluation the effects of communication through social media; in this case, it is Twitter service. Its aim is to compare the number of tweets from Vodafone Czech Republic with a group of users, who "talk" about Vodafone. The aim of authors is to determine whether there is a significant correlation between the number of tweets published by Vodafone and communication about Vodafone via Twitter – online social networking and microblogging service. The results of authors´ quantitative research are briefly presented here.

1. Introduction

The essential impact of social media on contemporary society is unquestioned. This is underlined by the statistics of most visited websites in the world according to Alexa Internet (2013). It is a phenomenon that continually shows a rapid development especially towards the social web and various kinds of system integration.

We can also find similar trends in the information-oriented scientific community. In the context of research area (Twitter) in this paper, the research teams often deal with the analysis towards knowledge management, as in Black et al. (2012), Cheong & Lee (2013), and system integration in order to achieve a new quality of service, as in George & Dellasega (2011), Chang et al. (2009), and research in this area gets strong inter- and transdisciplinary character. In this paper we would like to show the possibilities of regressive evaluation of communication activities and their impact on the example of communications of Vodafone Czech Republic (Vodafone) through the Twitter service.

1.1. Choosing of company and research question

We chose the Czech branch of multinational company Vodafone for our study. A fundamental condition for choosing this commercial enterprise was primarily high traffic on its twitter's channel. Secondary criteria for our choice were territory, continuity of existence and deeper integration of the channel into marketing communication. Compared to other two competitors in the Czech

Republic, Vodafone has the most followers (Vodafone: 16400; Telefónica: 3500, T-Mobile: 1500), so it can be assumed that there will be the greatest interaction.

The initial research question for this study was whether "we can say that the more Vodafone tweets causes the more people who tweets about Vodafone – is there a direct link?" It is the question which leads to evaluation of the results achieved and that is essential for the management of communication activity. To answer this question we adjusted the data collection and subsequent processing.

1.2. Data collection and its evaluation

A web application was created for the collection of data which communicates with the web service Twitter via REST (Representational State Transfer), which is intended specifically for distributed environments. Communication standards are described in the official documentation of Twitter (2013). A simple user interface was created for the application to work with collected data and for their visualization. The task of the program was a cyclical data collection which was scheduled to occur every 24 hours. For every day we were interested in full text of tweet, who created it (their source) and its date of creation.

The data collection was carried out between June 19, 2012 and December, 31 2012, that is 196 days. During this period, 7061 tweets were collected, of which 689 were tweets from Vodafone, 6372 from Czech Twitter users and 1190 were forwarding messages (retweets), where one of the recipients was also Vodafone.

We used the Pearson's correlation coefficient for evaluating collected data. Our goal is to decide on the level of significance 2.5% whether the increasing number of tweets of Group X increases the number of tweets of Group Y. However, if we want to reliably argue (on the chosen level of significance) that the variables are correlated, it is necessary to test the independence of two random variables x and y. It is the test of the zero values of coefficient of correlation $\rho(x, y)$, respectively one-sided version of the test. For this purpose, we chose alternative hypothesis H_1 of positive correlated of the variables. We will test:

$$H_0: \rho(x,y) \leq 0; \qquad H_1: \rho(x,y) > 0.$$

For this, we used the test statistics t. The critical value of t at the level of significance for all of our calculations can be found in the table of the Student's distribution $t_{2\alpha}(n-2)$; thus $t_{0.05}(194) = 1.972$. Based on the test statistics t and its critical value, we will accept or reject the hypothesis H_0.

2. Results and discussion

In this study we focused on three relationships which are interesting in the case of evaluation the success of communication activities of commercial enterprise, in our case Vodafone. These are:

- The relationship between the number of tweets published by Vodafone and the number of tweets of Twitter users in the Czech Republic in which users mention the Vodafone. In other words, we observe, whether the growing communication of Vodafone will increase communication of people about Vodafone. This correlation is important for us – the marketing specialist is able to better allocate human resources to social media channels. (Relationship 1)
- The relationship between the number of tweets published by Vodafone and number of retweets of Twitter users in the Czech Republic in which they mention the Vodafone. In

other words, we observe, whether the growing communication of Vodafone will increase forwarding the existing messages about Vodafone (another way of spreading messages about Vodafone). This correlation is important for us. (Relationship 2)

- The relationship between the number of tweets published by Twitter users in the Czech Republic and number of retweets of Twitter users in the Czech Republic in which they mention Vodafone. In other words, we observe, whether the growing communication of Vodafone will increase forwarding the existing messages about Vodafone (another way of spreading messages about Vodafone). This correlation is important for us. (Relationship 3)

In the first case (Relationship 1), the correlation coefficient r = 0.507, which means a medium dependence. We must also reject the hypothesis H_0 of the correlation impossibility of both variables. In this case, the test statistic at a significance level of 2.5% corresponds to t = 8.193. We therefore reject the hypothesis H_0 and we may say that there is a significant correlation between the number of tweets by Vodafone and number of tweets by people (in which Vodafone is mentioned). Based on the coefficient of determination, it is also possible to say that dependence of tweets of people (in which Vodafone is mentioned) on tweets of Vodafone is influenced by 25.7%.

In the second case (Relationship 2), the correlation coefficient r = 0.235, which means a weak dependence. We must also reject the hypothesis H_0 of the correlation impossibility of both variables. In this case, the test statistic at a significance level of 2.5% corresponds to t = 3.368. We therefore reject the hypothesis H_0 and we may say that between number of tweets of Vodafone and number of retweets of people (in which Vodafone is mentioned) there is a significant correlation. It is also possible to say that dependence of tweets of people (in which Vodafone is mentioned) on tweets of Vodafone is influenced from 5.5 %, based on the coefficient of determination.

In the third case (Relationship 3), the correlation coefficient r = 0.57, which means a medium dependence. We must also reject the hypothesis H_0 of the correlation impossibility of both variables. In this case, the test statistic at a significance level of 2.5% corresponds to t = 9.664. We therefore reject the hypothesis H_0 and may say that between number of tweets of people (in which Vodafone is mentioned) and number of retweets of people (in which Vodafone is mentioned) is a significant correlation. Based on the coefficient of determination, it is also possible say that the dependence of tweets of people (in which Vodafone is mentioned) on tweets of Vodafone is influenced from 32.5 %.

Regarding the mentioned results, it can be further discussed that in the monitored period the efforts of Vodafone in communication via Twitter were positively reflected in the creation of a fuss (the buzz) among other users. The correlation is between medium and weak, indicating the necessity of very active communication in case that Vodafone would like to ensure a greater impact of their activities in this communication channel. It has not yet been justified because of the minor use of this means of communication in the Czech Republic.

In case of retweets, in which the dependency is very weak, it can be said that other users of Twitter influence the number of retweet rather than actual communication activities of Vodafone itself. Vodafone has a minimal effect on the amount of retweets in which it is mentioned.

These research activities were quantitatively-focused. Therefore, neither the content of communication, nor the questions of its interpretation were addressed here. Communication based on complaints and problems could have an unwanted impact which could adversely affect the medial and marketing objectives.

3. Conclusion

Actually, it should be stressed that dependence can be described by this procedure, not causality. The correlation coefficient is only valid for data in the period in which they were collected. It cannot be said that we would obtain the same correlation coefficient in the case of full-year data collection. Despite of this, it is an important feedback which can be further discussed and may be considered in future.

This type of evaluation can be fully automated and can be a good source of information about the impact of communication via the internet service for marketing managers.

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References

Alexa Internet (2013) Top Sites – The top 500 sites on the web. [cited April 19, 2013]. Available from: http://www.alexa.com/topsites

Black, A., Mascaro, C., Gallagher, M., & Goggins, S. P. (2012) Twitter zombie: architecture for capturing, socially transforming and analyzing the twittersphere. The 17th ACM international conference on Supporting group work (GROUP '12). ACM, New York, NY, USA, 229-238. WOS: 000312603400028

George, D. R., & Dellasega, C. (2011) Social media in medical education: two innovative pilot studies. Medical Education, 45(11), s. 1158-1159. DOI: 10.1111/j.1365-2923.2011.04124.x

Chang, Y., Dong, A., Kolari, P., Zhang, R., Inagaki, Y., Diaz, F., Zha, H., & Yan Liu. (2013) Improving recency ranking using twitter data. ACM Trans. Intell. Syst. Technol. 4(1), 24 p. ISSN:2157-6904

Cheong, M. & Lee, V. (2009) Integrating Web-based Intelligence Retrieval and Decision-making from the Twitter Trends Knowledge Base. The 2nd ACM workshop on Social web search and mining: Hong Kong, China. ACM, New York, NY, USA. ISBN 978-1-60558-806-3.

Twitter (2013) The Twitter REST API. [cited April 19, 2013]. Available from: https://dev.twitter.com/docs/api

SECURITY/DEPENDABILITY OF CYBER-PHYSICAL SYSTEMS

SAFETY VS. SECURITY – RELATED TRADE-OFFS AND EMERGENT BEHAVIOURS IN CYBER-PHYSICAL SYSTEMS

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Keywords

Cyber-physical systems, safety, security, systems-of-systems, resilience, emergence, systems engineering.

Abstract

ICT (Information and Communication Technology) has become an influencing part of our environment. Our lives and as a consequence our style of living are changing, "embedded" ICT systems, building complex conglomerates of "cyber-physical systems" and in the end "systems-of-systems", are taking over control in an ubiquitous, pervasive manner. On the one hand, safety and comfort are improved (take e.g. road traffic, high speed trains and air traffic, robots, navigation, on-line banking etc.), on the other hand we lose many skills, and privacy and security are endangered. The increasing complexity and the increasing (inter) dependencies lead to many unforeseen effects ("emergent behaviour"). Thus benefits can turn into risks, regional disasters arise not caused by a single event but because of a combination of several cause unforeseen in their combination and impact. Mitigation concepts and emergency measures are depending on a far more holistic view with respect to the preceding hazard and risk analysis. Examples from previous years are shortly discussed, including some where emergency measures and mitigation measures were not successful for quite different reasons. These examples include: (1) Safety vs. Security: Trade-offs, prioritization, misuse of both, (2) Examples from different domains (automotive, banking, transport, services), (3) Systems-of-systems (electricity grid, critical infrastructure): Emergent behaviour, risk management, (4) Standardization issues.

1. Introduction – ubiquitous pervasive computing

ICT is everywhere – mainly in form of "Embedded systems". Often they are no longer visible but integrated into every day equipment and devices. Comfort, health, services, safety and security of people depend increasingly on them. This includes all kinds of "mobility" – mobile communications, smart vehicles, applications of autonomous robotic systems in manufacturing, services (even at home and in context of ambient assisted living, hospitals and the like) and surveillance, emergency services etc. Recent market research shows that 90% of innovation in the automotive industry is based on embedded systems, and upcoming traffic management relies on embedded intelligence and communications, like car-to-car (V2V) and car-to-infrastructure communication in both directions (V2I, I2V), with the vehicle as mobile sensor system.

In combination and close interaction with the (rather unpredictable) real-world environment and humans, networked embedded systems become so-called "Cyber-physical Systems" combining ICT with physics, acting independently, co-operative or as "systems-of-systems" composed of interconnected autonomous systems originally independently developed to fulfil dedicated tasks (including legacy systems). Their application is not only in the traditional areas of aerospace, railways, automotive, or process industry and manufacturing, but also in robotics and services of all kind, in home appliances (smart environments, smart homes, ambient assisted living) and health care. The impact on society as a whole is tremendous.

Demanding challenges have to be met by research, engineering and education. Smart (embedded) systems are regarded as the most important business driver for industry. They are a targeted research area for European Research Programmes in Framework 7, in the ARTEMIS Joint Undertaking (Artemis, 2011) , and in several dedicated Programmes (PPPs – Public-Private Partnerships like the "Green Cars Initiative" and the Electric Vehicles Initiatives). The European Commission has created the concept of the future JTI ECSEL (Electronic Components and Systems for European Leadership) in Horizon 2020 which in fact will be an integrated combination of the three basic ETPs (European Technology Platforms) ARTEMIS, EPoSS (EPoSS, 2011) and ENIAC (ENIAC, 2010).

Dependability (safety, security, reliability, adaptability, maintenance, sustainability, resilience) in a holistic manner becomes therefore an important issue, despite emergent behaviours and the trade-offs we have to take into account and prioritize in case of conflict. Co-operative, distributed networked cyber-physical systems and resilient systems (adaptive systems maintaining dependability even in changing environments) and their interconnection, integration and interoperation at "systems-of-systems" level providing completely new functionality add a hardly to manage dimension of complexity.

The difficulties arising will be demonstrated in a set of real-world examples, primarily (but not only) from the context of "safety vs. security", which plays a dominant role in this context today, particularly if looking at public safety and security and today's threats from cyber-crime and terrorism.

2. Cyber-physical Systems (CPS) and Dependability/Resilience Challenges

We have to tackle particular aspects of the three levels of software-intensive networked, highly integrated embedded systems which are building up our environment in a completely new, persuasive manner and influencing our lives much more than we are often aware of. These levels are known as

- Embedded systems (software-intensive systems, integrated in a hidden or visible manner in everyday devices, mobile or fixed, inside or outside us)
- Cyberphysical systems (combined complex embedded systems with sensors, actuators, integrating physics, mechatronics, intelligence, decision-making and perception)
- Systems – of – systems (aggregation of systems, composed of interconnected autonomous systems originally independently developed to fulfil dedicated tasks.

Comfort, health, services, safety and security of people depend more and more on these "cyber-physical systems". Particular aspects of these systems which have to be discussed in a holistic manner are:

- Dependability (an umbrella term, including properties such as safety, reliability, maintainability, availability, security, sustainability, robustness of systems which can be treated as predictable concerning behaviour in a defined environment and under defined conditions)
- Security, which is normally considered to be a dependability property, but is highlighted separately because it is dependent on robustness against deliberate human malicious actions and therefore not as easy predictable, particularly in a highly networked world with many interfaces and required access points
- Resilience, meaning robustness of service delivery even when facing changes (adaptation and changes during life time of a system, i.e. in a changing environment and under changing requirements which means loss of predictability, particularly important for cyber-physical systems)
- Emergence (unforeseen property (behaviour) of a system-of-systems, caused by the typical property of combinations of complex systems that the behaviour is irreducible to its individual constituents, i.e. more than the sum of the individual properties; emergence is central to the theories of complex systems).
- Trade-offs between the system properties addressed in context of dependability and resilience (e.g. safety vs. security, safety vs. reliability and availability, safety and security vs. maintainability etc.), including the factor of manageable cost vs. acceptable risk.

Three different aspects will be discussed here:

- Safety vs. Security: Trade-offs, prioritization, misuse of both
- Examples from different domains (automotive, industrial control, services)
- Systems-of-systems (electricity grid, critical infrastructure): Emergent behaviour, risk management
- Standardization issues

The design, operation, and protection, but also risk assessment, validation, verification and certification, maintenance and modification through the life cycle of these systems have to take into account the interplay between humans, environment and systems. Systems must be robust to cope with these problems in an adaptive manner ("resilient systems"), which is an ever increasing challenge for system design, verification, validation and deployment (Schoitsch, 2012).

Thus dependability (safety, security, reliability, adaptability, maintenance, sustainability, resilience) (Avizienis, 2001) in a holistic manner becomes an important issue (Schoitsch, 2008), exacerbated by emergent behaviours and interdependencies. Co-operative, distributed networked systems and resilient systems (adaptive systems maintaining dependability even in changing environments) and their interconnection, integration and interoperation providing completely new functionality add another dimension of complexity (Lee, 2008; Chroust, 2008).

The ubiquitous deployment of such software-based systems requires to take into account the complex interplay of software, hardware, networks, environment and humans actors in different roles, including unexpected and unpredictable, emergent system behaviour (especially in case of interlinked "systems of systems", composed of (legacy) systems originally designed as autonomous systems), and this particularly with its physical world environment and humans. The design, operation, and protection, but also risk assessment, validation, verification and certification, maintenance and modification through the life cycle of these systems (Schoitsch, 1997) have to

take into account unexpected behaviour or threats experienced from the real-world environment and the other interconnected systems. The interplay between humans, environment and systems must be considered in a holistic, interdisciplinary view for the distribution of tasks, including mutual overriding mechanisms for automated and human decisions, for performing interventions at system failures, etc. (Parasuraman, 2000). Systems must be robust to cope with these problems in an adaptive manner ("resilient systems"), which is an ever increasing challenge for system design, verification, validation and deployment.

In case of cyber-physical systems, the aspect of system-of-systems becomes pre-dominant. In the past, systems where to a certain aspect self-contained, and subsystems were designed to contribute to the overall system as a component. In system-of-systems, many of the systems constituting the system-of-systems were originally designed to fulfil its own tasks, and were later integrated in a larger context into a system-of-systems, often called "legacy systems" in the new context. They are not "subsystems" which would have been normally designed as parts of the overall system together with it.

This paper will focus on aspects of "safety" and "security" – as separated and interrelated system properties, and the impact of the interaction is neglected as has been done for a long time.

3. Safety and Security – some historical background

Safety in context of technical environments has already a long tradition. It started with the age of steam engines in the 18th century. A short overview just showing a few typical examples is the following:

- 18th Century: Steam engines are widely deployed in industry, e.g. to drive ships or to pump water out of mines → exploding steam vessels led to first regulations! (UK, US). It is noteworthy that in US it was for some time discussed if governmental regulations are necessary or desirable (US was always for "free enterprise", including taking into account public risks; opponents to regulations argued that liability and financial compensations should be sufficient to achieve safety goals – but in the end this was not convincing).
- 1866: in Germany TÜV = „Dampfkessel-Revisions Verein" (Technical Inspection and Control Agency) was founded (in Austria 1872)
- 19th Century: it were the Steam Days of transport – with safety and training arguments in railways the first locomotives were sold ONLY with trained engine drivers from England!
- Already before the first public railway line was opened (1827) the first railway accidents happened because of an exploding vessel: *31. July 1815* – the experimental locomotive *Mechanical Traveller*s with 16 death!
- Severe accidents happened already during the first months of railways in Austria!
- This led to the development of signalling systems.

Towards the end of the 19th century started the next area of safety institutions, marking the beginning of the age of electricity (which is still the basis of electronics and ICT): The Electrotechnical Associations.

1883 the Austrian Electrotechnical Association (ÖVE) was founded during the 3rd World Electricity Exhibition in Vienna (VDE in Germany followed 1893). The declarations with respect to goals and objectives were similar all over the world:

"….to foster and further develop the technical application of electricity, to establish a close connection between theory and practice, to protect national economic interest und to create a forum for both, experts and friends of electro-technology. A specific task of the organization is to develop **standards and regulations** in the field of electro-technology."

The international organization IEC was founded in 1906, which is the world's leading organization for the preparation and publication of International Standards for all electrical, electronic and related technologies. Since French was the leading diplomatic language at this time, most standards are still published in French and English, although all work nowadays is done in English. It is interesting, that ISO was founded rather late in 1947, so electrical norms and safety had been predominant on international scale for a long time.

Security outside the context of ICT has a long tradition as well, but the issue became relevant in the field of electrical systems rather late. It became critical for commercial business with the wide-spread use of networked computer systems and internet, and even more since embedded cyber-physical systems no longer were rather isolated in proprietary environments but became part of widely deployed, networked and integrated systems-of-systems affecting our daily life.

A short history of security and privacy reveals the following typical developments:

- 1971: Creeper - first self-reproducing Software
- 1972: Captain Crunch – Phreaking –„Injection"-type attacks
- 1979: Kevin Mitnick hacks Digital Equipment Corp.
- 1981: Elk Cloner – first Virus „in the wild" on Apple
- 1988: Morris – first worm distributes itself via internet
- 1999: Melissa – Makrovirus, distributed via E-Mail
- 2000: Mafiaboy – Denial-of-Service attack hitting Yahoo, Amazon, ...
- 2007: Storm Worm – Botnet (1-10 Mio PC's)
- 2007: Cyber-attack targeting Estonia
- 2008: Torpig – Rootkit, captures passwords, steals data, circumvents Anti-Virus software
- 2009: Aurora – Cyber-Spionage at Google & Co.
- 2010: Stuxnet – a new category of Malware
- 2011: attacks/stolen data affecting Sony, building new „communities" like Anonymous, Wikileaks working in some co-ordinated manner.

The motivation changed as well. Hacking started to show one's ability, just for fun and interest, the result was annoying but not dangerous. Then it became much more dangerous as it turned to systematic cybercrime (phishing, financial motivation and damage), and finally it became cyber espionage, cyber terrorism and cyber war with its full risk for society, driven by institutions with almost unlimited resources (manpower and finances).

Massively deployed systems applications of high potential for safety, security and privacy risks are arising in context of

- The grid control approaching private homes: smart grids for efficient power distribution, but our civilisation is very sensitive on loss of power because of almost all services and protective measures depend on appropriate power availability – on the other hand a lot of

data on individual behaviour, habits, information on presence and absence etc. become available, endangering privacy,

- Building automation and control (heat, cooling, elevators, fire alarm and fire fighting, doors/entrance and rescue), at least with remote maintenance access,
- AAL (Ambient Assisted Living) and health-care (from remote monitoring to automatic or triggered intervention),
- Large machinery and construction vehicles operating (semi-) autonomous, service robots in human populated environment and robotic farms.
- Highly automated process industry plants, power plants and manufacturing plants, even with remote "control via internet",
- Transport, particularly road vehicles utilizing car2car and car2infrastructure communication for (semi-) autonomous driving.

4. Emergent behaviour – the risks of default settings and comfort functions

4.1. Emergent behaviour: Armoured SUV car does not protect U.S. agents in Mexico drugs war

A hidden (or forgotten) comfort function for hurried commuters or comfortable family vacation trips "kills" U.S. special agent Jaime Zapata and his partner in Mexico (Miroff, 2012) (ACM SIGSOFT SW Engineering Notes 2012).

When he was killed by drug cartel gunmen in Mexico, Zapata was driving a heavily armoured SUV, being able to defeat intense machine gun fire, fragmentation grenades and land mines. His car was forced off the road in a well coordinated ambush and rolled to a stop. Then a quiet click – the door locks popped open! The whole protective measures became worthless – because of a comfort function for hurried commuters and families, still implemented and active! A really unwanted "emergent" behaviour!

This type of emergent behaviour is escaping proper risk and hazard assessment because of controversial, but hidden default settings.

However, this does not only apply to this case: Risk assessment is based on hazards to be considered, and real world environments are not easily predictable, so overrides and workarounds become important, but should not increase risk beyond acceptable levels, and basic settings have to be adapted to the expected use and hazards.

4.2. Beware of default settings and initial factory settings

Some examples from the same source (ACM 2012) as contributions to the discussion of this issue:

Take care of initial factory settings: defaults are often insecure, e.g. wireless routers shipped with security switched off, firewalls configured to allow all traffic etc.

Car door lock:

Defaulting locked without manual override can be dangerous in case of fire or loss of power;

Some cars lock in case the motor is running – but beware to leave the car with running motor just to adjust the right rear mirror from outside – the car remains locked, no re-entry!

Elevator defaults in case of alarm:

- Down to bottom by balanced gravity – bad in case of water floods
- First floor (main lobby) – bad in case of front-door armed building take-over
- Top of building – bad in case of fire.

Security doors and fire alarm:

Priority is to let people out (doors default open) – in case of false fire alarm, which might be deliberately set by a potential intruder, a security breach is achieved (Schoitsch, 2005)! This is an example that in some cases safety and security requirements are contradicting and prioritization is necessary, the deliberate misuse has to be counteracted by other means.

Car to Car Communication: What risks next?

Car to Car (or V2V – Vehicle-to-Vehicle) Communication is a promising approach to make future road traffic much more efficient, and many (research) projects, prototypes and evolving communication standards are engaged in this direction, with the final goal of truly autonomous driving; the first step would be platooning of "car trains" on high ways, i.e. a bunch of vehicles following a lead vehicle autonomously, controlled by information via V2V communication, and supported by a number of sensors controlling near distance behaviour and safety.

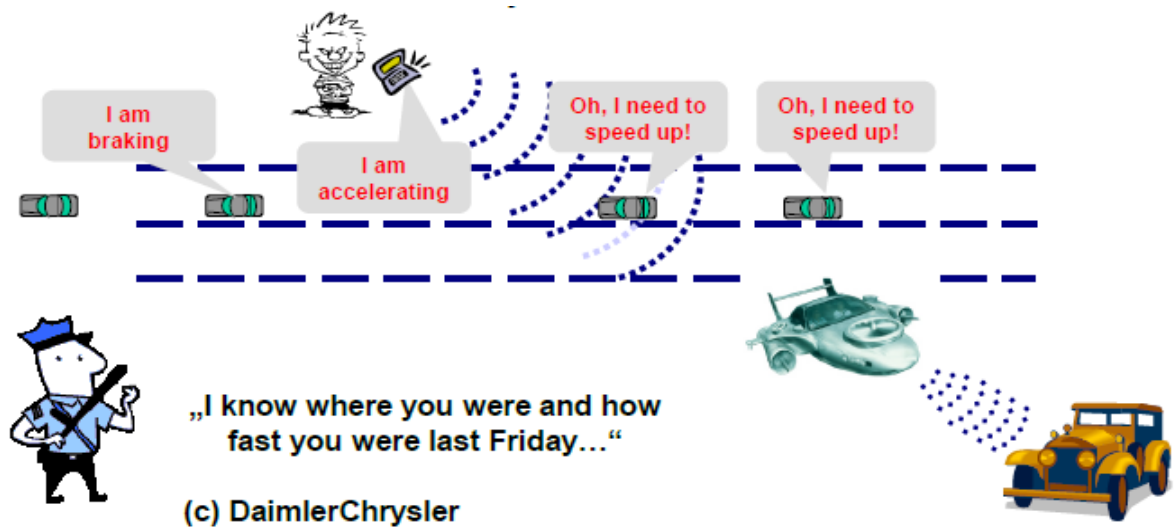

Fig. 1: Platooning road traffic: safety, security and privacy issues

This concept implies a number of safety, security and privacy issue (see Fig. 1) – and the liability issue is far from being resolved legally (who is responsible in case of an accident? The first driver? How strong is the individual driver control, how can alertness be guaranteed? There are many scenarios possible for technical and legal implementation). An additional problem is the long-term guarantee of security, keys can be broken, electronics can wear out partially, there must be alternatives in case a car is used ten years or longer, with the same devices inside or not, etc.).

Safety and security risks through Maintenance

There is a simple rule when talking and assessing risks of cyber-physical systems: Any access point is a risk – and there are always access points, often for reasons of maintenance and repair, for monitoring or homeland security, or just to enable cyber-physical communication between objects at all!

Imagine that manufacturers of cars see advantages in doing of remote maintenance (update) of in-car software (updates, error corrections) in the field via wireless communications to avoid expensive call-back. It works (sometimes) with space vehicles and satellites – why not in the field for cars? (see Fig. 2).

Here again, the hazards and risks need very thorough analysis – it has to be guaranteed that only in safe situations and in a secure manner downloads of proven updates for the actual configuration of software in the individual car are possible, taking into account many complex scenarios – just to download when the car is not moving is for sure not sufficient, since many scenarios can be imagined where cars stop, but have to restart immediately if required by the traffic situation.

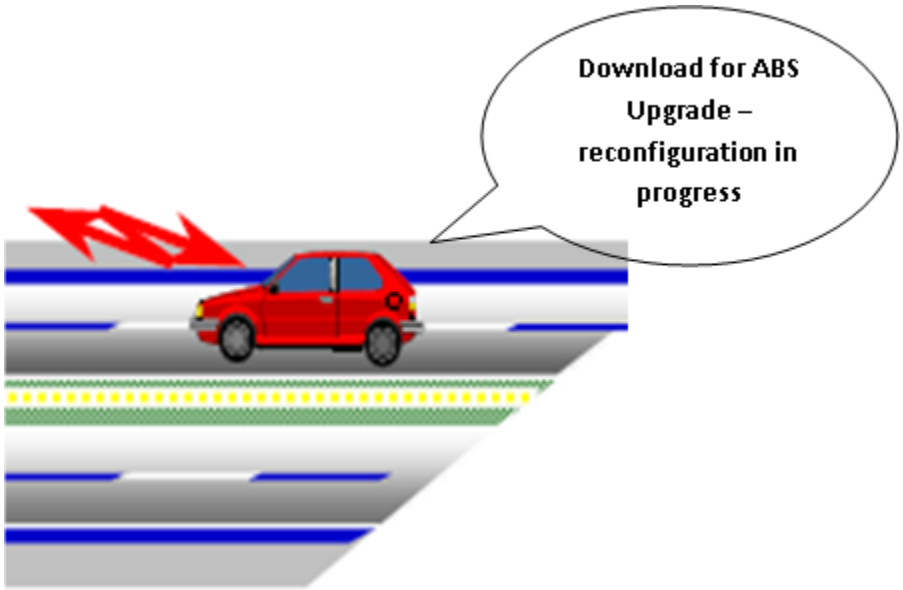

Fig. 2: Software download in the field?

At the moment, this is only possible via diagnostic interfaces in a qualified maintenance station, but what made the author feel uneasy was the fact that he has read in an automotive magazine an enthusiastic article written by a journalist just talking about the benefits in an uncritical manner, not even mentioning safety and security issues that should be tackled.

5. Security hits Safety – Industrial Control Systems (ICS/SCADA)

Industrial Control Systems, but also Critical Infrastructure Systems (water, electricity, gas, oil, transportation networks) have been for a long time decoupled from public networks, using their own networks and local communication lines and bus systems (including railways). With the advent of remote control, wireless communications and the use of internet for industrial communications as well, risks arose which were not taken into account before and in the currently existing installations.

Failures of industrial control systems due to malware are much more frequent than anticipated. In the US, the Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) investigated between Oct. 2011 – Sept. 2012 198 cyber-attacks. Several have been successful and led to several weeks of stop of production. The reasons have been in most cases maintenance activities where USB sticks are brought directly to the installation, or remote “industrial control via internet“. A distribution over application domains is shown in Fig.3Fig. .

One can imagine, that e.g. chemical plants, nuclear plants and sewage plants can be really critical endangering humans and environment severely (and not only cause financial loss).

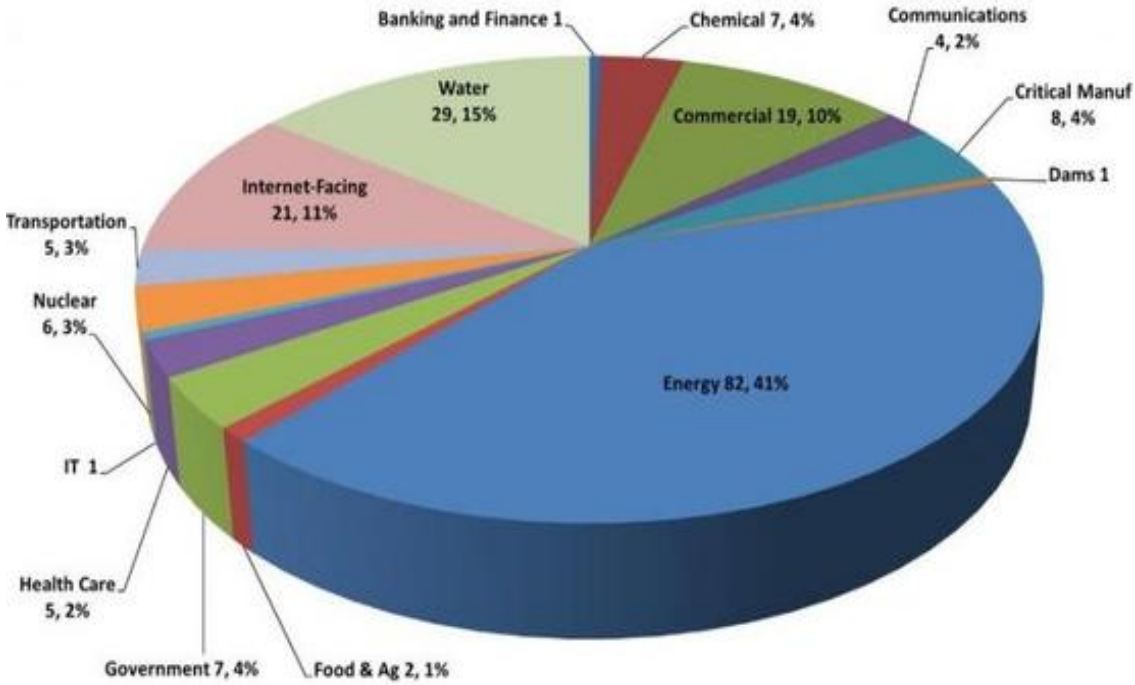

Fig. 3: Failures of industrial control systems due to Malware

In "Software", Oct. 2001, was posted an article by Tony Smith, titled "Hacker jailed for sewage attack". As often, it was a former insider employed by the company that had installed the system. His application for a job at the Maroochy Shire sewage control system in Queensland, Australia, was rejected by the area's Council, so he attacked for revenge electronically control system successfully. Millions of litres of raw sewage spilled out into local parks, rivers and a big hotel's grounds. Marine life died, the creek water turned black and the stench was unbearable for residents, as stated by the Australian Environmental Protection Agency. The attacker could be identified and was sent to prison for two years.

To find out how active the hacker scene is (institutional or not), TrendMicro, a German company specialized on Internet-Cloud Security, conducted an experiment: They simulated a fictitious water pump station completely including sensor readings and behaviour of a control systems, for a 8000 inhabitants city, with typical protocols and SCADA devices. One would assume that this is not an interesting target at all – but it took only about 18 hours until the first attack was registered, and there happened 49 attacks within one month started from 14 countries. Most of them could be classified as targeted (12 immediately, 13 repeated from the same source ("automated"), 14 are under further investigation but probably targeted as well) (Markt&Technik, 2013). The distribution over countries reveals an interesting, although not unexpected picture: Dominating are China and US, followed by Laos and UK) (see Fig. 4Fig).

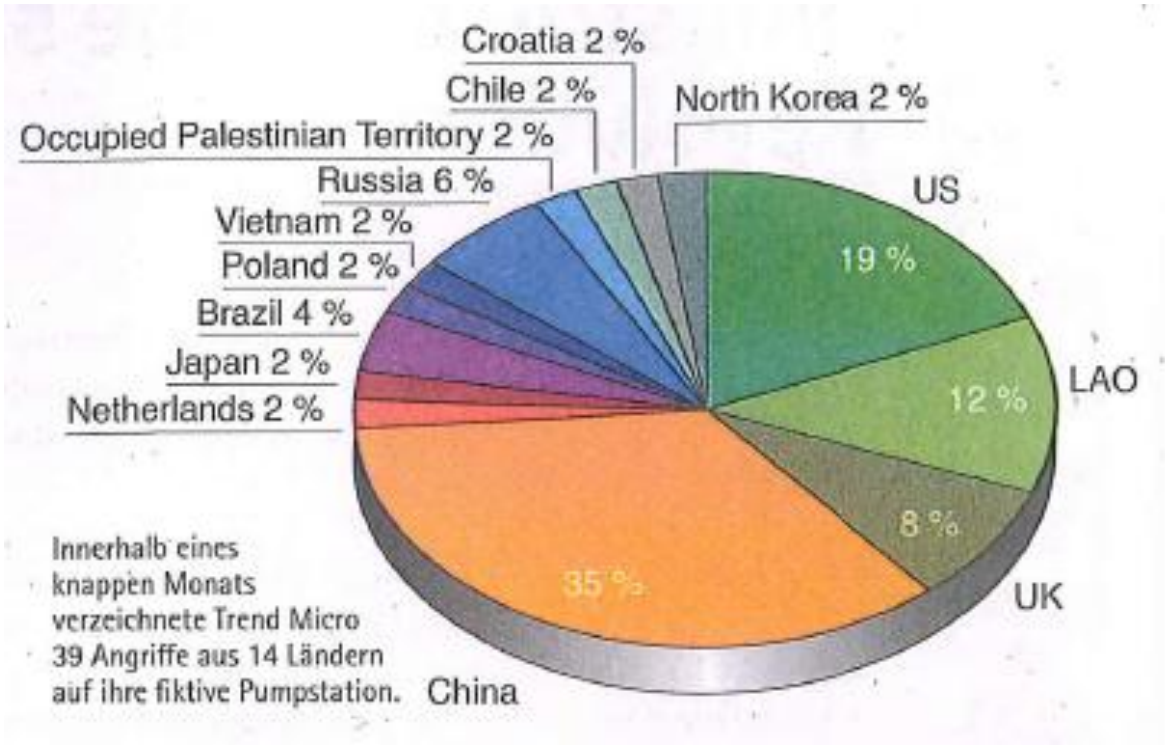

Fig. 4: Cyber-attack experiment – sources of attacks per country

The critical situations that can arise from security breaches, e.g. malicious insertion of wrong data or commands in a control loop, could cause dangerous situations (chemical reactor explosion, traffic jam, air traffic control, …), are best described by a statement of the chairman of the IEC TC65 WG 10 working group on standards on security of industrial communication systems: "We want to avoid that a chemical plant can become a bomb deliberately activated" (PCSRF, 2003).

In the past, nobody has thought it likely that someone could have interest in such an incident (Schoitsch, 2005; Pfitzmann, 2004), but not only after 9/11 we have to take into account malicious actions. Additionally, public acceptance (or non-acceptance), legal or environmental issues, liability, and social aspects influence system usage and dependability as well.

6. Functional Safety and Industrial Network Standards (Safety & Security)

There are basically two approaches how standards are trying to achieve conformance with required high level safety (and security) goals:

- Means-prescriptive: recommends means to achieve a certain safety/assurance level (easy to use if application conditions are well known, more difficult to handle if new technologies, methods or tools emerge) (example: IEC 61508 (ref. 8) and the whole IEC 61508 family, e.g. IEC 61511, EN 50128/29 (Rail), ISO 26262 (ref. 9) is less means descriptive than the others)
- Objectives-prescriptive: describes objectives (safety goals) to be achieved, means have to be argued by the applicants of the standards (more open to interpretation, but more flexible to new methods and technologies) (example: DO-178)

In practice, even standards which reflect mainly one of the approaches, have some rules included which guide interpretation (e.g. processes are recommended according to DALs in DO-178C;

argumentation is possible that the safety goals are achieved if not all "Highly Recommended" techniques and methods are applied in IEC 61508).

A safety case is required in EN 50129 (railways) and ISO 26262 (automotive), but only implicitly in other standards. In detail, what is meant by "Safety Case" is not the same among all the standards addressing the issue.

Security standards like ISO 15408 (Common Criteria - CC) choose an approach similar to DO-178C (DALs) by EALs (Evaluation Assurance Level EAL 1 - 7, quite different from the ISO 61508 group which is based on probabilistic risk levels (SIL 1-4), an approach that is not easily applicable in security). This standard helps evaluate, validate, and certify the security assurance of a technology product against a number of factors, such as the security functional requirements specified in the standard. Hardware and software can be evaluated against CC requirements in accredited testing laboratories to certify the exact EAL (Evaluation Assurance Level), i.e. its product oriented. Requirements for evaluation become stricter from EAL1 - Functionally tested, EAL2 - Structurally tested, EAL3 - Methodically tested and checked, EAL4 - Methodically designed, tested and reviewed, EAL5 - Semi-formally designed and tested, EAL6 - Semi-formally verified, designed and tested, to EAL7 - Formally verified, designed and tested.

ISO 27002 (formerly ISO/IEC 177799) establishes guidelines and general principles for initiating, implementing, maintaining, and improving information security management in an organization. The objectives outlined provide general guidance on the commonly accepted goals of information security management. It contains best practices of control objectives and controls in the following areas of information security management and looks at security from a holistic viewpoint (would include example 2), not only IT devices and systems.

How comes security to industrial safety in IEC?: During the last ten years, it was envisaged that industrial communication systems and networks are a vulnerable access point and can severely endanger plants, people and environment. In the first session, when the interdependencies between safety and security were discussed and some participants refused to discuss security because they were safety people, the convenor said "All I want is that my chemical plant will not become a bomb, independent from being a safety or security issue being the cause".

IEC SC65C Standards: Industrial networks (covering communications, industrial communications security)

"To prepare standards on Digital Data Communications sub-systems for industrial-process measurement and control as well as on instrumentation systems used for research, development and testing purposes" (IEC citation). This subcommittee handles an enormous number of standards and subparts of standards on (industrial) buses (field bus standards, real-time Ethernet, etc. etc.). Very important for the security aspect is the series IEC 61784 (Industrial communication networks – Profiles), including particularly for our purpose in the ARTEMIS projects the

- Profiles for real-time networks (IEC 61784-2),
- functional safety field buses (IEC 61784-3-xx) and
- IEC 61784-4 - Profiles for secure communications in industrial networks (AIT was one of the founding members of this group).

IEC/TS (Technical specification) 62657-1 Ed. 1.0 covers Wireless Communication Network - Part 1: Wireless communication requirements and spectrum considerations. Some of these standards or parts thereof are currently under development.

IEC TC 65 Umbrella WGs: TC 65 has on TC level some "umbrella-type" working groups, covering topics that were considered essential but not really fitting into one of the subcommittees. The most important one for objectives discussed here (especially for smart services, and cloud/internet applications) is TC65/WG 10: Security for industrial process measurement and control - Network and system security – it is not in SC65C because it is not focused on field buses (which are considered more internal for a plant). A major activity is centred around the series of IEC 62443 - Industrial communication networks - Network and system security, consisting of several parts with subparts, including e.g. System security requirements and security assurance level, Patch management and Certification of IACS supplier security policies and practices. This work is now done in close co-operation with ISA (Instrument Society of America, ISA 99 committee).

7. Trust: Combined Safety & Security approach to systems dependability

Members of the two IEC 61508 committees (for hardware/systems and software) (the author was involved in the work from the beginning) who are also member of the industrial communication networks groups dealing with secure industrial communication wanted during the first maintenance phase of IEC 61508 to include a specific chapter on security issues and interdependencies with safety integrity levels. The first approach towards an IEC 61508 – Common Safety/Security Life Cycle was to look at a series of industrial standards (safety and security) and to compare their scope with respect to different issues.

The next step was to look at the rigidness of requirements for higher SILs and EALs (wrt. to processes, formal verification etc.) and try to find some plausible relation between security and safety levels. One of the proposed requirements for mapping of safety & security levels shows Table 1.

SRL Security Requirements Level	Security functions and related Evaluation Assurance Levels according to ISO/IEC 15408	Hardware, software or ASICS and related Safety Integrity Levels according to ISO/IEC 61508
Low	EAL 3 + ?	SIL 1
reduced	EAL 4	SIL 2
Full	EAL 5	SIL 3

Table 1: SRLs and related verification requirements (proposal)

A combined Safety/Security Life Cycle was drawn (proposal, Fig. 5):

The security management life cycle can be considered and integrated in a holistic, unified model of parallel, equivalent activities:

- Definition and Implementation of Security Policy from „Concept" to „Security Requirements Allocation" similar to the safety life cycle,
- Security during System Development (includes Security during the whole lifecycle of the system (Documentation, Evaluation and Certification)
- Maintaining Security Level during Operations (includes Maintenance, Change Management and Incident Handling), Disaster Recovery and Business Continuity Planning). This is a critical issue in context of safety certification: Security outlives rather quickly its life time, so frequent updates are necessary – quite opposite to what safety people want, to avoid re-assessment and re-certification!

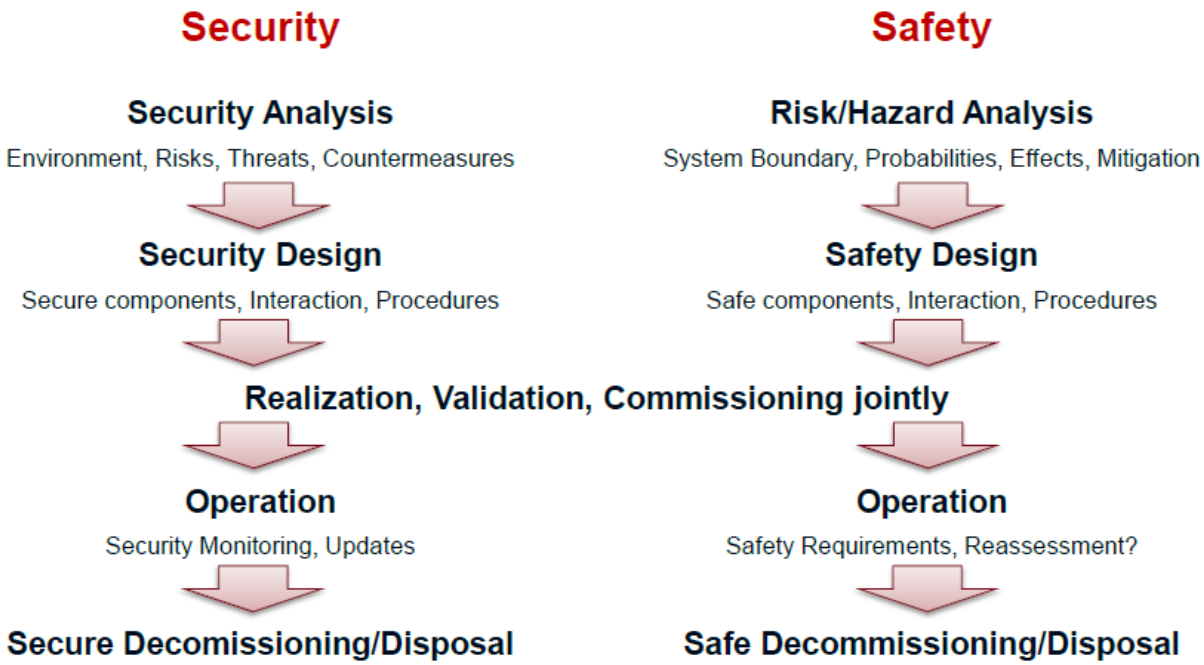

Fig. 5: An approach to a Unified Safety & Security Life cycle

Of course, there are different measures in parallel phases to take, e.g. decommissioning and disposal:

- Security: Secure management of data (un-retrievable destroyed or secure archiving under preserved integrity);
- Safety: Safe management of shut down or continued (degraded) operation, and/or safe disposal.

The unified approach was started by considering both aspects and interactions during system analysis and design, and describing requirements to cover both aspects in each phase, such integrating parts of security standards requirements and criteria (without defining new ones except absolutely required). Unfortunately, the task group did not succeed to define a consolidated view on these different approaches to system dependability in a more holistic manner, and there was not enough support from experts of both domains.

What remained after all?: The conclusion was to add separate clauses into IEC 61508 everywhere where security could have an impact on safety giving advice on how to integrate the security aspect as an additional hazard (risk) for the safety-critical system, i.e. to look at the safety impact of security breaches and then derive requirements for the safety critical system, based on a joint hazard and risk analysis. From a complete Annex remained a few clauses listed below, but at least there is some pointer in IEC 61508 to the security issue in safety related systems.

IEC 61508, Part 1, General requirements:

- (scope) … does not specify the requirements for the development, implementation, maintenance and/or operation of security policies or security services needed to meet a security policy that may be required by the E/E/PE safety-related system;
- 7.4.2.3. Hazard Analysis: …. If the hazard analysis identifies that malevolent or unauthorised action, constituting a security threat, as being reasonably foreseeable, then a security threats analysis should be carried out.

    - NOTE 3 For guidance on security risks analysis, see IEC 62443 series.
    - NOTE 4 Malevolent or unauthorised action covers security threats.
- 7.5 Overall safety requirements:
- 7.5.2.2 If security threats have been identified, then a vulnerability analysis should be undertaken in order to specify security requirements.

NOTE Guidance is given in IEC 62443 series.

- [21] IEC 62443(all parts), Industrial communication networks – Network and system security
- [22] ISO/IEC/TR 19791, Information technology – Security techniques – Security assessment of operational systems

IEC 61508, Part 3, Annex D: D 2.4 The following shall be included in the safety manual:

- Details of any security measures that may have been implemented against listed threats and vulnerabilities. (under "additional requirements for SW elements")

Unfortunately, the committee decided not to take into account in-depth considerations on security in the new standard draft. The security issue was delegated to another committee of SC65, to SC65C, WG 13, Digital Communications, Cyber Security, and the chairman of JTT4 became member of this committee. Unfortunately, this committee was not at all interested in safety, only in communications and cyber security. Both "worlds" again kept themselves separated!

8. Conclusions

Cyber-physical systems can already be found in aerospace, automotive, process industry, civil infrastructures, energy, health care, manufacturing, but also in private spaces serving at home, in entertainment and for ambient assisting living (AAL) purposes. The EC in its Framework Programmes and the US National Science Foundation have both identified cyber-physical systems and systems-of-systems as key research areas. Their experts expect that new services, increased adaptability, functionality, efficiency, autonomy, safety and usability will be the result of the advances in technology. Advances are expected with respect to intervention (collision avoidance), precision (nanotechnology, manufacturing, robotic surgery), operation in dangerous or inaccessible environments (rescue, emergency, catastrophe services, deep sea, mountains, mines) and co-ordination (traffic management and control air, sea and ground), buildings and energy, health-care covering different aspects (ARTEMIS SRA, 2011)(EPoSS SRA, 2009). Much effort is put into safety functions, but even more in comfort functions – often contradicting the safety goals under realistic circumstances, particularly if they are hidden and their interdependencies not well understood. What we could learn from the examples that we have to understand that

- In a networked world („cyber-physical systems") we need a holistic view: safety & security are interacting, we have to understand the impact of security on safety and vice versa,
- Safety & security communities cannot act independently, particularly in safety-critical systems engineering,
- Standards have evolved separately and independent – only very weak connections, should be further developed and interpreted,

- Safety Cases are a well-known method to provide arguments and assurance that a system is reasonably safe, have to be extended by security assurance to a „trust case“.

References

ARTEMIS Joint Undertaking (Advanced Research and Technology for Embedded Intelligence and Systems), www.artemis-ju.eu , ARTEMIS Strategic Research Agenda (SRA) (2011).

EPoSS European Platform on Smart Systems Integration, Strategic Research Agenda, 2009, http://www.smart-systems-integration.org

ENIAC European Nanoelectronics Initiative Advisory Council, Multi-Annual Strategic Plan 2010, www.eniac.eu

Avizienis, A., Laprie, J.-C., and Randell, B., Fundamental Concepts of Dependability, Technical Report 739, pp. 1-21,, Department of Computing Science, University of Newcastle upon Tyne, 2001. [http://www.cs.ncl.ac.uk/research/trs/papers/739.pdf] [UCLA CSD Report 010028, LAAS Report no. 01-145]

Chroust, G., and Schoitsch, E:, Choosing Basic Architectural Alternatives, in: P. F. Tiako (Ed.), Designing Software-Intensive Systems, Methods and Principles, Information Science Reference, Hershey – New York, IGI Global, 2008, Chapter VII, p. 161-221.

Driscoll, K. R., Murphy was an Optimist, Keynote at SAFECOMP 2010, Vienna, Abstract in: Proceedings of the 29th International Conference on Computer Safety, Reliability and Security, SAFECOMP 2010, p. 481-482, Springer LNCS 6351, 2010.

EN 50129 Railway applications - Communication, signalling and processing systems - Safety-related electronic systems for signalling, 2003.

Herrtwich, R.G., Automotive Telematics – Road Safety versus IT Security ? in: Proceedings of SAFECOMP 2004, Sept. 21-24, 2004, Potsdam, Germany, 23rd International Conference on Computer Safety, Reliability and Security. Springer LNCS 3219, ISBN 3-540-23176-5.

Hewison, Christian H. (1983). Locomotive Boiler Explosions. David and Charles. ISBN 0-7153-8305-1 and http://en.wikipedia.org/wiki/List_of_boiler_explosions

ICS-CERT, USA, 2013, The Industrial Control Systems Cyber Emergency Response Team (ICS-CERT), ICS-CERT Monitor April-June 2013 for 2012.

IEC 61508, Ed. 2.0 (2010), Part 1 – 7, “Functional Safety of E/E/PE safety-related Systems”, 2010.

IEC 61784, First edition. 2003-05: Digital data communications for measurement and control (all field buses, many parts).

IEC 61784-3-xx: functional safety fieldbuses

IEC 61784-4: Profiles for secure communications in industrial networks

IEC 6244: Network and system security for industrial-process measurement and control

ISO/IEC 15408-1:2009 Information technology -- Security techniques -- Evaluation criteria for IT security (3 Parts)

ISO 26262 (2011/2012), Part 1- 10, “Road vehicles – functional safety”.

ISO/IEC 27002 (2005) Information technology -- Security techniques -- Code of practice for information security management

Lee, E., Cyber Physical Systems: Design Challenges, Univ. of California, Berkeley Technical Report No. UCB/EECS-2008-8. http://www.eecs.berkeley.edu/Pubs/TechRpts/2008/EECS-2008-8.html

Levenson, N., IEEE Computer, Oct. 1994, “High-Pressure Steam Engines and Computer Software”) and (http://www.safeware-eng.com/system%20and%20software%20safety%20publications/High%20Pressure%20Steam%20Engines.htm)

Markt & Technik 2013/13, “Cyberangriffe auf Industriesteuerungen” (in German, “Cyber attacks on industrial control systems”), p.1-2, www.elektroniknet.de

N. Miroff, W. Booth, Armored SUV could not protect U.S. agents in Mexico, ACM SIGSOFT Software Engineering Notes, May 2012, Vol. 37, number 3.

Parasuraman, R., Sheridan T. B., and Wickens, C. D., A model for types and levels of human interaction with automation. IEEE Transaction on Systems, Man, and Cybernetics, A30(3), 286-295 , 2000.

PCSRF - Process Control Security Requirements Forum – Security Capabilities Profile for Industrial Control Systems (June 13, 2003; Aug. 8, 2003)

Pfitzmann, Why Safety and Security should and will merge. Invited Talk at the 23rd International Conference SAFECOMP 2004, Potsdam, September 2004. Proceedings of SAFECOMP 2004, LNCS 3219, Springer Heidelberg 2004.

Schoitsch, E., Design for safety and security. In: Cyberspace Security and Defense: Research Issues. Springer NATO Science Series, Vol. 196, 2005.

Schoitsch, E., A Holistic View at Dependable Embedded Software-Intensive Systems. In: Proceedings of "IDIMT 2008 Managing the Unmanageable", 16th Interdisciplinary Information Management Talks, p. 321 – 344. Schriftenreihe Informatik Nr. 25, Serie Universität, Trauner Verlag Linz. Proceedings IDIMT 2008.

Schoitsch, E., "Cyber-Physical Systems (CPS) - What can we learn from Disasters with respect to Assessment, Evaluation and Certifiaction/Qualification of "Systems-of-Systems"?"; IDIMT - 2012, Jindrichuv Hradec, Czech Republic; 12.09.2012 - 14.09.2012; in: "IDIMT - 2012: 20th Interdisciplinary Information Management Talks", Trauner Verlag Linz, Linz (2012), ISBN: 978-3-99033-022-7; S. 69 - 81.

Schoitsch, E., Managing maintenance and change. In: F. Redmill (ed.), Life Cycle Management for Dependability, p. 163-188, Springer, London 1997.

Tiako, P. F. (Ed.), Designing Software-Intensive Systems, Methods and Principles, Information Science Reference, Hershey – New York, IGI Global, 2009.

Note: The historical data for ISO, IEC, VDE/VDI, ÖVE, TÜV etc, were taken from the official web sites and publications of these organizations.

ARCHITECTURAL MODEL FOR INFORMATION SECURITY ANALYSIS OF CRITICAL INFORMATION INFRASTRUCTURES

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Keywords

Critical Information Infrastructure, information security, system architecture, reference model

Abstract

Critical Information Infrastructures (CII) are computer systems and networks that support and control operations of many critical infrastructures that our society depends on, such as power plants, electrical grids, and water and waste facilities. Since the operations of CII also affect physical world, they are a good example of large-scale, critical cyber-physical systems. In recent years, CII become an attractive target for cyber attacks and the potential impact of a successful attack could lead to disastrous consequences in the physical world. Thus ensuring the security of CII is of vital importance. A fundamental prerequisite to secure a CII system is a clear understanding and a consistent view of its architecture. However, because of the complexity and scale, this is challenging to acquire. In this paper, we propose a layered architectural view for CII, which aims at building a common ground among stakeholders and supporting the implementation of information security management processes. In order to manage the complexity and scale, we define four interrelated architectural layers, and use the concept of viewpoints to focus on a subset of the system. We indicate the applicability of our approach in the context of CII security analysis.

1. Introduction

Critical Information Infrastructures (CII) are computer systems that monitor and control industrial facilities and processes. CII are used in many critical infrastructures such as power grid, traffic management, gas and water facilities. CII consist of conventional IT systems and industrial control systems such as Supervisory Control and Data Acquisition (SCADA) systems, in which computer applications as well as human operators in the control centre collect measurements from remotely connected sensors and send commands to actuators in the field according to predefined process models. Consequently, CII extend the activities in the cyber space to the physical world to form large-scale and complex cyber-physical systems (CPS). Because of the critical nature of the physical devices and services they monitor and control, CII are an attractive target for cyber attacks. Since CII become increasingly interconnected and tend to use Commercial-Off-The-Shelf (COTS) IT products as well as open standards, they have to face the same vulnerabilities and threats that plague conventional IT systems. In addition, connectivity and the use of general-purpose hardware and software products make it easier for an attacker to understand and search for

weakness in the system. Stuxnet (R. Langner, 2011) is a well-exposed wakeup call on the imminent danger facing CII. Identifying the vulnerabilities and threats and protecting CII against cyber attacks is of vital importance. However, due to their characteristics this is not straightforward. CII are complex, heterogeneous, and large-scale Besides, CII have very strict real-time requirements, and the lifecycle of components in CII tend to be much longer than normal IT systems. This makes changing and hardening the infrastructure for security purposes difficult. Despite this being an acknowledged problem, securing CII continues to be a significant challenge (V. M. Igure, S. A. Laughter, & R. D. Williams, 2006), (McAfee, 2011), (Symantec,2011).

Clearly, to secure CII a systematic approach must be taken. A fundamental building block in the information security management process is *security analysis*, which aims at identifying assets, vulnerabilities, and the associated threats and potential attacks. A prerequisite of security analysis is to gain a systematic and comprehensive understanding of the CII under consideration. Due to their scale, complexity, and heterogeneity, a consistent view rarely exist. To this end, we propose a novel way to organize and describe CII systems and their environments and contexts using architectural layers. As often required in software design-level risk analysis, the layered architectural view is envisioned to assist security analysis by slicing and organizing CII to different technological concerns and layers of abstraction in order to build up a consistent "forest-level" view of the target system at a reasonably high level.

In the following: Section 2 describes related work and the motivation for a novel architectural view. Section 3 describes our approach to establish the architectural view. Section 4 discusses the applicability in the context of a set of security-related processes. Section 5 concludes the paper.

2. Related work

A consistent architectural view establishes a framework for understanding the target system, the entities within the system and their relationships, and system environments. When undertaking security analysis that involves different organizations and personnel, a reference architectural view helps to maintain consistency and common consensus among the participants. Common approaches so far are to model CII system in accordance with its network topology. For example, a typical architecture for power grid includes field devices connected to the SCADA network, which is connected to a corporate network (Pacific Northwest National Laboratory and U.S. Department of Energy, 2006). Such a topological view of the architecture is also used in (K. Stouffer, J. Falco, & K. Kent, 2011), US-CERT. In our approach, details of the network infrastructure are captured in a distinct layer that describes how data may flow in a CII; additionally, we also capture other aspects that are equally important from a security perspective.

Other approaches focus on the software services within CII. The VIKING reference architecture (VIKING project, 2010) models services and data flow, and their relationship to the network topology. An architecture meta-model includes three components: data-flow, service, and zone. In our approach, these aspects are modelled across different layers, making it more straightforward to identify and analyse the security aspects of each of the entities. Coupled with viewpoints, our layers can be collapse to consider multiple layers in security analysis.

The ability to identify and classify interdependencies within CII is important for security. Berg and Stamp (M. Berg and J. Stamp, 2005) proposed a system reference architecture by applying Object-Role Modelling (T. Halpin) in order to model data, functionality and internal interdependencies in CII. This approach is based on a mixture of function and network topology. As mentioned earlier, we separate infrastructure and networking aspects into distinct layers in order to make their analysis

more approachable. Using viewpoints, we can also collapse the layers in case of carrying out the object role modelling proposed by Berg and Stamp.

A slightly different approach is to first identify SCADA devices and then logically group their functions into abstraction layers. The ISA S99 standard (ISA99, 2007) proposes to create reference architecture from the entities identified as assets within an organization, and build the architecture model according to the specifics of the organization. ISA S99 maps the functional components of a CII system into five architectural levels: physical process, local or basic control, supervisory control, operations management, and enterprise systems. Our approach follows the same principle, i.e., we propose to first build an asset layer as the basis for other layers. Based on existing work, it can be observed that there is no consensus on how to model CII architectures, including what should be modelled. However, system architectures tend to be modelled to reflect network segmentation. There is no single solution that provides us with a comprehensive and adaptable view of CII system architecture for applying security analysis.

3. Architecture model

Reference architecture should capture the essence of the architecture of a collection of systems. Our architectural view is structured into four layers, which can be considered in the context of arbitrary viewpoints. This arrangement is summarized in Fig. 1. Each layer is intended to group system components and aspects for security analysis. A layer in the architecture consists of entities that are typically considered discrete -- for example, the communication layer includes aspects from layer two and three of the OSI reference model and the asset layer describe physical and logical entities. Since each CII system is unique, e.g., using a range of components and subsystems from different vendors configured in different ways, it is impossible to have an architecture model that captures all peculiarities of different CII systems working in different organizations and domains. Therefore, our proposal here is meant to be an architectural template, based on which specific CII system architectural views can be derived and instantiated.

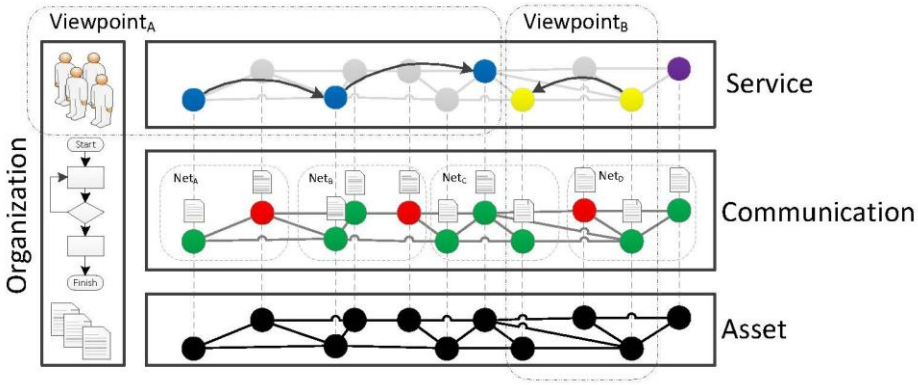

Fig. 1 Layered CII architectural view

To further manage the complexity and scale of CII, we make use of the concept of viewpoints. A viewpoint is *a technique for abstraction using a selected set of architectural concepts and structuring rules, in order to focus on particular concerns within that system* (G. Muller, 2011). A viewpoint is an arbitrary view of a CII that focuses on a subset of the system. A viewpoint can include system components from the same architectural layer as well as those from different layers.

The asset layer includes entities such as hardware, software, and data of a CII system that is usually considered as the IT asset of an organization. Hardware in CII are physical devices as well as the

communication links that connect them. Devices in CII can include those typically associated with enterprise networks, such as workstations and servers, and those that are related to SCADA systems, such as field devices, including Intelligent Electronic Devices (IDEs), Remote Terminal Unit (RTUs), Programmable Logic Controller (PLCs) and Distributed Control Systems (DCS). The field devices monitor meter readings and equipment status and control end devices such as sensors and actuators. Usually, the wired and wireless communication links connect the devices into the following topologies: geographically distributed field devices are connected over various communication links (e.g., dial-up telephone, leased line, power line, radio, and Wide Area Network (WAN)) to control centres in SCADA networks; the SCADA network is connected to a company's corporate network, and the corporate network is further connected to the Internet; firewalls are used to separate and protect different networks. Software includes operating systems, databases, and application software. Data is generated and processed by hardware and software components in SCADA systems. In the asset layer, the software and data are associated with specific hardware. Fig. 2 illustrates an example of asset layer.

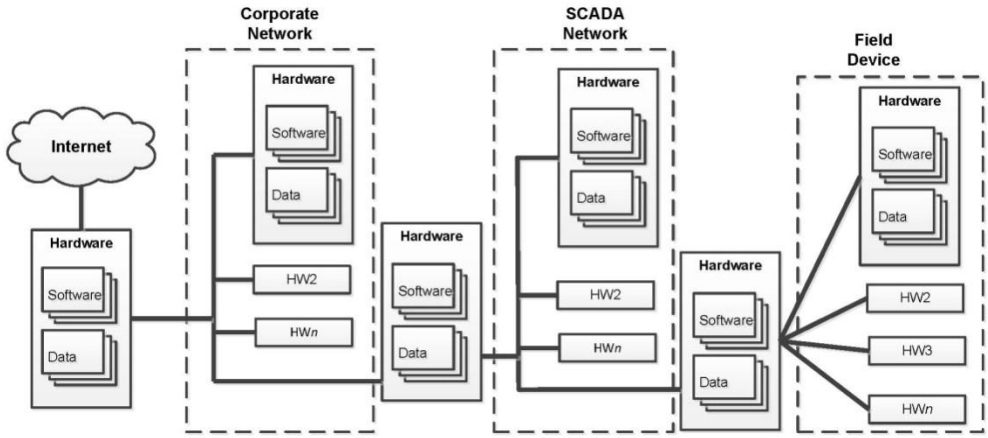

Fig. 2 Asset layer

Components in the asset layer should be relatively straightforward to identify. For example, a critical infrastructure asset owner typically has detailed information on each of the hardware devices and how they are connected -- e.g., maintained in an asset management system -- as well as the software installed on that hardware and the data exchanged at the I/O ports or APIs. The components can be specified using common IT asset specification methods like the "Specification for asset identification" (J. Wunder, A. Halbardier, & D. Waltermire, 2011), which defines a data model with asset types such as software, database, network, and service etc.

The way data can be transmitted and the means of realizing these data flows, e.g., using various protocols and services, is important for CII security -- the communication layer aims to describe this. This understanding can be applied when carrying out a threat analysis to determine the reachability of critical assets from remote networks, both internal and external. Furthermore, understanding which protocols are being used can identify vulnerabilities in the CII system. Building on top of the entities described in the asset layer, the characteristics of three main classes of entity are described in this layer: (1) communication enablers, (2) communication inhibitors, and (3) communication end points, as shown in Fig. 3.

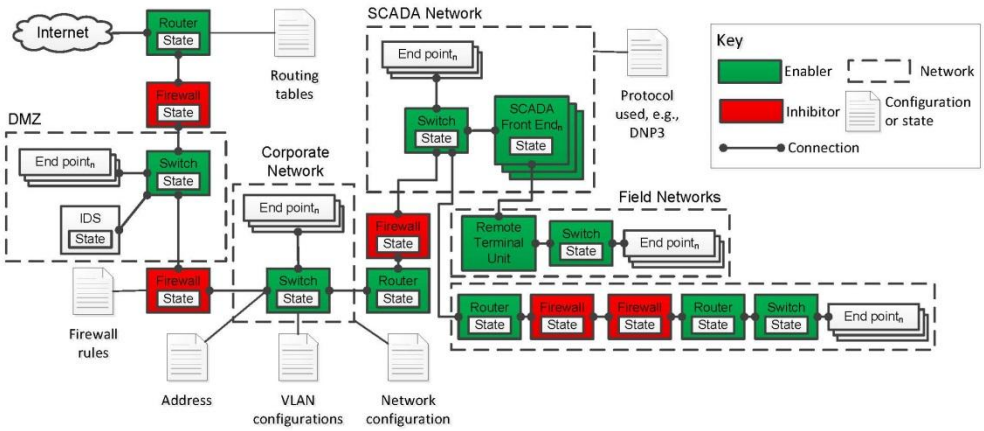

Fig. 3 Communication layer

Communication enablers include devices such as network hubs, switches and routers, e.g., a further form of enabler includes the means of interconnecting these devices, physically or virtually, e.g., with the use of Virtual Local Area Networks (VLANs). In short, communication enablers describe and implement how data should flow through the CII system. In contrast to the various communication enablers, inhibitors curb the flow of data through the CII system, and typically take the form of so-called middle-boxes, such as firewalls and Network Address Translation (NAT) devices. An intrinsic communication inhibitor in CII systems can come from the heterogeneity of the protocols that are used. For example, TCP/IP is the ubiquitous protocol arrangement in enterprise networks; whereas in control networks a wide-range of protocols are used, such as DNP3 and Modbus. The communication end points are entities sending or receiving data.

The service layer models the software services, applications, and functions in CII systems and the data exchanged among the services. We use the term “service” in a broad sense to denote software components that encapsulate and provide certain functionality. Consequently, an application can be considered as a service because it provides certain functionalities to other applications and the system. Likewise, databases, authentication servers, Web servers and application servers are also considered as services. A service can be a composition of standalone services which provides customized functionalities and business applications. A service can be implemented and deployed using numerous techniques, ranging from low-level embedded systems components to application software and flexible service mashups and orchestration engines. The data flows models the data exchanges among the services.

An example service layer is illustrated in Fig. 4. Services like sensor and actuator send measurement data and receive process commands to and from SCADA server through front end. HMI services are the interfaces of the operators to the SCADA server. Historian stores the historical data. A web browser in the corporate network can access these data. The SCADA application server provides various control centre applications such as power projects and overview monitoring. A Geographic Information System (GIS) service provides GIS data to data engineering server, which defines data structures and views for various services in the SCADA network. Communication server allows remote client to have terminal access to SCADA server for faster and more efficient maintenance work and information acquiring.

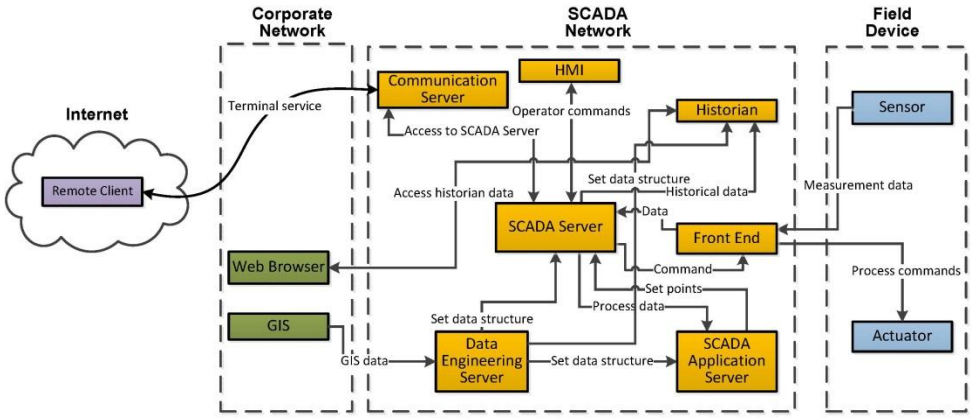

Fig. 4 Service layer

Adapting some of the Service Oriented Architecture (SOA) terminology, we can describe a service with the following attributes: (1) Service Descriptions define the capabilities and functional properties of a service, as well as the communication endpoint and operations supported by the service; (2) Interactions and Data Contracts, which define the schema used for exchanged messages as well as the protocol of interaction; (3) Fault Handling Procedures provide information in case of failures and undeliverable services; (4) Service Level Agreements hold important information about guaranteed quality criteria, such as availability, accuracy, responsiveness and so on. While these definitions are more feasible for business software in cooperate networks, the same concepts are also applicable to services in SCADA networks. For instance, in order to use a deployed firmware-controlled sensor, one needs to know the protocol and applicable messages to interact with this sensor; furthermore, what operations this sensor provides (type of measurement, value ranges, operating modes), how faults are signalized, and what level of service in terms of availability or accuracy this sensor guarantees.

The organization layer consists of relevant people and their activities, as described by organizational processes and policies. As an orthogonal layer, the entities in the organization layer are related in different ways to the other layers. This includes end-users of services provisioned by CII systems as well as maintenance personnel keeping the whole infrastructure up and running. People on an organization layer have predefined privileges (e.g., roles and access rights) on peer objects, including hardware, network configurations, services and data entities. A majority of an organization's activities can be described by business processes. Business processes can potentially span numerous departments across organization boundaries. Business requirements and corporate rules affect the execution of business processes, i.e., the order and context of tasks being performed. Furthermore, in most processes coordination through and intervention of humans is required, which makes people not only system end-users, but integral parts of the whole system architecture. When executing such processes, predefined tasks are performed by different stakeholders in series. This requires the delegation of privileges among people, for instance, the ownership of data objects depending on the current task. Finally, the execution of processes is influenced by security policies and guidelines, especially, how close they are lived and applied in the business context. Thorough monitoring of user actions and review with respect to these security-relevant artefacts can reveal weaknesses in corporate procedures.

We regard security policies, which describe security administration rules and enforcement hierarchy, as an integral part of the organization layer. Security policies include those for general IT systems, such as information security and risk management policies, as well as specific policies for

CII systems such as platform security, communication security, and application security policies (D. Kilman & J. Stamp, 2005).

As mentioned earlier, viewpoints are intended to provide a focused view of a subset of the architectural layers. A viewpoint can be *horizontally* aligned to a layer, or *vertically* intersect different layers. Viewpoints can be arbitrarily defined based on the security analysis that is being carried out. For example, a security team may wish to validate how an organizational level security policy is implemented from a technology and processes perspective. To do this they may define a set of viewpoints from the perspective of the different security policies under examination, which cuts across the organizational, service and communication layers, for example. This could reveal how a security policy is implemented in service access control mechanisms and firewall policies. A viewpoint can also be defined that only intersects a subset of different layers. For example, to analysis how organisational business process impacts system security, a viewpoint can include a part in the organizational layer and another part of role-based access policies in the service layer.

4. Security analysis

The precise nature of the instantiation of the architectural view, e.g., which entities will be enumerated and their attributes in accordance with the architectural template, will depend on its application to the security analysis of specific CII systems. A security team can make use of abstract representations of the architectural view to manage the complexity and scale of the system, and to introduce some automation to the process. We foresee a number of applications of our reference architecture. For example, we can use the framework from Schaeffer (A. Schaeffer-Filho, P. Smith, A. Mauthe, D. Hutchison, Y. Yu, & M. Fry, 2012) for developing and evaluating so-called resilience patterns that describe the configuration of various mechanisms, e.g., firewalls and anomaly detection systems that can be used to detect and mitigate well-known attacks, such as DDoS attacks. Their framework makes use of simulations to evaluate candidate resilience patterns; our reference architecture could be used to support the realisation of simulation models in this context. In a more formal way, we can apply the layered architectural view for attack modelling in smart grid proposed by Chen (T. M. Chen, J. C. Sanchez-Aarnoutse, & J. Buford, 2011) that makes use of Petri-nets. In their approach, "low-level" Petri-nets are created by domain experts that describe attacks in detail for sub-domains of a smart grid, e.g., attacks on smart meters. Then the low-level attack descriptions are merged with "high-level" Petri-nets that abstract details of an attack, and focus on important places, i.e., attack states. Common places in the two types of Petri-net are merged by identifying the transitions and places described by a common model description language. Using the layered architectural view, we can support this attack modelling approach -- for example, the systematic identification of low-level Petri-nets could be done on a per-layer basis, and viewpoints could be defined that identify places and their attributes across multiple layers. Furthermore, the lexicon of the model description language could be derived from the attributes contained in an instantiation of our reference architecture.

5. Conclusion

CII systems are the IT backbone of many critical infrastructures. Security analysis that identifies vulnerabilities, threats and attacks is an important task for securing and protecting critical infrastructures against cyber attacks. Establishing a consistent architectural view of the target system should be the first step in any security analysis. In this paper, we proposed a layered architectural view to support the implementation of security analysis. As a novel way to organize

and describe architectural information and to manage complexity and scale, we model CII systems in four layers: asset, communication, service, and organization layer. In addition, we introduced the concept of architectural viewpoints, which enables us to have a focused view on a subset of the system of interest during security analysis. We are aware that it is a challenging task to enforce a unanimous view on CII architecture among various stakeholders. The proposed architectural view is an attempt to establish and maintain a consistent view on the system architecture during security analysis. With abstract and focused presentations in the architectural view, we envision that more theoretical and formal methods, as well as automation techniques can be developed and applied for security analysis in CII.

Acknowledgement

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References

Schaeffer-Filho A., Smith P., Mauthe A., Hutchison D., Yu Y., & Fry M. (2012), A framework for the design and evaluation of network resilience management, NOMS, 401--408.

Kilman, D. & Stamp J. (2005), Framework for SCADA Security Policy, Sandia National Laboratories report SAND2005-1002C.

Muller G. (2011), A Reference Architecture Primer, version 0.6.

ISA99 (2007), Security for Industrial Automation and Control Systems-Part 1: Terminology, Concepts and Models, ANSI/ISA-99.00.01-2007.

Wunder J., Halbardier A., & Waltermire D. (2011), Specification for asset identification 1.1," NIST Interagency Report 7693.

Stouffer K., Falco J., & Kent K. (2011), Guide to Industrial Control Systems (ICS) Security, NIST SP 800-82.

McAfee (2011), In the Dark: Crucial Industries Confront Cyberattacks.

Berg M. and Stamp J. (2005), A Reference Model for Control and Automation Systems in Electric Power, Sandia National Laboratories report 2005-1000C.

Pacific Northwest National Laboratory and U.S. Dept. of Energy (2006), The role of authenticated communications for electric power distribution, Beyond SCADA: Networked Embedded Control for Cyber Physical Systems.

Symantec (2011), Symantec Critical Infrastructure Protection Survey.

Langner R. (2011), Stuxnet: Dissecting a cyberwarfare weapon," IEEE Security & Privacy, 9(3), 49-51.

Halpin T., Object-Role Modeling, http://www.orm.net.

Chen T. M., Sanchez-Aarnoutse J. C., & Buford J. (2011), Petri Net Modeling of Cyber-Physical Attacks on Smart Grid," IEEE Transactions on Smart Grid, 2(4), 741--749.

US-CERT, Control System Security Program: Overview of Cyber Vulnerabilities, http://www.us-cert.gov/control_systems/csvuls.html

VIKING project (2010), D2.3 SCADA system architecture.

Igure V. M., Laughter S. A., & Williams R. D. (2006), Security issues in SCADA networks, Computers & Security, 25(7), 498-506.

SMART ICT SOLUTION FOR BUSINESS AND PUBLIC SERVICES

SMART REQUIREMENTS FOR B2B REVERSE AUCTION PROCUREMENT

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Smart technologies, procurement, analysis, reverse auction, price, complexity

Abstract

The increasing complexity of networked business world and electronic solutions applied into procurement and especially in negotiation processes call for new services supporting more efficient decision making in this field. In the paper, we present the analysis on importance of real market transparency through increasing number of reverse auction participants and complexity of reverse auction parameterization. Our results shows, that the number of competitors is not only parameter for achieving more realistic prices and complexity of auction tools itself don't say about utilization of auction benefits and real value recognition The complexity of data and parameterization in electronic negotiation environment calls for smart technologies for analytical or data-mining purposes which will support the decision making to be more efficient.

1. Introduction

Smart ICT solutions are providing innovative answers to global challenges of business and public organizations. Innovations are provided for optimizing business processes, increasing effectiveness of public services or new services for citizens (Doucek, et al., 2010; Sudzina, et al., 2011; Zgodavova and Bober, 2012). In the past several years, the term "smart" emerged especially in energy sector and it is usually linked with ICT green and grid innovations.

But we can look on the term "smart" from several aspects, either as S.M.A.R.T. concept or as smart=intelligent things.

S.M.A.R.T. concept is based on self-monitoring, analysis and reporting technologies. Although at the beginning it was focused more on hardware devices, current perception is more general and is applied in every business or societal process (Dorcak and Pollak, 2011, Doucek, 2010; Doucek, 2011). The latest smart technology not only monitors activities but adds failure prevention by attempting to detect relevant signals and realize or support corrections in the system (Gavurova, 2011; Gavurova, 2012; Novotny, 2008; Szabo and Gavurová, 2011) On the other hand, smart makes sense of things. As smart is knowing how things go, smart technologies should makes sense to relevant processes with efficient decision support which has to measure a success but also to identify signals for correction and new knowledge possible to apply in global environment. In the field of business and public electronic services it means emphasize on the complex analytical

approach to provide more efficient and effective process. That's why, the quest of current RTD activities is to find, develop and deliver smart (optimal) solutions and services for business and societal environment where ICT plays now crucial role.

Smart ICT will summarize the cutting-edge information and best practices that corporations of all sizes need to support themselves through their journey toward building a more sustainable and more efficient enterprise. Through smart solution, the business processes will be simplified, easier integrated and more utilized to get the most out of its investment. Smart products will enable better cooperation and collaboration through visual and interactive experiences.

Together, smart growth is a way of approaching community development and expansion with the goal of making them "more liveable, more economically efficient, and more effective at meeting the needs of the people who live there.

Current innovations in business networking and eCooperation fields of research show opportunity how to extent the approach with smart features. Within e-negotiation or generally e-cooperation solutions, the crucial process of decision making is related to e-spend management. It is related with innovations how to effectively manage the money they spend using electronic tools (Glova et al, 2011). The trend in supply chain management and integrated spend management shows the tendency to electronic networks. Networking features provide not only social features, sharing knowledge or references or create more competitive environment but also provide huge amount of data generated with business transactions conducted within this network (Janke, 2011). Now the question related to smart approach is, how we can use these data to better monitor, control, analyze, report or regulate the environment or related processed to support continual improvements or sustainability in efficiency.

One of the crucial negotiation or spend management tools is reverse electronic auction, which provides some kind of competitive environment to achieve more real market price or conditions for purchased product or service. Electronic reverse auctions (eRA) provide not just huge potential savings or Total Cost of Ownership (TCO) reduction, but also improvements in quality and cycle time are expected. eRA represents an electronic sourcing method that builds a competitive and dynamic environment in which a number of suppliers compete against each other in real-time to win the business (Amelinckx, Muylle and Lievens, 2008). Theory assumes that eRA represents pure market environment with information perfectly distributed between both buyers and suppliers (Amelinckx, Muylle and Lievens, 2008). We don't fully agree with this assumption. Pure market environment with information perfectly distributed requires perfect market information vertically - across whole supply chain or horizontally – across several supply chains. But the eRA only simulate competitive environment within small business ecosystem consisted generally from selected suppliers. As generally the access to eRA is not absolutely open or perfectly distributed to all potential suppliers on the global market, it doesn't provide perfect information for achieving real market price or real market competitive environment. On the other hand, such a imperfection provide opportunities or challenges for smart technologies, which can work with data from this imperfect environment, monitor behaviour, results, changes or any other indicator and provide solutions how to improve real situation.

Although, eRA usage was significantly increased during the last few years, the way how to deal with them is still open. Moreover, such an increase in the eRA adoption was influenced by enormous marketing campaigns and it contributed to the e-bubble burst in 2000 as a result of unreasonable investments to IT. Due to such an extensive usage of eRA, great amount of procurement data already exists, however very little research has been done yet and the data hasn't been fully analysed and utilized.

New strategies call for next researchers to find optimal negotiation strategies within the procurement process and new methods of performance measurement in this field. Very few studies were performed on real business data and on potential technical improvements of electronic reverse auction tools for purchasing managers. The current situation shows, the eRA could be a strong tool in a hand of purchasing managers but it needs improvements in analytical and decision support solutions as extension for the e-negotiations. In the paper, we are examining the needs for smart procurement solutions, which is the part of the CentraLab project (Central Europe Programme) using the Living Lab approach for innovation creation in procurement processes.

2. Methodology

2.1. Research motivation

Existing research in the field of electronic reverse auctions is often characterized by the fact that different methods such as surveys, case studies, etc. are carried out in the laboratory environments. As valuable as these studies are, their results are very often significantly different to the experiments on real business data. In other words, results of such laboratory experiments are much more in line with existing auction theory. On the other hand, real business data usually has several restrictions preventing it to be so straightforward in supporting or rejecting different theory assumptions, just to mention a few: software solution simplicity (it does not support advanced settings), buyers' lack of knowledge, missing data, illogical data, etc. Failing to analyse such data and prove some theory assumptions would inevitably lead to widening the gap between theory and practice. Smart technologies implemented into the real solutions have to have real contact with real business data to be able fully utilize the benefits of potential decision support. All restrictions of real purchasing or negotiation environment known or unknown together with all data created within this process are very important to be integrated into smart analytical tools. This is crucial not only for just in time analyses but also for more strategic point of view to regulate and evolve this environment on the base of win-win approach. To fully utilize smart analytical technologies within this environment, features of business e-networking are required. The higher electronic connections, the higher competitive environment, more realistic prices or information asymmetry reduction will be achieved. The motivation for our research is the need for real competitive environment and existing growth of the complexity of e-procurement solutions where smart technologies can help. The need for development of related smart technologies rose from purchasing managers dealing with eRA solutions within several Central European events as eBIZ forum or directly from related companies.

2.2. Empirical Research Approach

One of the few assumptions where the practice does not doubt the theory is the questions regarding the influence of competition on the outcome of the auction. It is already well known and documented (Amelinckx, Muylle and Lievens, 2008; Carter and Stevens, 2007; SAP, 2006) that the higher number competitive bidders would result in lower final bid and so meaning higher savings. The first research question targets these assumptions and trying to prove it on the real business data. Less discussed but not least important is the questions regarding the usage of different auction settings and strategies. Several studies (Amelinckx, Muylle and Lievens, 2008; Carter and Stevens, 2007) have been carried out in this field defining a set of rules for visibility settings. They revealed that visibility settings could have a significant impact on the outcome of the auction, when applied correctly (reflecting market environment). The purpose of the second research question and its sub-questions is to analyze the complexity of possible auction settings, level of usage and finally

identify the potential for so called smart technologies that would provide intelligent support to the buyers. Both research questions with the corresponding sub-questions are listed in the Table 1.

Research question 1	**The higher the competition in the auction, the higher saving is expected?**
Research question 2	**The higher complexity of parameterization possibilities, the higher savings is expected?**
Research sub-task 2.1	Identification of the complexity of the auction settings.
Research sub-task 2.2	Identification of the most crucial parameters influencing the savings in the auction.
Research sub-task 2.3	The relation between level of auction settings adoption and savings.

Table 1 Research questions; Source: own table

In order to study research questions real auction data has been provided by a large Slovak company operating in the energy sector. Statistical methods such as correlations were calculated to determine the strength of the associations among the pairs of the selected variables and linear regression. For the further investigation of the data, data-mining technique – decision tree was used.

2.3. Sample

The empirical study is based on the sample of 882 auction cases that have been carried out between January 2011 and May 2013.

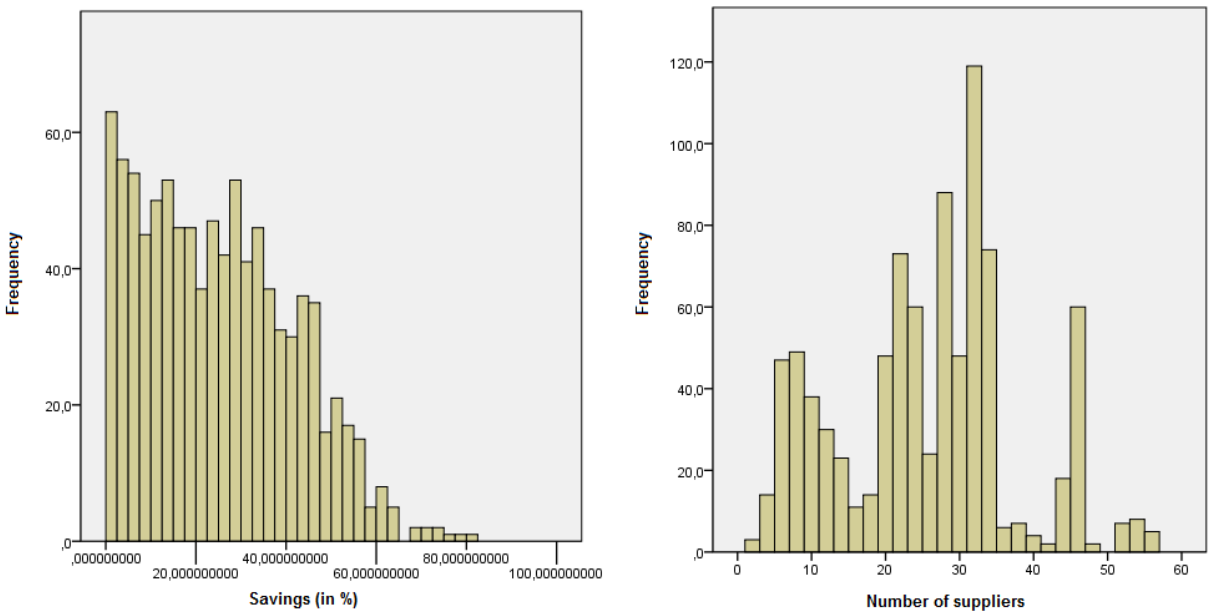

Fig. 1 Distribution of the savings and number of the bidders

The data are structured in such way that each row contains information concerning a single auction case with all the corresponding settings. For each auction case, following statistics have been calculated: number of bidders (NoB), number of bidders actively acting in submitting bids (NoAB), comparative price (set by a buyer before the auction starts), saving in the percentage.

As it is shown in the Fig. 1 distribution of the savings (on the left-hand side), does not comply with the normal distribution, but it represents decreasing function. Distribution of the number of the

bidders (on the left-hand side) shows some signs of normal distribution, however generally it cannot be considered normally distributed due to some local minimums and maximums.

3. Results

3.1. Impact of competitive environment on the outcome of the auction

In the first section, Research question 1 will be analyzed. It predicted there is a positive relationship between the competition in the auction and its outcome. In this case, level of the competition is represented by the number of the bidders. Some may argue (Carter, et al., 2004) that the higher number of the bidders does not inevitable have to represent competitive environment, meaning that in some cases one bidder may have much higher potential in the negotiation, resulting from economy of scale. In this case, whatever the number of the rest of the suppliers would be, there would still be only one competitive bidder. However, for the purposes of this study, it is assumed, that such cases do not exist and the number of suppliers can be considered as a measure of the competitiveness of the auction environment.

		Savings (in %)	
Pearson	**number of bidders (NoB)**	Correlation Coefficient	,369**
		Sig. (2-tailed)	,000
		N	882
	number of bidders actively acting in submitting bids	Correlation Coefficient	,277**
		Sig. (2-tailed)	,000
		N	882
Kendall's tau	**number of bidders (NoB)**	Correlation Coefficient	,265**
		Sig. (2-tailed)	,000
		N	882
	number of bidders actively acting in submitting bids	Correlation Coefficient	,218**
		Sig. (2-tailed)	,000
		N	882
Spearman's rho	**number of bidders (NoB)**	Correlation Coefficient	,378**
		Sig. (2-tailed)	,000
		N	882
	number of bidders actively acting in submitting bids	Correlation Coefficient	,302**
		Sig. (2-tailed)	,000
		N	882

Table 2 Correlation matrix: Number of Bidders vs. Savings dependency; Source: own table

As the first statistical method, correlations were calculated to determine the strength of the associations among the following pair of variables: number of the bidders – Savings and number of the bidders actively acting in submitting bids - Savings. The most commonly used bivariate correlation test - Pearson correlation test is calculated and then Kendall and Spearman follows to support the findings. In the Table 2, correlation matrix is shown.

The results shown in the Table 2 favour this hypothesis. Correlation coefficients between NoB and Savings vary from 0,265 to 0,378 meaning it could be considered medium correlation. Range of correlation coefficients between NoAB and Savings is quite similar, ranging from 0,218 to 0,302. Although, these results are in line with the most of the studies carried out in this field (Amelinckx, Muylle and Lievens, 2008; Carter and Stevens, 2007; SAP, 2006), the strength of the correlation was not as convincing as in these studies. Less convincing results could be caused due to the complexity of this problem, meaning that number of suppliers is not a sole factor influencing the outcome of the auction and other factors (e.g. auction settings) can significantly change it.

In order to further support these results, decision tree model using SPSS Clementine was built, see the Fig. 2. The Chaid algorithm was used, due to the fact that the output value (Savings) was of a continuous type. The Chaid algorithm divided the whole dataset, based on the number of bidders into 3 sub-sets. The first subset contains all the auction cases, where the number of the bidders was lower or equal than 27. The size of this subset is 468 auction cases (49,576% of the whole dataset) and predicted savings are 19,586%. The second sub-set contains auction cases, where the number of bidders was higher than 27 and lower or equal than 45, the size of this sub-set is 384 records (40,678% of the whole dataset) and predicted savings are 29,316%. The third sub-set contains 92 records (9,746%) that satisfy the condition that more than 45 bidders joined the auction. Predicted savings for this sub-set is 34,224%. Summarizing these findings, it can be seen that as the number of bidders increases, savings increases as well. The advantage of such a model is that, it does not just find the dependence between the two parameters, but also predicts concrete savings based on the number of bidders.

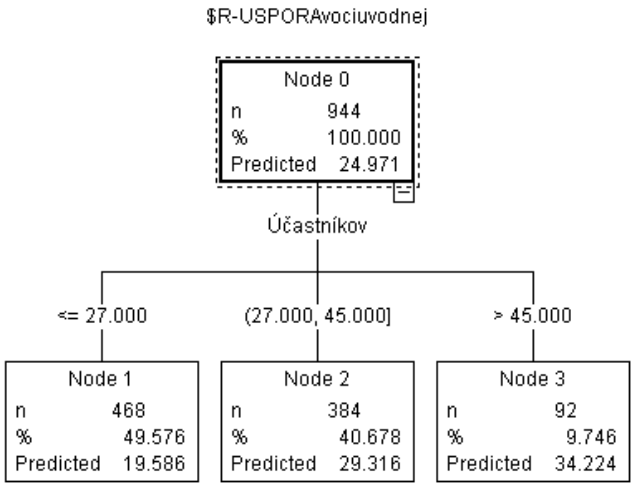

Fig. 2 Decision tree (CHAID algorithm): Number of Bidders vs. Savings dependency

3.2. Complexity of the auction settings

In the first section, Research question 2 with all the corresponding sub-questions will be analyzed. For the purposes of this analysis Auction Settings Adoption Indicator (ASAI) was calculated. This indicator contains 7 parameters that are most often set by buyers when using electronic reverse auctions. Each parameter entering the indicator can be of two values; either it is 0 or 1. If it is 0, it means, that this parameter was set to off, while 1 means that indicator was on, in the given auction. Taking into consideration nature of the Auction Settings Adoption Indicator, that has been designed by the authors for the purposes of this study only, it is clear that the similar study with which the results could be compared does not exist. However, for the purposes of this study, it is assumed that more parameters necessary to set before the auction requires more resources in the form of time-

spent and knowledge required from the buyers and so it should be compensated by the higher savings. According to this assumption, following prediction can be formed: the higher the ASAI is, the higher the savings are.

As the first statistical method, correlations were calculated to determine the strength of the associations among the following pair of variables: Auction Settings Adoption Indicator – Savings. The most commonly used bivariate correlation test - Pearson correlation test is calculated and then Kendall and Spearman follows to support the findings. In the Table 3, correlation matrix is shown. Correlation coefficients ranging from -0,100 to -0,150 mean only very small correlation. However the surprising part is the minus sign, meaning negative correlation. In other words, it is not just that the prediction was not supported, but if something, than quite opposite can be stated. Looking at the results interesting topic arises. Are these results affected by the lack of knowledge of the buyers, who even if they are willing to use advanced settings, they still adopt trial-and-error method? Would it be beneficial for the buyers, to have at their disposal any smart technology that would assist buyers in the whole auction process? The knowledge base in such a smart technology could be managed by the auction providers, or more interestingly, in case of networked environment, it could be self-regulated and could provide assistance based on best-practices from various clients.

		Savings (in %)	
Pearson	**ASAI**	Correlation Coefficient	-,150**
		Sig. (2-tailed)	,000
		N	882
Kendall's tau	**ASAI**	Correlation Coefficient	-,100**
		Sig. (2-tailed)	,000
		N	882
Spearman's rho	**ASAI**	Correlation Coefficient	-,127**
		Sig. (2-tailed)	,000
		N	882

Table 3 Correlation matrix: Auction Settings Adoption vs. Savings dependency; Source: own table

In the Fig. 3, it is clearly seen that the highest savings are achieved when the combination of 5 different parameters is used. However, this scatter plot does not identify, what are the possible combinations that would bring such high savings. Answer to this question is hidden in the decision tree model.

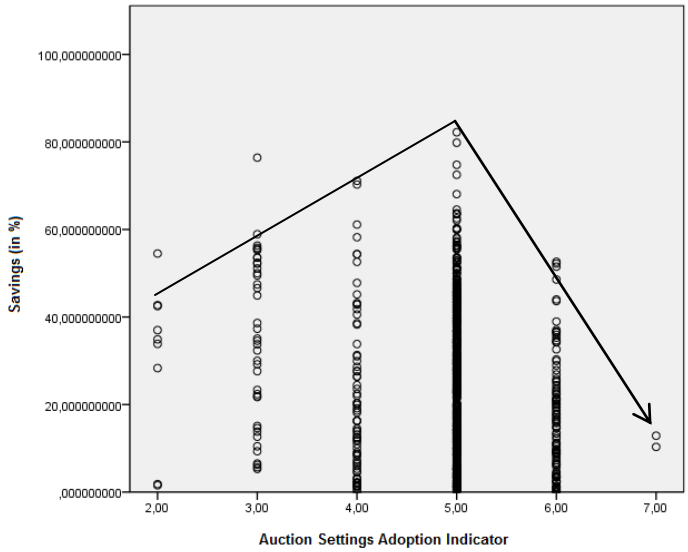

Fig. 3 Scatter plot Auction Settings Adoption Indicator and Savings dependency

In order to further analyze the impact of the settings on the outcome of the auction, decision tree model using SPSS Clementine was built, see the Fig. 4. The C5.0 algorithm was used, due to the fact that the output value – Savings were binned into 4 equally filled intervals (4 quartiles). In this case, three inputs were selected: Number of bidders actively acting in submitting bids (NoAB), Auction Settings Adoption Indicator (ASAI) and the auctioned value.

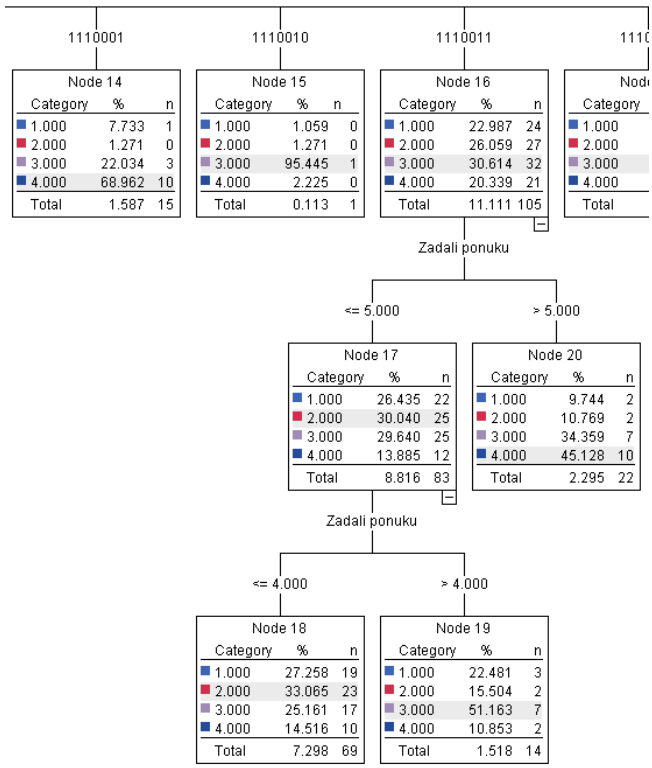

Fig. 4 Decision tree (C5.0 algorithm): Complexity of auction settings vs. Savings dependency

The generated model is too complex to be shown complete in the Fig. 4. On the first level, 21 combinations of different auction settings are shown with the corresponding frequencies of savings

in 4 given intervals. Some of the auction settings combinations are further divided by the number of the bidders actively acting in submitting the bids and possibly by the auctioned value. The final depth of this decision tree is 8 levels and 116 nodes in total. It is quite difficult for a human to analyze such decision trees and especially, when the number of the inputs increases and some automated smart solutions are required. In order to prove that such analysis makes sense, the following combination of auction settings – 0110100 has been singled out. This combination was adopted in 37 auctions in total. However, what is so interesting is the fact that 19 out of 37 auctions finished with the highest savings within the fourth quartile. Regarding the rest, 7 fall into the both third and second quartile, while just 4 out of 37 fall into the first quartile. This is just one of many possible findings that could have never been identified just by using standard statistical methods.

4. Conclusion

The purpose of this research was to analyse or discuss the need for higher support of business networking solutions providing higher transparency, competitiveness and better/more objective prices and negotiated conditions on the market. According to theory, where increasing number of competitors was only modelled and never fully achieved in physical worlds, the world of business networks or at least reverse auctions approach this reality to the theory's assumptions. We have tested the strength of the relations between number of competitors (a la market participants) and savings (price or negotiated contractual conditions) on real data very close to transparent market or market with full information. We have found that the number of competitor in real negotiation environment has really impact on negotiated price which seems to be more market realistic. On the other hand, the strength of correlation is not so high to fully accept the theory without deeper analyses of this complex problem as price seems to be not only factor influencing the more objective (real market) price. Together, we have examined also the complexity of auction parameterization for achieving better contractual conditions. We have found that the complexity itself does not say about fully utilization of reverse auction possibilities for electronic negotiations. According to decision trees, where we have only limited number of input parameters, it seems, that the problem of reverse auction optimal setting for most effective procurement is again more complex as many studies present. We have found that simple parameters presented in other studies as number of auction participants and two ways of information visibility in e-auction doesn't describe the efficiency of optimal procurement results. Due to number of new data created by new negotiation tools, it requires more sophisticated analytical or data-mining tool over the auction process to provide more quality decision support for achieving optimal procurement conditions (price, service condition, quality, etc.). It calls for smart solutions supporting procurement decision making integrating network data and new kind of data generated through innovations in auction parameterization.

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References

Amelinckx I., Muylle S., Lievens A. (2008), "Extending electronic sourcing theory: An exploratory study of electronic reverse auction outcomes", Journal of Electronic Commerce Research and Applications, Vol. 7 No. 1, pp. 119-133.

Carter C. R., Stevens C. K. (2007), "Electronic reverse auction configuration and its impact on buyer price and supplier perceptions of opportunism: a laboratory experiment", Journal of Operations Management, Vol. 25 No. 5, pp. 1035-1054.

Carter C. R., et al. (2004), "Reverse auctions: Grounded theory from the buyer and supplier perspective", Transportation Research, Vol. 40 No. 3, pp. 229−254.

Dorcak, P., Pollak, F. (2011). Analysis of effectiveness of selected social media, In: IDIMT-201: interdisciplinarity in complex systems: 19th interdisciplinary information management talks., Linz : Johannes Kepler Universität, 2011. Pages: 305-312. ISBN 978-3-85499-873-0.

Doucek, P., (2010). Human Resources in ICT – ICT Effect on GDP. In: IDIMT-2010: Information Technology - Human Values, Innovation and Economy. 18th Interdisciplinary Information Management Talks. Linz: Trauner Verlag universität, Book Series: Schriftenreihe Informatik Vol.: 32, pp. 97-106. ISBN 978-3-85499-760-3.

Doucek, P. (2011) Human Capital in ICT – Competitiveness and Innovation Potential in ICT. In 19th Interdisciplinarity Information Management Talks. IDIMT-2011. Linz: Universitat Linz, 2011, pp. 11-21. ISBN 978-3-85499-873-0

Doucek, P., Nedomova, L., Novotny, O. (2010). How ICT Effect the Czech Econnomy. In: Informační technologie pro praxi. Ostrava, 07.10.2010 – 08.10.2010. TU Ostrava, 2010, pp. 14–23. ISBN 978-80-248-2300-3.

Gavurova, B. (2011). Systém Balanced Scorecard v podnikovom riadení. In: Ekonomický časopis. 59(2), pp.163-177. ISSN 0013-3035.

Gavurova, B. (2012). Source Identification of Potential Malfunction of Balanced Scorecard System and Its Influence on System Function. In: Ekonomie a management. E+M. 15(3), pp.76-90. ISSN 1212-3609.

Glova, J., Gavurova, B., Szabo, S. (2011). Using RFID technology in supply chain management systems in aviation. In: Acta Oeconomica Cassoviensia. 4(1), pp. 13-22. ISSN 1337-6020

Janke, F., (2011). The Use of Hidden Data in Electronic Business Networks: Benchmark and Network Performance Indicators. In: IDIMT-2011: Interdisciplinarity in Complex Systems. 19th Interdisciplinary Information Management Talks. Linz: Trauner Verlag universität, Book Series: Schriftenreihe Informatik Vol.: 33, pp. 341-348. ISBN 978-3-85499-760-3.

Novotny, O. (2008). IT Performance Management as a part of the Corporate Performance Management System. In: IDIMT-2008 Managing Unmanageable. Jindřichův Hradec 10.09.2008 – 12.09.2008. Linz : Trauner Verlag Universitat, 2008, p. 15–22. ISBN 978-3-85499-448-0.

SAP White Paper, (2006), "Reverse Auction Best Practices: Practical Approaches to Ensure Successful Electronic Reverse Auction Events". [pdf] SAP AG. Available at: <http://www.sdn.sap.com/irj/scn/index?rid=/library/uuid/b018b90a-b9e5-2910-c6bd-f8f7bc3a34a9> [Accessed 3 July 2012].

Sudzina, F., Pucihar, A., & Lenart, G. (2011). A Comparative Study of the Impact of ERP Systems Implementation on Large Companies in Slovakia and Slovenia. In: Enterprise Information Systems, PT 1, Book Series: Communications in Computer and Information Science, Vol. 219, 322-330

Szabo, S., Gavurova, B. (2011). Význam motivačných determinantov v strategickom systéme merania a riadenia výkonnosti. (CD-ROM).In: Výkonnosť organizácie: Prístupy k zvyšovaniu výkonnosti organizácie: zborník príspevkov z medzinárodnej vedeckej konferencie : 22. - 23.9.2011, Nový Smokovec. - Poprad : Výskumný ústav ekonomiky a manažmentu, 2011 S. 249-262. - ISBN 978-80-970458-3-8

Zgodavova, K., Bober, P. (2012). An Innovative Approach to the Integrated Management System Development: SIMPRO-IMS Web Based Environment. In: Quality Innovation Prosperity, 16(2), pp. 59-70

THE SIGNIFICANCE OF GLOBAL MARKET DATA FOR SMART E-PROCUREMENT PROCESSES

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Keywords

Global market data, e-procurement, supplier, evaluation

Abstract

The efficiency of procurement process is determined by appropriate decision making in the field of winner selection problem. Within this decision making, data from internal and external data are considered by purchasing managers. In the paper we are examining the significance of the global market data usage for winner selection process against internal company data. The study is based on business simulation game and reveals the fact, that current preferences of purchasing managers are still more focused on price and then internal data aggregated by company from their past transactions. Although, in the field of ratings, purchasing managers with extensive eSkills prefer global market data for more efficient decision making.

1. Introduction

Supply chain management has been recognized as one of the most important business process and management functions for achieving higher business efficiency and competitive advantage. Within

global markets, companies are facing more intensively challenges in the field of improving their overall performance (Prajago et al, 2012). The fact that suppliers play a key role in affecting firms' performance has been well recognized in the literature (Donlon, 1996; Min and Mentzer, 2004; Kannan and Tan, 2006b; Li et al., 2006; Koh et al., 2007; Chow et al., 2008). According to Ford (2003), the high costs of purchased goods and services typically account for around 70% of the total cost (Ford, 2003).

One of the most crucial points of effective strategic supply chain management, the procurement function is considered (Talluri and Sarkis, 2002). In line with procurement process innovation, advances in information technology (IT) support companies to achieve substantial economic benefits within business processes (Devaraj et al., 2007; Doucek et al, 2010; Dorčák & Delina, 2011; Dorčák & Pollák, 2011; Sudzina et al, 2011; Delina & Tkáč, 2010; Hill and Scudder, 2002). Todays, e-procurement applications impact companies by costs reduction, increases of overall profitability, or generally improve procurement practices and economic benefits (Olson and Boyer, 2003). According to Delina & Tkáč (2010), one of the crucial factors how to increase efficiency of cooperation with suppliers and how to increase procurement efficiency is trust building in electronic business environment with special attention on reputation evaluation (Delina 2008).

However, procurement is a complex process involving sourcing, analyzing, negotiating and assessing. The ICT support for analytical and evaluation phases is crucial for better decision making and recognizing the value of e-procurement innovation (Novotny, 2008; Gavurova, 2011; Pridavok & Delina, 2013). To fully utilize effects of ICT in business processes, Doucek (2010, 2011) consider the human aspect and e-skills as crucial.

In this paper, we are examining winner selection decision problem in e-procurement process with focus on utilizing ICT solutions for access to global market data. The global market data in sourcing and negotiation analysis are important to recognize the value of business network data generated by huge amount of e-business transactions within this network (Delina, 2012). This value consists in extension of relevant information about supplier's behaviour and changes in external environment and better business/supplier risk management. Such ICT support can improve decision making and overall efficiency of purchasing in the company.

2. Methodology

2.1. General research problem

Smart solutions for eSupply chain management, esp. for e-sourcing and e-procurement should be based on general smart technology principles. These principles provide higher quality decision making through more sophisticated analytical data. The example, how to improve the decision making in global market, is to implement also data gathered and processed from external market as an extension of common local company data which were aggregated by the company during past transactions. Such a data can reflect global market risk, trends or specific behaviour of potential business partner hidden in local business data. This data extension can reduce opportunistic behaviour or negative trends in behaviour of potential business partners with undesirable impact on company's stability and different business indicators within SCM. For the better understanding, how the usability of global market data solutions are perceived by the purchasing managers within procurement processes, following experiment was proposed, realized and analyzed to answer our research questions:

- What is the position or significance of the access to the global market data provided by electronic procurement solutions by companies?
    - What is the position of global market data against other common parameters considered in winner selection process?
    - What is the position of global market data against local data aggregated by the company?

2.2. Design of the experiment

For the analysis, data from experiment based on simulation business game was used. Greenlaw et al. (1962) determine a business game (or business simulation) as a sequential decision-making exercise structure around a model of a business operation, in which participants assume the role of managing the simulated operation. In our case, purchasing managers were confronted with simulated situation in purchasing decisions. Each manager had approx. 30 rounds of winner selection process, where each round provided three business offers with several parameters:

- Price – which was generated within interval from worst price (1) to best price (5).
- Internal rating – representing general satisfaction of the company in all examined issues of already realized business transactions with particular supplier.
- Global market rating - representing general satisfaction of the global market (all companies on the market with historical experiences with particular business partner)
- Internal history – representing the frequency of business transactions historically realized with particular business partner within purchasing company.
- Global market history – representing the frequency of business transactions within global market (if the company is new on the market, or has already realized transactions with companies on the global market, not with examined purchasing company).
- Financial stability – representing the financial situation of the supplier, liquidity or other problems reflecting potential financial bankrupt/insolvency
- Satisfaction with the communication with relevant seller – representing overall satisfaction with direct person (seller), which is responsible for the communication with relevant purchasing company.

Each supplier within one round was ordered from 1 (the best) till 3 (the worst). For the analysis, we have used linear econometric model with dependent variable “Order” and several mentioned independent variables.

2.3. Sample description

Within the experiment, more than 400 companies (one purchasing representative for each company) from Czech and Slovak Republic were asked to join the business simulation game. For the differentiation between their e-Skills we have used 4 scales: 1 (none experiences or very little), 2 (basic e-communication skills), 3 (advanced e-business skills, e.g. with ERP), 4 (high e-business skills, e.g. usage of e-marketplaces, sophisticated negotiation tools, etc.). The basic description of our experiment and sample used is provided in Table 1.

Number of total rounds	13.161	Extensive e-Skills	34
Number of suppliers in one round	3	Medium e-Skills	100
Number of selection criteria	7	Low e-Skills	108
Number of companies involved	455	Very low e-Skills	35

Table 1. Description of experiment and sample

3. Research results

For the analysis, we have applied general linear econometric model to describe the statistical relationship between the various parameters of the winner selection process. As in each round, three supplier offers were ordered by purchasing managers where the first place was the best; the order was selected as a dependent variable.

3.1. Global market data vs. common winner selection factors

The position of global market data against all parameters considered in winner selection process is determined with very strong position of price what is visible from Table 2. The price is still a dominant factor for selection of supplier and within the model we see very big differences in t-tests of relevant parameters.

Linear model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,702	,058		63,518	,000
	Internal_rating	-,063	,003	-,115	-18,043	,000
	Global_rating	-,038	,004	-,068	-10,750	,000
	Internal_history	-,059	,010	-,038	-5,923	,000
	Market history	-,030	,010	-,019	-2,979	,003
	Price	-,276	,004	-,501	-78,618	,000
	Financial health	-,111	,006	-,117	-18,372	,000
	Satisfaction with communication	-,046	,006	-,049	-7,643	,000

a. Dependent Variable: Order

Table 2. Linear econometric model with all winner selection parameters

On the other hand, we can see that all seven parameters are significant on the 99% interval of confidence. The global data, in this case global rating and global history are still behind the local company data. Generally it means, that companies still prefer own aggregated data from their historical experiences. Simply, they trust more own data as the data gathered from market as external environment.

To be able to analyze the position of global data, we will exclude from the model price, financial health and satisfaction of the communication and have a closer look on ratings and long term relations in internal and external environment of the company.

3.2. Global market data vs. internal company data

To study the position of global market data against internal data aggregated by the company we will consider the experiences with ICT or ecommerce solutions as determinant.

eExperiences	**very low**			**low**		
Linear model	Standardized Coefficients			Standardized Coefficients		
	Beta	t	Sig.	Beta	t	Sig.
(Constant)		13,986	,000		26,529	,000
Internal rating	-,080	-3,258	,001	-,122	-11,271	,000
Global rating	-,083	-3,386	,001	-,066	-6,152	,000
Internal history	-,083	-3,410	,001	-,036	-3,372	,001
Market history	-,042	-1,700	,089	,001	,105	,917
eExperiences	**medium**			**extensive**		
Linear model	Standardized Coefficients			Standardized Coefficients		
	Beta	t	Sig.	Beta	t	Sig.
(Constant)		22,929	,000		13,030	,000
Internal rating	-,142	-11,037	,000	-,063	-2,557	,011
Global rating	-,092	-7,111	,000	-,077	-3,139	,002
Internal history	-,029	-2,251	,024	-,057	-2,327	,020
Market history	-,016	-1,229	,219	-,039	-1,602	,109

Dependent variable: Order

Table 3. Linear econometric model with rating's and business history parameters

We can assume that companies with more extensive e-experiences, e.g. with electronic marketplaces functionalities and character will recognize the value of global market data solutions for their procurement decision making. That's the reason, why we have tested ratings and historical parameters with linear econometric models for four samples according to their level of e-experiences (e-skills).

As we can see from Table 3, within companies with higher experiences the market history of potential supplier is not significant on the 95% confidence interval. Although, companies with highest e-experiences consider *Global rating* more important than *Internal rating*. It means they recognize the value of global market data against their bounded internal experiences.

		Local company data / Internal rating diff							
		-4	-3	-2	-1	1	2	3	4
		Count	Count	Count	Count	Count	Count	Count	Count
Price diff	-4	0	1	0	3	5	5	2	1
	-3	2	4	3	4	11	7	5	6
	-2	1	3	7	10	13	13	15	6
	-1	5	9	18	16	31	52	29	12
	1	11	15	56	70	79	85	46	28
	2	9	21	52	62	66	63	35	13
	3	7	18	29	43	48	39	30	11
	4	3	8	13	20	19	13	7	5

Table 4. Frequency table of relations between 1th and 2nd place price and internal rating differences

		Global market data / Global rating diff							
		-4	-3	-2	-1	1	2	3	4
		Count	Count	Count	Count	Count	Count	Count	Count
Price diff	-4	0	0	0	8	9	0	0	0
	-3	0	0	0	15	27	0	0	0
	-2	0	0	0	20	48	0	0	0
	-1	3	13	15	31	53	27	20	10
	1	17	29	49	89	84	63	37	22
	2	0	0	0	156	165	0	0	0
	3	0	0	0	96	129	0	0	0
	4	0	0	0	41	47	0	0	0

Table 5. Frequency table of relations between 1st and 2nd place price and global rating differences

As the whole experiment involved price as the winner selection process, and according to Table 2 the price determined lower level of significance of other parameters, we have also analyzed the differences in prices and ratings on the first and second place ordered by purchasing managers. We wanted to identify, if there exist some influence of internal and global ratings on first place selection when for example the price between first and second place was not so different. We have processed special frequency table providing information on differences between prices on the first and second places and the same with internal and global rating. Results are presented in Table 4.

From both tables we can see different situation in internal and global rating differences with comparison to price differences. In the Table 4, the values are distributed almost on whole table. It means, also by extreme price differences almost all positively and negatively correlated internal ratings differences with slight dominance of positive internal rating correlation is visible. In Table

5, we see interesting phenomenon. Global rating was considered as slightly positive determinant for winner selection only when small price differences exist. Especially, when second place was described by price worse about 1 level, then positive global ratings was more dominantly used in winner selection. And vice versa, when only small global ratings differences on 1st and 2nd place exist, then dominantly positive price differences were significant for winner selection. Generally, also this table shows some significance of global rating data although still with higher dominancy of price.

4. Conclusions

Current development of e-business and business intelligence solutions determine the efficiency of relevant decision making processes. Although, the e-procurement decision making processes are still little bit behind the wave and global market analyses and data are not so preferred by purchasing managers. Consecutive pressure on the smart processes and solutions used for decision making will affect also procurement environment. The evidence was shown in our research, were companies with highest e-experiences, e.g. with electronic marketplaces, consider global market data and analytical solutions more important than their internal data aggregated within the company during past periods about their business partners. This result provides the opportunity for smart solution developers and providers in the sector of e-procurement technologies in near future.

References

Chow, W., Madu, C., Kuei, C., Lu, M., Lin, C., Tseng, H. (2008).. Supply chain management in the us and Taiwan: an empirical study. Omega 36 (5), 665–679.

Delina, R. (2009). Reputation Building for Electronic Marketplaces. In: AMBIENT INTELLIGENCE PERSPECTIVES Book Series: Ambient Intelligence and Smart Environments. Vol. 1, Pages: 66-72, DOI: 10.3233/978-1-58603-946-2-66

Delina, R. (2012). Perspectives of enterprise networking for single e-market. In: IDIMT-2012: 20th Interdisciplinary Information Management Talks. Linz : Johannes Kepler Universität, 2012. pp. 327-336. ISBN 978-3-99033-022-7.

Delina, R., & Tkac, M. (2010). The Impacts of Specific ICT Solutions on Productivity. In: IDIMT-2010 Information Technology – Human Values, Innovation and Economy. Linz: Trauner, 2010, ISBN 978-3-85499-760-3.

Delina, R., Tkac, M. (2010). "Trust Building Mechanisms for Electronic Business Networks and Their Relation to eSkills." World Academy of Science, Engineering and Technology 6.71 (2010): 380-390.

Devaraj, S., Krajewski, L. & Wei, J. (2007), "Impact of e-business technologies on operational performance: the role of production information integration in the supply chain", Journal of Operations Management, 25(6), pp. 1199-1216.

Donlon, J., (1996). Maximizing value in the supply chain. Chief Executive 117 (10), 54–63.

Dorčák, P., Delina R. (2011). Impact of E-marketing Services on Economic Performance. Ekonomický časopis. 59 (1), 44-58, ISSN 0013-3035.

Dorčák, P., Pollák, F. (2011). Analysis of effectiveness of selected social media, In: IDIMT-201: interdisciplinarity in complex systems: 19th interdisciplinary information management talks., Linz : Johannes Kepler Universität, 2011. Pages: 305-312. ISBN 978-3-85499-873-0

Doucek, P. (2011) Human Capital in ICT – Competitiveness and Innovation Potential in ICT. In 19th Interdisciplinarity Information Management Talks. IDIMT-2011. Linz: Universitat Linz, 2011, pp. 11-21. ISBN 978-3-85499-873-0

Doucek, P., (2010). Human Resources in ICT – ICT Effect on GDP. In: IDIMT-2010: Information Technology - Human Values, Innovation and Economy. 18th Interdisciplinary Information Management Talks. Linz: Trauner Verlag universität, Book Series: Schriftenreihe Informatik Vol.: 32, pp. 97-106. ISBN 978-3-85499-760-3.

Doucek, P., Nedomová, L., Novotný, O. (2010). How ICT Effect the Czech Econnomy. In: Informační technologie pro praxi. Ostrava, 07.10.2010 – 08.10.2010. TU Ostrava, 2010, pp. 14–23. ISBN 978-80-248-2300-3.

Ford, D. (2003). Managing Business Relationships, 2nd ed. J. Wiley, Hoboken, NJ.

Gavurova, B. (2011). The Balanced Scorecard System in Enterprise Management. In: Ekonomicky casopis. 59 (2), 163-177

Greenlaw, Paul S., Herron, Lowell W. and Rawdon, Richard H. (1962). Business Simulation in Industrial and University Education. Prentice-Hall, Inc., Englewood Cliffs, N.J.

Hill, C. & Scudder, G. (2002), "The use of electronic data interchange for supply chain coordination in the food industry", Journal of Operations Management, 20(4), pp. 375-387.

Kannan, V.R., Tan, K.C. (2006). Buyer–supplier relationships: the impact of supplier selection and buyer–supplier engagement on relationship and firm performance. International Journal of Physical Distribution & Logistics Management, 36 (10), 755–775.

Koh, S., Demirbag, M., Bayraktar, E., Tatoglu, E., Zaim, S., (2007). The impact of supply chain management practices on performance of smes. Industrial Management and Data Systems 107 (1), 103.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S., Rao, S.S., (2006). The impact of supply chain management practices on competitive advantage and organizational performance. Omega 34 (2), 107–124.

Min, S., Mentzer, J., (2004). Developing and measuring supply chain management concepts. Journal of Business Logistics 25 (1), 63–100.

Novotný, O. (2008). IT Performance Management as a part of the Corporate Performance Management System. In: IDIMT-2008 Managing Unmanageable. Jindřichův Hradec 10.09.2008 – 12.09.2008. Linz : Trauner Verlag Universitat, 2008, p. 15–22. ISBN 978-3-85499-448-0.

Olson, J.R., Boyer, K. (2003). Factors influencing the utilization of Internet purchasing in small organizations. Journal of Operations Management, 21(2), 225-245.

Prajogo, D., Chowdhury, M., Yeung, A.C.L. & Cheng, T.C.E. (2012). The relationship between supplier management and firm's operational performance: A multi-dimensional perspective, International Journal of Production Economics, 136(1), March 2012, 123-130

Prídavok, M., Delina, R. (2013). Effective Spend Management Through Electronic Reverse Auction Configurations, Quality Innovation Prosperity, 17 (1), 1-9.

Sudzina, F., Pucihar, A., & Lenart, G. (2011). A Comparative Study of the Impact of ERP Systems Implementation on Large Companies in Slovakia and Slovenia. In: Enterprise Information Systems, PT 1, Book Series: Communications in Computer and Information Science, Vol. 219, 322-330

Talluri, S., Sarkis, J. (2002). A Model for Performance Monitoring of Suppliers. International Journal of Production Research. 40: 16. pp.4257-4269.

WHY MODERN MOBILE AND WEB-BASED DEVELOPMENT NEED A LEAN AGILE WEB APPROACH (LAWA)

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Abstract

Modern mobile and web-based services development requires a flexible management approach which adjusts to a dynamic software environment. Agile approaches provide an adequate basis for quickly changing requirements and the need for close customer collaboration. Still, there are certain requirements need to be addressed during the development phase. In this paper we examine why agile approaches are appropriate for software development in Web 2.0, Cloud and Mobile environments. It will be presented how agile methods and principles were applied in the start-up "Takeplace". From this case experience and theoretic approaches on Agile Unified Process, SCRUM or lean start-up, the LAWA – Lean Agile Web Approach – was developed. This approach is designed to be easily applicable in small projects, in start-ups focusing on IT development, but also within larger corporations.

1. Introduction

Mobile and web-based services in Web 2.0 Cloud environments challenge software developers and mangers due to rapid growth and volatile markets (Abrahamsson et al., 2003). Dynamic software development environment require adaptive and flexible development systems to avoid scope creep (Morien, 2005; Aitken et al., 2002). Classic practices – long planning phases followed sequentially by designing, developing, testing and deploying all required software parts – mismatch the dynamic web-service market (Augustine et al., 2005). In the past years, agile approaches were developed to adjust software management to the uprising demand for quick response to changes and the increasing need for customer inclusion.

In this paper, we examine why Web 2.0 requires agile approaches. In particular, relevant aspects of developing web-based services and their implications for a shift in managerial approaches are revealed. Essential aspects of agile software development and agile management are examined in order to provide an appropriate theoretic basis for the case example and presentation of Lean Agile Web Approach (LAWA). Further, the case example of "Takeplace" demonstrates the application of agile processes and principles in a start-up company. The case illustrates how traditional software development and managerial approaches were insufficient for a start-up company. Resulting, the design of the adjusted development approach LAWA – Lean Agile Web Approach – will be presented. Finally, the results will be concluded and the limitations of this research are described.

2. Underlying concepts

The increasing significance of Web 2.0 together with Cloud and the trend towards mobile application raised new challenging questions in software development. This section provides a brief overview of Web 2.0 principles and explains how agile management approaches address the specific requirements of mobile development environments.

2.1. Web 2.0 development

The term Web 2.0 is closely associated with Tim O'Reilly (2007) – it refers to web-based applications providing rich user experience with application functionality. It ensures information sharing, mutual user collaboration and user-generated content, which are an added value of the web-based services. According to O'Reilly (2007), seven major principles can be distinguished in Web 2.0. In this paper, two aspects are especially relevant.

First, the ability to control software's environment on the web, which helps to fix software without disturbing any updates, is a vital principle. For example, the popular web-based service Flickr deploys a new version of the service every half hour. This also means that software development is kept in a "perpetual beta" stage (Morris, 2006) for significantly long periods of time. Second – as the content of Web 2.0 is mainly user-generated, and communities and collaborations are a key aspect – services need to focus on user's expectations and needs to ensure user's satisfaction and commitment to a service. The term "network effect" describes the impact of users to a service or product. Each particular user creates the value of the service or product and changes needs of other users. This implies that the value of a service or product assembles in prince as well as *expected* size of the network (Farrell & Saloner, 1985). Sales are depending not only on the equilibrium of price or offer – user's contribution and satisfaction are an essential aspect regarding modern web-based services.

These characteristics of Web 2.0 – compared to Web 1.0 technologies – have an important impact on project management of web-based services. Special features of modern web-based services such a perpetual beta, absence of software release cycle, dynamic scalability, or lightweight programming models, sampling and testing (Mahemoff, 2006; Pitner et al., 2008) requires special approaches distinguishing from classical ones. In addition, mobile applications are developed in a similar dynamic way with emphasis to a close cooperation between developers and UIX/graphical designer. It arises from the need to have flawless user experience and graphical user interface, without which mobile applications cannot compete on the market and are doomed to fail. Due to very short prototyping cycle and the need for remote, flexible project management approaches are even more required.

2.2. Why Agile Management?

In the past years, several researchers elaborated that traditional management and development approaches – where process are pre-described and plans are followed – mismatch with the current evolution of the technological sector (Highsmith, 2004; Augustine et al., 2005; Nerur et al., 2005). Volatile environments, quickly changing technologies and markets, as well as a stronger focus on social aspects require innovative project management approaches beyond traditional, linear methodologies (Augustine et al., 2005; Coram & Boner, 2005). Based on Toyota's attempt towards leanness, modern software development methodologies – including eXtreme Programming (XP) (Beck, 1999) or SCRUM (Schwaber & Beede, 2001) – were developed. To create a meta-approach for the different streams on agile development and define basic principles for agile management, the "Manifesto for Agile Software Development" was published in 2001 (Beck et al., 2001). Certainly, further research referred to the basic definition and principles stated in this Agile Manifesto.

Agile methodologies - whereas *agile* is described as "the continual readiness of an entity to rapidly or inherently, proactively or reactively, embrace change, through high quality, simplistic, economical components and relationships with its environment" (Conboy & Fitzgerald, 2004, p.40) – are build upon principles such as responding to change, enabling simplicity by focusing on working software, facilitating relationships through close collaboration with customers, and emphasizing interactions between individuals (Beck et al., 2001). Further features are characterizing agile methodologies: working in small teams, a tight collaboration with all stakeholders, frequent reviews and reflections, short release cycles initiating continuous testing, and time-boxed prioritization and development (Coram & Boner, 2005). Unlike traditional methodologies, agile concepts rely on short, iterative, feature-driven development cycles, as well as on period reflection, which enables continuous learning (Chau et al, 2003), and on collaborative decision-making involving all stakeholders. Further, agile management approaches facilitate intense communication and the sharing of tacit knowledge (Nerur et al., 2005).

The characteristic of intense communication manifests in the SCRUM process – a lightweight, iterative and incremental process designed for software development – in daily meetings and regular feedback cycles (*sprints*) meetings which encourage sharing of tacit knowledge and involvement of stakeholders. Studies showed that a well-applied SCRUM process can increase the productivity significantly and reduces time effort (Morien, 2005). Still, this only applies if the SCRUM process is introduced in an environment that considers the essential aspects of agile management – such as openness and trust within the project team, and a respectful, cooperative approach towards the customer. As main positive effects of agile management are only fully achieved by creating a highly collaborative environment (Coram & Boner, 2005), agile methods should be understood as a comprehensive, managerial concept. As Highsmith (2004) stated: "Agility is more an attitude than a process, more environment that methodology" (p.8). The lack of reflection of the chosen technology and an operating environment generally may lead to improper decisions, which results in higher cost, longer development period, refusal on the market, or lower return on investment. This was one major reason for the design on LAWA which will be described in detail after referring to the case example from practice.

3. Case Example "Takeplace"

Takeplace[8] is a web service designed and implemented on the basis of expert requirements for an appropriate tool to facilitate the efficient organization of events based on meeting, sharing and communication. It is a cloud mobile and digital platform that handles all stages of an event, from the moment the idea is born to the participant feedback collection. Takeplace covers a wide range of sophisticated organizational processes with a unified user interface. Users are provided with a web and mobile interface and gain access to the standard services for organizing events according to various types.

3.1. Application of Agile Management in Takeplace

Takeplace was founded in 2010, starting with a small team of two to four persons; currently, up to eight people are working on developing web-based and mobile services. In the beginning, various approaches towards software development and management were tested, but not all approaches worked out well. Classical software development methods such as *Waterfall* showed their disadvantages during the development process: costs of debugging were high while the overall control of the process was not satisfying. Incremental approach improved progress monitoring, but still higher maintenance cost remained. Given the need for lowering the maintenance costs, agile management approaches were reviewed, and finally a SCRUM process seemed appropriate for the development environment.

In case of Takeplace, a one-week sprint period was examined to be most appropriate. Each sprint starts with the sprint planning, where the sprint goal is presented (major functionality usually in the form of the new Takeplace release, or tangible goal that is to be produced by this sprint) and product backlog items for the sprint are elaborated with the development team. In this phase of the process, all stakeholders are involved – not only product owner and developers, but also sales and marketing representatives. As they are in daily contact with the customer, they ensure the users' involvement in the development process, provide feedback, and communicate what customers expect in the next release cycle. At the end of each sprint, review meetings are organized to present the output of the iteration. Usually, the sprint review and planning are done at the same day, following the preceding testing phase.

Product backlog and sprint backlog are kept in services with customized environment according to our needs. This approach, which provides collaborative tools and various levels of details, ensures a close connection to all stakeholders in the project. Even persons with low knowledge of computer sciences get their needed information in an adequate form, while it allows software engineers to focus on the actual work. Further, it enables specific features adjustments within the backlog according to customer's feedback in real-time. From the backlog, it can be derived how much work was spent on particular product backlog items each day and if a task was estimated accurately.

Several special characteristics were found to be relevant in developing services like Takeplace. First, it is essential that all external tools, for example video processing external subsystem or participants' feedback collector, are taken into consideration before adding any product backlog items that are depending on these external functionalities. Having separated sprints for examined external tools proofed to be a good strategy as such sprints help to plan following sprints – it allows Takeplace's developers to consult the product owner in prioritizing and estimating the product backlog items included in external tool usage. Second, sprints to re-factor code have to be specified

[8] http://take-place.com

very explicitly, including precisely formulated sprint goals. Finally, as Takeplace uses several external systems and logical orchestration between core systems and external engines, a need for focusing on automated integration testing was examined, while unit testing was less effective.

Although, the implementation of a SCRUM process for the development was successful and reduced costs for maintenance, it seems that combining an agile development approach with a particular managerial approach was supportive. Flat organizational structures, cooperative decision-making, and a well-communicated corporate vision and strategy are a basis of this managerial approach. Further, the leadership style is based on creating an open environment by encouraging intensive communication and mutual sharing and consulting, and by giving team members freedom in their own work style as well as their work organization.

3.2. Interpretation and Implications for Modern Mobile and Web-Based Development

The example of Takeplace demonstrates how an agile approach provides an appropriate basis for working with quickly changing requirements and user-driven business demands. By applying a SCRUM process for developing web-based applications, maintenance costs were reduced and monitoring got effective. Sprint meetings intensified the cooperation with the customer, while daily meetings intensified the communication within the team. Supported by low hierarchical structures, cooperative decision-making and a facilitating environment, which enables communication and sharing of tacit knowledge and empowers the team members, Takeplace had successfully moved towards becoming an agile organization. Even though these agile development process and managerial approach seems appropriate, further adaptations needed to be done in order to optimize the development process, increase the managerial effectiveness, and ensure the success while Takeplace is growing. Especially critical and fundamental initial phases, where the idea, problem and prospective solution are validated, are integrated with lean business canvas and resulted in LAWA.

4. LAWA design

In order to fulfil the requirements mentioned in the previous chapters, we chose to base our approach upon agile methodologies, in particular the SCRUM process and the Agile Unified Process. Although the approach is called LAWA – Lean Agile Web Approach – it includes both: web-based and mobile application. This modern software development approach covers all phases - from the idea and project initiation through analytical phases, testing and releasing until marketing and business maintenance. Nevertheless, the emphasis lies on the initial phases (problem identifying, requirements gathering and their validation on the market) and high speed and scalable development process. Two features are specific for the design of LAWA:

- Independency on programming languages and software platforms.
- Utilization in the development of new software as well as the ability to reapply LAWA in existing applications where no methodology has been used yet.

The class of applications for which LAWA is most suited exhibits a regular Web applications and services as well as mobile applications, both developed by a single person or small team, that can be part of bigger structure actually. Examples include enterprise collaborative applications and mobile front-ends of traditional office applications. Since many mobile and Web applications have volatile life cycle that requires frequent updating, some means to routinize and automate both the initial development and subsequent update process is needed.

		Volatility in time: *Low*	Volatility in time: *High*
Complexity	*High*	Low usefulness [e.g. server-side systems]	High usefulness [e.g. collaborative cloud application]
	Low	Not useful [e.g. catalogue]	Medium usefulness [e.g. mobile application]

Table 1. Usefulness of the LAWA approach for design and development of web-based and mobile applications

Table 1 illustrates the applicability of LAWA for design and development of web-based and mobile applications. The two axes representing the complexity (Da-Wei, 2007) and volatility in time are really continuums rather than discrete branches of dichotomy. LAWA is particularly appropriate in two domains which are characterized by high time volatility and high complexity: enterprise collaborative and mobile front-ends applications. In comparison, complex applications with low volatility may gain benefits from applying the LAWA approach in the initiation, validation, design and implementation phase, but would not benefit noticeably in the maintenance phase. Also, if complexity is not high and changes are not frequent, LAWA could be applied but without much effect.

LAWA methodology differs from SCRUM and Agile Unified Process (AUP) in several dimensions: better user involvement, additional project intention validation in combination with lean start-up approach, higher emphasis on graphics, and a more detailed step-by-step procedure for software design and development. Further, different participate in each phase, but the involvement of all team members is highly recommended. *Table 2* provides an overview of the LAWA life-cycle phases.

Preparation	This is the fundamental stage of the whole development. The overall project plan is pre-designed on basis of expected outcomes. Those are understood as a vivid apparatus, in which every part is adjusted permanently. When identifying functional and technical parts of the project, business aspects of the final product or service are validated in parallel. Further, resulting costs of changes are marginal and maximize significantly the ROI for the client.
Specification	This phase is iterative in the LAWA methodology. Functionalities, sections or modules with the highest priority are selected first for an upcoming iteration.
Design	On the basis of processed requirements and conceptual analysis document a detailed behavioural description of the system – the design document – is created.
Construction	At this stage, proposed functionalities are implemented and cyclically validated.
Verification	This phase is performed in an independent iteration within multiple iterations. Here, detail testing is performed.

Table 2. LAWA life-cycle phases

5. Conclusion

Due to the changes that Web 2.0 and especially a *post-PC* mobile era introduce to the software development, management methodologies need to adapt to the dynamic and challenging environment. Traditional methods and techniques are often not suitable for development of modern web-based applications (Cohn, 2009; Holovaty & Kaplan-Moss, 2009; Kacvinský, 2012; Kacvinský & Škrabálek, 2012; Turk et al., 2002) due to the specific character of web-services; for

example fast advancement, strong competitors and the need for continuous development through *perpetual beta* or rapid deployment cycles (Škrabálek, 2010). According to (Ambler, 2007), the rate of the failure is more frequent with projects managed by traditional rigid methods than projects following Agile approach. Agile management, in contrast, emphasizes the focus on human resources, quick reaction on changes and on the importance of customer involvement, and therefore supplements the needs of web-based software development.

The methodology LAWA proceeds iteratively – comparable to the Agile Unified Process (AUP). But in contrast, LAWA requires fewer overhead during implementation as it uses prototyping (conceptual documents). UML is adapted in some parts, but uses other means such as custom procedures. The most significant benefit of LAWA is the awareness of business aspects in projects which minimize the risk of project failure.

5.1. Limitations

Takeplace is one example of how modern web-based development can be successful through applying agile lean processes and principles. As start-up company with lean organizational structures, Takeplace has the possibility to include all stakeholders. Introducing agile approaches in existing, larger companies is often not as successful. According to Augustine, Payne and Woodcock (2005), the rate of failure is more frequent with projects managed by traditional rigid methods than projects following agile approaches. However, many companies are trying to apply agile approaches in software management; but actually follow slightly customized *Waterfall models*, or ignore needed changes such as intensive customer collaboration and an open, trustful working environment. The authors emphasize the need for further empirical research on the effects of agile software development in open, trustful collaboration situation in web-based environments.

Finally, LAWA is a conceptual model, but more detailed description of each phase needs to be elaborated in the future.

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References

Abrahamsson, P., Warsta, J., Siponen, M., & Rokainen, J. (2003). New Directions on Agile Methods – A Comparative Analysis. Proceedings of the 25th International Conference on Software Engineering (ICSE'03), Washington (pp. 244-254). IEEE Computer Society.

Aitken, J., Christopher, M., & Towill, D. (2002). Understanding, Implementing and Exploiting Agility and Leanness. International Journal of Logistics Research and Application: A Leading Journal of Supply Chain Management, 5(1), 59-74.

Ambler, S. W. (2007, November 21). Is Agile really that successful? Dr.Doob's Journal. Retrieved from http://www.drdobbs.com/architecture-and-design/dr-dobbs-agile-newsletter-1107/204200877?cid=Ambysoft, latest access: 06/20/2013.

Augustine, S., Payne, B. S. F., & Woodcock, S. (2005). Agile Project Management: Steering from the Edges. Communication of the ACM, 48(12), 85-89.

Beck, K. (1999). eXtreme Programming Explained: Embrace Change. Boston: Addison-Wesley.

Beck, K., Beedle, M., van Bennekum, M., Cockburn, A., Cunningham, W., Fowler, M., Grennings, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., & Thomas, D.

(2001). Manifesto for Agile Software Development. Retrieved from http://www.agilemanifesto.org, latest access: 06/20/2013.

Chau, T., Maurer, F., & Melnik, G. (2003). Knowledge Sharing: Agile Methods vs. Tayloristic Methods. Proceedings of the Twelfth International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE'03) (pp. 302-307). IEEE Computer Society.

Cohn, M. (2009). Succeeding with Agile: Software Development Using SCRUM. Upper Saddle River, NJ: Addison-Wesley.

Conboy, K., & Fitzgerald, B. (2004). Towards a Conceptual Framework of Agile Methods: A Study of Agility in Different Disciplines. Proceedings of the 2004 ACM Workshop on Interdisciplinary Software Engineering Research (WISER '04), Newport Beach, California (pp. 37–44).

Coram, M., & Boner S. (2005). The Impact of Agile Methods on Project Management. Proceedings of the 12th IEEE International Conference and Workshops on the Engineering of Computer-Based Systems (ECBS'05) (pp. 363-370). IEEE Computer Society.

Da-Wei, E. (2007). The Software Complexity Model and Metrics for Object-Oriented. Proceedings of the IEEE International Workshop on Anti-Counterfeiting, Security, Identification (pp. 464-469).

Farrell, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation. The Rand Journal of Economics, 16(1), 70-83.

Highsmith, J. (2004). Agile Project Management: Creating Innovative Products. The Agile Software Development Series. Boston, MA: Addison-Wesley.

Holovaty, A., & Kaplan-Moss, J. (2009). The Definitive Guide to Django: Web Development Done Right (2nd ed.), Apress Series. CA, USA: Apress Berkely.

Kacvinský, M. (2012). Agile software development methodologies. Diploma thesis. Brno, Czech Republic: Masaryk University.

Kacvinský, M., & Škrabálek, J. (2012). How to achieve competitiveness development? Connect, January 2012, 48-49.

Mahemoff, M. (2006). Ajax design patterns. Sebastopol, CA: O'Reilly Media.

Morien, R. (2005). Agile Management and the Toyota Way of Software Project Management. Proceedings of the 3rd IEEE International Conference on Industrial Informatics (INDIN) (pp. 516-522).

Morris, J. H. (2006, August). Software Product Management and the Endless Beta. Carnegie Mellon University. Retrieved from http://jimmorris.blogspot.co.at/2006_08_01_archive.html, latest access: 06/20/2013.

Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of Migrating to Agile Methodologies: Organizations must carefully assess their readiness before treading the path of agility. Communication of the ACM, 48(5), 73-78.

O'Reilly, T. (2007). What is Web 2.0: Design Patterns and Business Models for the next Generation of Software. Communication & Strategies, 1, 17-37.

Pitner, T., Drášil, P., Hampel, T., & Steinbring, M. (2008). Get Ready For Mashability! Concepts for Web 2.0 Service Integration. In Proceedings of the 10th International Conference on Enterprise Information Systems. Barcelona, INSTICC (pp. 160-167).

Pitner, T., & Drášil, P. (2009). Building Complex Systems on Top of Web 2.0. In Proceedings of the 4th International Conference on Software and Data Technologies (Vol. 2, pp. 179-182).

Schwaber, K., & Beede, M. (2001). Agile Development with SCRUM. New York: Prentice-Hall.

Škrabálek, J. (2010). Integrated Approach in Management of Modern Web-based Services. Dissertation Thesis Topic. Brno, Czech Republic: Masaryk University.

Turk, D., France, R., & Rumpe, B. (2002). Limitations of Agile Software Processes. Proceedings of the Third International Conference on Extreme Programming and Flexible Process in Software Engineering (XP2002) (pp. 43-46). Springer-Verlag.

AN INITIAL PROPOSAL FOR A TEST GOVERNANCE FRAMEWORK IN BUSINESS ORGANIZATIONS

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Testing, information systems development, vendor management, outsourcing, TMMi

Abstract

Software testing as a part of software quality management is currently not a well-covered topic in the information system research, especially from the organizational viewpoint - a serious gap between research and industry exists and continues to broaden. This article helps to bridge this gap. It addresses several organizational aspects of testing and test management, and proposes concept of test governance process framework as a response to the industry needs. Presented framework will allow business organizations to utilize testing outsourcing and offshoring in the future, while they are able to keep key knowledge for strategic and tactical management of testing in-house.

1. Introduction

For business organizations in various segments of the market, information systems (IS) development activities typically do not belong to their primary aim. These organizations rarely operate their own IS development department. Many others assign part or whole software development and testing activities to external partners. Presumption of cost saving benefits is often a primary reason. However, such approach is rarely utilized without complications – new factors e.g. trust, commitment, mutual benefits (Jain, Poston, & Simon, 2011) arise and must be properly managed in order to finalize IS development projects successfully.

Additionally, business organizations often setup their contracts as fixed-time/fixed-price in order to precisely estimate total costs. Although one may assume that this model is rarely fair for both the parties in every case, choosing of a vendor in this mode and with the lowest possible price in the mind is quite common in the business reality (Galin, 2004). Consequently it is quite obvious that proper vendor management must be performed by client organizations in order to prevent project escalation (Kataja & Tuunanen, 2006) during its lifecycle. One of the key project activities of an IS development project is software testing. This activity is considered by the research literature as one of key success factors in IT projects (Chua, 2009), but in an everyday reality it is often cut down due to several constraints. Therefore business organizations are encouraged to implement principles to effectively and coherently govern the software testing process – both over internal and external testing teams, which may be furthermore provided by different vendors, either onshore or offshore.

The aim of this paper is to introduce research framework for this topic and propose grounds of method for implementation of such principles. Primary target group of this research are not software-intensive organizations (hereafter vendors), but rather client business organizations which often lack long-term know-how and best practice in this field, as public models and frameworks are currently not available.

2. State of Art

Although in recent years coverage of software testing in research literature seems to get better, some kind of gap between researchers and industry practise still exists (Mäntylä, Itkonen, & Iivonen, 2012). This problem is global as well as local: Havlickova (2012) points out to the fact that research in the field of software quality management and testing is only loosely connected to the business practice also in the Czech Republic and encourage better cooperation between scholars and industry. As Buchalcevova (2009) states the use of software development methodologies, either rigorous or agile, in the Czech Republic is high below the world's level. In following paragraphs, several key organization aspects of software testing management in business organizations are discussed and new term "test governance" is introduced.

2.1. Organizational Approach

Multiple researchers have studied organizational aspects of testing. A case study run by Ahonen et al. (2004) focuses on three Finish companies and introduces three different organization models being used in real world practice. From this work one should highlight the interdepartmental model, which is being used in many non-software intensive organizations. Responsibility for the testing process in this model is split between several departments, each with own goals. This consequences in the main problems: focus on department interfaces, missing of overall process goals by respective players, the tendency to transfer costs and responsibilities to another department. In contrast, Martin et al. (2007) present results of product-based testing approach in software intensive organizations but also conclude that "agenda for software testing research has to be extended to address the relationship between the organization and the testing process." Karhu et al. (2007) provide an insight in the process of knowledge management between customers and vendors (testing agencies). They stress out the fact that testing outsourcing and knowledge management are tightly interconnected.

Valuable inputs are presented in the work of Jain et al. (2011). Their work focuses on client managers' responsibilities in managing software-testing projects, mostly from offshore perspective. Jain et al. argue that "literature provides limited guidance on CMs' [client managers'] project management responsibilities when projects are outsourced, whether vendor is located onshore or offshore". Their research based on case-study research methodology contributes mainly in description of challenges connected with this kind of projects and possible ways for overcoming them. This work highlights conclusion about importance of continual project status updates and communication of project priorities changes. Another important factor for multivendor environment represents according their study the need for sharing of project knowledge – but with awareness and respect to intellectual property of particular vendors. Consequently, I feel these two factors (i.e. project updates, knowledge sharing across projects run by different vendors) as key ones for proper management of testing in multivendor environment by client organizations, irrespective if vendor is onshore or offshore. However, there is still some limitation for my research. Case based research of Jain et al. and connected discoveries are limited to a single client organization and three vendors based in India, so their results shall be generalized with care.

Finally, Sanz et al. (2009) provide conceptual proposal of a process model to create a test factory – autonomous organization entity being responsible for testing – i.e. for provision of testing services. Their work identified three categories of testing processes – Management, Technical and Support. Their conclusion of not existing process model to construct such organizational entities can be confirmed, but at the same time I lack clear responsibilities distribution among client and vendor in their model. Jain use the term "finger outsourcing" for the form "where vendors simply execute the given test cases and report results" as opposite to "more strategic form where vendors take a lead role in test management and planning".

2.2. Test, Quality and IT Governance

In organizations running multiple software development activities (typically IS development projects) handled by different teams, implementation of common and coherent principles to oversee testing activities in broader context must be done. I call these common principles a test governance mechanism. As the definition of test governance has not been established in research literature yet, I propose (particularly based on industry praxis) a new definition: test governance is a high-level process for overseeing test management activities ranging from the organizational level to the project level (Charankar, 2011), as well as alignment with overall organization business goals. IBM presents in their whitepaper slightly different context of quality governance from the perspective when the testing is to be finished. From their point of view, quality governance is understood as "deciding the 'who, what, when, why and how' of decision making" (Cantor, Lundblad, Sinha, & Williams, 2008). I advocate for potential utilization of Test Maturity Model Integration (hereafter TMMi) for test governance process in client organizations. TMMi has been developed by TMMi Foundation as a test process framework enabling test process improvement. It is complementary to Capability Maturity Model Integration (CMMI). Organization's test process maturity is represented by five levels (Initial, Managed, Defined, Measured, Optimization), each with respective process areas which should be implemented in order to reach requested level (TMMi Foundation, 2012). One of the disadvantages is that TMMi lacks client-vendor interface definition.

Some kind of dilemma emerges here: from the perspective of IS research where the organisational viewpoint dominates, the term "information systems quality" has significantly broad meaning (Von Hellens, 1997). In the IS audit literature, quality and security are often considered as a part of IT governance field (Svata, 2010). On the other side, one must also consider the perspective of software engineering (SE) field where the engineering approach dominates. Software testing is considered as an important, but historically underestimated part of this field (Ahonen et al., 2004). In SE, understanding of the term "software quality" is focused towards software development in more narrow way i.e. "the quality of software within the information systems" (Von Hellens, 1997). This SE subfield is often referenced as Software Quality Management (Sommerville, 2007). On the top of that these two approaches cannot be seen in isolated forms, without considering both perspectives. SE is often threaten as integral part of IS (development/design) research field by IS researchers, since it has been a part of computer science – a referent discipline for IS research (Morrison & George, 1995). To sum up, my research has been performed mostly within the IS research frame (oriented towards business organizations), but with integrating key concepts from SE field. As existing IS research typically does not embody great affiliation to similar relevant problems of the industry praxis and most of the existing research work has been done in SE, I find this approach as reasoned and well-founded. Consequently, the term "test governance" is inspired by key concepts from SE, but solves issues of IS design within a frame of a business organization. Typically it is well suitable for the case when IS development is outsourced and multiple vendors are engaged in the process. From this point of view, it might be alternatively also seen as a fractional part of "IS quality governance".

To sum up, although I have provided research conclusions regarding several test organization issues and some initial attempts of industry to define test and quality governance principles, I conclude that currently there is a research gap in the field of effective test organization and test governance processes in client organizations as current literature provides only limited guidance. I especially lack research sources concerning effective test and quality governance in client organizations. That means, governance over multiple software projects including software projects in outsourced environment.

3. Initial Findings

In order to bridge this gap, I present results of my research in the field. Action research has been used as a research fundamental: presented results are based on author's personal involvement in multiple software projects including outsourced ones. Action research is a legitimate research method in IS research and it is primary targeted "to solve current practical problems while expanding scientific knowledge" (Baskerville & Myers, 2004).

3.1. Proposed Research Framework

In order to study presented issues, research framework (Fig. 1) is proposed. The framework sums up key aspects I plan to accompany in the research.

Components of the research framework			
Client organization perspective, e.g.:	**Client organization aspects**, e.g.:	**Technical aspects**, e.g.:	**Human aspects**, e.g.:
• single IS project • group of IS projects • whole organization	• project management mechanism • test governance mechanism • process frameworks • client testers profile • organizational climate and culture • organizational structure	• test design techniques • methods of static and dynamic testing • CASE tools	• trust between client/vendor • mutual benefits • trust between members of the same organization • client/vendor national culture clashes • other psychosocial factors of vendor and client managers

Fig. 1: Structure of the research framework

This framework evolved from the diagnosing phase of the action research in a large financial organization in the Czech Republic. Partial goal of this paper is to explain general concept of my research and future plans. Due to the space limit of this paper, only brief overview is presented here. Following components (aspects) portrayed in Fig. 1 are explored in terms of this paper (i.e. Client organization perspective) and future research (i.e. other categories).

- Client organization perspective is an approach enabling study of these aspects at various levels of an organization. Single IS project or group of IS projects (it typically means projects within limits of Software Development Lifecycle - SDLC) is an approach preferred currently by many organizations, but it lacks integration with general organization goals at top organizational (strategic) level. No organization can rise its TMMi maturity beyond level 2, if the whole organization approach is not applied (TMMi Foundation, 2012). The main scope of this paper is to draft these perspectives in more detail (see below).

- Client organization aspects sum up many organizational variables that greatly influence the whole problematic under study.
- Technical aspects are not the primary target of this research, but they must be definitely included in the concept.
- Human aspects outline a very important part of future research. Some initial concepts in this area are already outlined in an additional research paper, currently being in the review process.

3.2. Organizational Framework for Test Governance (Client Organization Perspective)

This part of the paper outlines the concept of client organization perspective in more depth. Inspired by the concept of splitting up Business Informatics Management competencies into three levels, namely strategic, tactical and operational (Vorisek & Pour, 2012), Fig. 2 proposes Test Governance Process Framework (TGPF) covering various responsibilities and management activities in the field of software testing management. The names of TMMi process areas (in italics) were used when applicable, original TMMi maturity levels are indicated (in brackets) when appropriate for a process area or a key concept derived from TMMi.

TGPF is based on the finding that business organizations often experience problems when dealing with cross-organizational test management issues. I.e. in this form TGPF represents an abstraction of key problem areas across the management levels. One of the key characteristic differentiating maturity of level 2 and 3 organizations in the capacity of TMMi is a unification of test processes in order to get consistent set of management practices for multiple software projects run by the organizations is (TMMi Foundation, 2012). So consequently, presented framework will facilitate business organizations to follow TMMi level 3 characteristics in order to reach this level of maturity, but only key aspects are highlighted as well as several key practices have been amended based on research results. For example neither Test environment process area (level 2) is presented in this framework, nor Peer Reviews (level 3), as these process areas are often challenging ones and presented framework is not intended to replace TMMi. It rather aims to conceptually divide management responsibility between client (i.e. strategic and typically also tactical level) and vendor (i.e. operational level) organizations, and still keep the management (governance) control over the whole process in hands of client organization. The responsibilities and activities in TGPF are split up into (1) top organizational level, (2) middle organizational level, and (3) project level (Fig. 2).

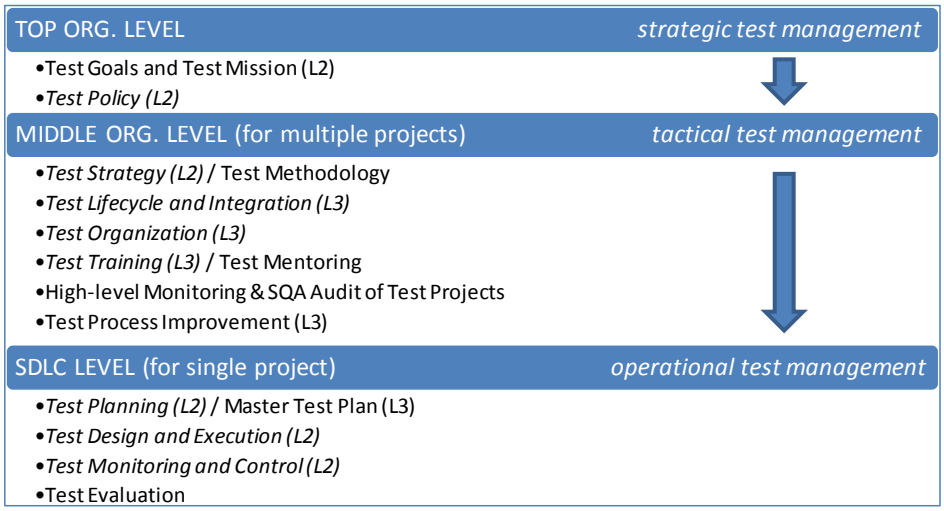

Fig. 2: Test Governance Process Framework (TGPF)

In typical case, top organizational level (1) is represented by the Chief Information Officer of the business organization and in the proposed concept his or her role is limited to set-up general goals of testing and quality, and to issue overall test policy valid for the whole business organization. Such test policy must be aligned with quality policy required by the quality management system implemented in a business organization. Middle organizational level (2) in the field of software testing can be represented by various roles, typically by Chief Test Manager or Software Quality Officer, who are responsible for general testing issues and test process unification across whole business organization. His or her role is the crucial one as he or she is responsible for formulation and enforcement of common principles of software testing across the whole organization – namely for publication of test strategy/test methodology and test lifecycle covering levels of testing and other general project-independent aspects such as defect management principles, roles description, details of produced artefacts, standard entry/exit criteria for defined quality milestones (quality gates) etc. It should be pointed out to the fact that the term "test methodology" is preferred to prevent potential conflict regarding terms definition – test strategy should not to be confused with strategic management tools. Other tasks of tactical test management consist of software quality assurance (SQA) audit function (Galin, 2004). It is focused on testing (i.e. keeping an eye on operational test management tasks from an independent perspective outside the project team) and should not be confused with an independent IS audit function. Test training and mentoring responsibility etc. are the remaining parts. Project Software Development Lifecycle (SDLC) level (3) represents management activities that are typically referenced when „test management" is mentioned – such activities cover all management demands of test planning, test design and preparation, test execution, test evaluation, as well as continual test monitoring and control. These activities are typically software project activities, performed during a software project lifecycle. I also argue that shared vision of "testing excellence" must be an essential part of test governance mechanism. This term is conceptually interconnected with the organizational climate and culture.

3.3. Outsourcing Possibilities

It has been already noted, TGPF is beneficial for management both for internal and external testing teams. Yet, there are various levels of vendor involvement into testing process. Generally only strategic test management is expected to be performed by the client organization itself. Although I see no conceptual problem in outsourcing of tactical test management, in most of the organizations this level will stay in hands of such organizations too, as the main testing knowledge foundation is presented here. One may assume that activities controlled by operational test management are typically part which will be subject of outsourcing. In such case, there are following outsourcing possibilities:

- Test design only
- Test execution only
- Combination of design and execution
- Autonomous test project management
    - As a part of complete software project realization by the vendor
    - As an independent part – "test factory" (incl. testing third party software)

The level of involvement will typically depend on business organization maturity in the field of test management. As suggested by Jain, possible way ranges from „finger outsourcing" (execution only) to "more strategic form" (autonomous test project management). Nevertheless I argument that

test management of strategic and tactical activities -as the key part of TGPF- plays a significant role in all these outsourcing options.

4. Conclusion

In this paper I have proposed TGPF as a result of my research in the field of test organizing in business organizations. This research represents novelty approach for the area of software testing and IS development research as (1) only little previous research has been conducted, (2) existing research typically just maps current business practise by means of ethnographic/case study methods, (3) existing proposals do not deal with client-vendor interface, and (4) people-related aspects are mostly ignored in this field. I have also provided overview of possible outsourcing options regarding software testing. I generally argue for better software project coordination and monitoring by the client organizations when software projects are outsourced and this framework is a suitable tool. This paper generally represents work-in-progress type of paper, as validation of TGPF is currently being done in a real financial institution in the Czech Republic as part of consequent phases of action research project. This is the main limitation of this paper.

I intend to incorporate TGPF into a methodology pattern in the frame of the Methodology Framework for IS/ICT (MeFIS) (Buchalcevova, 2004). These further details will be published as a part of a subsequent paper. Concurrently I also explore possible impacts of cognitive and psychosocial factors (and other human aspects) on IS development projects coordination from viewpoint of software quality, and the relationships between project and test managers as well as team members from both possible perspectives (i.e. horizontal and vertical), as well as the influence of improper testing praxis on IS project failures. But due to the scope of this paper, these crucial issues are only drafted here as a part of the proposed research framework.

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References

Ahonen, J., Junttila, T., & Sakkinen, M. (2004). Impacts of the organizational model on testing: Three industrial cases. Empirical Software Engineering, 9(4), 275–296.

Baskerville, R., & Myers, M. (2004). Special issue on action research in information systems: making IS research relevant to practice--foreword. MIS Quarterly, 28(3), 329–335.

Buchalcevova, A. (2004). Methodology patterns - concept, classification and processes for their application. ISAS/CITSA 2004: Int. Conf. on Cybernetics and Inf. Technologies, Systems and Applications and 10th Int. Conf. on Inf. Systems Analysis and Synthesis, Vol 3, Proceedings (pp. 200–203). Orlando, FL.

Buchalcevova, A. (2009). Research of the Use of Agile Methodologies in the Czech Republic. INFORMATION SYSTEMS DEVELOPMENT: CHALLENGES IN PRACTICE, THEORY AND EDUCATION, VOLS 1AND 2 (pp. 51–64). New York. doi:10.1007/978-0-387-68772-8_5

Cantor, M., Lundblad, M., Sinha, A., & Williams, C. (2008). When am I done testing? IBM whitepaper. Retrieved from ftp://ftp.software.ibm.com/common/ssi/rep_wh/n/RAW14026USEN/RAW14026USEN.PDF

Galin, D. (2004). Software Quality Assurance. From theory to implementation. Harlow, England: Pearson Education Limited.

Havlickova, A. (2012). The perception of software quality and testing in Czech software companies. Journal of Systems Integration, 3(4), 15–28. Retrieved from http://www.si-journal.org/index.php/JSI/article/view/139

Charankar, M. (2011). Achieving Better Test Governance. Practical PM journal, (9). Retrieved from http://practicalpmjournal.com/2011/09/achieving-test-governance/

Chua, A. (2009). Exhuming IT projects From their graves: An analysis of eight failure cases and their risk factors. Journal of Computer Information Systems, 49(3), 31–39.

Jain, R. P., Poston, R. S., & Simon, J. C. (2011). An Empirical Investigation of Client Managers' Responsibilities in Managing Offshore Outsourcing of Software-Testing Projects. IEEE Transactions on Engineering Management, 58(4), 743–757.

Karhu, K., Taipale, O., & Smolander, K. (2007). Outsourcing and knowledge management in software testing. EASE'07 Proc. of the 11th int.conference on Evaluation and Assessment in Software Engineering (pp. 53–63).

Kataja, A., & Tuunanen, T. (2006). Information systems development methods and reducing information asymmetry: a way to decrease project escalation in outsourcing? Proceedings of the 14th European Conference on Information Systems, ECIS 2006 (pp. 1–8).

Mäntylä, M. V., Itkonen, J., & Iivonen, J. (2012). Who tested my software? Testing as an organizationally cross-cutting activity. Software Quality Journal, 20(1), 145–172.

Martin, D., Rooksby, J., Rouncefield, M., & Sommerville, I. (2007). "Good" organisational reasons for "bad" software testing: An ethnographic study of testing in a small software company. 29th International Conference on Software Engineering, ICSE 2007 (Vol. 8, pp. 602–611).

Morrison, J., & George, J. (1995). Exploring the software engineering component in MIS research. Communications of the ACM, 38(7), 80–91.

Sanz, A., García, J., Saldaña, J., & Amescua, A. (2009). A proposal of a process model to create a Test Factory. ICSE Workshop on Software Quality 2009 (pp. 65–70). Vancouver, Canada.

Sommerville, I. (2007). Software Engineering (8th ed.). Harlow, England: Addison-Wesley.

Svata, V. (2010). Recent changes in the IS audit environment. IDIMT-2010: INFORMATION TECHNOLOGY - HUMAN VALUES, INNOVATION AND ECONOMY (pp. 75–82). Linz: Universitätsverlag Rudolf Trauner.

TMMi Foundation. (2012). Test Maturity Model integration. Ireland. Retrieved from www.tmmi.org

Von Hellens, L. A. (1997). Information systems quality versus software quality. A discussion from a managerial, an organisational and an engineering viewpoint. Information and Software Technology, 39(12), 801–808.

Vorisek, J., & Pour, J. (2012). Management of Business Informatics (czech lang.). Prague: Professional Publishing.

DECISION-MAKING SUPPORT IN E-PROCUREMENT: PRACTICAL ISSUES OF E-AUCTIONS EFFICIENCY MEASUREMENT

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Keywords

Decision making, efficiency, electronic reverse auction, savings, measurement

Abstract

Practical measurement of electronic reverse auctions success, mainly from economic perspective presented by financial savings, deals with several issues. The question of precise and sensitive methodology for savings measurement is still open as practitioners and researchers use different approaches. In the paper different approaches to savings measurement are compared and their practical benefits and limitations are discussed. Two approaches – savings based on Initial Price and Estimated Price - are empirically compared using real data from Slovak environment. The dependence of essential inputs of these savings calculation approaches is tested and the estimated regression model describing the relationship between them is presented.

1. Decision making in Electronic Reverse Auctions usage

The practice of recent years has shown us that the process of an e-procurement, and mainly electronic reverse auctions, can bring the companies price savings and many other benefits. Therefore the proper understanding in order to exploit its full potential is essential. Further study of hidden knowledge in electronic reverse auctions results and proposal of next generation and "smart" applications for business based on this knowledge is crucial in order to face the problematic business conditions affected by recent crisis.

According to (Mabert and Skeels, 2002), electronic reverse auction (eRA) is a special case of electronic negotiation where several suppliers compete for the business to supply products or services and successively bid the prices down. eRAs are intended primarily for non-strategic goods (in the ABC analysis for B and C products). Among the greatest benefits and advantages according to many authors (Smart and Harisson, 2002; Losch and Lambert, 2007; Penfield, 2007; Kouklík, 2009; Kaplan and Zrník et. al, 2007; Manoochehri and Lindsy, 2008) we can include: *significant financial savings* (first purchases-average savings of more than 15% from the originally offered prices and the maximum financial savings-more than 70%). A typical feature of electronic auctions is also its *transparency* and the whole *documentation of purchase* (its progress is monitored by many stakeholders and therefore there is no room for corruption. In addition, the whole process of

carefully recorded and documented and thus any ambiguity can be dealt with immediately). The purchasers can also reach *savings in transaction costs* (the most significant are time savings associated with reduced labour costs). Other advantages are: *availability, improving the quality and supply guarantees* and *the implementation of effective and routine procedures for procurement.*

Decision making in e-auctions covers issues related optimal number of invited supplier (Memeti, 2011), length of auction (Wagner and Schwab, 2003), different parameterization (e.g. visibility in e-auction) according to different market conditions (Prídavok and Delina, 2013). According to (Wagner and Schwab, 2004) is possible to determine three categories of factors that may impact the success of the eRAs: purchasing management related conditions, auction design and eRA process. We focus on purchasing management related conditions which are: specification simplicity, the number of qualified suppliers and the competition among them, switching cost of incumbent suppliers, price visibility and also eRA volume, preparation and lotting. They influence positively or negatively the success and also buyer-supplier relationships. In the following scheme are showed these impacts (green coloured arrows present positive effects and red coloured arrows negative effects). Sometimes these conditions have positive effect on both of them (success and buyer-supplier relationships), e.g. price visibility (full price visibility is important for the success of electronic auction but also can worsen previously existed relationship between the buyer and the supplier).

In procurement decision making processes different information and data are available and therefore different metrics can be exploited to increase the efficiency, such as metrics based on Balanced Scorecard System (e.g. Kaplan and Norton, 1992; Gavurová, 2011, 2012; Šoltés and Gavurová, 2013) or data deeper understanding (Stewart, 1995; Gunasekaran et al. 2004; Delina, 2004; Janke, 2011; Dorčák and Delina, 2011; Dorčák and Pollák, 2011; Janke and Pridavok, 2012). The potential of increase of efficiency of eRAs usage still is not fully exploited (Delina and Pridavok, 2013).

However, further optimization of procurement processes is significantly conditioned by precise efficiency output measurement. The problem of further optimization of procurement processes arose within the *CentraLab* project (*Central Europe Programme)* which uses the Living Lab approach for innovation creation in procurement processes in order to create smart procurement tools to increase the efficiency of companies´ and municipalities´ spend management resulting in enhanced regional development. Appropriate understanding of procurement efficiency is crucial not only for creation of different tools for decision support in procurement processes, but also for the proposal and settlement of proper motivational system for buyers professionals.

In the paper practical aspects of economic success measurement will be discussed and two approaches of savings calculations (representing success) - based on Initial Price and Estimated Price – will be compared to assess whether both approaches provide similar results and therefore can be used as substituting approaches.

2. Practical Measurement of Electronic Reverse Auctions Success

The assessment of eRA's usage efficiency is strongly connected to its measurement. Many experiments (e.g. success of eRAs – for instance *Research note: Evaluating eReverse Auctions* from authors Irani, Elliman and Hackney, 2006) were discussing the term success of eRAs, some of them were able to provide evidence of eRA's efficiency. Problem occurs, when it comes to the assessment in terms of real company's conditions. Most of the studies showing the benefits of eRA's deployment provide evidence based on "anticipated" savings, but in order in order to be able

to discover and deploy full potential of eRAs to bring further savings for companies, it is evitable to bring methodology enabling precise savings measurement. Different practical problems still need the provision of answer – e.g. choosing eRAs vs. Sealed Bids (or Electronic Tenders), or different research attempts in eRAs parameterization (Carter and Stevens, 2007; Eichstadt, 2008; Pridavok and Delina, 2013) in order to achieve even better results. Crucial issue in both research directions is measurement of the procurement success.

2.1. Savings as Economic Success of eRAs

The term success is used by different authors in order to name the efficiency of eRAs. But what does success, or efficiency in eRAs mean? Is it economic success, what implies economic savings? Is success a significant competition among invited suppliers, as goal of eRAs is to ensure the competition in order to get the best possible price? It is obvious we can identify several situations while using eRAs, which could be described as a success. However, most of the authors consider economic savings to be the most meaningful presentation of eRA's success. (Manoochehri and Lindsy, 2008) The aim is to discuss in more detail the success from economic savings perspective.

Savings are most commonly known indicator of success of electronic reverse auction. Although, the savings, mainly the ones connected to investment products, are usually calculated on the Total Cost of Ownership basis, in our case, by savings we mean amount of costs for procured product/service which was not spent when using the eRAs in contrast to amount of costs we would spend using basic procurement procedure without eRAs. The reason for focusing on Price only is hidden in data we use – most of the procurement cases uses single criteria selection model based on Price. On the other hand, we will not compute savings using the winner's final price, but the lowest final price (this may differ in situations, where multiple criteria were used for winner selection and the supplier with lowest price did not win due to worse position at other criteria). In this research, we assess the ability of eRAs to make prices lower - not necessarily meaning the price is single criterion. *The definition of savings itself is the reason of its problematic measurement* – how do we measure this virtual amount of costs we would spend using different (basic) procurement procedure (or in other words – other procedure than eRA) at the same market conditions (Wyld, 2011). The problem of appropriate savings measurement is also regularly discussed among procurement practitioners on conferences focusing on electronic auctions (e.g. eBiz forum in Ostrava, Czech Republic).

2.2. Different Approaches to Savings Measurement

There are different approaches, how savings of eRAs can be calculated. In this section, two approaches will be discussed – Savings based on Estimated Price and Initial Price. Mathematically, saving is usually expressed as percentage and can be calculated with following formula:

$$S = \left(1 - \frac{P_F}{P_X}\right) * 100 \tag{1}$$

S Savings (in %),

PF Lowest Final Price in Auction

PX Estimated or Initial Price in Auction according to chosen method for savings calculation – the price which was expected by buyer professional before auction was initiated

E-auction savings are most commonly based on the expectations of buyer professionals and are computed as the reduction in expected price for specific product or service.

Savings based on Estimated Price

Savings are mathematically computed via Formula 1, when Estimated Price is used for variable P_x. Different possibilities (procedures) exist in order to determine the Estimated Price for planned selection procedure.

Initial informative survey (pre-bid gathering)

Estimated price is the price received by initial informative survey made by buyer via phone, e-mail or browsing the internet. In this case the price presents basic, but actual catalogue price, what is good variable in order to catch the actual savings. All changes in conditions influencing the price of product / service are incurred in prices provided by informative bids. On the other hand, it takes a lot of effort of buyers to gather this information. Moreover, the savings calculated at the end are influenced by the selection of pre-bidders in the beginning, as buyer might be willing to contact more expensive pre-bidder in this informative bidding round and reach higher savings at the end. This behaviour might be more favourable for buyer, when motivational system in company would be somehow connected to reached savings.

Final price in last auction for the same item

By estimated price for upcoming auction the final price of last auction for the same product/service is considered. Positive aspect of this method is that the price is less virtual as the price was confirmed by past activities and therefore it is more meaningful. On the other hand, when comparing actual auction price with price from last auction, the saving will be much lower, or saving can be negative as well. Using this savings computation method, the eRA's implementation would have one-time and unrepeated effect on savings. The savings would after short time end up distributed around zero value, as eRAs do not bring endless savings, they rather ensure higher efficiency than sealed bids or catalogue based procurement (a matter of course in situations where eRA's usage is appropriate for procurement of specific product/service). This method is not respecting the changes in price levels due to different current market conditions as the price is connected to market conditions in the past, which are probably no more valid. Moreover, to use this method, you need to have at least one case from the past, and therefore it is important, mainly in companies buying hundreds of products/services yearly, to create internal catalogue of procured items (products/services) in order to allow easy searching of historical auction data connected to particular item. Otherwise, using historical information would become time-consuming.

Subjective expectations of buyer

This method is based on the subjective (personal) estimation of buyer professional about the actual price of the product/service which is to be procured by e-auction. As it is subjective estimation, it is difficult to compare saving reached by two different buyer, as such estimations are usually not supported by any reasoning – it is therefore hard to assess, whether the buyer estimated catalogue price, sealed bid price, or eRA price whether the estimated price reflects actual market and macroeconomic conditions. On the other hand, this method might be less time consuming.

Savings based on initial auction price

Alternatively, eRA's savings can be computed using data which are available in eRA application's database, where final price of auction competing round is compared to initial price in this round. This method is used mainly among researchers (e.g. Smart and Harisson, 2002; Losch and Lambert, 2007; Penfield, 2007; Wyld 2011). Initial price in competing (contest) round is usually the best (lowest) price for product/service from preliminary bidding round. In most auction procedures, preliminary bidding round is the first round where potential suppliers show their interest in competing for procured product/service and it is based on Sealed-Bid method. To explain it in

simpler way we can say that before an auction contest round starts, the electronic tender (sealed-bids) takes place in order to assess whether all potential suppliers (auction competitors) meet the requirements on procured product/service. The saving based on the Initial Price round is computed by Formula 1, where Initial Price in Auction contest round is used for variable P_x.

This savings method solves following problems, which were described in above described methods:

- necessity of buyer's extra effort, as the price is automatically gathered by eRA application,
- low availability of data, according to same argument as mentioned above – moreover, the data are gathered for each auctioned product/service,
- inclusion of the changes in market conditions, as the price is proposed by suppliers who are aware of actual market condition (incl. inflation, exchange rates, etc.). On the other hand, as suppliers know, this is not their final price for competition they are not obliged to submit the price identical to their catalogue price or the price they usually submit within sealed-bid.

2.3. Data description

In order to assess the savings connected to performed reverse auctions different indicators can be composed depending on data available being gathered by electronic reverse auction application. In this paper, we conducted analyses the data gathered by eRAs application widely used in Czech republic, Slovakia and Poland, and the sample consists of 1,836 auctioned items (meaning products or services) realised between 2007 and 2012 within Slovak environment.

As estimated price can be larger, equal and smaller than final auction price, the saving computed with Estimated Price used for variable P_x in Formula 1 can have positive, zero, but also negative values, what is visible in histogram of Savings calculated with Estimated Price (Fig. 1) constructed on real data. We can see observations are roughly symmetrically distributed around mean value 7.67% of savings. Most of the observations are distributed between negative saving (loss) of approximately -40% and positive saving of approximately 60%. Based on the available database, long-run savings are therefore expected to be 7.67%, although standard deviation is quite high with level of 36.069%. Within cases, no formal rule for price estimations was established, and it cannot be identified which estimation option was chosen. The total available number of e-auctioned items, where Estimated Price method for saving computation was used, is 1,836, what presents 10.87% of all auctioned items (16,878). We can therefore add another disadvantage of this method – scarcity of such a data.

According to fact, that Final Price will be always lower or equal to Initial Price, the saving computed with Initial Price used for variable P_x in Formula 1 will always come from interval $\langle 0;100)$. When we look into histogram of Savings calculated with Initial Price (Fig. 1) constructed on real data, we can see observations are distributed between the savings values 0 and 85%. When comparing results to Savings calculated with Estimated Price (Fig. 1), savings based on Initial Price are not symmetrically distributed around centred value, as the most observations belong to interval containing zero savings. This can be caused by many auctioned items within multi-item (combinatorial) auctions, where only one supplier (auction participant) submitted the price proposal. The mean value of savings is at the level of 37.68% with standard deviation 21.01. When we exclude the observations with only one participant attended (resulting in zero savings) the mean would change to 39.32% with standard deviation 19.956, and the distribution would then become roughly symmetrical.

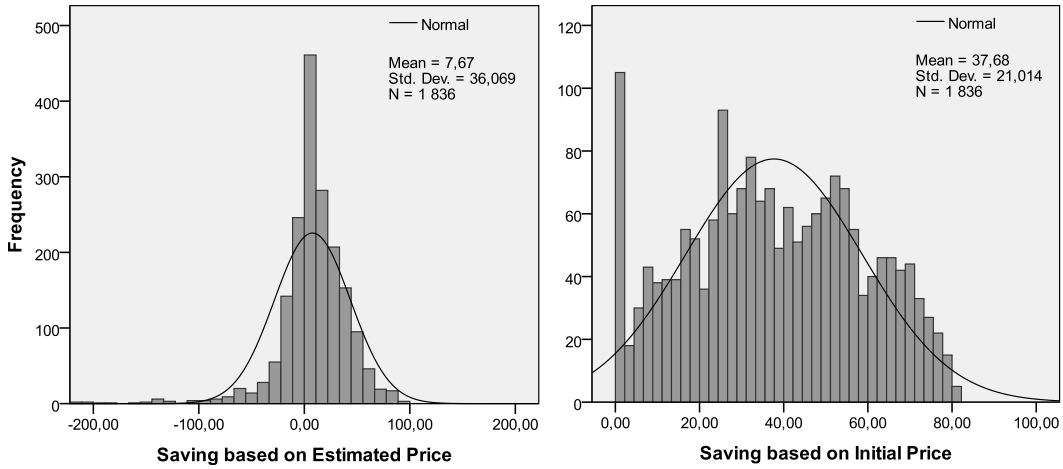

Fig. 1 Histograms of Savings based on Estimated Price and Initial Price; Source: own figure

2.4. Comparison of approaches

Measurement of savings based on Estimated Price is concerned to be more meaningful, as the buyer uses different practices to form his expectations about the actual price of the product/service being procured. Therefore, in this section presented approaches for saving calculations will be compared and the level of dependence will be tested between the Initial Price and Estimated Price. As we will use correlation coefficient to test the hypotheses, firstly, in order to choose from parametric and non-parametric correlation tests, the presence of normality within variables´ distributions needs to be examined. According to Kolmogorov-Smirnov and Shapiro-Wilk normality test (where Sig. are at the level of .000 for both variables and both tests), both Initial Price and Estimated Price are not normally distributed, and therefore we will use Kendall's Tau-b non-parametric correlation test in order to test the level of dependence between these two variables. Kendall's Tau-b was chosen due to fact, that in contrast to Spearman's´ rho, it is more effective in determining whether two non-parametric data samples with ties are correlated (Kendall, 1938). *The working hypotheses about statistical independence between Initial Price and Estimated Price will be tested.*

Non-Parametric Correlation			Estimated Price
Initial Price	Kendall's tau_b	Correlation Coefficient	.919
		Sig. (2-tailed)	.000
		N	1836

Table 1 Nonparametric correlation coefficient; Source: own table

The table presenting the correlation coefficients describing the relationship between Initial Price and Estimated Price for auctioned products and services shows that both variables are very strongly positively correlated (see Table 1). The Kendall's Tau-b is at the level of 0.919 with significance at the level of .000, meaning that there is very strong relationship between these two variables and therefore we can reject our null hypothesis about the independence of variables. According to this test we can state the effect of both variables when computing savings is approximately identical.

To better understand the correlation result, the X-Y plot is shown (Fig. 2). We can see the observations are linearly distributed, although they are not distributed around line Y = X what could be expected – as distribution around line Y = X would mean both variables are perfectly dependent. We can see observations are linearly distributed mainly above the line Y = X, what

shows Initial Price tends to be above Estimated Price by buyer. This can be explained by basic psychologically based laws of pricing, where seller's pricing choice is influenced by his willingness to earn money and on the other hand buyer's pricing choice is influenced by his willingness to save money.

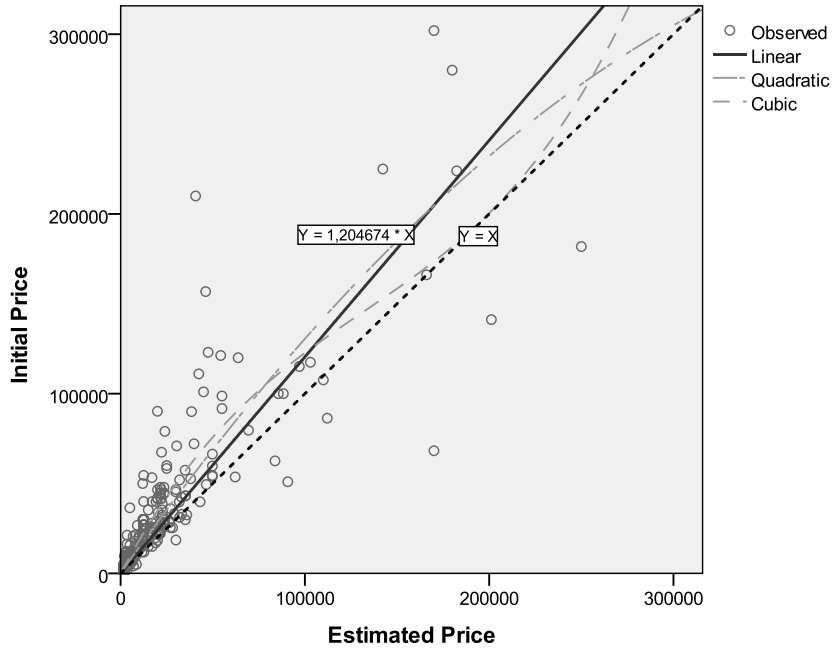

Fig. 2 Relationship between Estimated Price and Initial Price; Source: own figure

Moreover seller, when submitting the price in preliminary bidding round, knows the bid is not is last bid and he still will have enough space to reduce the price and to compete other potential suppliers if needed. Although the preliminary bidding round is analogy for sealed-bids (tender) selection procedures, suppliers are not psychologically forced to reduce the price to the level they would hypothetically do when submitting the bid within real sealed-bids (tender) selection procedure.

As the observations are linearly distributed and are not lying on line Y = X, the Linear Regression Model will be constructed in order to express the mathematical relationship between variables. The Estimated Parameters and the summary of Linear Regression Model (LRM) are presented in Table 2. The mathematical relationship between Initial Price and Estimated Price, according to estimated LRM, can be written in following way:

$$P_I \cong 1.205 * P_E \tag{2}$$

P_E Estimated (Expected) Price by buyer in Auction for specific product/service

P_I Initial Price in Auction Contest round, what equals to lowest price in preliminary bidding round

Additionally, the estimations of quadratic and cubic curves (Table 2) and the curves (Fig. 2) are presented as their R2 level is even higher than one related to linear regression. However, to asses, whether these non-linear regressions (but mainly cubic one) describe the relationship between Initial Price and Estimated Price in more precise way, more observations with higher level of price is required and therefore we leave this issue open for future research initiatives and the attention will be paid to Linear Regression Model results.

Dependent Variable: Initial_Price

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	b1	b2	b3
Linear	,834	8788,805	1	1755	,000	1,205		
Quadratic	,843	4707,807	2	1754	,000	1,450	-1,444E-6	
Cubic	,862	3658,141	3	1753	,000	1,919	-9,256E-6	2,336E-11

Table 2 Model summary and Parameter Estimates - whole sample; The independent variable is Estimated_Price; Source: author

According to coefficient 1.205 in Formula 2 buyer's estimations are smaller than lowest price submitted by potential suppliers within preliminary bidding round by 20.5%. In other words, the psychological difference between buyer's and seller's first expectations about the result of the electronic reverse auction (Galinsky et al. 2009) is dismantled on estimated "equilibrium" line (shown in Fig. 2) with parameters described in Formula 2.

It is obvious, there is linear relationship between studied variables, although Initial Price and Estimated Price are not perfectly substituting each other, and when we use any of the variables for savings computation, we should see results with similar meaning but different absolute values. However, it is still difficult to easily say, what is the level of saving we obtained, these variables can be used as inputs for savings computation and the results are meaningful when analyzing for instance changes in savings over time, within different product/service categories and within different buyers.

3. Conclusions

The assessment of eRA's usage efficiency is strongly connected to its measurement (Wyld, 2011). Without ability to sensitively and precisely measure (or estimate) the savings connected to used electronic reverse auction, the further investigations in its further savings possibilities (mainly optimal parameterization of eRAs proposed by Eichstadt, 2008, Prídavok and Delina, 2013) will be problematic, as the savings potential of these techniques is expected to be lower in contrast to initial eRAs implementation impact. The imprecision of assessment methodology might therefore significantly influence the results of examined researches. Appropriate understanding of procurement efficiency is crucial not only for creation of different tools for decision support in procurement processes, but also for the proposal and settlement of proper motivational system for buyers professionals.

Two approaches of savings calculation – based on Initial and Estimated Price - were analyzed and compared. As the result, both prices, which are essential for savings calculations, are statistically dependent and they therefore bring similar results, although they differ in absolute values. Each approach of savings measurement is meaningful and appropriate for analyzing the changes in savings over time, within different product/service categories or within different buyers. Both approaches have their own advantages and limitations and they differ mainly in the ability to provide information on actual price respecting recent market changes which was the result of competition. Although Initial Price method respects market changes and is the result of competition in preliminary round and should be therefore preferred for savings measurement, in comparison to estimation about price based on informative survey, suppliers are not in psychological pressure to push the prices downwards and therefore Initial price tends to be "bubbled" by approximately 20%

in average, what was illustrated in estimated Linear Regression Model. This difference in prices expected by suppliers and buyer might be also the result of traditional psychological problem of pricing, where suppliers tend to see the price higher and buyers wish to have the price lower (Galinsky et al. 2009). The appropriateness of regression models with slightly stronger accuracy for description of the relationship between Initial Price and Estimated price is still open for future research based on broader sample in terms of products/services prices.

In order to be able to compute savings which could be broadly accepted and comparable, the business networking aspect needs to be included – where we could obtain actual price for specific product or service as for instance the average of its selling prices on electronic business network within procurements realized recently within short period of time. Mentioned networking aspect could be utilized with Business Intelligence solution and would provide benchmark tool in order to compare the level of savings the organization was able to obtain in contrast to practices of other companies in the electronically networked environment. Another aspect, which should be respected within the savings measurement, is the influence of different market characteristics within different product / service families. The product classification should be therefore as a prerequisite of this "next generation" savings measurement methodology.

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References

Carter C. R., Stevens C. K. (2007), "Electronic reverse auction configuration and its impact on buyer price and supplier perceptions of opportunism: a laboratory experiment", Journal of Operations Management, Vol. 25 No. 5, pp. 1035-1054.

Delina, R. (2004). Aplikovaná ekonometrika pri hodnotení efektívnosti elektronického obstarávania. Ekonomie a Management, 7(2), 35-46, ISSN 1212-3609.

Dorčák, P., Delina R. (2011). Vplyv elektronických marketingových podnikových riešení na ekonomickú výkonnosť. Ekonomický časopis. 59 (1), 44-58, ISSN 0013-3035.

Dorčák, P., Pollák, F. (2011). Analysis of effectiveness of selected social media, In: IDIMT-2011: Interdisciplinarity in Complex Systems: 19th Interdisciplinary Information Management Talks, Linz: Johannes Kepler Universität, 2011. Pages: 305-312. ISBN 978-3-85499-873-0

Eichstadt T., (2008). "Applying Auction Theory to Procurement Auctions – An Empirical Study Among German Corporations", in Gimpel H. et al. Negotiation, Auctions, and Market Engineering. Springer-Verlag Berlin Heidelberg, Berlin (DE), p. 58-67.

Galinsky, A. D., Ku, G., Mussweiler, T. (2009). To start low or to start high? The case of auctions vs. negotiations. Current Directions for Psychological Science, 18, p. 357-361.

Gavurová, B. (2011). Systém Balanced Scorecard v podnikovom riadení. Ekonomický časopis, 59 (2). 163-177, ISSN 0013-3035.

Gavurová, B. (2012). Source identification of potential malfunction of balanced scorecard system and its influence on system function. Ekonomie a management. 15 (3) (2012), p. 76-90, ISSN 1212-3609.

Gunasekaran, A., Patel, C., McGaughey, E. R. (2004): „A framework for supply chain performance measurement, Science direct", International Journal of Production Economics, 87.

Irani, Z., Elliman, T., Hackney, R. (2006). Evaluating eReverse auctions (EeRA): A Research note. European and Mediterranean Conference on Information Systems (2006), p. 1–2.

Janke, F. (2011). The Use of Hidden Data in Electronic Business Networks: Benchmark and Network Performance Indicators. In: IDIMT-2011: Interdisciplinarity in Complex Systems: 19th Interdisciplinary Information Management Talks, Linz : Johannes Kepler Universität, 2011. p.: 341-348. ISBN 978-3-85499-873-0

Janke, F., Prídavok, M. (2012). B2B Network Performance: Practical Aspects of Network Supply Adequacy Indacator. In: IDIMT-2012: ICT Support for Complex Systems: 20th Interdisciplinary Information Management Talks. Linz: Johannes Kepler Universität, 2012. p. 337-346. ISBN 978-3-99033-022-7

Kaplan, M., Zrník J.et. al.. (2007). Firemní nákup a e-aukce. 216 (1), p.34-35, ISBN 978-80-247-2002-9.

Kaplan, R.S., Norton, P.D. (1992). The balanced scoreboard measures that drives performance. Harvard Business Review, 70 (1), 71–79.

Kendall, M. (1938). "A New Measure of Rank Correlation". 30 (1–2): 81–89.

Kouklík, V. (2009). B2B elektronické aukce. Bakalárska práca, p. 23–24.

Mabert, V.A., Skeels, J.A. (2002). Internet reverse auctions: valuable too in experienced hands.Business Horizons 45 (4), 70–76.

Manoochehri, G., Lindsy, Ch. (2008). Reverse Auctions: Benefits, Challenges, and Best Practices. California Journal of Operations Management 6 (1), 124–125.

Memeti, E., (2011). Electronic reverse auctions: Factors of success. Research paper study, p. 15.

Losch, A. & Lambert, S. (2007). Information behaviour in e-reverse auctions. Journal of Enterprise Information Management, 20 (4), 447-464.

Prídavok, M., Delina, R. (2013). Effective spend management through electronic reverse auction configurations. Quality innovation prosperity. 17 (1), 1-9.

Smart, A. & Harrison, A. (2002). Reverse auctions as a support mechanism in flexible supply chains. International Journal of Logistics: Research and Applications, 5 (3), 275-284.

Penfield, P. (2007). 3 avenues to cost reduction. Supply Chain Management Review, 11 (8), 30-36.

Stewart, G., (1995). Supply chain performance benchmarking study reveals keys to supply chain excellence. Logistics Information Management 8 (2), 38–44.

Šoltés, V., Gavurová, B. (2013). Application of the cross impact matrix method in problematic phases of the Balanced Scorecard system in private and public sector. In: Journal of Applied Economic Sciences, 8 (1), p. 99-119. ISSN 1843-6110

Wagner, S., Schwab A., (2004). Setting the stage for successful electronic reverse auctions. Journal of Purchasing & Supply Management 10 (2004) 11–26.

Wyld C., D. (2011). Current research note on reverse auctions: Part 1 – Understanding the nature of reverse auctions and the price and process savings associated with competitive bidding. International Journal of Managing Value and Supply Chains (IJMVSC) Vol. 2, No. 3, September 2011, p. 11-23.

CHANGING THE RAW MATERIAL INDUSTRY THROUGH DIGITALIZATION AND INFORMATIZATION

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Keywords

Digitalization, informatization, intelligent decision-making platform, predictive monitoring, mass flow management, human/machine communication

Abstract

This paper characterizes the important features of digitalization and demonstrates how it is transforming mining or raw materials sectors. It reviews how informatization is a business strategy and examines integration architecture model, an advanced mine-wide information platform, knowledge management, intelligent decision-making platform, predictive monitoring systems and human/machine communications. The paper aims to consider what would be required for a mining company to operate as a modern advanced technology-supported business. It attempts to provide a vision of some future advanced technology scenarios.

1. Introduction

The world today is characterized by the coexistence of physical and digital world. Digitization is the foundation for the digital world - a world that is virtual. Using the digital world is in practice represents informatization, which forms the link between informatics and its applications. Informatization of raw materials extraction and treatment processes is not concerns only minerals, but necessarily includes the area of tangible raw materials of a different nature (such as renewable raw materials, wastes, value-added products etc.). An important category of raw materials consists of intangible nature – data, by processing which are information and knowledge. The aim is an integrated holistic solution, which encompasses the entire value chain of raw materials - from seeking mineral resources, their extraction, primary and secondary processing, to finalize the product. Informatization in this area must take into account the reuse and recycling of raw products (waste processing) based on mineral resources, revitalization of mining activities, as well as information support for the mining business, management and logistics systems tailored to mining companies, including all necessary service business processes (security, maintenance, transportation, etc.) and finally not forgetting the high-profile European socio-economic aspects.

2. The Future Mining Trends Harmonization

The underground mine of tomorrow will need a transition from static control model to the dynamic control one, to be able to process large amount of varying kind of data (Cehlár, Rybár, Soušek, Szabo, 2011). The solution resides in novel mass flow and logistics system model based on centralized plant design, economic parameters management principles and an intelligent technological logistics system designed and based on a vertical/gravity principle. Further to that, the mass flow management and logistics processes have to be renewed. Technology logistics (TL) is such an approach solving not technical issues or aspects of equipment but technological ones, which enables to design and control equipment not according to technical sites, which is often limiting, but according to technology effectiveness (Dorčák, Koštial, Husárová, 2011). Upon this principles could be solved the new lean mining structure, process and equipment integration, production process balancing, stock and equipment flow capacity, operating and transportation batch harmonization at production process (mass flow management) and gravity principles leading to minimization, directness and flow regularity within production process. How can mining adapt the process of digitalization and informatization?

Informatization of raw materials extraction and treatment processes is not concerns only minerals, but necessarily includes the area of tangible raw materials of a different nature (such as renewable raw materials, wastes, value-added products etc.). An important category of raw materials consists of intangible nature – data, by processing which are information and knowledge. The aim is an integrated holistic solution, which encompasses the entire value chain of raw materials - from seeking mineral resources, their extraction, primary and secondary processing, to finalize the product (Dorčák, Spišák, 2011). Informatization in this area must take into account the reuse and recycling of raw products (waste processing) based on mineral resources, revitalization of mining activities, as well as information support for the mining business, management and logistics systems tailored to mining companies, including all necessary service business processes (security, maintenance, transportation, etc.) and finally not forgetting the high-profile European socio-economic aspects.

Digital factory based on informatization and digitalization for thermal processing of raw materials represents our own research (VRP workplace) consisting of digital models creation of technological processes and apparatuses and their integration. VRP systems research in this area consists of information support, material flow optimization, scheduling, logistics, integrated automated processing of data in order to implement and support intelligent plant - SMART factory (see Fig.1). Our own concept also supports the concepts of ETP_SMR where is defined a strategy of 21st century mining company and conception of so-called invisible mine.

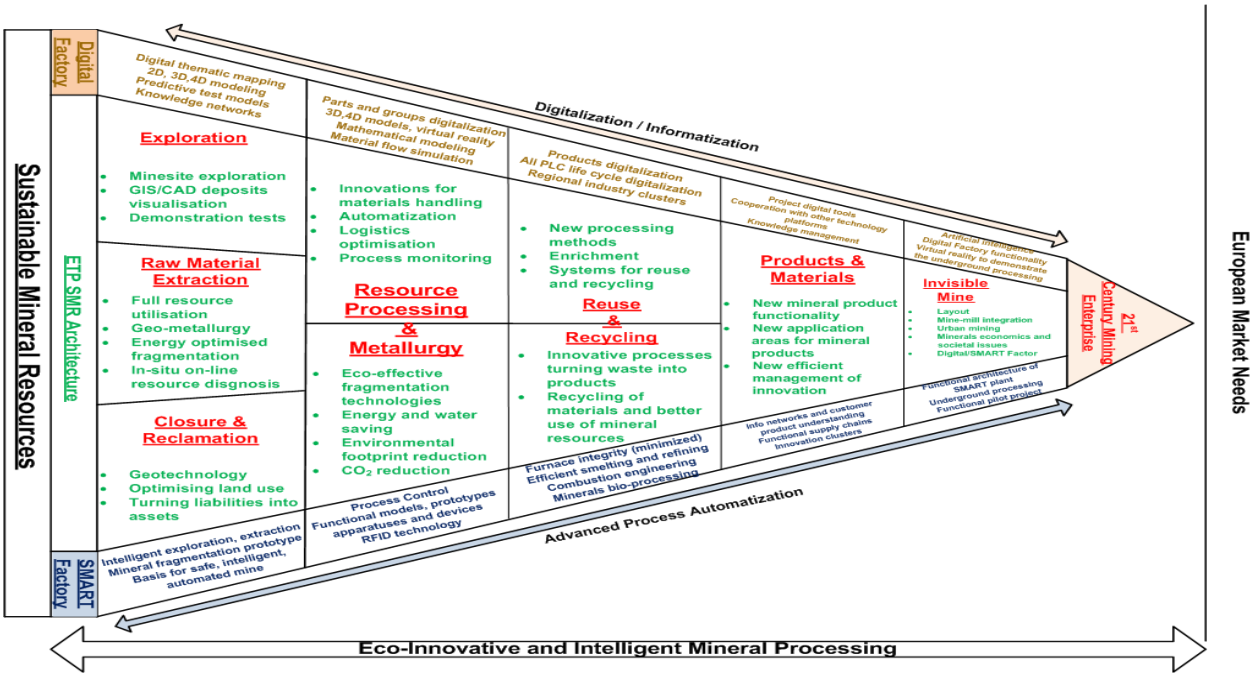

Fig. 1 – VRP Research Conception

3. Changing the Raw Material Industry

The main goal for the future intelligent underground mine structure is to develop a decision support system for real time production control and optimization. Such a system will be beneficial for miners to analyse real time data and take prompt necessary actions and utilize the front-edge techniques to increase productivity and decrease energy consumption for underground mines.

The system should have inputs from the several sources. One is real time data acquisition in underground mines, e.g. signals of RFIDs (Radio Frequency Identification) and environmental sensors, work parameters and coordinates of pumps, generators, fans, conveyers, crushers, etc. The others include models of underground infrastructure, e.g. geometry of ramps, shafts, drifts, and models of grade distribution, blocks and faces.

The raw material and mining industry is highly dependent upon the acquisition and interpretation of data. Until the mineral resource is extracted from the host rock, every ton of ore is virtual, that is entirely based on data. Physical asset valuation is based on information; therefore it is critical that we manage the knowledge that is acquired within our organizations. Applications of knowledge management in mining industry include the following examples:

- Developing exploration databases containing geological, geophysical, and geochemical information about geographical regions complete with remote sensing data, satellite images, results of analyses undertaken, and discoveries made.
- Packaging feasibility studies and environmental impact assessments as "knowledge documents" that directly address the concerns of the target audience, i.e. financial institutions and government officials in charge of approving financing and mining permits.
- Producing a comprehensive map of the knowledge sources in the mining company for quick reference and access to qualified people. It represents building of knowledge databases, content management and electronic document systems. Engineering consulting firms can

build a central repository of professional resources available to the company, complete with curriculum vitae and cross-referenced with a project database archive containing documentation, drawings, maps, simulations, calculations, etc.

- Developing WEB-based open discussion platforms for sharing best practices and benchmarking within organizations and the industry.

It is important that knowledge encapsulates insight and is not only a sharing of information. To be knowledge successfully transferred, it is essential that people document the added value of their experience. Knowledge Management needs not be technology-intensive and should not be technology-driven (Horizon2020, 2011). Although technology such as the Internet, grid computing, cloud computing can be a powerful enabler of business processes and organizational transformation, it is merely a means to implement knowledge management practices on a large scale across and beyond the enterprise.

As a result, the output of the system should assist to supervise and control the production, back to predefined short-term production targets with most likelihood and optimal approaches. The implementation of such a system mainly consists of multi-criteria analysis, algorithms design, programming, simulation and/or commissioning. For underground mines, the multi-criteria are normally comprised of production rates, ore grades, time, environmental quality, and consumption of water, electricity and fuel.

1. **Mine-wide digitalization and informatization model** – integration of information requirements as well business and domain models, data integration, distributed computing and storing system for mining production, development of relation model for interconnection to mine-wide network and cloud monitoring platform. An intelligent decision making platform which will use the information from simulation models, historical data and current signals to propose new or altered production strategies, performance, risk and cost analysis in long-term mining planning and safety strategies. The platform form will achieve real-time data from several mining sub systems. There are three main steps to be taken: analysis, evaluation and determination of the requirements, development of the models as well as modelling of the scenarios and connection to the Intelligent Platform for the support of the decision makers as above. The final aim is to build a Mine-wide information network by creating a knowledge based network structure in the form of new knowledge creation through the in depth analysis of process data.
2. **An advanced mine-wide decision support system** - an intelligent decision making platform that aids the decision makers in making the right decision in a timely manner:

- numerical models, historical data and field signals using
- new or alternative production plans
- performance-risk-cost analysis in long-term mine planning
- real-time data from several operating sub-systems acquisition,
- reference models and digital engineering tool; modelling of scenarios
- ground control system and rock bolt sensor technology,
- SCADA (supervisory control and data acquisition) system to monitor the performance of underground mobile equipment (as loaders and haulers)

3. **Intelligent Predictive Monitoring System** - this system should monitor in real-time mode key components of the production activities and safety policy related to intelligent mining

processes. Predictive monitoring and its control algorithms are characterized by the following features:

- the computation of the sequence of control actions that minimize the management criterion,
- allow to take into account major traffic delays, inverse response and a relatively complex dynamic processes,
- compensate the impact of measurable and immeasurable disturbances,
- formulate an optimization problem, taking into account border management,
- explicitly predict the behaviour of the process in the future,
- calculate a sequence of management intervention values that ensures monitoring of reference variable by output process variable.

4. Intelligent Predictive Monitoring System

Mining technological processes are complex processes with a large number of sub-processes and variables of different types of control algorithms, optimization, planning and decision making. Predictive control methods are beneficial for the management area, from a number of reasons: part of these methods is to optimize the management interventions, or a prerequisite for economical operation of systems with economic benefits include the ability to control algorithms and a limitations of process variables without changing the structure and finally it is a multi-dimensional systems management. In order to realize the stated properties, it is necessary to apply complex optimization procedures. They are often a limiting factor in these methods, since they are time consuming. Research and development in the field of predictive control continues and brings new advanced solutions. One such a solution is a procedure based on genetic algorithms, whose contribution is that it gives in the case of early termination of the algorithm (such as cancellation terms) a sub-optimal solution that can get out of the local extremes. Such an intelligent predictive monitoring system should monitor in real-time mode key components of the production activities and safety policy related to intelligent mining (Spišák, Zelko, 2010). It should offer the following breakthroughs.

4.1. The cloud monitoring technology

The cloud monitoring technology offers the architecture of the future with high-level information distribution and displaying of the current mining and ground conditions through web based services for quick access to various specialists and end-users, and other relevant capabilities related to computing resource sharing aiming cost-cutting thanks to near real-time remote services through the cloud.

4.2. The multi-scale and multi-frequency monitoring

The multi-scale and multi-frequency monitoring are both the quasi static (1D and 3D) and dynamic fields (through induced seismicity monitoring) in the mine. Most practical industrial process data contain contributions at multiple scales in time and frequency. Unfortunately, conventional statistical process control approaches often detect events at only one scale. Multi-scale process monitoring uses a tool condition monitoring in a machining process, which integrates discrete wavelet transform (WT) and statistical process control. Firstly, discrete process is applied to decompose the collected data from the manufacturing system into uncorrelated components. Next,

the detection limits are formed for each decomposed component. A case study, i.e., tool condition monitoring in turning using an acoustic emission signal, demonstrates that the new method is able to detect abnormal events (serious tool wear or breakage) in the machining process. Multi-frequency monitoring systems monitor vital signs and events. The main advantage of using multi-frequency architecture is the possibility to improve the detection sensitivity of dynamic field in mine while cancelling movement with signal processing. Real-time monitoring of the natural and induced seismicity within and around active mining fields provides critical data to mitigate potential damage to surface infrastructure. This invaluable digitalization provides the basis for making informed decisions about production optimization and adjusting operational practices over the field's life time. Permanent installation of a wireless network of ultra-sensitive sensors at the surface is designed for high-resolution real time detection of production-induced seismicity over the entire area of raw material interest.

4.3. Costs-to-benefit monitoring

Costs-to-benefit monitoring offers the cost-to-benefit evaluation and monitoring of cost aspects accomplished by organizational, logistics and technology changes. Such a system should provide dynamic economic comparison of real data of the present state compared to data after technologic logistics optimization. Mining companies would benefit from such a cost monitoring system taking into account their specific production and financial goals. Overall costs will be reduced to enable exploiting lower grades, extending life of mine and overall profitability. The results are monetary statements to mine life cycle costs, mining costs, mining risks and performance of mining performance units. The benefits from cost monitoring are the following:

- The holistic and synchronous consideration of costs, risks and performance already during the strategic planning;
- The analysis and evaluation of technique and economic planning alternatives as well as the utilization analysis of multiple planning scenarios.

5. Conclusion

Because of minimal underground infrastructure required due to plant capable of being installed vertically and because of mine-mill integration accomplished by in-situ methods, gravity methods, process methods and system modelling, the future mine platform would come with the resource, energy, waste, economic and environmental impacts. At the same time this concept would strengthen the position of mining industry as the innovative progressive industry. The benefits could be verifiable:

- Mines profitability increasing as a result of cost reduction.
- Work safety improvement through the knowledge concerning processes and equipment location and risk reduction connected with production line failure.
- Work culture improvement due to use of modern and advanced ICT infrastructure and automating process operation with built-in intelligence – process called the SMARTization.

Information and Communication Technology (ICT) traditionally has been viewed as only a support or operational tool in business. New innovative and advanced development in ICT infrastructure, however, has facilitated the creation of cloud-computing infrastructure services and tailor-made and industry-specific applications, a more cost effective and diverse way of doing business (Zelko, Lavrin, 2011). Digitalization and informatization is currently the main mechanism for the

streamlining of business activities that is now widespread amongst manufacturing and mining companies seeking to improve competitiveness. Technological change through the advanced technologies and organizational restructuring has been observed to bring gains in productivity and market share. The raw material and mining industry also faces similar acute competitive pressures.

A presented facts are supported by own original research used in some structural projects and international projects which promote the above general presented facts. Our workplace is established in the European structures farthest from the Slovak R & D organizations. We are a member of European Technology Platform for Sustainable Mineral Resources (ETP SMR), where we are a member of High-Level Group and one of the founders of new platform. We are the member of the largest European research project - FP7 Program/Project I²Mine: Innovative technologies and concepts for intelligent deep mine of the future. We are the member of another FP7 project: ERA-MIN dealing with building a European research network in industrial raw materials and the cross-border co-operation programme HUSK: Virtual reality laboratory for factory of the future. Our workplace is a proactive member of the consortia for the new European Innovation Partnerships: European Innovation Partnership (EIP) on Raw Materials and KIC (Knowledge Innovation Community).

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References

Cehlar, Michal; Teplicka, Katarina; Szabo, Stanislav. (2009). Possibility of new mining project extracting in conditions of crisis. In: ACTA MONTANISTICA SLOVACA, Vol. 14, No 4, pp. 314-322

CEHLÁR, Michal; RYBÁR, Radim; SOUŠEK, Radovan; SZABO, Stanislav. (2011). Surface mining technology and economy. Pardubice: Institute of Jan Perner. 2011. p. 331. ISBN 978-80-86530-76-5.

Dorčák D. & Spišák J. (2004). Reengineering methodology using for optimization of complex processes of raw materials extraction and processing, Acta Montanistica Slovaca, Slovakia, 2004, 9 (2), 72-78

Dorčák D. & Koštial I., Husárová M. (2011). Creating a digital factory concept on earth resources extraction and processing, Advanced technologies in extraction and processing of earth resources, Proceedings from conference, 2011, Slovakia, 51-54

Horizon 2020 (2011). The Framework Programme for Research and Innovation, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, Brussels, 2011, COM(2011) 808.

Koštial, I. & Rybár, P., Podlubný, I. (2002). Informatization of raw materials extraction and processing - looking forward to the XXI century, Acta Montanistica Slovaca, Košice, 2002, 4 (1), 231-234

Lavrin A. & Zelko M. (2006). Knowledge sharing in regional digital ecosystems, Organizacija, Slovenia, 2006, 39 (3), 191-199

Lipsett, M.G. & Ballantyne, W.J.,Greenspan, M. (1998). Virtual Environments for Surface Mining Operations,

CIM0 Bulletin, 1998, 1 (1)

Prawel, D. (2007). The Advent of Visual Manufacturing, White Paper, President & Principal Consultant, Longview Advisors Inc, London, 2007

Spišák J., & Zelko M. (2010). The Advanced Technologies Development Trends for the Raw Material Extraction and Treatment Area, Products and Services, from R&D to Final Solutions, SCIYO, Croatia, 2010, ISBN , 257-278

Zelko M. & Dorčák D., Husárová M., Olijár A. (2010). The proposal of new technology within the concept of "invisible mine", Proceedings from conference, Czech Republic, Ostrava VŠB-TU, 2010, 1(1), 197-203

Zelko M. & Petruf M., Spišák J. (2010). Environment and risk factors as the part of the European technology platform for sustainable mineral resources, Proceedings from conference, Slovakia, 2010, 131-136

INNOVATION OF MINE-WIDE PRODUCTION SYSTEM IN RAW MATERIAL RESOURCES AREA

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Abstract

This paper presents our concept proposal of objectives to reach the challenges of some new European innovation trends in raw materials resources area consisting in innovation of mine-wide production systems and supporting processes in this area. These concepts aim at helping EU manufacturing and mining enterprises, to adapt to global competitive pressures by improving the technological base of production across a broad range of sectors. The information support contribution to these initiatives should improve the efficiency, adaptability and sustainability of production systems as well as their better integration within business processes in an increasingly globalised industrial context. The challenges include the areas of digital factories and enterprises and finally smart factories. Next research should address these challenges in particular and will encourage international cooperation under the innovation of mine-wide production system in raw material resources area.

1. Introduction

In today's industrial sector in EU, mineral resources industry not excluding, an innovation trends are changing the way companies produce, distribute and support their products. Economic constraints has opened up markets and sourcing opportunities for producers everywhere. It has brought new customers and increased sales, along with new competitors, unfamiliar customer expectations, relentless margin pressure, and the complexities of global supply and distribution. Also with reference to that state of things a new challenge of the Raw materials strategy is introduced by the HORIZONT 2020, an on-coming R&D programme of EU (Horizon 2020, 2011) "Ensuring the sustainable supply of non-energy and non-agricultural raw materials:

- The aim is to improve the knowledge base on raw materials and develop innovative solutions for the cost-effective and environmentally friendly exploration, extraction, processing, recycling and recovery of raw materials and for their substitution by economically attractive alternatives with a lower environmental impact.

- Activities shall focus on: improving the knowledge base on the availability of raw materials; promoting the sustainable supply and use of raw materials; finding alternatives for critical raw materials; and improving societal awareness and skills on raw materials". To adapt within this borderless market environment, society have adopted new innovation ideas: lean principles, continuous improvement and other process disciplines aimed at increasing efficiency, improving quality, reducing waste, lowering costs and abbreviating development cycles (Grohol M., 2012)"

For that reason for a reason of new challenges a new strategic research agenda is preparing by a consortium of relevant stakeholders from mining or raw materials area, creating a network on industrial handling of raw materials for European industries. The strategy states that new challenges require advanced research and innovation to improve the capacity of existing technologies to discover new deposits, new manner of raw materials processing and to improve the efficiency of the entire life cycle from mineral extraction and processing to product design, use re-use and the exploitation as secondary resource of product at the end of their industrial life. The development of a circular economy incorporating a maximum level of recycling, substitution and optimized use of resources must become a top priority in the coming decades.

The concept also accepted a growing interest to describe the whole process chain to improve the efficiency of minerals and critical metals extraction (geo-metallurgy). There is a need to extend the studies to include all the relevant minor elements in increasingly complex raw materials (Cehlár, Teplická, Szabo, 2009). A mine-to-metal or mine-to-product concepts would be the most appropriate approach at this respect.

Among other research and development innovative topics, the strategy (from the point of information support) stated a need for:

- Novel process control through intelligent use of IT, sensors in extraction and processing, Enhanced information architecture and automation for entire processing plants.
- Design of large integrated multi-technology products and processes by flexible and concurrent design methodologies and tools as well as modelling and simulation.
- Optimal control of the products and processes during their entire lifecycle based on adequate information on their usage and condition. For this, there is a need of novel concepts to collect data and further to identify the relevant information. This could be achieved by embedding intelligence to production systems and development of the required products. Data analysis tools (data acquisition, processing and analysis) could be researched to bring information in easily understood forms to operators and for provision of services thus enabling outstanding human-system joint intelligence.

An important goal is to develop future mineral adaptive processing plants, automatically recognizing different feed compositions and to be able to readily adapt such variability. This will require:

- Enhanced information architecture and automation for entire processing plants.
- Development of suitable on-line sensors and off-line analytical methods that will record characteristics such as grade, mineralogy, texture and response (grinding energy required, throughput in the plant, expected recovery, product quality and tailings properties).
- Improved link between 3D geological knowledge and extraction strategies for entire deposits by the form of a geo-metallurgical model that will yield all characteristics and variability tangible for mineral processing.

Indicated approach open a development towards a “custom driven / oriented extraction”.

2. Innovation and Knowledge Management

The process of managing innovation (or innovation management) is the practice of gathering and evaluating innovative ideas in a structured fashion, with a goal of selecting the best ideas with the greatest bottom-line potential for implementation. These enable companies to solicit targeted ideas from all stakeholders and customers and gather them into a centralized online database. Innovation management systems have traditionally evolved from Knowledge Management systems, since a large portion of knowledge was already available for quick and easy access. Innovation management systems are usually generic solutions that can be modified for use in any industry. Current applications are focused on the application of Innovation Management solution for mostly cost reduction. But two costs from an industry standpoint are clearly essential: materials costs and processing (mostly energy) costs. These typically account for between 60 to 70 % of the cost of goods sold. Hence improving upon these key areas would result in the maximum benefit. Material cost reduction in this context stands for any attempt to reduce the cost of raw materials through activities like value engineering, lean production, better technology, competitive benchmarking, part rationalization, packaging change, better logistics etc. Productivity improvement stands for modification of any process – like a core manufacturing process or like a support process such as material handling.

The process of innovation management implementation, however, has many hurdles. Some of these are:

- **Lack of information visibility** – represents the inability to have a snapshot of the status of the innovation initiative. Informatization, digitalization and application of virtual reality represented by virtualization, visualization and animations play a vital role.
- **Long cycle times** – the time required for the generation of the idea to the actual benefit accruing to company. There is a need to include life cycle data in the databases, to build in End-of-life (EOL) collection and logistics and End-of-life pre-processing.
- **Setting metrics and their tracking** – there is a need to be set several indicators and their metrics in the context of cost reduction, environmental process impact (water and energy consumption), which could be set for overall company goals. The indicators and metrics should be drill down for specific entities like departments, suppliers and product lines (aggregates, nodes, components). Nowadays most companies have sub-optimal indicators and metrics setting for a cost reduction goal without thoroughly analysing their past performance and the status of their current cost reduction initiatives. Another question is a metrics tracking - it is often highly sensitive.
- **Inability to leverage past experience** - a mining industry is characterized by geographically disparate (flat deposits, underground, deep mining) locations through the entire process life cycle of processing operations. Because there is the absence of a structured process to share the information, so the same could not be replicated across other models being made in various locations. It seems to be that an inability to leverage past experience becomes a significant challenge.

Innovation management is facilitated by the use of Innovation Management (IM) tools. In fact today there is no comprehensive or at least a partial solution of IM tools in the field of mineral resources. In some areas nowadays IM tools are mostly Web based, enabling to transcend

traditional location barriers. As we mentioned above, innovation management systems also provide structured processes for evaluating and sharing ideas. This tends result in a larger quantity of very high quality ideas. The progressive collaborative technologies like workgroups, expert finders, and knowledge management (KM) solutions like indexing and archiving can be leveraged to create a solution to address all the challenges. The authors´ vision is **to integrate innovation and knowledge triangle** into one smooth solution creating such a new education programmes, innovation projects and business opportunities (see Fig 1).

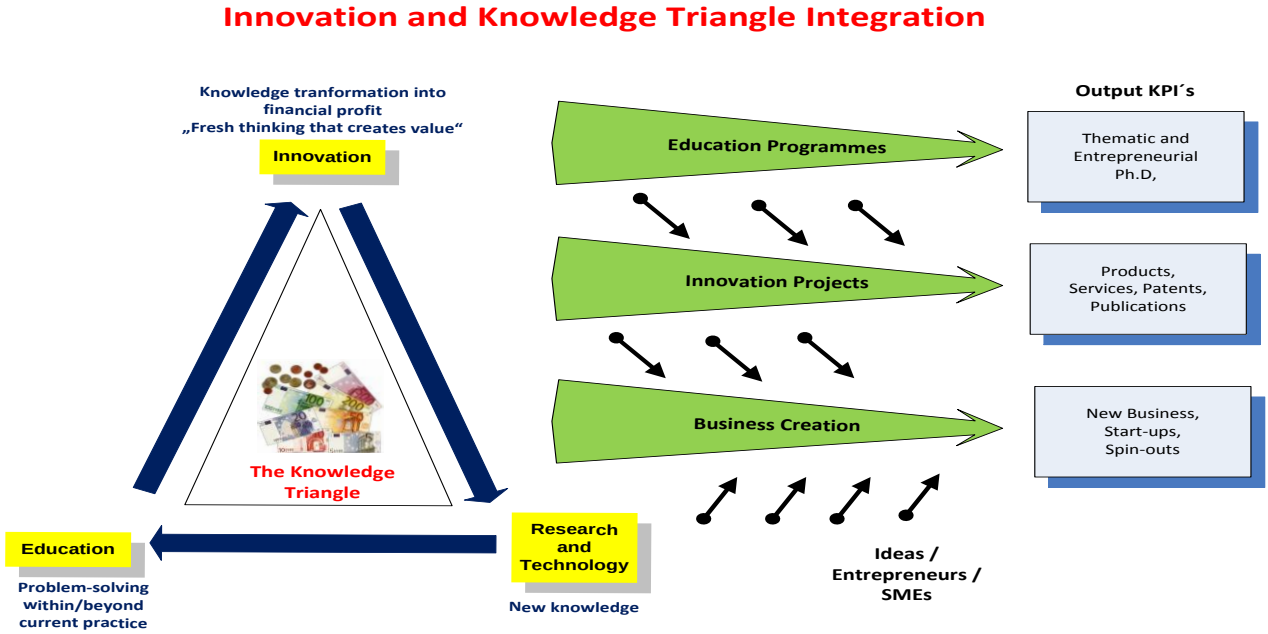

Fig. 1 – Innovation and Knowledge Triangle integration

3. Designing mine-wide production system in Raw Material Resources Area

3.1. Production lifecycle management

Designing a production lifecycle management (PLM) concept covers an integrated approach to enhance the product and production engineering processes. Within this concept the simulation is one of the key technologies and can be applied in virtual models on various planning levels and stages to improve the product and process planning. In the first phase of such a PLM concept the focus should be on integrated product engineering. In the case of new concept for sustainable row materials production it means integration and exploitation of processes in exploration, extraction, materials processing and recycling. For application of this type of integrated production engineering are many only a few tools already available in the market. The second phase includes the plant design and optimization in a collaborative environment concurrently with the product engineering. Couple of tools are available for specific purposes. However, there is still a lack of open integration possibilities between tools, planning levels, and optimization on a multi criteria level. The third phase of a PLM concept focuses on operative production planning and control down to the factory floor. This approach requires an extremely high effort and future research is needed to develop methods and tools for this approach.

Future work should focus on open standard interfaces available for integration of various tools from different software vendors into the digital factory system architecture. The realisation of the digital

factory concept needs various application components such as design and planning software, GIS, visualisation or simulation tools (Kuehn, 2009). All these have to function closely together. A single application system cannot cover the complete range of required functionalities; this can be achieved with the use of specialised software systems and their integration. Therefore, the requirements for each such a system include:

- Networked system and data architecture with integration of processes and product development process.
- Open system architecture with standard interfaces.
- Modular architecture for expandability.
- Efficient data management.
- Consistent 3D and 4D-visualisation platform.
- Advanced documentation and content management systems (DMS and CMS).
- Knowledge management approach involving to the system.

The mine-wide production system concept or architecture in raw materials area requires the integration of design, engineering, planning, simulation, visualization, communication and control tools on all planning and factory levels (Koštial, Rybár, Podlubný, 2002). Each of the particular tools requires specific algorithms and specific data. The mine-wide production system approach aims at using common data for all applications on different modelling levels in order to enable collaboration with virtual models for different purposes and different levels of detail (Prawel, 2007). Therefore an open architecture is an important feature of the mine-wide production system concept. In practical use a mine-wide production system applications require the use of diverse SW components. For the integration of suppliers into development and supplier networks, open interfaces need to be developed with the exclusion of the proprietary ones. Open interfaces and interoperability are the key factors for implementing digital manufacturing concepts (Kuehn, 2009). Conversely, the lack of open standards within mine-wide production system environment creates significant integration and implementation effort for customers trying to deploy a production lifecycle management.

3.2. Comprehensive platforms for production-relevant knowledge

The future concept and architecture of production-relevant knowledge and generally within mine-wide production system design of raw materials area, addresses the production lifecycle management through interoperable models, engineering platforms, computer-assisted product, process development and analysis, virtual prototyping and testing environments to reduce the need for physical mock-ups. *Generally it covers the three main areas to develop, the fourth is authors´ own contribution:*

1. **Comprehensive engineering platforms** - that enable cross-disciplinary information sharing, workflow integration and the capture of production-relevant knowledge (e.g. manufacturing or treatment process knowledge embedded in the models and the engineering tools), supporting the reuse of knowledge across stakeholders and the product lifecycle (e.g. from use to design). The product lifecycle in raw material processing area should support the focus areas covering the whole lifecycle - from exploration and extraction until reuse and recycling. It should reach processes from the exploration, the identification of valuable mineral resources to the sellable products. All steps of the supply and production chain for mineral resources should be underlined with societal issues of various kinds.

2. **User-intuitive tools for simulation and virtual prototyping** with forward and backward compatibility – that enable using of finer digital models to increase accuracy and integrating aspects such as functionality, forming, assembly. The work should also aim at interoperable models enabling the use of various aspects of design and engineering, model auto-generation and robustness (e.g. automated meshing and optimisation) as well as the use of CAD, CAE, Virtual Reality, volume, fluid, structure, polygonal and process models in the various production stages. The future is the adaptation to next-generation of high-performance multi-core computing clusters (cloud computing).
3. **Modelling and simulation tools** of full (holistic) complex products and processes – that enable using of multi-physics and support for tolerance changes in the models. The very important is the digital modelling and simulation of product and production process behaviour, e.g., regarding material properties from micro to macro scale (from the atomic level upwards).
4. **Costs-to-benefit monitoring** offers the evaluation and monitoring of cost aspects accomplished by organizational, logistics and technology changes. System should provide dynamic economic comparison of real present state data compared to data after technologic logistics optimization. Reduced costs enable exploiting lower grades, extending life of mine and overall profitability. The results should be costs-to-benefit efficiency to mine life cycle costs, mining costs, mining risks and performance of mining performance units.

3.3. Innovation of mine-wide production system

Mines and factories of mineral resources sphere are targeting on complex long life products which have to be adapted permanently to the changes of environment. The engineering of next-generation companies along all life cycle phases from investment planning to ramp-up and operation requires digital manufacturing technologies and tools. From the point of information support the research needs to focuses on development and applying the methods, instruments and tools for modelling, simulation, visualization and optimization of products, factories, manufacturing resources and processes (Kostúr, 2002). The aim is the state-of-the-art digitalized environment for integration and distribution of data, models, engineering tools, simulation applications and computing resources. The comprehensive research area within an innovation of mine-wide production systems should include:

- Production lifecycle management:
    - a reference model for holistic and continuously integrated of various production process planning – production lifecycle model
    - a design for rapid manufacturing of products and resources - engineering in hybrid and complex environments
    - an evaluation of plant performance from the complex view
- Factory Data Management:
    - modelling of networked, mine-wide complex (with respect to new sustainable concept of raw materials) and knowledge-based plants
    - reference company data model for systematic and continuously data management
- Digital Engineering Tools:

  - development, applying and integration of innovative and advanced digital engineering tools
  - sensor or RFID-based identification and localization of plant objects - context-aware applications
  - workflow management systems for production lifecycle and knowledge-based plant operations,
  - knowledge management implementation,
  - Virtual Reality (VR) applications and intuitive interfaces (speech recognition, and 3D-input devices)
- Advanced Engineering for Processing:
  - advanced technology - based distribution and networking of data, models, tools and computing resources
  - ICT - integration platform for the continuously integrated and multi-scale modelling and simulation.

4. Conclusion

New, mentioned above, business challenges demand from manufacturers and producers within raw materials industry to streamline their operations, accelerate the pace of business, reduce waste and enhance product quality. Intelligent advanced solutions (Digital Factory, SMART Factory, Intelligent Mine of the Future) play a crucial role in meeting these demands when deployed as part of an integrated infrastructure. Connectivity between a manufacturer's enterprise management systems and its distributed work processes, supply inventories, employees and products provides the basis for continuous data capture and access. It enables real-time distillation of raw data into actionable information, and makes those insights available at any decision point, at any time. This new approach is well supported by the large 7FP project I^2MINE (Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future) [I^2MINE, 2012]. The project marks the start of a series of activities designed to realise the concept of an invisible, zero-impact mine (the Technical University of Košice participates in the project).

Innovation of mine-wide production system in raw material resources area by an intelligent top-ranking technologies lead to improvements in terms of new product properties, production speed, cost, energy and materials consumption, operating precision, waste and pollution management. The advanced technologies supported by advanced solutions (production lifecycle management, comprehensive platforms for production-relevant knowledge, digitalized environment) in mining industry will be based on knowledge-based systems and the related services (e.g. simulation of aggregates and processes, extraction and finishing lines). Advanced solutions can be applied in all manufacturing and processing industries and form an important element in the supply chain of many high value industrial businesses. (Dorčák, Spišák, 2004).

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References

Cehlar, Michal; Teplicka, Katarina; Szabo, Stanislav. (2009). Possibility of new mining project extracting in conditions of crisis. In: ACTA MONTANISTICA SLOVACA, Vol. 14, No 4, pp. 314-322

CEHLÁR, Michal; RYBÁR, Radim; SOUŠEK, Radovan; SZABO, Stanislav. (2011). Surface mining technology and economy. Pardubice: Institute of Jan Perner. 2011. p. 331. ISBN 978-80-86530-76-5.

Dorčák D. & Spišák J. (2004). Reengineering methodology using for optimization of complex processes of raw materials extraction and processing, Acta Montanistica Slovaca, Slovakia, 2004, 9 (2), 72-78

Grohol M. (2012). European Commission, Potential for a pan-European knowledge base on resources and reserves; 13 September 2012, Brussels

http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/eu_us_knowledge_raw_materials_en.pdf

Horizon 2020 (2011). The Framework Programme for Research and Innovation, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, Brussels, 2011, COM(2011) 808.

I2MINE (2011). Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future, The project is funded by the European Commission under the Cooperation Programme of the 7th Framework Programme for Research and Technological Development in the 'Nanosciences, Nanotechnologies, Materials and new Production Technologies (NMP)' theme, Grant Agreement No: NMP2-LA-2011-280855 - I2Mine, http://www.i2mine.eu/

Kostúr, K. (2002). The development of information technologies, Acta Montanistica Slovaca, Košice, 2002, 4 (1), 235-238

Koštial, I. & Rybár, P., Podlubný, I. (2002). Informatization of raw materials extraction and processing - looking forward to the XXI century, Acta Montanistica Slovaca, Košice, 2002, 4 (1), 231-234

Kuehn, W. (2009). Digital Factory – Integration of simulation enhancing the product and production process towards operative control and optimisation, Wuppertal, 2009

Lavrin A. & Zelko M. (2006). Knowledge sharing in regional digital ecosystems, Organizacija, Slovenia, 2006, 39 (3), 191-199

Lipsett, M.G. & Ballantyne, W.J.,Greenspan, M. (1998). Virtual Environments for Surface Mining Operations,

CIM Bulletin, 1998, 1 (1)

Prawel, D. (2007). The Advent of Visual Manufacturing, White Paper, President & Principal Consultant, Longview Advisors Inc, London, 2007

Spišák J., & Zelko M. (2010). The Advanced Technologies Development Trends for the Raw Material Extraction and Treatment Area, Products and Services, from R&D to Final Solutions, SCIYO, Croatia, 2010, ISBN , 257-278

Zelko M., & Lavrin A. (2011). New trends improving the management and technological base of production on Earth resources, Transactions of the Universities of Košice, Slovakia, 2011, 1 (1), 18-22

Zelko M. & Petruf M., Spišák J. (2010). Environment and risk factors as the part of the European technology platform for sustainable mineral resources, Proceedings from conference, Slovakia, 2010, 131-136

ETHICS AND SOCIAL RESPONSIBILITY IN THE COMPUTER AGE

ETHICS IN THE CYBERSPACE

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Keywords

Information ethics, public space, private space, cyberspace, hyperreality, technology

Abstract

The paper deals with two groups of ideas: one is focusing on the losses caused by cyberspace, the other on the gains and new conditions brought by the virtual conditions. The first group regrets the loss of individual appearance of things, which manifests itself in the loss of the public space, in the loss of meaning in hyperreality and in considering things as disposable. The other stream of ideas stresses the new situation brought by the cyberspace and new definition of old ethical concepts in it. The second stream of thought believes individuality can be kept in the new conditions. The paper concludes with an attempt to unify these two types of thought – we should evaluate what was lost and try to keep it if it is necessary for the respect of the individual.

1. Ethics and ICT

The task of ethics or moral philosophy is to reflect and examine moral norms and values of a given society. That also means showing the limits, problems, discrepancies, conflicts and contradictions of a given morality. It breaks its given everyday status which seems unchangeable and obvious. In my article I'll discuss some conflicts of present morality raised by the era of computers.

ICT present a new environment for ethics. In the era of computers we have been facing new ethical questions and challenges related to computer crime, privacy and anonymity, intellectual property, social engineering, information overload, internet addiction, digital divide, surveillance etc. So far it is not clear how to solve them and if traditional ways of ethical thinking are still relevant.

It is not a chance computers spread in 20th century. The time was ready for them. They on the other hand supported some tendencies in the society. I think the loss of auraticity to use W. Benjamin's term was one of the introductory manifestations of the new situation in society and simulacrum to use J. Baudrillard's term is one of the late manifestations. ICT has put us into a new situation of balancing between old and new ethics for computer mediated content, of solving new ethical dilemmas, understanding new facts related to virtual content and its effects. I'd like to trace the history of individuality and specificity loss and its ethical consequences.

There is a big question whether the changes mean a decline, deterioration, degradation of full man's existence or whether they just mean a new era in the development of man, a new situation where the human potential is not lost, his true values not harmed, but used in different contexts only. That is why opinions regarding the effects of ICT differ. We can differentiate between two groups of ideas.

2. Critics of computer age

On the one hand there are thinkers critical to modern ICT based society like H. Arendt, W. Benjamin, M. Heidegger, J. Baudrillard, H. Dreyfus, A. Borgman etc. They criticise the virtuality and generality of modern time and claim ICT and their effects deprive man of something substantial. Computers and other instruments of ICT allow infinite reproducibility. The only individuality was closed into the man's subjectivity which lives its private life. We have lost the sense for public and political (in the original Greek sense). It can be documented on the change the story of Antigona has undergone in the history. K. Kosík (1993) characterized our time as post-heroic. It means that everything heroic is transformed into shallow, pedestrian, small-minded. He continues the thinking of S. Kierkegaard who characterized modern Antigona as isolated and atomised. The power of groups is measured by numbers and not as a relationship of concrete individuals. Isolated individuals form crowds. The situation of modern Antigona is not a tragedy, but unhappiness. And that is why she can't destroy the misery of modern society. A typical example of modern man is Kafka's Markéta Samsová who without emotions accommodates to the metamorphosis of her brother in the next room. Any deep emotion towards her brother is impossible for her.

What we lose in computer age is auraticity, respect and understanding for the here and now; at best it is closed in the unique interpretation of the general product. What we need is the sense of obligation for the other.

More and more codes of ethical conduct won't help as we would need some force ensuring their following. That doesn't mean ethical codes of conduct are useless, they are necessary if we don't want to end up in arbitrariness. But they must be supplemented with respect for the individuality. The balance was violated in modern times. Our task as ethicists is to draw attention to the discrepancies.

To show the loss of respect for individuality I'd like to present the ideas of H. Arendt, P. Baudrillard and M. Heidegger with respect to their critique of modern society and the loss of the world perception. I don't want to say their thinking is similar or even identical, I am just showing some of their commonalities with respect to the loss of contact with the individuality of things.

2.1. Collapse of the public space

H. Arendt criticises current society for the lack of public space and politics in its original Greek sense (1958). Public space for Arendt consists of two related aspects: space where the individual may freely and equally express his opinion and try to persuade other participants of the public space; the second is a common world which is formed by common culture, norms, understanding, institutions etc. and provides a relatively stable context for our activities. The first aspect provide free space, the second provides background or scene where meaning can appear.

Public space has for Arendt the features of artificiality, spatiality and the distinction of public and private interests. If we apply these characteristics on the cyberworld we will see that it doesn't fulfil them. Artificiality means that it is not based on any natural features and that it must be developed and cared for. It is a cultural achievement. And if are losing our common culture we are losing the public space, too. Cyberworld is artificial, but it is a different type of rationality than Arendt stresses. No common culture can be found there. For the public space to flourish we need to create a common cultural background for it. The connection of computers in the internet is not able to create the common culture. It must be learned in the process of education and raising. Without it the cyberspace is just an area of selfish interests where people insult one another.

Public space is different from the private intimacy which rules over the cyberspace if it isn't substituted by the prerequisites of public space. The natural intimacy felt e.g. in families can't create the public space because it doesn't respect the other in his difference and is based on other conditions than just free discussion. We could say it is selfish.

The second feature of common space for the exchange of ideas, differences and looking for a common solution seems to be found in the cyberworld. But its extreme range and size make it difficult for people to meet at one common place. Moreover the search engines are dominated by technical algorithms, some webpages and blogs are more dominant than other and so the awareness of differences is limited and common solution just seeming. This condition can be fulfilled theoretically, but usually isn't fulfilled in reality. In addition to that aspects like digital divide, firewalls and aggressive forms of advertising make the situation still worse.

The third feature focuses on the fact that public activity is an end in itself, not a means to an end. Public interest is something beyond the short-term private interests and concerns the world that lies beyond the self as it was and will exist regardless of the self. The public space is a precondition for an independent thing to appear and for its recognition. (d'Entreves, 2008) This feature is fulfilled to a limited extent only, too. Cyberspace is an area of big economic interests as its popularity and influence is enormous. To expect that it will be just an area of respect is illusory. In any case we may find some islands and aspects of respect in it. I will point to them later.

Modern time is for Arendt characterized by loss of the common world, elimination of the public action and extension of introspection and private pursuit. It has led to apathy in the public space and in human relations as such. This process is thoroughly described in R. Sennett's book Fall of the Public Man (1992). Actually the healthy trustful relation to another human being requires a respect for him. The respect is part of the public space whereas reduction of the fellowman to my own interests forms the essence of private space. And that is why real ethical approach towards the other is impossible without the public space. Men become apathetic and resemble what K. Kosík describes as the modern Antigone.

We shall see later that this characteristic is exaggerated and extreme. In any case it shows a trend supported by the cyberworld. Cyberworld doesn't educate, the establishment of authority is difficult in it. It can promote public space under the condition people behave in accordance with its principles. If they don't cyberworld doesn't force them, on the contrary, cyberworld is a jungle where anybody can do what he wants.

2.2. Hyperreality

P. Baudrillard claims in his early works (The System of Objects (1996), The Consumer Society (1998), and For a Critique of the Political Economy of the Sign in (1981)) that objects in today's consumer society are involved into the nets of signs and meanings invested into them by media, fashion, sports and other modes of signification. He argues that the monopolist economy developed demand management to steer and support consumption. Companies concentrated on the support of prestigious goods and developed their sign value. Products gained a new value in addition to use value and exchange value – they've got sign-value. The prevalence of marketing in all its forms especially in advertising, packaging, display, mass media etc. spread the use of sign value. Individuals get their identity and prestige through the display of the products owned. Veblen's notion of conspicuous consumption (2005) represents a good illustration of what Baudrillard means. This way of production homogenizes controls and dominates social life robbing of freedom, creativity and human potential. And cyberworld helps spreading the sign values and any way of communication without the relation to the real world.

In his later works (Symbolic Exchange and Death and Simulation and Simulacra) Baudrillard stressed the importance of representation for society. Whereas the modern society was characterized as productive because everything was organized around production, for the postmodern society simulation is the most important phenomenon. Everything is simulated in it. We can point out to television, cyberspace and virtual reality. We live in hyperreality of simulations, images and spectacles. Human identity is formed by appropriation of images, codes and models for the perceptions of reality, culture, living of life. In this society the differences are changing and everything relates to everything else. Entertainment, information, IT and ICT provide more intense experience than banal everyday life. This is the sphere of hyperreality which is more real than the real reality. From that it implies that hyperreal images, codes and models control both our perception and behaviour. It is impossible to trace the causes of the ideas or ways of behaviour as any individual is influenced by an enormous amount of images, codes and models. Things are too proximate and too intensive; they are too close for the individual who is not protected by anything. They penetrate him and he can't resist. Modern individual is open to everything even though he is extremely confused. At the extreme the subject "becomes a pure screen a pure absorption and re-absorption surface of the influent networks" (Baudrillard, 1988, p. 27). People are so much fascinated by the images provided that the meaning itself becomes secondary. The media massage has no message and no meaning. (Kellner, 2013)

Hyperreality is composed of images and appearances that are empty. Human emotions like happiness are found through simulation and imitation without the contact with the reality. An example offers D. J. Boorstin (1992, p.48): "we come dangerously close to depriving ourselves of all real models. We lose sight of the men and women who do not simply seem great because they are famous but who are famous because they are great". What we lose is according to Baudrillard intensity, enjoyment and emotional investment because we have changed it for apathetic, disillusioned and uncommitted life. Nothing has its meaning, because meaning requires a scene to appear. Everything is piled up together and has too much meaning and so no meaning. Cyberworld with its virtuality takes away from reality and creates a world of its own.

To sum up what was Baudrillard's idea from the beginning was the dominance of object over the subject. Subject is overwhelmed and dominated by the object and its relations. However without the subject the object loses meaning as well. The subject doesn't have time to orient oneself because it is overwhelmed. It doesn't have any distance, it can't choose, it can't evaluate. The cyberworld with its surplus of information, artificial links, hypertext, tags etc. corresponds to what Baudrillard describes. Man should try to find his way out of it, to manoeuvre out and form his own identity.

2.3. M. Heidegger and the enframing of technology

M. Heidegger in his famous article The Question Concerning Technology (1978) points out the fact that the problems we are facing don't come from technology itself, but from our technological orientation. Getting rid of technology or improving it won't help, because we remain bound to it. "Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it." (Heidegger, 1976, p. 287) Our conception of technology is instrumental (aimed at achieving an end) and anthropological (it is a human activity). "The will to mastery becomes all the more urgent the more technology threatens to slip from human control" (Heidegger, 1976, p. 289) And what does instrumentality mean? Heidegger answers the question later in his article: "The revealing that rules in modern technology is a challenging [Herausfordern], which puts to nature the unreasonable demand that it supply energy which can be extracted and stored as such." (Heidegger, 1976, p. 291) We could see what challenging means if we contrast it with the way poetry reveals things. Heidegger himself shows the difference on the way technology and poetry treats the German river

Rhine. For technology the aim is to build a dam or a power plant. A poet sees in the river a source of inspiration and cultural pride. Technology transforms everything into a reserve. That is its way of treating things. Everything in the world is for technology only good for something, everything must at the disposal of man, nothing has value in itself. And here we return to the beginning of this article. Even the other man has a value only as a means to an end, and not in itself and that is why no ethical perspective exists from the technological point of view. To call human beings human resources reveals what Heidegger means. Our current perspective does not let things appear as they are.

In order to control the world, produce reserves and find means for an end man requires precise and scientific knowledge. But we mustn't forget science is preceded by our technological orientation. And our technological orientation is hiding the appearance of things as they are, they can't appear in their truth. Our orientation makes their appearance impossible.

Even in such instrumental orientation we don't control the way nature reveals itself, man doesn't master everything. And what is more, because man manages technology and decides on its deployment he is not the total instrument for an end. That implies there are gaps in the technological orientation through which the world as it is may come. As our instrumental orientation is not total, there is a chance of finding a new one. Nothing radical is possible, we can neither get rid of technology completely nor blame it for everything and consider ourselves its victim.

Heidegger doesn't think humankind is doomed to one orientation. He thinks that humans can realise that they are part of the process of things revelation and that their orientation is not the only one. In addition to that humankind doesn't control nature completely. If humankind understands it is an active element in the revelation of things, it can change its instrumental approach and start to listen to the voice of things. "The closer we come to the danger, the more brightly do the ways into the saving power begin to shine and the more questioning we become." (Heidegger, 1978, p. 318)

3. Supporters of the new situation brought by ICT

Other thinkers like R. Capurro, H. Nissenbaum, H. Moravec, R. Kurzweil, M. Eldred, D. Nagel, M. Arnold and others stress the aspect of novelty of the situation where new understanding, new hermeneutics and new ethics is necessary in order to handle the new situation. They are not uncritical, they show new situation including its threats. They try to understand the new situation and use its potential. And for that a new ethics is required. Capurro (2010) suggests a new understanding of our bodies based on digital technologies, opening new possibilities of communication, artificiality, privacy, self and subjectivity.

What these authors stress is that even in the new conditions the balance is necessary. The world is complex and when one part of it changes, the other parts have to change as well, because they are interconnected. What we must avoid is one-sidedness. No principles and ideas are realised in their pure state; in relation to opposing principles only. The previous thinkers are criticised for being too one-sided. It should be noted cyberspace also seduces to one-sidedness.

I hope I've managed to show that the previous thinkers support a balance, too and they point out that the balance was lost in modern times. We must carefully examine the state of affairs brought by cyberspace to evaluate what we are losing and what we are gaining. My perspective is oriented on the individuality perception as it is an ethically relevant principle.

3.1. New concepts of privacy and publicity

Privacy and publicity must be determined together. One is not determinable without the other. However there is always a cultural influence (including technological development) in their understanding. As individuality steps back into the man's subjectivity public space changes as well. Individuality is not respected in the outer world and is treated as disposable. However people react to the change. One of the reactions is distrust and creation of fictive identities. People are afraid to enter their real data when communicating with somebody unknown. Their individuality is in danger. If we try to keep it, we'll have to consider new circumstances. Their individuality will be transformed and maybe more fragmented. People have many roles, are in contact with a lot of others, are available online almost 24 hours and the sense of privacy changes. Helen Nissenbaum in her book Privacy in context (2009) stresses the contextual dependence of private/public distinction and supports the right to appropriate flow of information (Nissenbaum, 2009, p. 127). That is what Arendt underestimates.

Modern ICT differ from classical mass media in interactivity. Interactivity allows individuals not only to receive messages, but also to send them. It is true internet provides new opportunities for communication, but also brings new forms of surveillance. Society and our understanding of the world have changed. A new ethics and a new theory of interpretation seems to be necessary as messages live almost autonomous life separated from their authors and information is easily available. Some of the principles are included in the following paragraph. They show the effort to realize the problems immanent in the new situation and suggest a solution which accepts the change of our environment and our approach.

The discussion all depends on how strict and concrete idea about man and his behaviour we have. R. Capurro (2012) thinks private and public spaces are interconnected as well as to them related concepts of trust and fear. Fear is related to uncertainty and groundlessness of human existence, trust means creation of common space where we can rely on one another. For the creation of trust norms, values and customs are necessary. Capurro also stresses the connection of world and self on which freedom is based as a feature that forms the identity of the self by reacting on the pictures of itself from the world and selecting from them. And the relationship and manifestation of trust and fear changes together as the relation of man to his world changes. That is why the questions about ethics are related to the question about who the human being is and how he is formed. Such basic questions are aimed at the activistic efforts proposing sets of measures for the privacy protection. Before these measures the questions about humane identity and how it is formed must be resolved. Provisionally we may say that the measures must be very general to allow the formation of both private and public space, fear and trust, but may not privilege any form over another or block the formation of any form. In addition to that we must learn our lessons from the critique of modern times.

As human being's identity is formed in relation to the world and its reactions, privacy means withdrawing from the shared public world and into the intimacy of only some selected individuals. There are actually many private lives according to the circle of participants (family, friends etc.). In the public sphere the masks or identities differ according to the situation, but their audience is not limited to any specific group. We should add that for the public space to appear the conditions suggested by Arendt must be fulfilled. They don't require the public space to be separated from the private space, they may be part of one area of human activity, including the business sphere. People make business for their own profit, but still may respect their partners. The same is true for more personal relations. Friendship or love are composed of favour and respect. In the private part the other is reduced, in the public respectful part he is uncovered in his individuality.

The play of revealing and disclosure is played in every space. In modern society the public and private spaces are separated not as spaces for hiding and disclosure, as was the case in antiquity, but according to the audience. In both spaces the play between hiding and revealing occurs (Eldred, 2012, p. 85). So what must be kept and guaranteed is the sender's decision about the audience of the message. Only the state can be allowed to decide in cases of general interest to interfere and break the privacy – but it must keep the privacy of the data. The problem of today's cyberworld is that it is very difficult to live a private life in it. It can be said (Eldred, 2012, p. 96) cyberworld offers much more (hitherto unknown) space and possibilities to present oneself to others in general. That is true, but we must reflect the threats revealed by Arendt and others and take measures not to lose some important aspects of human life. Probably we should consider her distinction between public and private space as methodical, showing the extremes. In reality they should be connected. What Arendt warns against is the prevalence of private space and so private interest. But to limit the distinction between public and private space on the distinction among the groups of information receivers is too short-sighted. It is one aspect of the distinction, but there are more than this one.

Actually none of the critiques of modern times thinks we can or should simply return to any historical period. They just warn against the losses in modern times. And the reason is ethical – man has responsibility for the other in its individuality and specificity which is multidimensional. However it is a complex matter, which is in addition to that contradictory. Nonetheless we are still obliged to satisfy the other and the others.

Similar ideas are valid for Baudrillard's hyperreality and Heidegger's technology. It would be naïve to think we should get rid of symbols and virtuality and treating things as disposals. What we should do is to balance the one-sidedness and support the neglected aspects, too.

If we summarize the three streams of ideas described above we can see that man's affinity to technological way of perceiving things prevents him seeing the things as they are in their individuality and that manifests itself both in the political area and in the abundance of virtual meaning things have for man. The political area is an arena for the revelation of things and without it they live their poor life in the man's subjectivity. But there they dominate over him and man becomes confused as there is no background on which they could appear. The following ten principles represent an effort to reconstruct the appearance of things through establishment of a common stage which would convey meaning and let things appear.

What is lost in present times is the understanding of the cyberworld and distance in other words respect for the other. The intricacy of the cyberworld is enormous there are no shared rules as anonymity prevails. Man's orientation is above all technological in the above sense. Because of that things and human beings don't appear in their fullness, they become general objects of manipulation. The following norms try to establish a common space where things could appear. They avoid the intricacy of the cyberworld and stress education of the users. That will help create a common world where things could appear. If these suggested principles are realised deliberately they could avoid the problems shown above and use the advantages of the cyberworld at the same time. For that the critique of modern society must be considered. The revelation and regulation of information manipulation helps limit hyperreality and disposability of things, enhance cyberworld transparency and promote respect for the other. And substantial is also good education and training, not only technical, but ethical, too.

3.2. Ten principles for the ethical internet

Carsten Ochs, Martina Löw (2012) suggests ten principles for the development of culture in the internet sphere and the fair treatment of information. A condition for that is that internet is

understood as a collective good for which everybody is responsible. Internet users must understand it sufficiently and be able to decide freely. The problem can't be limited neither to the individuals nor to the institution. Both sides are responsible and both sides should be regulated by ethical, possibly legal regulations. The ten principles won't secure fair ethical behaviour on the internet, they are just one step towards it.

The first principle deals with the insufficient transparency of internet providers and other institutional organizations operating on the internet. The individuals can be monitored easily, but they don't know who and how processes their information. Inspired by M. Foucault H. Nissenbaum (2010) speaks about informational panopticum where individuals can be monitored, altered, and be subjected to experiments. The asymmetry of information is unfair and must be supported to benefit the individual users. The internet users should know who stores what information about them, for what purpose and how he processes it. They should be also able to express their discontent and refuse it.

The second point concerns the confusedness and complexity of general terms and conditions for using software or other virtual product. Users don't have time and juridical skills to understand it. Very often they don't know under what conditions they use a product. Ochs and Löw (2012) support the idea of universal terms and conditions for products used on the internet. They would be also taught at school. Possible changes or adjustments would have to be justified and marked clearly. Machine reading and processing of terms and conditions would also be an alternative. Technical solutions like P3P should be supported.

The third point stresses the user's ability to control storing, processing and passing of information. The general condition can't be based on the principle "take it or leave it". The user must be allowed to use the software even if he doesn't submit information on himself.

In addition to that the software and internet provider must be available and accessible. Electronic media and virtualization can make the communication very difficult and providers can hide behind many walls. The physical presence in an office would improve trust and reliability. The increased costs may be in this measure's way.

The fifth measure establishes a certifying institution certifying fair treatment of a company or a software product. Identity and ethical quality of partner seems to be confused for the internet users.

The sixth suggestion is to establish Trust centres for users who are not so advanced in the area of internet. The trust centres would administer the private information of those users and would arrange and process the transactions according to the users´ wishes and requirements. The not advanced users have problems with the intricacy of internet communication and with the rapid changes of possibilities and requirements.

The users can't transfer the whole responsibility for their behaviour on other institutions and that is why their knowledge and skills in this area must be developed. The seventh recommendation aims at society wide discussion and education, e.g. at schools. Some norms for the behaviour on the internet can be developed. Users can learn how internet works, what can be expected from it and how to protect themselves and how to behave responsibly towards others. More skilled users could inform the beginners. Internet providers know a lot, many users very little.

The eighth provision supports the right and freedom of users by ruling out the possibility to form a unified and interconnected profile for various activities on the web. If it were possible to split the profiles the problem would decrease. Users can have a different identity for music, books etc., but it would not be possible to combine these identities together. The users would still have the advantage of getting personalized offers, but the providers would not have their complete identity.

Related to the eighth provision is also the ninth one. It prevents creation of the profile by software that generates random queries. Its operation can be adjusted to the user's needs so that e.g. the search history can become unclear, but the consumer behaviour can be recognizable.

The last tenth recommendation concentrates on the interconnection of personal information. Free time activities are available for all users including employers. So the linking of personal information provides more information on the users than they wish to provide. The possibility of de-linking the information would be a solution.

4. Relation of the two types of thought

The critics usually present the losses brought by ICT. They think what we lose is more valuable than what we gain. And what we lose is according to them the real contact with the individuality of things, with reality and perception of it in its full sense. Its supporters stress the new situation, new contexts and its advantages. They think man has no fixed qualities, he can't be defined without his environment and society and healthy relation can be developed in various modes of interactions.

H. Arendt criticises the broadening of the sphere satisfying human needs where everything is just a function of human consumption and the loss of the public space where worlds and acts are appraised as such without the reduction to anything else. M. Heidegger criticised the effort to control and manipulate the world instead of letting it speak. Baudrillard criticised the abundance of meaning which leads in its extreme to the loss of meaning.

These above presented two groups of ideas needn't contradict one another. They may be complementary. While the first line of thought focuses on what was lost, the other shows new horizons, opportunities and threats. I hope I have shown an example of their combination in case of public space and individuality respect.

To be more general, we may ideas of M. Heidegger and H. Arendt. For both of them the return to the tradition is impossible. Our old concepts and judgements were destroyed in modernity and don't have their original value and meaning. We can't appropriate the tradition any more, we can only appropriate our past. Arendt suggests two ways out of the current situation. One is inspired by W. Benjamin and tries to connect past and present and show relevance of some historical concepts in the present time. The lost potential of the past may find actualization in the present. The second way was inspired by M. Heidegger and tries to find impurities in the old concepts and clean them to identify their original meaning. The tradition as a whole can't be recovered; it must be critically evaluated and moments valuable for the present must be found to illuminate our present conditions. (d'Entreves, 2006) I will leave out the Baudrillard's solution as it is rather tricky and not unanimous throughout his work.

From that it follows that cyberworld can't be accepted as it is that we must question it permanently support the tendencies which are valuable, but cyberworld suppresses. Only then we will able to use its potential.

There are both pros and contras of internet and we must keep discussing them and drawing attention to them. That is why this forum and this conference are important.

5. Conclusion

Everything new brings and introduces something new and ruins something old. That is the world's cycle. And the new virtual technique and technology is no exception. It has a Janus face as M.

Arnold (2003) states. I think what is necessary is to question both the current and new order. And that is what ethics does: it reflects, examines and questions moral order and its norms and so prepares place for something new about which we know why we are accepting it.

New cyberreality puts us into a new situation where we lose the contact to concrete individuals, and live in generality. The original ethical appeal to take responsibility for the other face to face him loses its urgency. That means cyberspace can't replace reality and its relations, we would lose much more of the world than we would get. Heidegger's enframing can't replace being in its full sense. In spite of our deep attraction to cyberspace I hope it will not replace the full sense of being as it is only an approach and as soon as we realize it we are saved. The deeper we succumb, the more strongly it will remind us it is just our approach. Its critique is our chance.

To get rid of cyberspace is not a solution, too. It should become one of spaces for communication and expression of one's potential. In any case we shouldn't accept it as it is, but cultivate it in order to let things and people appear as they are.

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References

Arendt, H. (1958). The Human Condition. Chicago: University of Chicago Press.

Arnold, M. (2003). On the phenomenology of technology: the "Janus-faces" of mobile phones, in Information and Organization 13 (2003) 231–256

Baudrillard J. (1981). For a Critique of the Political Economy of the Sign, St. Louis: Telos Press., ISBN-13: 978-0914386247

Baudrillard J. (1993). Symbolic Exchange and Death, London: Sage, ISBN-13: 978-0803983991

Baudrillard J. (1994). Simulacra and Simulation, Ann Arbor: The University of Michigan Press, ISBN-13: 978-0472065219

Baudrillard J. (1996). The System of Objects, Verso Books, ISBN 9781859840689

Baudrillard J. (1998). The Consumer Society, Paris: Gallimard, ISBN-13: 978-0761956921

Baudrillard, P. (1988). America, London: Verso, ISBN: 0860912205

Boorstin, Daniel J. (1992). The Image: A Guide to Pseudo-Events in America. New York, NY: Random House, ISBN-13: 978-0679741800

Buchmann, J. (Ed.). (2012). Internet Privacy, Eine multidisziplinäre Bestandsaufnahme / A multidisciplinary analysis, acatech – Deutsche Akademie der Technikwissenschaften

CAPURRO, R. (2010). Digital hermeneutics: An outline, in AI & Society, 2010, 35 (1), 35-42

Capurro, R., Eldred, M., Nagel, D. (2012). IT and Privacy from an Ethical Perspective Digital Whoness: Identity, Privacy and Freedom in the Cyberworld, in BUCHMANN, J. (Hrsg.), 2012, Internet Privacy, Eine multidisziplinäre Bestandsaufnahme / A multidisciplinary analysis, acatech – Deutsche Akademie der Technikwissenschaften

d'Entreves, M., P. (2008). Hannah Arendt, in The Stanford Encyclopedia of Philosophy (Fall 2008 Edition), Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/fall2008/entries/arendt/ [retrieved on 01-05-2013]

Eldred, M. (2010). Arendt on whoness in the world, in BUCHMANN, J. (Hrsg.), 2012, Internet Privacy, Eine multidisziplinäre Bestandsaufnahme / A multidisciplinary analysis, acatech – Deutsche Akademie der Technikwissenschaften

Heidegger, M. (1978). Basic Writings, David Farrell Krell (Editor), Routledge & Kegan Paul PLC, ISBN-13: 978-0710086464

Heidegger, M. (1982). The Question Concerning Technology, and Other Essays, Harper Torchbooks

Kellner, D. (2013). Jean Baudrillard, The Stanford Encyclopedia of Philosophy (Spring 2013 Edition), Edward N. Zalta (ed.), URL = http://plato.stanford.edu/archives/spr2013/entries/baudrillard/

Kosík, K. (1993). Století Markéty Samsové, Český spisovatel, ISBN: 8020204423

Nissenbaum, H. (2009). Privacy in Context: Technology, Policy, and the Integrity of Social Life, Stanford University Press, ISBN 0804772894

Nissenbaum, H. (2009). Privacy in Context: Technology, Policy, and the Integrity of Social Life, Stanford Law Books, ISBN-13: 978-0804752374

Ochs, C., Löw, M. (2012). Un/faire Informationspraktiken: Internet Privacy aus sozialwissenschaftlicher Perspektive, in BUCHMANN, J. (Hrsg.), 2012, Internet Privacy, Eine multidisziplinäre Bestandsaufnahme / A multidisciplinary analysis, acatech – Deutsche Akademie der Technikwissenschaften

Sennett, R. (1992). The Fall of Public Man, W. W. Norton & Company; Reissue edition

Veblen, T. (2005). The Theory of the Leisure Class: An Economic Study of Institutions, Aakar Books, ISBN-13: 978-8187879299

ETHICAL AND SOCIAL ASPECTS OF INTERNET SEARCH IN HISTORICAL PERSPECTIVE

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Information ethics, internet, web search

Abstract

At the dawn of the 21st century everyday life of the common citizen of industrialized society has become more and more intertwined with Internet technologies and services. One of the prominent Internet services is the web search and the first part of the paper describes its history, current state and emergence of dominant search websites. The second part focuses on ethical and social implications of the described process. The paper discusses social bias of web search, problem of visibility on the Internet and relevance to concept of political voice. Several proposed solutions are analyzed in the final sections of paper.

1. Introduction

Since the beginning of the 21st century everyday life of the common citizen of industrialized society has become more and more interconnected with Internet technologies and services. The Internet is slowly making its way into people's private lives. Email was followed by instant messaging applications like ICQ or MSN, and most recently by Internet telephony either SIP based or Skype. The most frequently used and probably the most important are still full text web search services. Along with the new technologies also new companies have risen from the ashes of the dot com bubble at the beginning of the century.

The process of commercialization of the Internet has led to retreat from its original ideas. The original vision of the Internet imagined it as a dense distributed network with no dominant websites; Internet standards and protocols were designed with this vision in mind (Abbatte, 1998; Berners-Lee, Fischetti, 1999). Many people believed that new sources of online information would inform citizens more about politics and would help to involve previously inactive citizens into political participation. Early visionaries believed that the Internet would become a robust forum for political debates and that the openness of the Internet would allow ordinary citizens to publish their opinions along with professional journalists (Hindman, 2008:1).

The rest of the paper is structured as follows: Section 2 presents short historical overview of development of web search services, Section 3 analyzes relevant social and ethical issues, and Section 4 finishes with conclusions and acknowledgements.

2. Advent of search engines

In the beginning of the Internet era, a typical user spent most of his time "surfing" Internet websites which meant going from one web to another, and then to another based on the links present on previous webpages or in some cases manually maintained directories of websites usually focused on a specific theme. With the increasing amount of web pages more ambitious projects emerged – web global catalogues trying to include every important internet web site for any topic. These catalogues were created and maintained semi-automatically and were organized by a topic based hierarchy. Most of these global web directories have not survived until today, but one of them became very successful – Yahoo.

As the amount of Internet websites grew, manually and semi-automatically maintained catalogues were not flexible enough to provide complete and reliable reference of the web content. The number of fully automatic search engines was developed with a similar central idea – crawler software browsing through web space and collecting information about webpages into a central database paired with user interface and search software performing retrieval functions on the database content. Again, there were a handful of such web services, apart from experimental and academic software, one of the first was AliWeb in 1993, then WebCrawler, Infoseek, Lycos in 1994, Magellan, Excite, AltaVista in 1995, Inktomi, Northern Light, SavvySearch, Infind, and many others later. In 1998 the Google search web site was launched. In following years it has slowly become a dominant Internet search engine. Yahoo introduced Inktomi powered full text search in 2001, later migrated to Google technology and then implemented its own search engine in 2003-4. Since 2009 Yahoo uses Microsoft Bing technology.

Along with Yahoo and Google, the third very popular web site that includes web search service is Microsoft's MSN/Windows Live in 2009 renamed to Bing. Several MSN/Windows Live specific tools were developed and distributed as part of the Windows operating system and provided to users as an automatic update of the operating system or published as a free download add-on.

Search engine	**Share 2007**	**Share 2010**	**Share 2012**
Google	53.6%	66.6%	66.7%
Yahoo!	19.9%	16.0%	12.2%
MSN/Live/Bing	12.9%	12.0%	16.3%

Table 1

During the last few years the following three internet websites emerged: Google, Yahoo, Bing – as centers of the Internet traffic and dominant web services providers on the Internet. In the Table 1 there are their websites' shares of the full text Internet search service in 2007, 2010 and 2012 (comScore, 2008a, 2011, 2013). Google is leading by a significant margin since 2007 – the Internet search is Google's primary area of expertise (Nielsen, 2007).

Each of these websites had a different background and a different primary area of expertise. In Yahoo's case it was a large semi-automatically maintained hierarchical catalogue of websites, in case of Google it was an efficient and fast full text Internet search web service, and in case of Microsoft's MSN/Windows Live/Bing it was its strong position in desktop software and specifically its advantage as a developer of the most popular operating system. Over time these websites developed into a comprehensive suite of various web services. Such additional services typically include email, news, weather forecast, TV and cultural events program, photography sharing, discussion forums and many others. There are of course many specifics. Microsoft at first

developed the MSN/Windows Live in its core as a social networking website (based on the concept of social networking websites like Myspace or Facebook), enabling users to easily share information and communicate with their friends. Google tried to attract users by ability to customize their search homepage, providing online office suite applications and many other small but useful gadgets like its geographical map web application, online library or even house interior design application. This ability to develop and integrate this wide range of Internet applications leads some commentators to claim Google as a standard-bearer of Web 2.0 (O'Reilly, 2005). All these companies – Microsoft (as part of operating system), Google and Yahoo – provided instant messenger applications: Live Messenger, Google Talk and Yahoo Messenger. Since 2006 Live Messenger and Yahoo Messenger are compatible and users of these two instant messaging networks can communicate with each other. In 2013 Microsoft Live Messenger was discontinued and replaced by Skype internet phone and messaging service, acquired by Microsoft in 2011 (See Microsoft, 2011).

Such an approach aims at developing a complete framework of Internet applications that suits all needs of an average Internet user. The purpose of such web application suites is to keep users inside or to *internalize the Internet traffic*. A very small number of external links is offered and the user is encouraged to stay within the limits of the internal web and use only services that are provided on this website.

The advent of Web 2.0 is characterized mainly by social networking services and web applications. As we have already described Microsoft made social networking applications the core of its MSN/Windows Live website. It may seem that social networking sites are competitors for sites like Google and dominant Internet websites are probably well aware of the importance of social networking in the future of the Internet. In 2006 Google acquired YouTube (social networking website for video streaming) and recently Google developed OpenSocial interface aimed to be common ground for developing applications for social networking applications. Although only a couple of not so very well-known social networking sites joined this initiative at launch – Orkut, Salesforce, LinkedIn, Ning, Hi5, Plaxo, Friendster, Viadeo, later also MySpace, Bebo and SixApart announced their participation. It may be also noted that MySpace was acquired in 2005 by Fox Interactive Media. The Facebook social networking site founded in 2004 remains the only large social networking website that is still independent. In 2011 Google launched its own social networking service Google+.

In the light of these events another interesting questions may be considered: What websites do Internet users really regularly visit? Already in November 2008 Internet statistics captured totally 190 m. unique users in the USA. Google website was visited by 146 m. unique users, Yahoo website was visited by 143 m. users and websites operated by Microsoft were visited by 123 m. unique users (comScore, 2008b). We may conclude that the majority of users visit three dominant sites regularly or more typically – uses them as their primary point of departure even when visiting other websites. E.g. Google and two other dominant websites are the most important sources of visiting users for music related websites in the UK (Hopkins, 2006). Many users go to these specialized websites after searching for a keyword for example in Google and choosing from the presented list of results. In the light of presented statistics it may be also interesting to mention that there exist ongoing efforts of Microsoft to acquire Yahoo (Isidore, Lev-Ram, 2008).

3. Social and ethical relevance of Internet search

The reason why we describe this development is to illustrate the continuous process of centralization of the Internet services. Such process implies questions relating to many different

scientific areas – it may be interesting, for example from the point of view of economics, to ask whether the essential characteristics of the Internet itself necessarily result in forming of some kind of natural monopoly. Becoming a central site of Internet traffic is enormously expensive. Hindman (2008, p.84) points out that Google pays out billions of dollars annually to have other websites which send visitors to his web services. Similarly, costs of computer equipment are extremely high – already during the years 2003–2005 Google spent $1.33 billion on property and computer equipment. The total number of servers operated by Google has been in year 2009 estimated between 450 thousands and 1 million. Google does not make this information public, however Miller (2009) revealed, that its single container data center often holds more than 45 thousands servers and according to Shankland (2008) already in year 2008 Google had more than 35 such large data centers across the globe. Due to inability of standard database software to deal with amounts of data Google has to handle, a new database system called BigTable was internally developed and is used to manage as much as 6 petabytes of data across thousands of servers (Lai, 2009). Such circumstances make it extremely difficult and expensive to seriously compete with Google.

If we focus on ethical and social implications of the described process, the first problem we encounter concerns the description of the situation itself. It has been already pointed out by Moore (1985), one of founders of computer ethics, that there are often conceptual muddles that need to be sorted out. Also Johnson (2004, p.68) asks "How are we to conceptualize a search engine?" Technical development we have described in previous paragraphs results in technology and information artefacts that have many unique properties unlike anything else in human history. Johnson therefore believes that when we are dealing with issues like these, it is not the case of "simple" applied ethics, because it involves a complex conceptual analysis and interpretation of completely new phenomena not just applying existing ethical theory to a new situation. World Wide Web inventor Barners-Lee suggests that the complexity of the web has grown to the level of complexity of the human brain – there are 10^{11} webpages and there is a similar number of neurons in the brain. He says that now we do not fully understand the nature of the emergent systems that have cropped up on it (Marks, 2009).

The fact that search engines raise not merely technical issues but also political ones was recognized already by Introna and Nussbaum (2000, p.17). They focus on the ranking of websites in search results and explain the nature of the problem in what we can call sociologically and technologically based bias. The technological, software design of web search engines implicates preference of specific websites, "popular, large sites, whose designers have enough technical savvy to succeed in the ranking game". There is also a socially or economically based preference of sites "whose proprietors are able to pay for various means of improving their sites' position".

The social bias can be also connected even with the ethnic or racial background and current demographic patterns of the Internet access and usage (Hoffman et al., 1997, Hoffman, Novak, 1998). The important outcome is that information relevant to some ethnical group, which is not numerous or for whatever reason does not use the web as intensively as others may be ranked lower in search results sets than information on more popular websites. This constitutes what we may call *visibility* on the Internet. If dominant web search pages are major sources of incoming users for many webpages then the visibility of a webpage is determined by the position which it has in the result sets returned for some typical queried key words. This search engines visibility is closely related to what is in political science called *political voice* and is one of its central concepts. It has been pointed out that clear, loud, and equal voice of citizens in politics is a requirement for meaningful democratic participation (Verba et at., 1995, p. 509; Hindman, 2008, p. 6).

Let us imagine a situation preceding presidential elections (let us say in a country like the USA). Most responsible voters try to find out relevant information about their candidates. There is a lot of relevant information on television and in newspapers but some people prefer to find such information on the Internet, and the importance of online information will probably even rise in future. Now what happens if a dominant search engine deliberately presents at the top of its result set webpages idealizing one of the candidates and pages containing mostly criticism and denouncement of other candidates? Such manipulation can be done in a way that is not easily recognizable. Does it have measurable effects on the results of elections? While there is a considerable amount of work trying to analyze the impact of new media on politics and democracy (see e.g. Abramson et al., 1990) the specific role of internet search engines has not yet been sufficiently analyzed. We already know that the link structure of the Internet, the element that is the most important for most of search engines is not itself politically neutral and Roger (2004, p. vii) has shown that it can be analyzed in terms of what he calls "politics of association".

The exact working of a search engine and its algorithm are considered an industrial secret. Engineers and owners of the search providing company are free to modify it in any way they want. A question then may be: What is the legal status of a search service? What is the relation between a user and a service provider? Something like that is usually stated in a "terms of service" document however for example in the case of Google there is not anything mentioned regarding the characteristics of the search results. Is there any obligation (legal or moral) of a search service provider related to the set of results he presents to a user? Google describes its determination to provide correct results in one of its basic documents: „ [our search results] …are unbiased and objective, and we do not accept payment for them or for inclusion or more frequent updating" (Page, Brin, 2004). However exact legal (and moral) status of such a statement is unclear.

One way of overcoming such possibilities of abuse is to use the open source approach to software development or at least a partial open source approach – like in case of Microsoft which made the source code of its Windows OS available to selected public institutions and government authorities (Microsoft, 2010). But such an approach seems to have a number of drawbacks in the case of search websites. Introna and Nussbaum (2000, p. 16) note that web search companies are loath to give out details of their webpage ranking algorithms for fear that abusers and spammers will use this knowledge to trick them. There are ongoing efforts of many individuals and companies to guess details of ranking algorithms, some even with scientific backing (Pringle et al., 1998).

Other authors suggest that some kind of regulation should take place on the Internet. However, such suggestions are made only in very general terms, without any specific regard to web search. Livingstone and Lunt (2007) say: "Access to, and the content of, the press, television, Internet, and so on should be evaluated, therefore, not in terms of what contents or services they provide but in terms of the possibilities they afford or impede."

Anderson (1993, p. 141) similarly claims that there is a category of goods that should not be left entirely (if at all) to the marketplace because there are inherent ethical limitations of the market norms (See also Introna, Nussbaum, 2000, p. 23). There are goods for which this claim is uncontroversial, such as: person, body, friendship, political rights like the right to vote, but she controversially believes that the same applies to a much wider range of goods such as public spaces artistic endeavour, addictive drugs and reproductive capacities (See also Fabre, 2006). Introna and Nussbaum (2000) believe that also Internet search services belong to this specific category of goods and say that while for goods like cars or bottled salad dressing etc. the marketplace is a perfectly adequate distribution mechanism, for other goods this distribution fails to properly express values of the liberal democratic society committed to freedom, autonomy and welfare. Introna and Nussbaum therefore agree with Anderson (1993) in her substantial claim that goods belonging to

the category of political goods have to be distributed in accordance with public principles and not just by the market mechanism. The reason for such a conclusion is the belief that while retaining a full range of options in bottled salad dressings or cars has no impact on the political sphere, retaining visibility of a full range of political options expressed on the Web has key importance in maintaining the pluralistic democratic society (Anderson, 1993, p. 159; Introna, Nussbaum, 2000, p. 23). The argument may be reduced to this: while we may live in a perfectly democratic society with only one variety of salad dressing available, the democratic character of society would be endangered if there would be only one kind of a political opinion offered by search results of internet search services.

As a supportive argument Introna and Nussbaum (2000, p. 25) claim that the special character of search services is derived from special character of Web itself. The Web is a public good and it earns this character in many of the same ways as other public goods. The meaning of the term "public" itself signifies something that is not privately owned and the Web seems to be public at least in this sense. While its constituent parts – hardware and software, could be privately owned the Web as a whole is not privately owned by any particular entity. Similarly, it does not come under jurisdiction of any single sovereign state; therefore its character invokes a number of difficult legal and legislative dilemmas (See also Johnson, Post, 1996).

Gaus (2009, p. 5) says that many characteristics of the Web are similar to what is usually called "common pool resources" like fresh air or water – resources that are characterized by relatively open (public) access and private consumption. We can encounter similar classes of problems – just like pollution is a prime example of a common pool problem related to fresh air (over-use of the air's ability to dissipate waste gasses leads to the depletion of that ability), the email spam is an example of a common pool problem related to the Internet (abuse and over-use of the email ability to efficiently and cheaply deliver messages leads to the depletion of that ability).

Another important point is contribution of availability of information to market effectiveness. To function properly and to maximize efficiency the free market presupposed that parties involved in market exchange have information about what they are exchanging. Economic theories of free market generally assume that both parties to an exchange are equally informed. Recent research focused on how asymmetric information can affect market transactions – if one party does not have access to full information regarding the subject of transaction, we can no longer suppose that market exchanges are truly mutually beneficial and maximizing efficiency (Gaus, 2009, p. 11; Sandler, 2001). The Web then may be seen as part of "market infrastructure" that ensures that everyone does have equal access to information and therefore ensures free market efficiency. The search service obviously plays an extremely important role with regard to this function of the Web; therefore as the necessary condition of the efficient function of the market it may not be seen just as one of many marketplace subjects.

While an asymmetric information problem is relatively uncontroversial the similar problem of asymmetric bargaining power lies at root of many current economic and political controversies. Many government regulations like labour laws regulating hours and factory conditions are justified by the claim that employers and workers have asymmetric bargaining power. While some inequality in bargaining power does not harm effectiveness of the market and the mutual benefit from the exchange there are others that seem to have such an effect. Gaus (2009, p. 12) describing such an economic situation cites Nozick (1974, p. 180), who argues: "a person may not appropriate the only water hole in a desert and charge what he will. Nor may he charge what he will if he possesses one, and unfortunately it happens that all the water holes in the desert dry up but his." If now the hypothetical appropriator of a single source of water makes an offer of a glass of water for all your property this would be what is in economic theory called "coercive offer" – an offer that

exploits one's bargaining power and cannot be refused. Such a situation on market results in a sort of exploitation of those in need and not in mutual advantage.

If we now extend this line of argumentation to finalize this article with question – what if there would be only a single comprehensive search service on the Web, would not we be in a situation similar to the one described above with a single source of water in the desert?

4. Conclusion

This paper provided short historical overview of development of web search services and described process of their centralization and of internalization of Internet traffic. On this foundation then the most relevant social and ethical issues implied by this development were analyzed: the conceptualization of the search engine, the bias of search related to Internet visibility and problem of political voice. Also some proposed solutions were shortly investigated like open source approach and regulation.

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References

Abbatte, J. (1998), Inventing the Internet. Cambridge, MA: MIT Press.

Abramson, J. B., Arterton, F. C., and Orren, G. R. (1998), The Electronic Commonwealth: The Impact of New Media Technologies on Democratic Politics. New York: Basic Books.

Anderson, E. (1993), Values in Ethics and Economy. Cambridge and London: Harvard University Press.

Berners-Lee, T., Fischetti, M. (1999), Weaving the Web: The Past, Present and Future of the World Wide Web by its Inventor. Britain: Orion Business.

comScore, (2008a,2011,2013). December 2007,2010,2012 U.S. Search Engine Rankings. http://www.comscore.com/Insights/Press_Releases/2008/01/Top_US_Search_Engines , http://www.comscore.com/Insights/Press_Releases/2011/1/comScore_Releases_December_2010_U.S._Search_Engine_Rankings http://www.comscore.com/Insights/Press_Releases/2013/1/comScore_Releases_December_2012_U.S._Search_Engine_Rankings

comScore, (2008b), Media Metrix Ranks Top 50 U.S. Web Properties for November 2008. Press release 16.12.2008, http://www.comscore.com/press/release.asp?press=2626

Fabre, C. (2006), Whose body is it anyway?: justice and the integrity of the person. Oxford University Press.

Gaus, G. (2009), The Idea and Ideal of Capitalism. In: Brenkert, G. G., Beauchamp, T. L. The Oxford Handbook of Business Ethics. Oxford University Press. http://www.gaus.biz/Gaus-Capitalism.pdf

Hindman, M.S. (2008), The Myth of Digital Democracy. Princeton University Press.

Hoffman, D. L., Novak, T. P., Venkatesh, A. (1997), Diversity on the Internet: The Relationship of Race to Access and Usage. Paper presented at the Aspen Institute's Forum on Diversity and the Media , Queenstown, Maryland, November 5–7.

Hoffman, D.L., Novak, T.P. (1998), Bridging the Racial Divide on the Internet. SCIENCE, 280 (April 17), 390–391.

Hopkins, H. (2006), Bebo and MySpace Network Maps for Music Category, Hitwise Pty. Ltd. http://weblogs.hitwise.com/heather-hopkins/2006/11/bebo_and_myspace_network_maps.html

Introna, L. D., Nissenbaum, H. (2000), Shaping the Web: Why the Politics of Search Engines Matters. In: The Information Society, 16(3).

Isidore, C., Lev-Ram, M. (2008), Microsoft bids $45 billion for Yahoo. In: CNN Money. 1.2.2008. URL: http://money.cnn.com/2008/02/01/technology/microsoft_yahoo/?postversion=2008020108

Johnson, D. G. 2004, Computer Ethics. In: Floridi, L. (ed.) The Blackwell Guide to the Philosophy of Computing and Information. Malden/Oxford/Carlton: Blackwell Publishing.

Johnson, D. R., Post, D. (1996), Law and borders – The rise of law in cyberspace. Stanford Law Review 48(5).

Lai, E. (2009), No to SQL? Anti-database movement gains steam. In: Computerworld. 1.7.2009. URL: http://www.computerworld.com/s/article/9135086/No_to_SQL_Anti_database_movement_gains_steam_

Livingstone, S., Lunt, P. (2007), Representing Citizens and Consumers in Media and Communications Regulation. The Annals of the American Academy of Political and Social Science, Vol. 611, No. 1, 51–65.

Marks, P. (2009), Berners-Lee: We no longer fully understand the web. (Interview with T. Berners-Lee). In: New Scientist. Issue 2711. June.

Microsoft, (2010). Shared Source Initiative. URL: http://www.microsoft.com/resources/sharedsource/default.mspx

Microsoft, (2011). Microsoft to Acquire Skype. Press Release. URL: https://www.microsoft.com/en-us/news/press/2011/may11/05-10corpnewspr.aspx

Miller, R. (2009), Who Has the Most Web Servers? In: Data Center Knowledge, May 14th, 2009. http://www.datacenterknowledge.com/archives/2009/05/14/whos-got-the-most-web-servers/

Moor, J. (1985), What is computer ethics. In: Metaphilosophy. 16(4). pp. 266–275.

Nielsen. (2007), NetRatings Reports – August 2007 data for the Top U.S. Search Providers. http://www.nielsen-online.com/pr/pr_070919.pdf

Nozick, R. (1974), Anarchy, State and Utopia, New York: Basic Books.

O'Reilly, T. (2005), What Is Web 2.0. Design Patterns and Business Models for the Next Generation of Software, http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Page, L., Bryn, S. (2004), Letter from the Founders, In: Amendment No. 9. To Form S-1 Registration Statement Under The Securities Act of 1931. Google Inc. Registration No. 333-114984, http://www.sec.gov/Archives/edgar/data/1288776/000119312504142742/ds1a.htm

Pringle, G., Allison, L., Dowe, D. L. (1998), What is a tall poppy among web pages? in Proc. 7th Int. World Wide Web Conference, Brisbane, pp. 369–377, April 1998, & Comp. Networks & ISDN Systems 30(#1–7).

Rogers, R. (2004), Information Politics on the Web. Cambridge, Mass. : MIT Press.

Sandler, T. (2001), Economic Concepts for the Social Sciences. Cambridge: Cambridge University Press.

Shankland, S. (2008), Google spotlights data center inner workings. In: CNET News. 30.5.2008. URL: http://news.cnet.com/8301-10784_3-9955184-7.html

Stross, R. (2008), Planet Google: One Company's Audacious Plan To Organize Everything We Know. New York:Free Press.

Verba, S., Schlozman, K. L., Brady, H. (1995), Voice and Equality: Civic Voluntarism in American Politics. Harvard University Press.

ETHICAL ISSUES AND DILEMMAS IN CONTEMPORARY SOCIETY

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Ethics, ethical issues, ethical dilemmas

Abstract

Contemporary society is faster-moving and changing globally, emotionally, technologically, and environmentally. People and organizations have changing needs and expectations. More and more people are employed collecting, handling, and distributing information. So in society arise new ethical dimensions - how to manage data, how to think about the truth, etc. Therefore the organizational practices have been implemented on the basis of organizational norms, rules, and values that have been agreed upon by society. In the so called information age, when information are easy to access and easy to falsify, starts a growing necessity to solve ethical issues than ever before.

In contemporary society, the ethical issues must be dealt with the individual, social, and political levels at various dimensions - information rights and obligations, property rights and obligations, system quality, quality of life and others.

This article deals with the current ethical issues and dilemmas in contemporary society and attempts to look for ways in which they can be solved.

1. Introduction - Ethics and ethical issues

Is ethics simply „to do what is right“, when people's activities often demands to select from alternatives that are neither wholly right nor wholly wrong? What does ethics means?

Liberty, equality, community, and control create a "societal moral compass map" (Mason, 1997). Ethics is a concept of standards which promote values (trust, good behaviour, fairness, honesty, equality, dignity, diversity and individual rights, etc.) for people's lives or for managers, politicians, professionals, their practices and decisions, under which they evaluate the alternatives of behaviour as right (ethical) or wrong (unethical). Ethics is concerned with moral obligation, responsibility, and social justice and reflects the character of the individual and the character of an organization as a collection of individuals (Mauro et all, 1999). Ethics has three basic criteria that must be met: obligations, moral ideas, and consequences (Ruggiero, 2004).

Ethical issue is "a problem or situation that requires a person or organization to choose between alternatives that must be evaluated as right (ethical) or wrong (unethical)". (Business Dictionary, 2013).

Ethical standards are "principles that when followed, promote values such as trust, good behaviour, fairness, and/or kindness". (Business Dictionary, 2013).

Ethical values mean "the set of established principles governing virtuous behaviour". (Business Dictionary, 2013).

Ethical behaviour means "acting ways consistent with what society and individuals typically think are good values". (Business Dictionary, 2013).

Philosophers have been discussing ethics for at least 2500 years (since the time of Socrates and Plato). One of the oldest foundations of ethical standards is religion. Also culture (a pattern of behaviour and values that are transferred from one generation to another) defines certain behaviour as acceptable and other as unacceptable.

About 1980s organizations started to specify ethical principles, particularly to „stay away from" scandals. Many new ethical issues were raised with computers, their combination with telecommunication, with other media, with the development of the internet. Why? Because what people thought was private, has quickly become public. Because what people thought was truth, could quickly become false. Because what people thought was right, quickly became wrong. In last decades information technology affects common issues such as copyright protection, intellectual freedom, accountability, privacy, and security. Therefore we can consider ethics and computer ethics as parts of a global ethical system in the contemporary society.

2. Examples of ethical issues and events

Many times the ethical issues just in life, in management, in business, in politics, in the use of information or in the use of information technology even crop up on a daily basis. Every ethical issue has an impact upon society and its parts – organizations, entrepreneurs, humans. Sometimes – „thanks" to internet or other media – it seems like that some people never examined the ethical issues in consideration.

Business	**Management**	**Information and information technology**	**Labour**	**Others**
bribing powerful officials	conflicts of interest	dependence on systems	gender discrimination at workplace	terrorism
high pressure selling tactics	wrongful use of resources	vulnerability to system errors and poor data quality	employee harassment	genetic modifications
leaks of information	forcing labour to work at below minimum wages	collecting data by government on individuals and organizations and using them for a variety of purposes	violation of worker rights	black market with human organs
compromising on certain aspects like product quality,	mismanagement of contracts and	invasion to privacy	spying on friends, co-workers,	misusing webcams or global

safety	agreements		business rivals	positioning system
omitting the side effects of the usage of products	abuse of the power	workplace monitoring	taking part of assets of the company to another one or for starting of own business	cloning techniques
dumping good at loss making prices just to earn market shares	operating within the limits of the law	profiling – combination of data from multiple sources and creation of electronic dossiers of detailed information on individuals and their behaviours	not equal opportunities in employment for female and minority employees	drug production and distribution
colluding with competitors to fix higher prices	fudge on budgets	computer crime - data theft	immigrant labour	developing and selling various kinds of weapons
accounting manipulations	using interpersonal relationships and information opportunistically	software piracy	personal gain	child labour
using deceptive advertising	corruption	hacking -bypassing a computer system/network's security	bugging and taping workers	air, water or land pollution
generating secret reserves	strong alliances of managers and politics	phishing		waste liquidation
showing higher or lower profits as per convenience	wrong managed procurement	problems with protection of intellectual property, copying and transmitting of digital material over the Net		ambiguous or incomplete information in advertising
controversial practices like animal testing	data manipulation	stalking spamming - based on the stolen Internet mailing list		lobbyists attempting to influence legislation, etc.
deception in packaging, quantity or size	bossing	phishing – e-mail fraud method with the aim to gather the financial and personal information from recipient		industrial and other espionage
not complying with health, safety and environmental standards	not giving continuous feedback to employees	virus infection		
imitating or copying	steeling ideas of	cyber stalking -		

ideas of others and using them as own	employees and using them as own	repeated threats or harassment by the use of e-mail or other computer-based communication		

Table 1: Overview of contemporary ethical issues (author, Patil, S.B., 2012, Relkin, 2006)

Each of these issues can affect all business operations and can lead to serious companies' losses.

2.1. Examples of actual unethical events

- In 2012 hackers attacked in Czech Republic websites of political parties, in March 2013 websites of news (www.ihned.cz, www.idnes.cz and www.novinky.cz), websites of the Czech central bank, the Prague Stock Exchange and several of the country's commercial banks, Prague Public Transit Company (DPP) alongside with the websites of T-Mobile and O2, two Czech mobile phone operators had been disrupted. Hackers have also targeted dozens of computer systems at government agencies. The hackers appear to be using a distributed denial of service (DDoS). As the media informed, there was in no case of loss of client data or the impact to stock exchange trading. According to Czech provider of computer and internet solutions (Charvat, 2013) "the events of the past three days have shown that the Czech Republic is an easy and unprotected target for hackers" and "the Czech Internet has not sufficient experience with hacking attacks".
- The roles which are significant just for some exclusive groups. In 2012 in Germany the discussion arose concerning to the ethics of the top managers incomes and social fairness and in 2013 also about their rents. Not all of them are considered as successful managers. The advantages of euro-parliamentarians, who do not pay fund contribution to union bill of health, but they gain above standard medical help for free (dental or chest implants, spa care, etc.).
- Methanol scandal in Czech Republic in 2012 - 2013. Methanol which is mainly used for industrial purposes was illegally used to produce cheap liquors. There were deaths, or the affected people went blind. Police have accused some 50 people in connection with the scandal.
- Black market with human organs. „World Health Organisation estimates 10,000 black market operations involving human organs" (Guardian. 2013). „Traffickers treat human organs as nothing more than economic commodities in a globalized economy" (Goble, 2000). There exist „organ brokers", who advertise their services (especially in China) for buying e.g. the kidney. There exist „centres of transplant tourism" (at Philippines). Doctors offer healthy services free for the homeless people, collect the information about the patients, store them on PCs until required. Than people have an unfortunate accident and body is never discovered (Billericky hubpages, 2013). Many patients can be also misdiagnosed as having a problem and so surgeon can harvest the organ to sell on the black market.

There could be cited much more examples of unethical issues and events. Some of them are discussed more and solved, some of them are broad-minded, some of them are discussed very seldom. All of them lead to the question - why people act unethically?

3. Why people act unethically?

All people should behave and act the way, which would uphold the good of society. All people should decide between what is right and what is wrong and act for the betterment of society. So why people act unethically, even if the organizations and societies develop expectations in individuals about the correct course of action e.g. Code of Ethics or privacy protection in the European Union nations directive requires companies to inform people when they collect information about them and disclose how it will be stored and used? (EU – Data protection in the European Union, 1995).

„Employees´ ethics at work is driven by a complex set of individual issue-specific, and environmental factors" (Kish-Gephart, 2010). Possible reasons of unethical behavior are:

- lack of education in ethics – people do not understand ethics, what it means to be ethical (Pam66. 2006) – including that most of them never learned the Ten Commandments,
- no clear society moral compass and the culture/policy enabling people to decide what is right or wrong, or to follow some manager behaviour
- unethical actions under the stress and confusion,
- hope, that the unethical action will never be discovered,
- hope, that person act „in the organization's interest" and the organization will defend his or her behaviour,
- strong pressure to fulfilling priorities as profit maximization, expanding market share, cutting costs,
- emphasise on self-gain - the dominance of the private interests over the interests of the organisation or public.

Psychological traps as the root causes of unethical behaviour according (Hoyk, Hersey, 2010) are for example: „Obedience to Authority", „Need for Closure", „The False Consensus Effect". All of them we can meet in the practice. Obedience to authority is based on manager order to employees to do something on agreement without thinking. It could outcome from negative employee experience with the use of power by manager, which overrides the unethical order to ethical one. Need for closure leads to the outcomes under the press or time pressure in which a person does not consider more possibilities of solving the situation but „jumps on" the first opinion. False consensus effect means that a person is not feeling shame and guilty, when he acts as the others – „everybody does it" – what is in fact self-deception to unethical behaviour.

4. Ethical dilemmas

From ethical issues arise also ethical dilemmas – situation, in which two or more ethical principles are in conflict. "Ethical dilemmas, also known as moral dilemmas, are situations in which there are two choices to be made, neither of which resolves the situation in an ethically acceptable fashion. In such cases, societal and personal ethical guidelines can provide no satisfactory outcome for the chooser. Ethical dilemmas assume that the chooser will abide by societal norms". (Your Dictionary. 2013).

The University of Notre Dame's John J. Reilly Center for Science, Technology and Values (2013) has announced its inaugural list of emerging ethical dilemmas and policy issues in science and

technology for 2013. On this list the ethical dilemmas are: privacy issues and protecting personal and private information from „genetic tests and personalized medicine“, the security of „implanted medical devices“ against hackers, „low-quality and counterfeit pharmaceuticals“, data collection and privacy - what kinds of information should be collected and retained, „human enhancements“ – not just/only for therapeutic purposes, but for magnifying human biological fiction blond the societal norm, and others.

Dilemmas involving discrimination, harassment, fraud, contractual breaches, favouritism and consistent policies regarding pay, rewards and discipline are common occurrences in many organizations (Hartel, 2010).

Other possible ethical dilemmas are the situation, when societal and personal ethical guidelines cannot provide satisfactory outcome for the chooser. Examples (Your Dictionary. 2013) are: personal friendships and long term relationship – e.g. findings about violating the company's information technology regulations; societal dilemmas – called also Kohlberg dilemmas - e.g. lack of money at the patient side and refusal of the pharmacist to wait for money to pay the drug, which can save the patient life, etc.

What to do, when any decision violates the ethical standard which people have adopted during their lives? How to decide, when manager set a task to employee, and he/she founds it as nonethical, even nonlegal? Should he/she fulfil the task, or should refuse it? What will be the consequences? Sometimes it can be a black-white decision - or to save own job, or refuse the task and be fired. Another example can be co-working on project. Managers know that some project activities will not bring any effect, but will bring additional costs. They do not make any objection, but instruct their employees – „save time, when we have to do it, do it once for a whole month and we will not have any problem“. How to behave when manager want to know your name and pass-word to your PC, even if both of us know, that it is forbidden?

As we can see, ethical dilemmas may arise due to a conflict between the professional and personal values, due to a conflict between a person's moral values and perceived role or due to unavoidable alternatives. Solving ethical dilemmas is dependent on the culture of the society/organization, on the personal advancement and courage.

5. Conclusion

Contemporary society is dealing with a huge amount of ethical, often illegal issues. Some of them are well known, some of them are not. But both groups need broad discussion and publicly clear solution.

Ethical issues and dilemmas should be solved in a way protecting people (employee) rights, individual values and beliefs. All decision should be fair, protecting the common good, to comply with laws and safety regulations.

How to improve ethical behaviour in society? Which tools for improving ethics should be used? Ethical problems could help to solve:

- An ethical code, which should define principles, ethical norms and rules of ethical behaviour equal for all employee (including top executive) and should incorporate the system of control and punishment in case of their violation. And its regular dissemination and enforcement.
- An ethical audit, which can help discover information about values shared by the company (whether the company management is trusted or mistrusted, whether the employees are

loyal to the company or not, whether they are informed and can approach their superiors with complaints or suggestions).

- Applying the principles of information system security. Adhere to the Netiquette and use self-control, particularly through the use of filtering software.
- More exploitation of the camera systems for monitoring the environment.
- Applying leadership by example, as managers are responsible for providing ethical leadership and for communicating organizational ethics (especially, when events must be interpreted).

Managing ethics is serious business especially for managers, politicians, professionals. Cultural diversity and changing values mean that perceptions are likely to differ in areas where the right answer is not always clear. Ethics cannot become irrelevant in information age. There are many new challenges for reasonable building information security, e.g. high standard security of information systems, which does not allow free access and use of information to anybody.

There is no excuse for the unethical behaviour in any of the hereinbefore issue. Each of us should examine every decision carefully and from an ethical point of view toward making the kind of ethical word.

Most important in contemporary society is therefore the permanent education in the sense of ethics from the youth to the old age, which can indicate new inspiration and comparison with the world and can help to create a climate for ethical behaviour.

References

Billericky hubpages. (2013) Human Organ Trafficking, Black Market Human Organ Trade,

Buying Stolen Hearts, Lungs & Kidneys For Cash.

http://billericky.hubpages.com/hub/Human-Organ-

Trafficking-illegal-Human-Organ-Trade-Buying-Hearts-Lungs-Kidneys-For-Cash

Business Dictionary. Ethical issue. Ethical Standards. Ethical values. Ethical behavior. (2013)

http://www.businessdictionary.com/definition/ethical-issue.html#ixzz2LvENdKH8

http://www.businessdictionary.com/definition/ethical-standards.html#ixzz2LvEfHaZK

http://www.businessdictionary.com/definition/ethical-values.html#ixzz2LvFLcKM2

http://www.businessdictionary.com/definition/ethical-behavior.html#ixzz2LvFkbju1

European Union, Data protection in the European Union. Directive 95/46/EC. (1995).

http://ec.europa.eu/justice/policies/privacy/docs/guide/guide-ukingdom_en.pdf

Goble. (2000) 'World: Analysis from Washington – Globalization of Slavery',

http://www.rferl.org/nca/features/2000/12/05122000205456.asp

Guardian. (2012). Ilegal kidney trade booms as new organ is „sold every hour".

http://www.guardian.co.uk/world/2012/may/27/kidney-trade-ilegal-operations-who

Hartel, C.E.J., Fujimoto, Y. (2010). Ethical Issues In Businesses. http://www.studymode.com/essays/Ethical-Issues-In-Businesses-Today-402120.html

Hoyk, R., Hersey, P. (2009). The Root Causes of Unethical Behavior. Graziado Business Review, Volume 12 Issue 2; available: http://gbr.pepperdine.edu/2010/08/the-roo-causes-of-unethical-behavior/

Charvat, T. (2013). Comment to „Hackers attack also mobile operator´s websites". http://aktualne.centrum.cz/czechnews/clanek.phtml?id=773217

Kish-Gephart, J., Harrison, D. A., Klebe L. (2010). Bad apples, bad cases, and bad barrels: Meta-analytic evidence about sources of unethical decisions at work. Journal of Applied Psychology, 95(1)

Mason, Richard O. (1997). Ethics of information management, Cox School of Business - Southern Methodist University. http://www.newswise.com/articles/ethics-of-inormation-management

Mauro, P. (1995). Corruption and growth. Quarterly Journal of Economics 110 (3), 681–712.

Pam66. (2006). Current Ethical Issues in Business.

http:// www. Studymode.com/essays/Currennt-Ethical-Issues-Buseniss-76881.html

Patil, S. B. (2012). Ethical issues in business. http://www.buzzle.com.articles/ethical-issues-in-business.html

Relkin, J. (2006). 10 ethical issues confronting IT managers. http://www.techrepublic. com/article/10-ethical-issues-confronting-it-managers/6105942

Ruggiero, V. (2004). Thinking Critically About Ethical Issues. Edition: 8. ISBN-10: 0073535907, ISBN-13: 978-0073535906

Transparency International. (2005). http://www.transparency.cz/index.php?lan=cz&id=2802

University of Notre Dame's John J. Reilly Center for Science, Technology and Values Emerging Ethical Dilemmas in Science and Technology, Dec. 17, 2012, http://www.sciencedaily.com/releases/2012/12/121217162440.htm

Your Dictionary. Ethical Dilemma Examples. (2013). http://examples.yourdictionary.com/ethical-dilemma-examples.html

DOMAIN-SPECIFIC LANGUAGES AS MEAN OF INTER-HUMAN COMMUNICATION

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Domain-specific languages, corpus linguistics

Abstract

Domain-specific languages (DSLs) have potential to supersede standardized formal notations which is used by scientists, engineers and managers in their written documents (books, articles, proceedings, etc.) and thus dramatically change the position of computers within the net of inter-human (more specifically inter-scientist or inter-manager) communication. This paper briefly describes current status in the field of DSL (especially hosted domain-specific languages) and their roots in the evolution of universal programming languages. Focus is on human aspects of domain-specific languages and their usage by non-programmers. The interpretation of DSLs (and generally all programming languages) as primarily human languages allows application of some methods of classical linguistics in this area. Therefore the paper discusses applications of corpus linguistics which can provide solid foundation for subsequent research of DSL.

1. Introduction

The human beings have used complex language systems for tens of thousands years (very pessimistic estimate). Natural languages are sufficient for overwhelming majority of situations which can arise in our lives.

But there are areas in which natural languages are not fully sufficient – scientific and engineering communication. In these areas natural languages are supplemented by more formal languages based on a mathematical notation. However, complete substituting of natural languages by a formal mathematical notation is possible only in very special and limited contexts and in very mathematized science disciplines (mathematics, physics). In most cases the mathematical notation forms only islets inside surrounding natural languages utterances. In addition, this notation is used predominantly in written texts and its spoken form is secondary (conversely for natural languages the spoken form is primary). In fact, there is some kind of symbiosis between natural and formal languages in scientific texts – natural languages in highly formalized form are interlinked with fully formalized notations and both parts are mutually dependent.

But in my opinion there is strong competitor for contemporary scientific notation – programming languages. You can even assume stronger assertion:

Programming languages cannot supersede the natural languages as the main mean of inter-human communication, but they have potential to supersede (or at least to marginalize) contemporary scientific or engineering formal notation.

This assertion does not imply single universal scientific programming language. In present the thousands of programming languages exist and in future the situation will not be changed. On the contrary, explosion of specialized languages (including very specialized ad hoc dialects) can be expected.

The notations written by a programming language are interpretable as a program i.e. they are compilable to machine code of a universal computer. But program codes have another function – they are formal description of mental models of human beings. And humans do not create models for themselves or for (still unintelligent) computers. They want to share their models with others. They want to communicate their ideas with colleagues.

Unfortunately, contemporary mainstream languages are not ideal medium for sharing of models among practitioners. Programming languages as *Java* or *C* have been designed for programmers not for scientists or managers. The practitioners have to first describe their models in a formal notation which is not directly processable by computers and then this model hast to be (manually) translated to a program code (with the help of a programmer). In the process of translation the program becomes more comprehensible to computers and in the opposite direction less comprehensible to humans.

Moreover, the new role of programming languages requires solid foundation. Final part of the paper offers one solution from the world of natural languages – corpus linguistics offering starting point for new researches.

2. Brief look at history

The programming languages have been designed for humans since the dawn of universal computers. Moreover, one of the first programming languages was targeted to scientists and engineers (*Fortran*) and immediately afterwards the *Cobol* was targeted also for managers. Unfortunately (but quite naturally), programming languages have been modeled primarily with computer hardware in mind.

The more modern mainstream programming languages (from 1970s) brought some revolutionary ideas (i.e. abstract data structures), but these languages are designed primarily for professional programmers and for non-engineering usage (computer games, GUI application, web pages. etc.). No wonder, that some practitioners have ignored this progress and have persisted at Fortran or *Cobol*.

Lisp (1958) is exception in this context. This language has been designed quite differently from other programming languages and it has provided three features which are crucial for representation of a formal model.

1. a simple representation of non-numeric values (abstract symbols and data constructs)
2. data and code representation are identical, i.e. the Lisp program code is directly processable by Lisp program (*homoiconicity*). This feature makes possible *metaprogramming*, i.e. programmatic transformation of program codes (in very high abstract level) (Pearce, 1998)
3. unused data are automatically disposed by *garbage collector*. The management of data structures is trivial and memory leaks or invalid access to memory object are impossible.

Unfortunately, strange syntax (with a plenty of parenthesis) and lack of efficiency has marginalized the impact of Lisp programming language for formalized representations of scientific model.

The second and the most interesting divergence from mainstream programming language design was formed by *simulation languages* of 1960-70s. These languages was designed by practitioners for a simulation of scientific (physics, chemistry, management, medicine, etc.) models. Simulation languages brought some innovative contributions:

1. prominent declarative code = declarative description of a model
2. utilization of formalized English language

In 1960s and 1970s thousands of simulation programming languages existed but their direct impacts in the field of formal representation have been very limited. The main reasons were:

simple grammar and often poor design of simulations language

> The design and especially implementation of programming languages was (and still is) very complex task) requiring not only knowledge and experience but also invention and intuition.

unsatisfactory maintenance and lack of standardization

> The sustainable support of programming language requires a group of active users or/and commercial support. The majority of simulation languages had only a handful of users and were used only in academic sphere and standardized only by their implementers.

fragmentation and inflexibility

> Some simulations languages covered only a very small field of research and were almost useless in other areas. The modifications were almost impossible and a transfer to a more distant research area was almost unimaginable.

weak position in educational sphere

> The courses of programming have been based on mainstream programming languages. Even graduated managers and researcher in applied sciences are more familiar with a common programming language (e.g. *Fortran*, C, *Java*) than with a specific simulation language.

The popularity of *ad hoc* simulation languages have strongly declined since 1980s. The twilight of simulation languages are paradoxically linked to success of one of them – *Simula 67* (Dahl, 1967). This simulation programming language combined advantages of universal language with some principles of simulations and has introduced new paradigm – *object oriented programming*. The basic evolutionary relations of these languages are depicted in Fig. 1.

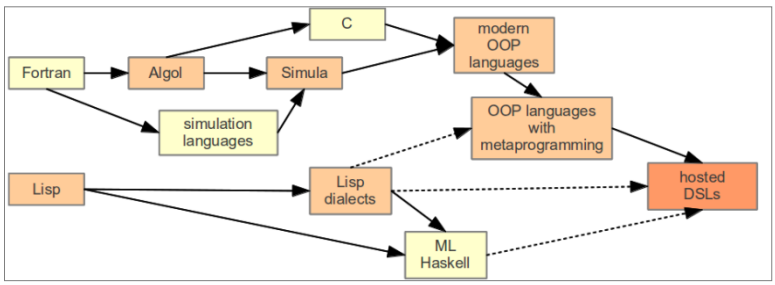

Fig. 1: Evolution of language from point of view of general formal notation

The object oriented paradigm had potential to support specialized formal inter-human notations for practitioners, but it did not happen. Object oriented paradigm has become the leading approach in software industry but its impact on practitioners is much weaker. The modern object oriented programming languages are based on old imperative languages. The objective constructs are often

interpreted as (unattractive) secondary extensions. But there are internal reasons as well. The OOP constructs are focused on data representation and procedural changes of encapsulated data. The description of object lifetime is therefore quite procedural and in principle it does not differ from constructs of older languages.

Above that, some important components are missing from mainstream OOP languages:

1. declarative descriptions (including structural description of input data models)
2. symmetric and extensible model of object interaction (OOP approach prefers one interacting object – denoted as *this* or *self*, other actors are interpreted as second-class participants).

3. Domain-specific languages

However, new class of programming languages have emerged since 1990s – the *domain-specific languages* (often abbreviated as DSLs). These languages have not brought revolutionary changes and they do not form a clearly defined group. In fact, the DSL is only generic designation, which cover languages from mark-up (HTML) to universal languages of classical design (e.g. *Matlab* language), or from tools for system programmers (*shell scripts*) to specialized languages of social sciences e.g. NLTK toolkit for computational linguistics (Bird, 2009), economics (Berthold, 2011), (Plummer, 2003) or medicine (Bilitchenko).

Domain-specific languages share only a few basic principles:

1. DSLs are dedicated to a particular problem domain or particular solution technique
2. DSLs are often a natural extension to code libraries and frameworks, making their use easier and more consistent (Tolvanen)

These principles address some issues of older specialized languages, especially high costs of new language design and implementation (including often underestimated costs of documentation).

The new domain-specific languages are always based on existing libraries and framework. Some of them are created within a universal language by metaprogramming – *hosted (embedded) domain-specific languages* (Tratt, 2008, Sheard, 2002). Hosted languages can naturally share libraries with hosting languages (including definition of complex OOP objects) and sharing is possible also for language constructs and documentation. Moreover, the creation of these languages is automatable by metalanguages (metalanguages are also form of DSL!) and other software tools.

The main advantages of *hosted domain-specific languages* (from the point of view of potential usability for the inter-human communication):

- wide range of prepared objects (from standard object oriented library of hosting language or prepared in hosting language exclusively for the DSL)
- declarative data representation (with human friendly syntax)
- declarative description of transformations
- more complex or nonstandard control flow (not only linear flow or loops)
- (modifiable) syntactic shorthands (for the most used constructs)
- context based semantic (data or relations inferable from a context are implicit or optional)
- more free syntax and embeddability – some syntax is optional or more variants are supported, this make easy to embed language constructs in a formal (or natural) contexts

- *composability* – support of cooperating code in several domain-specific languages which can be selected and assembled in various combinations to satisfy specific user requirements

Unfortunately, some advantages are more likely only *promises for the future* (e.g. true composability) and others can be hardly found in one single domain-specific language.

The metaprogramming facilities of hosting language make possible to radically change syntax and semantics of the language. However, only a couple of hosting languages have potential to hide their basic syntax and semantics and these languages are on periphery of interest. Other languages allow only cosmetic changes of their syntax and semantics.

For example *Python* programming language (and some others modern scripting languages) support open and extensible *metaobject protocol* (MOP) (Kiczeles, 1993), which enables internal modifications of object and class semantics, which affect object creation and method calls. The modifications are limited to semantic level i.e. modified semantics must be mapped to standard Python syntax (only standard identifiers are replaceable). The power of metaobject protocol has been used in several Python libraries, e.g. especially in web frameworks. The web frameworks are pathfinders of the creative utilizations of metaobject protocols because the metaprogramming can greatly simplify some typical web idioms (URL routing, session management).

Programming language *Boo*, which is based on Python, supports by far the most advanced metaprogramming facilities among non-Lisp programming languages (Rahien, 2010). The Boo allows programming transformation of abstract syntax trees during initial compilation phase by relatively high level programming constructs (AST macros). This transformation is capable to inject radically new constructs into the language and to completely hide original syntactic constructs.

For example following (directly executable) code fragment exploits simple geospatial DLS which have been presented in Fišer (2013).

```
place Praha:
  latitude: 50|05
  longitude: 14|26

place Berlin:
  latitude: 52|30
  longitude: 13|24

standpoint Praha:
  iterate_other: print place, ": distance =", place.distance
```

This advanced hosted DSLs exhibits these features:

- *maximal concealment of hosted language syntax:* the fragment use only one direct Boo constructs – printing statements
- *important role of declarative notation:* input data (i.e. topographical positions) are represented by purely descriptive manner

- *radical simplification of object model:* the underlying object model are simplified (classes are totally omitted, objects and variables are unified)
- *semantics based on nested contexts:* the utilization of contexts reduces complexity of language utterances and allows relatively linear representation of hierarchical structures.

Programming languages have used the context based semantics in mechanisms of subprograms and OOP methods. More advanced types of contexts are available by some sorts of polymorphism.

In sphere of domain-specific languages, the usage of contexts is much broader. The contexts are not limited to infrastructural and low level constructs but they are related to a targeted model. In our code fragment the block *standpoint* creates natural context which is typical for a navigation application: the implicit point from which distances and bearings are measured.

Unfortunately, this type of domain-specific languages cannot be directly utilized for high-level description of complex science models, because:

1. The metaprogramming support is currently available only in *peripheral languages* or in the form of peripheral constructs. The metaprogramming constructs are poorly documented and are not included in basic courses of university curricula. Therefore the potential of hosted DSLs is known only to programmers, not to practitioners who can utilize this potential.
2. The domain-specific languages are not only collection of new constructs and extension and they have to be *designed as a whole*. The documentation of DSLs (including grammar see Parr, 2007) should be automatically inferable from supporting (meta)code or vice versa.
3. Design of DSLs must be *robust and consistent* i.e. any construct of new language has to be either valid or it produce well defined error with the semantic of new domain-specific language. The contemporary metaprogramming tools support only low level checking tools. The most problematic aspect of metaprogramming, two-phase execution of code has to be reflected in design of testing tools.
4. The *efficiency* of hosted DSLs is often suboptimal. The DSL metaprogramming constructs often require additional overhead (e.g. dynamic dispatching) and do not produce optimal data structures. The efficiency is not primary goal of DSLs, but the competition with classical programming languages makes optimization necessary.
5. The *human aspects* of programming languages or their role in inter-human communication are not common object of scientific research (compared to their mathematical and technical aspect). The research of programming languages by methods of classical linguistics seems almost impossible, because the programming languages are artificial products and their complexity is incomparable to natural languages. Nevertheless, programming and natural languages share important features and some tools of classical linguistics are also applicable in the world of programming.

4. Corpus linguistics

The corpus linguistics is relatively modern branch of classical linguistics which use huge databases of real utterances (typically only of written language) for statistical processing (especially frequency of morphemes in various context). Modern corpus linguistics utilizes computers for a *storage* (the biggest corpora contain tens of billions of lexical units) for a *data processing* and *visualization*.

The basic principles of corpus linguistics are applicable to programming languages because

1. programming languages have fixed textual representation
2. programming languages contain contextually dependent constructs
3. source codes exhibit sufficient language variations (i.e. the syntax is sufficiently free)
4. programming languages evolve in time (and this evolution is at least partly natural)
5. programming languages vary in space (i.e. they form the team and personal idiolects)

Naturally, there are some differences:

1. the utterances of programming languages (source codes) must be correct (at least for compiler), i.e. their dialects depends on compiler implementation
2. sources codes are continually changed in a span of years or even decades
3. the semantics of source codes is often defined by external sources (libraries)
4. the syntax of typical programming language is strongly hierarchical

The utterances stored in corpora must be accompanied by metadata. In the case of natural language, the metadata contains spatial and temporal information and characterization of an originator or other contextual information. The spatial and temporal metadata are also possible for source codes but more important are metadata about compiler to which they are targeted and metadata about their software project (type of project, its scope, size of software team, etc.)

Currently (2013, July) there is no large corpus of sources codes and billions of line of older source codes (1960-1990) are almost lost or unavailable (Dolorey, 2009). Therefore it is necessary to start with populating of corpora of mainstream programming languages (*C++*, *Java*, *Python*, etc.) and with implementation of tools for processing of source codes on level of abstract syntax trees (the processing on the level of tokens is insufficient for the semantic analysis). The standard tools as compilers and tools for *static analysis* (Lincke, 2008) are useful but not entirely suitable.

Domain-specific languages typically utilize exotic syntax constructs or very complex data structures. These constructs require advanced parsing methods (e.g. semantics based parsing). Therefore, the design of ad-hoc parsers of DSLs for corpora is by far more challenging.

Fortunately, some embedded domain-specific languages are processable by their hosting languages or standard libraries of these languages. This type of support has been typical for Lisp with simple homoiconic syntax, but high-level tools for self-parsing appear gradually in other languages.

5. Conclusions

The usage of programming languages for representation of formalized parts of scientific documents can revolutionary change the position of computers in scientific teams (see Fig. 2).

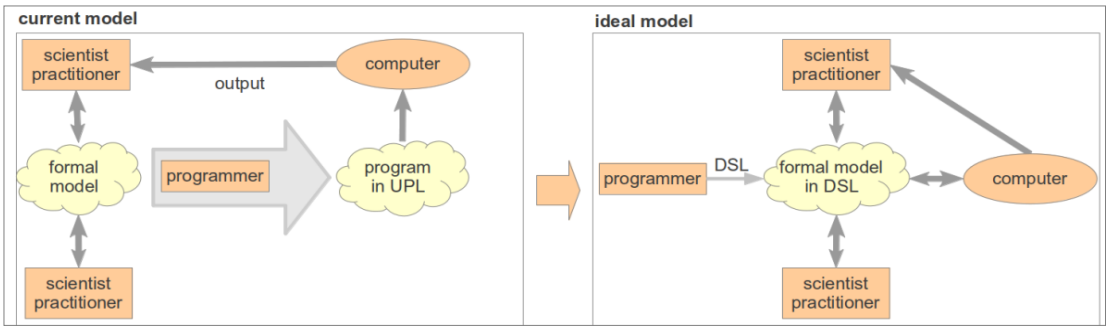

Fig. 2: Current and ideal model of cooperation with a computer system

Nowadays, the scientific formal model is shared only among scientists or managers and for the computer processing must be translated to a *universal programming language* (UPL in Figure 2). Model based on specialized domain-specific languages is more symmetric. In this case the scope of direct sharing of models is extended to computers (including computer clusters, tablets and even e-books readers) which can help with a simulation of model, a presentation (in the form of optimally formatted texts) and a visualization (2D and 3D graphs or animation) (Galitsky, 2008).

Unfortunately, no one single programming language can play this role (the history of computer languages show several unsuccessful candidates). The currently most promising candidates are domain-specific languages – broader groups of relatively simple languages designed for representation of single scientific discipline or even single research model. The ad hoc domain-specific language is possible to construct from the scratch but this approach is very time-consuming and requires a detailed knowledge about design and implementation of programming languages. The improvement of poorly designed languages by evolution is in principle possible but inefficient.

In my opinion, there is only one solution to these issues – domain-specific languages, which are constructed inside existing universal programming languages by mean of metaprogramming. These hosted domain-specific languages utilize constructs of hosting language and its compiler and it has direct access to libraries of hosting languages or at least their subset (typically by simplified object oriented code).

The new position of programming languages also assumes new approaches to research in the field of programming language syntax semantics based on interpretation of domain-specific languages as mean of inter-human communication. In this approach some tools of linguistics of natural languages are reusable including corpus linguistics.

References

Berthold. J. (2011). Domain-Specific Languages for Finance. 11 Oct, 2011, New Thinking about Global Challenges Conference, Berlin.

URL: http://www.gsdp.eu/uploads/tx_conturttnews/Berthold_-_Domain-Specific_Languages_for_Finance.pdf

Bilitchenko, L., Liu, A., Cheung, S., Weeding, E., Xia, B.; Leguia, M.; Anderson, J.C. & Densmore, D.; Eugene – A Domain Specific Language for Specifying and Constraining Synthetic Biological Parts, Devices, and Systems. PLOS.

URL: http://www.plosone.org/article/info:doi/10.1371/journal.pone.0018882#abstract0

Bird, S. and Klein, E. & Loper, E. (2009). Natural Language Processing with Python. O'Reilly Media, Inc., 2009.

Dahl, O.-J. & Nyggard, K. (1967). Simula – A language for programmingt and decription of discrete event systems. Introduction and user's manual, Norwegian computing center.

Delorey, D. P. & Knutson, C. D. (2009). Mining Programming Language Vocabularies from Source Code, in Proceedings of the Psychology of Programming Interest Group Conference (PPIG '09), Limerick, Ireland.

Fiser J. (2012) Will we think in programming languages? In. Acta Informatica Pragensia Vol 1, No 1 (2012). pp. 1-21.

Galitsky B. & Usikov D. (2008). Programming Spatial Algorithms in Natural Language, in Papers from the 2008 AAAI Workshop. Technical Report WS-08-11 published by The AAAI Press, Menlo Park, California, pp. 16-23

Kiczales, G., Ashley, J., Rodriguez, L.; Vahdat, A. & Bobrow, D. G. (1993). Metaobject protocols: Why we want them and what else they can do, Object-Oriented Programming: The CLOS Perspective, pp. 101-118.

Lincke, Rüdiger, Lundberg, Jonas & Löwe (2008). 'Comparing software metrics tools', International Symposium on Software Testing and Analysis, pp. 131-142.

Parr, T. (2007). The definitive ANTLR reference : building domain-specific languages, Pragmatic Bookshelf, Raleigh, N.C.

Pearce, J. (1998). Programming and Meta-Programming in Scheme, Springer.

Plummer, Martyn (2003). JAGS: A Program for Analysis of Bayesian Graphical Models Using Gibbs Sampling, Proceedings of the 3rd International Workshop on Distributed Statistical Computing (DSC 2003), March 20–22, Vienna, Austria. ISSN 1609-395X.

Rahien, A. (2010). DSLs in Boo: Domain-Specific Languages in .NET, Manning Publications.

Sheard, T. & Jones, S. P. (2002). Template meta-programming for Haskell, in Proceedings of the 2002 ACM SIGPLAN workshop on Haskell, ACM, New York, NY, USA, pp. 1—16.

Tolvanen, J-P. Creating a Domain-Specific Modeling Language for an Existing Framework [online]. Method & Tools - Software Development Magazine [2013-04-03].

Tratt, L. (2008). Domain specific language implementation via compile-time meta-programming, ACM Trans. Program. Lang. Syst. 30(6), 31:1--31:40.

MANAGEMENT PROCESS IN EDUCATION SPHERE IN THE LIMITS OF SYSTEM-CYBERNETIC APPROACH

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Keywords

Management, education sphere, the pedagogical cybernetics.

Abstract

The purpose of given article is the analysis of evolution of treatment by researchers-teachers of full structure of management process' participants in education. Besides, features of the organization and realization of management by educational systems within the limits of the system-cybernetic approach are found out.

1. Introduction

The understanding of management essence in general and in an education sphere in particular gradually changed depending on what scientific methodology was used by researchers for the analysis, formalization, planning, organization and practical realization of management processes (Maryska, Doucek, Kunstova, 2012).

Long enough period of time the simplest variant of full structure treatment of management process' participants was used by researchers. It is actual today as well. In particular in pedagogics, analyzing managerial processes with use of scientific principles of educational management, researchers focus attention only to mutual relations of the management subject (operating system) and management object (operated system). However thus, actually, causes and effects of designing, planning, direct realization of management influence and corresponding expectations concerning its final result are ignored. (Maryska, Doucek, Novotny, 2012)

2. System-cybernetic approach in the educational management

Earlier in a number of scientific publications, in particular in the monograph (Jablochnikov, 2011), it has been proved by us that management in an education sphere can be successfully realized with use of principles of the system-cybernetic approach. The purpose of given article is the analysis of evolution of treatment by researchers-teachers of full structure of management process' participants in education. Besides, some features of management organization and realization by educational systems within the limits of the system-cybernetic approach are found out.

As the teachers-researchers consider, the treatment specified above allows to concentrate on the main thing and to abstract from minor, for the purpose of achieving the fullest understanding of realization management mechanisms and defining the ways of its optimization. However, in our

opinion, the given thesis is erroneous. Being limited only to the analysis of mutual relations character of management object and subject, the researcher will involuntarily become the participant, as a matter of fact, of some show under the general motto «management for the sake of management». Thus, the course of management process becomes an overall objective of set of actions on its realization, instead of achieving some optimum condition of object owing to management realization.

2.1. Environment as the third «participant» of management process

In cybernetic sense the management purpose, as a rule, is optimization of functioning or working out of some effective behaviour of operated object in the valid conditions of its existence or somewhat predicted (expected) conditions and restrictions which will be actual through a certain time interval. Thus, it is supposed that there is some reality which is a component neither of object, nor of subject of management. However influence of this reality somewhat feel both object, and subject. Besides, its valid and expected (predicted) parameters represent themselves as conditions of administrative actions necessity and restrictions concerning existing possibilities of these actions' realization.

Such reality is the environment (third «participant» of management process) in which, as a matter of fact, really exist management subject and object, continuously carrying out their activity, communicating and realizing corresponding purposeful influence. Environment parameters to some extent form and predetermine behaviour of object and subject. Thus, to ignore presence of such third «participant» of management processes is inexpedient, though at such approach the formal description of mutual relations which are analyzed and considered by the researcher becomes considerably complicated.

Application of system and cybernetic approaches principles to the analysis, planning and organization of management process in educational sphere expects the obligatory account of influence of environmental factors on management object and subject, and also on processes of practical realization of management process. The educational branch is a component of social and economic relations in a society, it is created for the decision of problems existing in society and it serves for satisfaction of inquiries of society's separate elements and their groups. The classical cybernetic scheme of a known principle of «a black box» is a vivid example of the account of existing conditions and restrictions of an environment, at carrying out the analysis and the organization of influence of operating system on operated system.

It is also not possible to reach the planned purpose of management realization without realization forecasting of an environment condition (sets of numerical values of all its defining parameters) on some time interval for which the full management cycle is realized. It is caused by properties of dynamism and even stochastic parameters of an external environment at management subject and object. Such position is quite adequate and for an educational sphere.

2.2. Concept of educational purpose

In due time, in the monograph (Jablochnikov, 2011, p.322) it had been formulated by us the definition of concept «educational purpose (the purpose of training, education, development etc.)» within the limits of system-cybernetic approach. In our opinion, it is in advance established values or borders of parameters of educational system (educational process), as an object of management which should be reached owing to its functioning, dynamical development, active self-development and efficient control of it.

Even the preliminary analysis of noted above concept «educational purpose» leads to a formulation of quite logical question: «By whom or due to what in advance established values or borders of parameters of educational system (process) which should be reached owing to management realization are established?»

The one who establishes certain levels of parameters in which the management object should be resulted, should know the purpose of administrative actions' realization, quite clearly understand existing quantitative and qualitative character of communications between productive and defining parameters, and also be, to some extent, interested in successful achievement of the final result owing to management realization.

Whether always and whether necessarily such interest, knowledge and understanding should be inherent in the subject of management (operating system)? And whether management objects, which in operating conditions of education system are rather intellectual developed persons or their groups, can be interested in change of their present condition (behaviour)? And also, whether the management subject can, carrying out regulation of object behaviour, carry out, so to say, some social order generated within the limits of environment (society) and directed on satisfaction interests of its elements or some separate part of such environment?

2.3. Observer as the fourth participant of management process

Taking into account quite logical questions formulated above, within the limits of the system-cybernetic approach the concept «observer» is introduced. «Observer» is actually the fourth participant of management process, and its interests actually compel all other participants to operate actively enough for achieving purpose established by him (in an education sphere - the pedagogical purpose, the purpose of training, development or education). Besides, within the limits of the system-cybernetic approach along with concept «educational purpose» is introduced the separate concept «purpose of management of educational processes (systems)».

As it is noted by us in the monograph (Jablochnikov, 2011), the purpose of management of educational processes is desirable (planned) positive, from the point of view of the observer, result of joint functioning of set of operating and operated systems. This result is reached by various quite admissible ways, at some expenses of material, power, information and human resources, through a definite time, and also in the conditions of influence of environmental factors and in the presence of set of restrictions.

Under «observer», within the limits of the system-cybernetic approach to management of educational processes and systems, every possible representative of all interested in management realization parties are understood. For example, it can be – administration of higher educational establishments, teachers, students, parents, customers of educational services, society as a whole etc. – or those who organize, supervise, and sometimes directly realize management in an education sphere. Introduction of concept «observer» allows removing a number of insoluble questions which arise at orientation to the simple representation scheme of relations «subject-object» in educational processes' management.

Concept «observer» as an independent element of management process, has appeared only within the limits of so-called «new cybernetics». As it is noted above by us, educational management, in most cases operates only with two concepts – «management object» and « management subject». The classical cybernetic approach considers influence of the third element - environment (an external environment). Representatives of «new cybernetics» in particular have concentrated attention to causes and effects of management realization, finding-out degree of its success, productivity and efficiency. As a result of such actions' realization, some nuances and features of

formulating the purposes, the relative objectivity of result estimation, which somewhat became defining, main points of all management process, have been revealed.

In this sense, definition of realized requirement for the organization of some educational process or creation of corresponding system, with the further management of them, for the purpose of their optimization, and also those participants for whom all given actions are realized, is important enough. To education as a separate branch of social and economic relations, it is inherent plurality of objects and subjects of management which are characterized by a variety of defining parameters. For this reason, interests of large set of observers which are listed above should be considered.

Interests of these «observers» have different vectors, and estimations of the results received owing to management realization - sometimes essentially opposite. For this reason, except direct management which is understood as purposeful influence on object, the coordination of interests of all active «observers» should be necessarily carried out, i.e. coordination of the purposes is executed. The management final result can, though not to the full degree, however basically satisfy requirements of all «observers» in the valid conditions and existing restrictions of functioning which are formed by environment (an external environment).

2.4. Definition of active and passive observers

Using here concept «the active observer», we actually introduce classification which should expect, as well, presence of «the passive observer». In this case, their classification is introduced by us on basis of existence within the limits of the system-cybernetic approach of two kinds of productive parameters of management objects – operated and observed. If «observer» is interested only in corresponding levels (borders) of some parameters of management object (operated educational system or process) which are only observed, we suggest classifying it as a passive one. Otherwise, that is when «observer» estimates both kinds of parameters (operated and observed) and makes active actions for achieving these parameters of some planned values, it is an active one.

Management of such systems difficult by nature, structure and quantity of components as an educational one, taking into account noted above remarks, gets a bit different status which within the limits of the system-cybernetic approach more likely corresponds to concept «coordination» or, in other words, - «management of management».

2.5. Criterion function of educational processes' management

One of features of system-cybernetic approach application for the organization of management in educational sphere is an optimization of object's management (a choice of variants of its realization to achieve purpose in the best way). «Observer» estimates optimality degree, too. For comparison of variants of object's behaviour management and choosing the best of them, some formal dependence, which characterizes degree of approach to the established purpose, is applied. It is a criterion function or criterion of managerial processes optimality.

Criterion function (purpose function) of management of educational information processes in due time has been defined by us as formalized by any way dependence of productive parameter on defining parameters and characteristics changes of operated object. It adequately displays quality or efficiency of management realization or degree of its purpose achievement. Criterion function – it is also some formalized reflection of interests of «observer» or all set of observers (Jablochnikov, 2010).

Synthesis of administrative actions' system begins with formulating of criterion function which for educational system depends on its social mission and operating conditions. It also expresses

following parameters: transition time of system from one condition in another; expenses of material, power, information, human, other resources for successful purpose achieving; economic benefit which is reached due to functioning; social effect; indicators of quality of educational processes, in particular, - competence of universities' graduates.

The term «criterion function» is fully perceived and actively used by teachers-researchers. In relation to educational processes they use it in their scientific publications often enough. In particular these are such researchers, as G. Elnikova, V. Ortynsky, P. Tretjakov, G. Petruchenja and others.

H. Frank, who is one of founders of cybernetic pedagogics, wrote that the training purpose is the final behaviour that is such which should be inherent to the person after the end of educational process. It is regulated by the teacher or the curriculum. This researcher understood process of achievement of the educational purpose, as formation of complex of adequate professional behaviour, depending on a specific situation (Frank, H., 1962).

S. Emeljanov and E. Nappelbaum, characterizing social systems, noticed that «they are notable by understanding of behaviour and are the result of planned or of not planned designing both as from within, and from the middle. Thus, social systems always are much more difficult than understanding of their essence at a project and designing stage. In their behaviour there are unforeseen phenomena which can be predicted neither by analysis and studying of separate elements' functioning, nor by taking into account their interrelations» (Emeljanov, 1981, p.12).

3. Summary

Thus, within the limits of the system-cybernetic approach to management in an education sphere, it is offered by us to expand somehow the structure of participants of management processes. Except of the object and subject of management, traditionally defined in pedagogical management, as well as an environment, in structure of participants of management process we included «observer». This fourth participant, as a matter of fact, becomes a key figure. It begins and organizes managerial process, defining its purpose, estimating degree of such purpose achieving and an optimality of administrative actions' execution.

References

Emeljanov, S., V., 1981. Системы, целенаправленность, рефлексия / С.В. Емельянов, Э.Л. Наппельбаум // Системные исследования. – Москва: Наука. – С.7 – 37.

Frank, H., 1962. Kybernetische Grundlagen der Pädagogik. Eine Einführung in die Informationspsychologie und philosophischen, mathematischen und physiologischen Grundlagen. – Baden-Baden: Agis-Verlag; Paris: Gauthier-Vilars, 1962. – 175 S.

Jablochnikov, S. 2011. The pedagogical cybernetics: system-cybernetic approach to management in education / S.L. Jablochnikov // Monograph. – Vinnitsya: LTD «Planer». – 406 p.

Jablochnikov S., 2010. Dynamic Models of Management of Pedagogikal Systems. IDIMT–2010. Information Technology–Human Values, Information and Economy. 18th Interdisciplinary Information Management Talks, September 8-10. – 2010.– Jindrichuv Hradec, Czech Republic. – p. 243–249.

Maryska, M., Doucek, P., Kunstova, R. 2012 The Importance of ICT Sector and ICT University Education for the Economic Development. Prague 05.06.2012 – 07.06.2012. In: 3rd International Conference on New Horizons in Education (INTE). [online] Amsterdam : Elsevier, 2012, s. 1060–1068. ISSN 1877-0428. URL: http://www.sciencedirect.com/science/article/pii/S1877042812040608

Maryska, M., Doucek, P., Novotny, O. 2012. Requirements of companies on the knowledge ICT specialists for the ICT administrator role. Barcelona 02.02.2012 – 05.02.2012. In: 4TH WORLD CONFERENCE ON EDUCATIONAL

SCIENCES (WCES-2012). [online] Amsterdam : Elsevier, 2012, s. 4389–4393. ISSN 1877-0428. URL: http://www.sciencedirect.com/science/article/pii/S1877042812019969

CORPORATE PERFORMANCE MANAGEMENT

IMPACT OF CRISIS ON CORPORATE PERFORMANCE MANAGEMENT DEVELOPMENT

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Keywords

Crisis, developmental tendencies, corporate performance management, performance measurement, management accounting

Abstract

The paper is devoted to developmental tendencies of the corporate performance management (CPM) which have come from the reaction to present course of crisis and its impact on its information support. Its aims are to analyze principle aspects by which crisis has influenced the CPM orientation and consequently to describe the impact of these aspects on company information systems development with main stress on the management accounting (MA) developmental trends.

In the first part the paper concludes that especially financial and non-financial management integrity and tendencies stressed performance as a future potential, as internal source of the ability to achieve success in external (market) environment, as strategically oriented concept and as an activity produced invisible assets are important for its recent development.

In the second part the paper investigated the impact of the above stated tendencies on the CPM information support. It summarized that mainly user size of performance measurement, integration of decision acts and their information support, the need to respect multidimensional substance of business process and its management, increasing importance of the quality target information (system of plans and budgets) and visualization and instructiveness of presented information are the values which contribute to the CPM information support by the most substantial way.

These tendencies are also apparent in the MA development. Apart of above stated trends also higher stress on its relevance for managerial control, dual conception of the management and financial accounting relation, effort to enhance information support of strategic decision tasks and time interval shortening for accounting information needed for operational and tactical management are the other values of the MA development.

1. Preface

Although only short time has passed from the first demonstrations of global crisis up to now, it is very inspiring for many areas of our being including corporate performance management. Consequently, analysis and evaluation of all these aspects is the task more for broadly conceived

monograph than for a short paper. Nevertheless, it is possible to stress its most important developmental tendencies. Their understatement actually has lead not only to fall of many companies in the crisis; some of them even have stood at its birth and conversely – their recent taking into consideration can create substantial competitive advantage in the fight for imaginary place on „business sunshine".

In this regards, the aims of this paper are the following:

- To analyse principle aspects by which crisis has influenced the orientation and priorities of company performance management;
- To describe by an evaluating way the impact of these aspects on development of company information systems as tools which should integrate all functions of corporate performance management in adequate information support assuring quality performance measurement; and
- To document these tendencies also on the development of management accounting which is often called as information backbone of performance measurement systems.

2. Definitions

Naturally, fulfilment of the stated aims requires definitions of all three analysed subsystems.

Although performance management is understood quite differently in the different literature sources, most of authors come from the system concept in its definition: they perceive the performance management system as the instrumental system which – similarly like the other instruments by which people influence their environment – "enables managers to influence by a rational way the economic subjects´ development – so that they are able to fulfil the aims they have been founded for "(CIMA, 2002).

Its principle feature is a system interrelation of organizational, planning, control, motivation and decision-making functions integration with information function which penetrates all the other above stated functions. From the practical viewpoints it means that these systems should enable managers to control performance by an optimum way on the basis on adequate information.

Consequently, performance management development can be understood as the characteristics of the business environment development; of course both elements are closely inter-related and they influence the managerial abilities development and the information support of the managerial control.

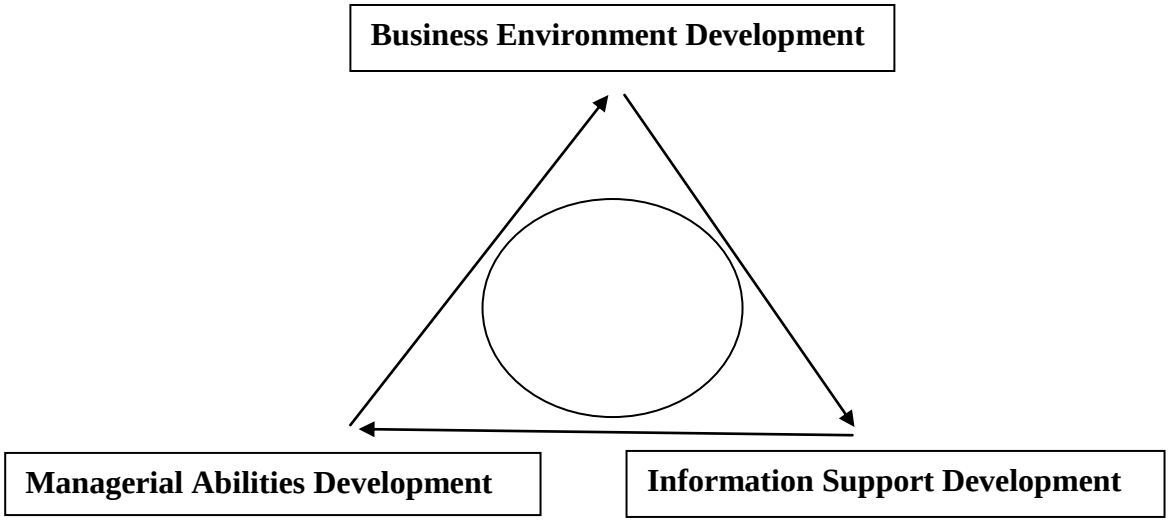

Fig. 1: Performance Management System development (source: the author)

The quality performance measurement is the principle precondition of successful performance management. According to CIMA definition (CIMA, 2002), it is defined as "The process of assessing the proficiency with which a reporting entity succeeds, by the economic acquisition of resources and their efficient and effective deployment, in achieving its objectives."

Also management accounting definition has passed substantial development; from initial stress to differentiate it methodologically from financial accounting, recently it has been stressed its information benefit for managers.

This benefit is stressed also in the most often quoted management accounting definition (CIMA, 2002): "The application of the principles of accounting and financial management to create, protect, preserve and increase value to the stakeholders of profit and not-for-profit enterprises, both public and private. Management accounting is an integral part of management, requiring the identification, generation, presentation, interpretation and use of information relevant to: formulating business strategy, planning and controlling activities, decision-making, efficient resource usage, performance improvement and value enhancement, safeguarding tangible and intangible assets and corporate governance and internal control".

3. Performance management developmental tendencies

However, one of the crisis consequences is the fact the stated definition is the subject of many inspiration considerations recently which do not negate it but which develop it in the relation to the changes of business environment and managerial needs. Let us give a notice at least to the most important ones.

Theory and practice mutual relation

Is a progressive company practice integrated enough with modern general conceptual approaches? It is a question which is crucial for recent success of any organism operating in business environment including companies and their financial management.

With many difficulties and at the edge of interest only those companies survive who do not have implemented modern outcomes about the business environment development in their system of management; but – also negative consequences of theory retreats from real practical questions and

it starts to create its own world of questions and answers which – in better case – are not interesting for managers and – in worse one – they lead managers by a wrong direction.

Financial and non-financial management integrity

Already the beginning of nineties of 20th century is in the auspice of strong press on integral connection of financial management with the management of non-financial line of business process; in some areas of mainly strategic management this integrity has appeared in the changes of priorities of their inter-relations. After that, also the crisis has shown again the necessity to build the performance management system on the integrity of both groups of criteria.

The following objections have started to stress against traditional primary company orientation to financial criteria:

Financial targets come especially from the owners´ requirements; however, companies´ prosperity is (especially in a long-run) more influenced by consistency of broader spectrum of stakeholders who share production and usage of companies´ values; among them customers and employees play the most substantial role;

Primary managers´ interest to fulfil top financial criteria (which are usually assessed in regular year intervals) orients them more to tactical than strategic aims. It has negative impact on companies´ development especially in the cases if tactical and strategic consequences of managerial decisions are not in the compliance.

From the viewpoint of potential controversy between tactically measured results and strategic intentions it is important to differentiate financial (ex-post analyzed) results and factors (value drivers) which assure company development and which is necessary to control (ex-ante) so that company reaches desired results.

In relation between value drivers and reached results is important that it is necessary to devote greater attention to value drivers in the performance management; if a company management succeeds in assuring long-term favourable value drivers´ development it will not be surprised by long-term favourable development of financial criteria; however, equivalence is not valid in this relation: it is possible to assure financial criteria growth in the operational and tactical horizon by such provisions which can undermine long-term company development.

They are the main reasons why the company targets should be formulated (and after that also analyzed) in a broader context of mutually related financial and non-financial criteria whose fulfilment prolongs time horizon of the company successful development.

Balance Scorecard (BSC) is probably the most elaborated and most popular system of such criteria. Its principles were formulated by R. S. Kaplan a D. P. Norton (Kaplan, Norton, 1992, 1996, 2000) at the beginning of nineties of the 20th century. Its detailed characteristics as well as description its relation to management accounting exceed the scope of this paper.

Performance as a future potential

The evaluation of "recent" performance has been perceived more and more as an analysis of future success (benefit) than as a judgment of past, already realized provisions and actions; the principle task of the performance measurement is to look for the answers for questions what direction we should orient our recent and future decision-making and how our today decision-makings and actions contribute to a future benefit than the questions what are today consequences of the decisions and acts which we or our predecessors made in the past".

Performance as internal source of the ability to achieve success in external environment

The aims which create the base of performance measurement are formulated on the basis of internal analyses of company managers; nevertheless, the only fact that the company has differentiated from competitors and has reached a positive effect by comparing of realized external outputs and incurred external inputs is the final recognition of the successful performance.

Performance as strategically oriented concept

Comparison of above stated outputs and inputs is not possible to make on traditional underlying assumptions, qualitative characteristics and requirements for recognition, definition and valuation of the financial statement elements in such a way they are defined with regard to information needs of financial accounting external users; especially substantially part of economic sources incurred in the innovation part of business cycle and derived controversy between committed and incurred costs is used much earlier than their benefit is approved by the revenue recognition; thus, the matching of revenues and incurred costs brings higher information potential if it is carried out for a recognized part of business cycle than on traditional comparison for a fixed, shorter or longer time period (Šoljaková, 2009).

Performance as activity produced "invisible assets"

Especially in relation to the above stated strategic size of performance measurement many benefits occur by a way that is not the subject of traditional accounting disclosure; namely sources invested into the innovation part of business cycle are often presented – due to uncertainty and difficulties connected with their future benefits – as period costs; the recognition, definition and valuation but also management of invisible assets development which are not disclosed in the traditional balance-sheet (such as research outcomes, intellectual assets and capital potential, networking benefits based on long-term relations to suppliers and customers, goodwill based on long-term positive company perceiving and many others) has been becoming substantial part of performance management and measurement (Marr, 2006, Kaplan, Norton 2004, Wagner, 2009).

4. Performance measurement developmental tendencies

Of course, all above stated tendencies have been influencing also information systems whose role is to integrate organizational, planning, control, motivation and decision-making functions with information function which penetrates all the other above stated functions. Moreover, especially information systems face some other issues whose importance has been stressed by crisis; the most important of them are – in my opinion – the following ones:

User size of performance measurement

Really not new but often omitted tendency comes from the fact that performance evaluation is (similarly as any other evaluation) always dependent on the questions: for whom, for what purpose the performance has been judged (Wagner, 2009).

This inter-relation has its reflection in to views:

- The first (and also more often) one reacts to past and stresses: if traditional view on information reflection of business process has come from a principle "by one information it is possible to assure more similar decision tasks by a compromise way", on the other hand, recent approach stresses: every decision task should have its own original information background.

- It is apparent that – although this view is quite logical – only decreasing costliness of data-mining has enabled application of above stated principle. However, crisis and its reflection in requirements to information quality bring also a new view on user-friendliness of information systems – including this part which should be a pillar to a financial manager: does not lead us a low costliness and a fixed substance of information system potential to such long-term behaviour we decrease user benefit of information systems by an increased extend of rendered data?

Encouraging of information system suppliers to preserve a concrete data segment in system in the case a user analysis has assessed it as redundant and even misleading but information system enables express it without additional costs is typical example of this approach.

The defend sounds paradoxically in such cases: „Nobody needs it today? But – you do not know whether somebody would not need it in a future; so, the best solution will be if we leave it in the system "just for information".

Integration of decision acts and their information support

The second comment is connected with the complexity of recent systems of company management. The effort of progressive firms to develop them on the base of multi-dimensional understanding of business process has been leading to continuously stronger integration of all substantial aspects of its purposeful control:

- Strategic, tactical and operational horizon;
- Product, responsibility, customer, territory and process sections;
- Organizational, planned, control, motivational, decision and information functions;
- Mutually inter-related natural and financial substance, where
- It is necessary to support financial line by information for quality management of financial performance, position and ability to produce cash and to allocate it effectively.

Does this complexity an axle which is necessary to follow primarily?

Apparently yes: it is integration between decision-making process and its information support. Practically, all successful business "fights" of the last years can be expressed generally in a shape "on time and by a adequate way we have reacted to threats which have been indicated by our information system in advance" – and conversely: many losers admit they have not reacted to announced problems, or – due to non-quality information system or non-ability to analyse its signals by a qualified way – their reactions have been incorrect.

Multidimensionality of management and its information support

Increasing complexity of business environment has its reflection in the management multidimensionality, too. Traditionally, managers have required quality information support for the product and responsibility centre management; recently, they also need even more quality information for the management lines of activities, sub-processes, processes, customers, distribution channels, sales territories and even others.

The necessity of adequate information support increases the importance of correct solution of so called allocation problems – questions why and how to allocate financial parameters to the above stated objects. Principle motto of their solution closely connected with user size of performance measurement is for a long time underestimated idea: it is not primarily important how but why it is necessary to allocate costs to the allocation objects. That is, it dos not exist generally correct way of

allocation; its adequacy must respect not only causal relation of costs to the allocation object but also (and especially) decision task which is solved on the basis of this allocation.

The important conclusion recently influencing ways of allocation is the finding that there is no substantial decision task which could be solved on the basis of traditionally and broadly applied reproduction way of allocation. This way comes form the consideration that – if a company wants to survive in a long-term run – it must be able to cover also causally wide costs in the product price. Practical application of this consideration leads to reality that

- Companies allocate huge volumes of "overheads" (in which are often hidden substantial direct costs) in relation to machine hours, prime wages or other allocation bases whose sense was to express company value added to purchased economic resources; and
- The "overhead" allocation is exclusively based on direct proportion in the sense "the more concrete products have been produced the higher amount of common overhead they must contribute to cover".

However, especially competition development and connected increasing necessity to derive product prices not from their costliness but from their value for customers show more and more that this allocation way not only does not increase company information potential but even lead to many false managerial decisions.

This is the reason why allocation ways concentrate primarily on quality information support of the following three types of decision tasks (Král, 2010):

- The tasks solved on existing capacity based on correct quantification of variable costs and margins which respective allocation object asks or brings;
- The tasks coming from calculations of allocation objects´ full costliness which are used in the long-term effectiveness evaluations of the allocation objects; and
- Motivation tasks whose aim is to motivate managers to behaviour which is beneficial for the company as a whole aims fulfilment.

Pressure on the quality target information

Very critical discussion on efficiency and "value added" of target information (systems of plans and budgets) came already through the middle of eighties of the 20th century. Its concussion was – somewhat surprisingly – not only "rehabilitation" but even recognition of increasing importance of this information for the successful companies´ development. Even more important conclusions were the findings that new business environment creates pressure on substantial innovation of the process of the target information development and usage.

Thus, the last twenty years are characteristic by effort to change methodology of the plans and budgets development and usage and to enhance its system conception, especially in the areas of eight questions: what are the principle aims of the plans and budgets system, what is its time dimensions, what principles it is necessary to respect in the stages of the system development and usage for a company as a whole, how to transform plans and budgets from hierarchically higher levels to lower ones, how to exploit the whole system as an instrument of communication and coordination, what are the possibilities of the system usage as a motivation instrument, what types of plans and budgets to use and how to control the system fulfilment.

All above stated tendencies have grown on importance in connection with crisis and they have had natural impact also on broadness of the budget types – quite in the compliance with the approach that different aims and decision tasks can not be satisfied by the only one type of information.

Despite their broad variability it is apparent that – in the usage of different types of budgets – the tendencies struggle to proceed from fixed to flexible budgets, from indexed to zero-based budgets, from budgets given to fixed time interval to rolling budgets, from universal cost drivers (bases of allocation) to activity based budgets and from limit to indicative budgets.

System of management motivational function

Quality of information support is closely connected with communicational and motivational functions of system of management. "We have overcome hard crisis time thanks to team spirit of our company" can be heard from managers who document on many examples that crisis has strengthened (not disrupted) a firm. Of course – not only quality financial management or its information support create a team; on the other hand – many sad stories can document the fact that non-quality financial management proves to "dismantle" a company team.

It belongs to a good financial manager competence to transform (not to break down) company aims to lower responsibility levels so that their employees feel not only compliance of their work with company results and controllability of criteria they fulfil, but also motivational shell of assigned tasks and their internal ability to create of belonging together atmosphere. What is important in this regard, it is the principles that

- although the reward systems must reach also the lowest level of companies´ hierarchy they must be coordinated from the companies´ top level; and
- it must be in the compliance not only with the principle of fast reaction to good/bad operational results but especially with strategic company aims and means of their fulfilment.

It is not quite surprising that the questions of reward systems has become again the subject of increasing interest of academics still even the crisis time (see for example Armstrong – Brown, 2010, Manzoni, 2010); but, what is more surprising that it is apparent from some empirical investigations that "companies usually follow recommendations of contemporary mainstream literature, which suggest centralised approach to this area" (Petera, Wagner, Menšík 2012b) – what is quite positive finding but – on the other hand – "relatively weak are companies in putting strategic initiatives …" ((Petera, Wagner, Menšík 2012a).

Visualization and instructiveness of presented information

All above stated tendencies serve to enrich managers which can control business process with the help of better information support; at the same time, however, they put higher requirements on their professional competence – on their ability to combine and connect purposefully mutual, often very complex and wide relations of causes and consequences. The danger of information overload and difficulties connected with the interpretation of recognised facts it is possible to eliminate to some extend by rational visualization of inter-relations, by graphical expression of the stages and developmental tendencies and by other means which – by a better way than excess of numbers – can enable to understand analysed parameters development and its patterns.

Graphical means have one more advantage – by a reverse way they influence didactically managers´ professional competence and their general ability to perceive and consequently understand and by control actions react to more and more complex inter-relations of business environment.

5. Management accounting developmental tendencies

It is apparent that all above stated tendencies have their reflection also in the management accounting development. As traditional view on the management accounting aims, content and structure comes from contrast to financial accounting (see the following overview inspired by Král, 2010) recent stage is more characteristic by values whose effort is to overcome its narrowly disciplinary orientation and to find interface to principle question how to incorporate management accounting information into to performance management systems by the most effective way. It is necessary to understand these values in their inter-relations and in integrity of their mutual functionality.

Management Accounting Traditional Values

Financial accounting is oriented more on the past events; conversely, management accounting should bring information for comparison of current activities and their desired stage or progress and for evaluation of compared variants of future development.

External relations between company and its environment are the principle financial accounting subject. Management accounting reflects not only external but also internal relations between centers, outputs, processes and other controlled allocation objects.

With regard to the fact that financial accounting information is available – beside others - to competitors the financial accounting information submitters have the tendency to hide some important information – sources of "business secret". Results from sales have principle role among it. Conversely, management accounting should give broadly structured and detailed information about these results.

Management accounting is the accounting of responsibility intersections: each of the internal revenue recognition by the transmitting centre should be accompanied by internal cost recognition by the taking centre at the same time.

Principle management accounting task is to provide managers with quality information about the factors influencing company profit. It appears

- In the differential view on the way of actual and pre-determined profit measurement,
- In the effort to express the contribution of individual products, processes, centers and other drivers to the total profit, and
- In the necessity to quantify alternative levels of incremental, differential or opportunity profit.

This is content, structure and detail of information about costs, revenues and their difference, what creates the essence of principle management accounting orientation.

Nevertheless, above the frame of above stated performance management and measurement tendencies also some other trends have been influencing management accounting development. Let us point out the most important of them only.

Management accounting – financial information system

Especially fast development of accounting for decision-making has impact not only on a broader spectrum of providing information but it also has reverse influence on management accounting methodology. Mainly, fast development of accounting for decision-making has had impact on not only broader spectrum of provided information but also it has reverse influence on the management accounting methodology. Traditional orientation on complex results of business process and usage

of balance and double entry elements has got into the controversy with the requirements for originality and timeliness of bases for decision-making.

Consequently, management accounting has been perceived more and more as financial information system that is closely connected with traditional "hard core" of accounting system but whose principle aims are purposeful selections of accounting information, information from the other subsystems of company information system and from the company environment so that company management is supported by quality information for the management control.

Dual concept of management and financial accounting and its development

The other tendency has lived its boom already in eighties of the 20th century and – although some experts argue that the IAS/IFRS system is softening causes of dual conception – its relative broad practical usage in our companies is the proof that it is not still retired. General outcome of the dual conception is the fact that accounting understanding of business process creates integral element of performance management system.

Principle proof of this fact is that gradual formulation of the company strategic aims, their product-oriented, customer-oriented, responsibility and process transformation and – finally – variance analysis come from the triumvirate of synthetic budgeted or actual information: balance-sheet, income statement and cash flow statement.

Especially in connection with the business environment changes but also in relation to growing pressure to financial accounting harmonization it is apparent that "backbone" of performance management systems must be created by such way of accounting disclosure that is primarily subordinated to managers´ requirements. In comparison of management and financial accounting information it is stressed their contentually and structurally different conception.

Dual concept has developed on the base of monism criticism – on the criticism of such accounting conception which comes from single definition, valuation and presentation of accounting elements describing business results. The principle aim of dual concept was to differentiate information support for managerial control and for external financial accounting users, especially if harmonized financial accounting outcomes have not provided managers with adequate information for their purposes.

Recently, in the times of enhancing external users requirements but also in the times of external users´ and top managers´ information needs convergence the dual concept is changing; it is transformed into the tendency to analyze business process results in mutual comparison of different approaches to recognition, definition, valuation and presentation of assets, liabilities, equity, expenses, income, inflows and outflows. This tendency is in the compliance with the above stated user oriented character of performance measurement (Král, 2010).

Strategic performance management and its information support

With regard to the basic limitation of accounting which is – in its traditional substance – tactically oriented instrument many methods have been developing in the last twenty years whose basic aim is to overcome this limit and to create a support of strategic company management. Especially in the cases that these instruments and methods of their exploitation come from the accounting understanding of the business process they are covered under the common title of Strategic Management Accounting (Šoljaková, 2009).

Value chain analysis is its principle method. It comes from the recognition of activities, sub-processes and processes which produce value and from their differentiation from those they do not produce it. The method extension behind traditional company borders (Extended Enterprise

Concept) and connected restructuring of relations to suppliers and customers is the substantial change of the method applied recently.

Value chain analysis and connected value chain management are accompanied by row of information instruments and methods whose aim is to give a basis for investigations of mutual relations between costs and benefits of individual value drivers; Activity Based Costing and the other AB techniques (as Activity Based Budgeting and Activity Based Accounting) are examples of them as well as Just In Time and Total Quality Management.

The next method comes from the effort to manage products life cycle by the methods of investment decision making. Calculations of a new product, product line, a new market or distribution channel effectiveness is usually based on a modified net present value calculation and it includes estimations of future outflows connected with research, development, start up, production, declination and liquidation of production consequences. These discounted outflows are compared with estimated, again discounted inflows from sales or other benefits which a new product or other project implementation will bring. The method is called Life Time Costing or Life Cycle Costing (Šoljaková, 2012a).

The next progressive costing method - Target Costing – is oriented to target criteria. While traditional procedure comes from the question "What is the costliness of a product?" and only after it "What could be its price?", target costing reverses the questions sequence: it comes from the information about the price a customer will be willing to pay, and it serves as limit of maximum product costs with regard to desired (target) return on investment. Consequently, target criteria budgeting should have integral impact not only on strategic cost management but on the whole system of targets including standards, costing system and system of budgets and – in the phase of their analyses – including accounting system and variance analysis.

Although some doubts exist whether strategic management accounting concepts fulfil the targets stated at the beginning of its development (Šoljaková, 2012b) its importance for the future performance measurement systems is without any doubts.

Time parameters of accounting information

In controversy to the effort to prolong time horizon of management accounting information exploitation also the relation to availability of accounting information for operational and tactical management has substantially changed in the last ten years. As traditional way of accounting figures presentation has been primarily based on their reliability and verifiability (which require to record an event after documents have reached accounting department), conversely, recent requirements for reports´ elaboration stress their relevance and speed of reaction. Thus, many multinational companies require from their national locations month reports developed on relatively strict accrual basis the second or third day after the analyzed period and year reports (strictly connected with audited financial statements) by a week after the *year* end. It is reflected in the more tied relation between actual and desired business process but also in the stronger pressure on effective connection of management accounting and company control system.

6. Conclusions

Although only short time has passed from the first demonstrations of global crisis up to now to make a comprehensive analysis of its impact on corporate performance management, it is possible to stress its most important developmental tendencies. In this regards, this paper has followed the following aims:

- To analyse principle aspects by which crisis has influenced the orientation and priorities of company performance management;
- To evaluate the impact of these aspects on development of company information systems as tools which should integrate all functions of corporate performance management in adequate information support assuring quality performance measurement; and
- To document these tendencies also on the development of management accounting which is often called as information backbone of performance measurement systems.
- Regarding the first aim it seems that especially financial and non-financial management integrity and tendencies stressed performance as a future potential, as internal source of the ability to achieve success in market environment, as strategically oriented concept and as an activity produced invisible assets are important for its recent development. Naturally, these trends have substantial impact also on the corporate performance management information support. From this view-point especially user size of performance measurement, integration of decision acts and their information support, the need to respect multidimensional substance of business process, increasing importance of the quality target information and visualization and instructiveness of presented information are the values which contribute to the CPM information support by the most substantial way.
- These tendencies are also apparent in the management accounting development. Besides of the above stated trends also higher stress on its relevance for managerial control, dual conception of the management and financial accounting relation, effort to enhance information support of strategic decision tasks and time interval shortening for accounting information needed for operational and tactical management are the other values of the MA development.

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References

Armstrong, M., Brown, D. (2010). Evidence-Based Reward Management: Creating Measurable Business Impact from Your Pay and Reward Practises, Kogan Page.

CIMA (2002). Management Accounting – Official terminology. The Chartered Institute of Management Accountants, First published 1982, revised 2002, London 2002.

Kaplan, R. S., Norton, D. P. (1992). The Balanced Scorecard – Measures that Drive Performance. Harvard Business Review.

Kaplan, R. S., Norton, D. P. (1996). The Balanced Scorecard: Translating Strategy into Action. Harvard Business School Press, Boston.

Kaplan, R. S., Norton, D. P. (2000). Balanced Scorecard - strategický systém měření výkonnosti podniku. Management Press, Praha, ISBN 80-7261-032-5.

Kaplan, R.S., Norton, D.P. (2004). Strategy Maps: Converting Intangibles Assets into Tangible Outcomes. Harvard Business School Press, Boston, ISBN 1-59139-134-2.

Král, B. (2010). Manažerské účetnictví, 3. Rozšířené a aktualizované vydání. Management Press, Praha, ISBN978-80-7261-217-8.

Marr, B. (2006). Strategic Performance Management. Leveraging and measuring your intangible value drivers. Butterworth – Heinemann, ISBN0750663922.

Manzoni, J. F. 2010. Motivation through Incentives: a Cross-Disciplinary Review of the Evidence. In: Epstein, M. C., Manzoni, J. F., Dávila, A.: Management Control" Measuring and Rewarding Performance, Emerald, pp. 19 – 63.

Petera, P., Wagner, J., Menšík, M. (2012a). An Empirical study of performance measurement systems in the biggest Czech companies with focus on balanced scorecard. Praha 14.9.2012. In: Performance Management: From strategy to action. Praha: Vysoká škola ekonomická v Praze, ISBN 978-80-245-1888-6.

Petera, P., Wagner, J., Menšík, M. (2012b). Empirical Investigation into the Quality of Performance Measurement and Management Systems Implemented in the Biggest Czech Companies. Cambridge 11.07.2012 – 13.07.2012. In: PMA 2012 Conference: From Strategy to Delivery [CD-ROM]. Cambridge : Institute for Manufacturing, 13 s. ISBN 978-1-902546-43-8.

Šoljaková, L. (2009). Strategické manažerské účetnictví. Management Press, Praha, ISBN 978-80-7261-199-7.

Šoljaková, L. (2012a). Strategic Management Accounting Development during Last 30 years. European Financial and Accounting Journal, Praha, ISSN 1802-2197.

Šoljaková, Libuše. (2012b). Strategic Management accounting: why are not expectations fulfill? Zlín 20.09.2012. In: SVOBODOVÁ, Libuše et al.(ed.). Advances in Finance & Accounting. WSEAS Press, Zlín ISBN 978-1-61804-124-1.

Wagner, J. (2009). Měření výkonnosti – Jak měřit, vyhodnocovat a využívat informace o podnikové výkonnosti. Grada Publishing, Praha, ISBN 978-80-247-2924-4.¨

KPI BASED PUBLIC SECTOR MANAGEMENT – PILOT PROJECT

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Keywords

Performance management, efficiency, KPI, key process indicators, property management, real estate management, benchmarking, public administration

Abstract

Corporate performance measurement and management is nowadays generally widespread discipline in the private sector. In the public sector, however, these activities are still not applied in majority of countries including the Czech Republic.

This paper presents approach for managing selected areas of public administration with using defined key performance indicators (KPI) connected to governmental budgeting processes. Paper also describes how this approach was applied and tested in the area of state real estate management and budgeting.

1. Introduction

In these days performance based management should be part of every major private sector company. Duty of managers of these companies is to collect data, analyze and transform them into information as a basis for decisions by which the company is managed. These activities take place either on level of management of company itself (branch, subsidiary) or on the central level of holding (mother company).

The very essence of performance management is to define the key performance indicators (KPI's) for each department or functional area. KPI's represent a set of metrics that focus on those aspects of performance that are most critical for the current and future success of the company. (Parmenter, 2007). Performance measurement is therefore essential for effective management of the organization (Wagner, 2009).

Examples of main KPI's areas are effectiveness, efficiency and quality. It is also necessary to have effective system of reporting, which processes all the data and allows to process further analysis and modelling.

KPI's are typically used in areas such as performance management of infrastructure and operations, measurement of application parameters, human resources or financial management. KPI's thus

define standards to ensure that the output is in the desired quality and performance, and that the processes operate as intended.

At the public sector level the situation is very similar. Rise of new activities that allow monitoring and measuring the performance of state organizational units can be observed. On the basis of these activities, known as benchmarking, further decisions are taken. The most advanced approach is applied in the UK (Cabinet Office, 2010), (National Audit Office, 2011) and New Zealand (New Zealand Treasury, 2011).

2. Research Questions

In the private sector, reporting, monitoring of KPI's and performance management has been proven to deliver results (Učeň, 2008). The overall objective of our research is to determine whether the same method can be used in the public sector, to provide a basic overview of approaches to this area applied abroad and to evaluate the possibility of their application in the Czech Republic. The intention is to create a set of indicators and related methodology of their measurement and apply them in the public administration.

The main research question in the context of this paper *is whether it is in the Czech Republic possible to obtain data from available public administration information systems, use them for the calculation of KPI's and apply them in the process of management of the state.*

For the scope of this paper, however, this topic is still too extensive. Therefore we would like to limit it to the factual area of public administration real estate management, within which methodology can by verified by pilot implementation. With this limitation, there are open doors for further research, verification of the obtained results for other areas and formulation of general findings applicable to the area of performance management across public administration.

3. KPI and Benchmarking in Public Administration

KPI metrics in public administration are based on years of experience of countries such as the UK (Cabinet Office, 2010), Canada (Office of the Auditor General of Canada, 2004) or New Zealand (NZ Treasury, 2011). Performance and efficiency indicators of public administration are divided into those which measure the "front office", i.e. public services offered to the population and businesses, "middle office", i.e. supporting functions of the state and those that measure the "back office" i.e. the part of administration of the state resources, namely, internal services and operational activities of public authorities that are necessary for the "front office" service provisioning.

KPI measurement and performance management of internal services, the "back office", is usually the first stage of the transition to the effective public management. This area also allows mass benchmarking (self-comparison) of public authorities.

Key impulse for the creation of performance measurement system, hence any management information system, is generated by demand for decision support information, typically by senior financial managers (Procházka, Vořišek, Novotný, 2013). Only when the information is really used in decision making process, there is a willingness to provide accurate, useful and real data (information). Only by the analysis of data it can be determined what improvements are needed and how the managed system will gradually improve itself. Otherwise, data collection becomes a bureaucratic exercise (e.g. in Australia, New Zealand and Canada are the ministry responsible for

benchmarking, they are also in charge of expenditure side of budget and also have an obligation to ensure the functionality and effectiveness of public administration as a whole.

4. Real Estate Management Performance

Let's focus in more detail on a specific area of real estate management, which is a key area of this paper. The content of real estate management lies in optimizing of assets and support processes associated with it. The main objectives are the overall savings in support and asset management, faster requirements processing, more efficient use of assets.

4.1. Method of Measurement and Benchmarking in Real Estate Management

Taking into account the above-mentioned experience of foreign countries in the field of real estate properly defined KPI metrics should provide, in accordance with (Vyskočil, 2007) and (Hrabě, 2013), answers to the following questions:

- Does property management provide effective use of office space? Does organization use office-space properly (m^2/FTE)?
- How to improve the professionalism in real estate management?
- What is the quality of property management services?

Reaction of EU to the above questions is a new standard in the area of property management – a set of standards EN 15221, 1-7. (EN 15221, 2007). While standards with serial number 1-6 have been adopted earlier (2006, 2011), the seventh part of the standard: "Facility Management – Part 7: Performance Benchmarking" was adopted recently.

To achieve the overall cost of facility management, EN 15221-6 prescribes to add full-time capital expenditures to annual operating expenses, but subtract annual revenue income. After data collection and analysis, financial criteria can be expressed in FTE costs, workplace or per m^2.

Recommendations on how to manage the area of property management, described in next chapter, do not aim to substitute the role of the government which has to decide the appropriate approach to property owned by the state.

Thus in particular, if the government decides to reside primarily in owned estates, it will try to make the best use of their buildings (or higher market rents in their buildings, market or lower lease from third parties, effectively utilized spaces, etc.)

4.2. KPI for supporting Real Estate Management in the Czech Republic

To measure performance in real estate management in the Czech Republic we recommend using one of the following KPI's:

$$KPIvarA = \frac{a + b + c - d}{\frac{e}{f}} \qquad KPIvarB = \frac{a + b + c}{\frac{e}{f}}$$

where

a is expenditure on operation and maintenance of all buildings owned by the institution,

b is rent (outgoing payment for leased space),

c is expenditure on energy and water,

d is income from rental of buildings owned by institutions,

e is m^2 of area,

f is nr. of FTE (full time employees).

KPIvarA is aimed to efficient use of buildings in public administration ownership. However, the government can make the decision that is to maximize the use of state buildings and institutions and relocate all institutions from leased buildings to vacant state buildings. This decision could be supported by *KPIvarB* aimed to maximization of state buildings use.

These indicators should be the primary sources for regulating the financial performance of real estate use. For detailed decisions of managers of state institutions we recommend to use the following set of complementary indicators that will provide a more accurate reflection of the reality and eliminate most of the possible counterarguments of inefficiencies.

Secondary indicators (for management of individual organization units) could be:

- m^2 / FTE,
- variations in prices when renting space (payment to organization),
- variations in prices when renting space (payment from organization).

4.3. Method of performance management in property management

Metrics and KPIs are the basis for effective management, but not its aim. Objectives for the real estate area include:

- Optimally equipped workplace of employees in public administration.
- Sustainable development of buildings and equipment of public administration.
- Minimization of the cost of property management while maintaining other targets.
- Minimization of media and energy consumption.

Based on the observed values of KPI's, from our point of view, the real estate can be managed by two ways:

- Capping the total expenditures (at a resolution of organization category),
- Setting max m^2 per employee (FTE).

After considering these alternatives, we propose capping spending in the budget calculated over all institutions of the same category = KPI (median). Ceiling set at KPI (median) + 10%.

5. Pilot project in real estate performance management

5.1. Data

Two data source systems were considered for pilot verification of the methodology- CRAB system and VDK database. The first of these was a system CRAB (Central Registry of Administration Buildings). It is a unified database with records of the administration building at the national level, which is managed by ÚZSVM (Office of the Government Representation in Property Affairs). The initial analysis of the sources indicated that there was initial building condition survey and registry was loaded with data of 14 institutions (out of 670 state institutions, although it were major

ministries), because providing the data records was on a voluntary basis that date. Due to the incompleteness of the data content in this system, this source had been rejected and for pilot testing was chosen the other source of documents, databases VDK (Government Dislocation Commission).

The main content of this database is represented by the data about objects, originating from the survey across national institutions in 2006. ÚZSVM states that these data represent about 60% of the buildings that are in state ownership (ca. 4000 records). This is the status data that has been updated over the years 2007 and 2008 for selected objects in order to precise them.

5.2. Applicability of KPI

Analysis of available data shows that the $KPIvarA$ (see above) cannot be calculated. Available data allow only calculating $KPIvarB$, so we used it in the pilot verification.

For each organization (i.e. OSO) median *KPIvarB* was then determined from all objects, and the individual objects, subsequently, were compared with relevant ones (peer group).

An example could be courts, which have inherently different requirements of office space per employee than as health officers. On the other hand, comparison of KPIs between courts themselves is of great importance.

Additionally median of *KPIvarB* was also calculated within a single organization (OSO) in a particular region, which reflects in the case of objects various organizations rent within the frame of the region.

Introduced system of measuring and comparing performance through KPI may in addition to promoting self-governance of the government's position also serve a variety of purposes - from measuring work efficiency and effectiveness of resource utilization, through the evaluation of investments in public administration (including IT investments), then through motivation and reward of public administration managers and employees to the performance and finally also to output budgeting.

5.3. Outputs

Calculation of selected KPI and secondary indicators, which are described in the previous chapter, has been successfully verified by the pilot implementation. In the first step all relevant attributes of the object level were calculated. These were subsequently grouped under the jurisdiction of the OSO, and in these groups median *KPIvarB* and partial indicator m^2/FTE were determined, optionally also by OSO in each region.

In the field of real estate management both of the proposed methods were applied. Cap on total expenditure in the range - the median group + 10% - was determined for each group and the maximum office space for one employee.

To demonstrate the effects that arise from the management decision with using the *KPIvarB* the total possible savings based on capping expenditures were calculated. *The results show that, in capping the expenditures on the basis of organization / organizational units can achieve annual savings of up to approximately 870 million CZK (difference between actual expenditures and expenditures if capping is applied).*

6. Conclusion

The main research question of this paper - *whether it is in the Czech Republic possible to obtain data from available public administration information systems, use them for the calculation of KPI's and apply them in the process of management of the state* - was confirmed and the example of the state's management of the property as well as prove.

However, the hypothesis was confirmed in a particular area of government administration (real estate), and therefore, space for further research and verification of obtained results to other areas opens up. Subsequently, the global model can be formalized and general findings applicable to the area of performance management across the public administration formulated.

Research findings (Procházka, Voříšek, Novotný, 2013) have been also presented to the Czech Republic Prime Minister and he requested the Minister of Finance to further elaborate this concept and to apply it in the selected areas for the next year state budget elaboration processes.

References

Cabinet Office (2010). Back Office Benchmark Information 2009/2010. Retrieved January 31, 2013, from http://www.cabinetoffice.gov.uk/resource-library/back-office-benchmark-information-200910EN 15221-1 (762001) (2007) Facility Management. Part 1, Terms and definitions

Hrabě, P.(2013), Koncepce KPI pro pilotní ověření v oblasti správy nemovitostí (Concept of KPI in the area of real estate management), NERV working group draft. Praha, 2013.

National Audit Office (2011). Public Audit Forum performance indicators. Retrieved January 31, 2013, fromhttp://www.nao.org.uk/help_for_public_services/ performance_measurement/paf_performance_indicators.aspx

New Zealand Treasury (2011). Administrative and Support Services Benchmarking Report. Retrieved January 31, 2013, from http://www.treasury.govt.nz/statesector/ performance/bass/benchmarking/2008-10

Office of the Auditor General of Canada (2004). Performance Audit Manual. Retrieved January 31, 2013, from http://www.oag-bvg.gc.ca/internet/docs/pam_e.pdf

Parmenter, D (2007). Key Performance Indicators (KPI): Developing, Implementing, and Using Winnig KPIs. Willey, John & Sons, Incorporated, ISBN 0-470-09588-1.

Procházka J., Voříšek,J. Novotný,O. (2013). Řízení vybraných oblastí veřejné správy pomocí KPI (Management of selected areas of public administration with using KPI). Retrieved January 31, 2013, from http://www.vlada.cz/assets/media-centrum/aktualne/NERV_JanProchazka_KPI.pdf

Učeň, P. (2008). Zvyšování výkonnosti firmy na bázi potenciálu zlepšení. Grada Publishing as.

Vyskočil, V., Štrup, O., Pavlík, M (2007). Facility Management a Public Private Partnership, 1. vyd. Kamil Mařík – Professional Publishing,. ISBN: 80-86946-34-4

Wagner, J. (2009). Měření výkonnosti: jak měřit, vyhodnocovat a využívat informace o podnikové výkonnosti. 1. vyd. Praha: Grada, 248 s.

INTANGIBLE FACTORS OF COMPANY'S PERFORMANCE

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Keywords

Intangible assets, intellectual capital, invisible assets, knowledge, performance factors.

Abstract

The current studies show, intangible assets generate about 70% and more of the company's value. Despite this fact, there is still no prevailing conceptualization of intangible assets, and even the term "intangible asset" itself is used ambiguously. These are reasons why the article focuses on the current state of the art in the field of intangible assets research, above all their identification and recognition. It reveals that the common ground for intangible assets lies in the resource based theory of competitive advantage of the firm. Then the most important types - referred to as primary intangible assets - are identified, such as human capital, structural capital, company's relations, strategic capital and innovations. The primary intangible assets are contrasted with the complementary ones (such as management control system, performance measurement, information and communication technology or employees' incentives and compensation schemes), which serve as an organizational catalyst enhancing the impact of the primary intangible assets.

1. Introduction

Daum (2003) stated, "The portion of a company's reported net assets compared with its market value has in many cases become so small today that the relevance of a balance sheet, which reports on these assets, and the effort accountants and auditors put in to set it up properly, has become questionable." (p. 4) He demonstrated this phenomenon on the cases of Microsoft, Coca-Cola or SAP companies and cited the conclusions of the study carried out by Thomas A. Stewart (1997) showing the increasing role, which intangible assets play in the generation of a company's value. The study compared a share of intangible assets in the market values of S&P 500 companies between 1982 and 1999 and quantified how the share soared from 38% to 84%!

Kaplan, Norton (2004) presented similar conclusions when they observed "Even after the bursting of the NASDAQ and dot-com bubbles, intangible assets – those not measured by a company's financial system – account for more than 75 % of a company's value. The average company's tangible assets – the net book value of assets less liabilities – represent less than 25 % of market value" (p. 4).

Finally Adams and Oleksak (2010) assigned approximately 75% of the company's value generation to impact of intangible assets too, but they admitted possible confusions, especially in the situations

when the market prices of shares are volatile (p. 96). That was why they supplied other, more persuasive data: "But no one can ignore the gap when there is a merger or an acquisition. This is the moment when traditional accounting and the reality of the knowledge economy come head to head. A good illustration of the extent of this gap was an Ernst & Young survey of 709 transactions in 2007 that showed, on average, only 30 % of the purchase price could be allocated to tangible assets" (Adams, Oleksak, 2010, p. 97).

A few mentioned examples present the importance of intangible assets in achieving company's performance. Such importance calls for proper management of intangible assets and successful managing has to comply with the generally accepted managerial rule: "you cannot manage what you cannot measure". Moreover – in the case of intangible assets – it has to be added "you cannot measure, what you cannot identify ". That is why the aim of this article is to identify the significant groups of intangible assets. More precisely it means to compare various conceptions and frameworks of intangible assets and synthesize these different approaches into one final classification.

2. Identification of intangible assets

The importance of intangible assets emerged in connection with the strategic management thinking. Scholars and practitioners of strategic management strive to find out why certain companies outperform the other ones. According to Pettigrew et al. (2002), in the first era of strategic management, "Business performance was explained by factors of industry structure and the conduct of firms within the industry" (p. 462). In other words, such view focuses on positioning a company and its products on the market and assumes that all firms are similar inside.

The change in strategic thinking came with the second era of strategic management in mid 1980s. It is connected to **resource based theory.** This approach emphasizes the internal resources and distinctive capabilities that determine how effectively the firm can compete with its competitors not only in the same, but also in different industries.

Prahalad and Hamel (1990) referred to such firm capabilities as *core competencies*. The next subsection will show more terms used for intangible factors of competitive advantage. At this point, let us give the concrete example of core capabilities application. Henderson and Clark (1990) describe the case of Canon's entry into the photocopier industry. That industry was led by Xerox Company, which supplied big organizations with large copiers. Canon leveraged its strengths in optics and imaging gained in its camera business and applied them in the construction of small photocopiers for copy-service franchisers (such as Copy Cop). Xerox did not anticipate such attack and was unable to answer effectively to the Canon's challenge for years.

2.1. Intangible factors of competitive advantage in literature

The current literature discusses wide range of resources of competitive advantage. Itami and Roehl (1987) were ones of the first authors who pointed out the importance of intangible factors, "Corporate resources are conventionally defined as the people, goods, and capital a firm can deploy to meet its short- and long-term goals. A small but increasing number of managers add information to the list. The final item is not easy to pin down. Technology is an example, but information is much more than that. Consumer trust, brand image, control of distribution, corporate culture, and management skill are all informational resources. I call these information-based resources *invisible assets*, and they are just as essential for effective operation as the more visible corporate resources. More than that, I believe they are the most important resources for long-term success" (p. 12).

According to Marr (2005, p. 30), Richard Hall was first author who introduced the concept of **intangible assets** (instead of invisible assets) as critical value driver in 1992. He split them to two categories. First category was *intellectual property* – intangibles for which the company has property rights – and *knowledge assets*, that cannot be owned, represented the second category.

Sveiby (1997) offered similar static view of the all company's intangible assets, but he added view of their financing (see Fig. 1). The detailed classification of intangible assets is also obvious from Fig. 1. Sveiby distinguishes *personnel competences* residing in the knowledge and capabilities of employees, *internal structures* including written manuals, databases and other records remaining in the company even if particular employee leaves it, and *external structures* consisting in relations to the subjects in the firm's environment.

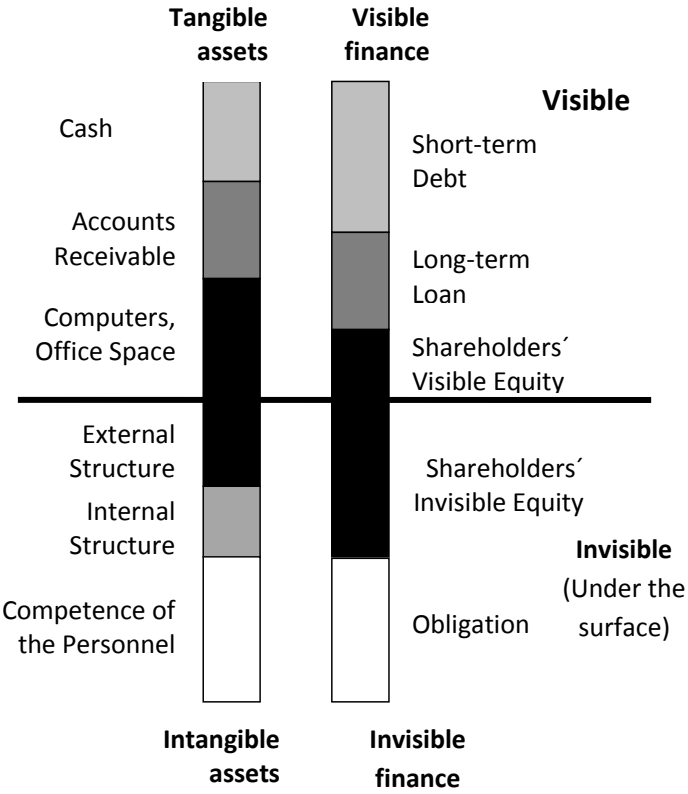

Fig. 1 – Visible and invisible items of the balance sheet; Source: Sveiby (1997, p. 11)

Kaplan and Norton (2004) defined intangible assets as "knowledge that exists in an organization to create differential advantage" (p. 202). Such definition reveals close association between intangible assets and **knowledge**. In fact, knowledge is the substance of any intangible resource of competitive advantage as Roos and Ross (1997) already mentioned "regardless of whether you call it invisible assets, absorptive capacity, core competencies, strategic assets, core capabilities, intangible resources, organizational memory, or other concepts carrying similar meaning" (p. 414).

Alavi and Leidner (2001) define knowledge using hierarchical approach, "A commonly held view is that data is raw numbers and facts, information is processed data, and knowledge is authenticated information" (p. 109). The most frequently used distinction is *tacit* versus *explicit knowledge* made first by Polányi (Nahaphiet, Goshal, 1998, p. 245). Both types of knowledge need to be managed so that companies reach the point where all employees and company's partners have right knowledge in the right time. Marwick (2001) explains: "**Knowledge management** is the name given to the set

of systematic and disciplined actions that an organization can take to obtain the greatest value from the knowledge available to it. ... Effective knowledge management typically requires an appropriate combination of organizational, social, and managerial initiatives along with, in many cases, deployment of appropriate technology" (p. 814).

Intellectual capital represents another popular term connected with intangible factors of company's competitive advantage and performance. Marr (2005, p. 30) stated that **intellectual assets** were predecessors of the concept intellectual capital. However, the majority of intellectual assets is out of company's control and that was why Adams and Oleksak (2010) noticed, "If you don't own something, the logic goes, then it's wrong to talk about it as a corporate asset" (p. 46). The ICM Gathering held in January 1995 defined intellectual capital as "knowledge that can be converted into profits" (Lev, 2001, p. 155). Similarly, Subramaniam and Youndt (2005) consider intellectual capital to be "the sum of all knowledge firms utilize for competitive advantage" (p. 451). Adams and Oleksak (2010) prefer the concept of **intangible capital** with the same meaning, "The combination of all the intangibles in an organization is intangible capital (IC), sometimes also called intellectual capital" (p. 39). Lev (2001) admits the terminological confusions at the beginning of his book, "I use the terms *intangibles*, *knowledge assets*, and *intellectual capital* interchangeably. All three are widely used – *intangibles* in the accounting literature, *knowledge assets* by economists, and *intellectual capital* in the management and legal literature – but they refer essentially to the same thing: a nonphysical claim to future benefits. When the claim is legally secured (protected), such as in the case of patents, trademarks, or copyrights, the asset is generally referred to as *intellectual property*" (p. 5).

2.2. Variety of intangible factors of competitive advantage

If we skip from terminology of intellectual capital to its structure, we will find out it is interestingly ununiformed as well. Based on research in five American companies, Roos and Roos (1997, p. 416) identified the following parts of intellectual capital:

- **human capital** consisting of knowledge capital, skill capital, motivation capital, and task capital;
- **organizational capital** with subcategories:
    - business process capital (flow of information, flow of products and services, cash flow, co-operation forms, strategic processes);
    - business renewal and development capital (specialization, production processes, new concepts, sales and marketing, new co-operation forms);
- **customer and relationship management** including customer, supplier, network partner, and investor relationship capital.

Consultants Edvinsson and Malone (1997, p. 11) differentiate only two basic categories of intellectual capital:

- **Human capital**, which cannot be owned by the company and consist of combined knowledge, skill, innovativeness, and ability of the company's employees, including company's values, culture and philosophy.
- **Structural capital**, which means all that left behind when staff is going home (hardware, software, databases, organizational structures, patents, trademarks etc.). Customer capital is also a part of structural capital, but later in their book, Edvinsson and Malone (1997, p. 146) take it apart.

Youndt and Snell (2004, p. 338) split intellectual capital into three distinct categories:

- **Human capital**, which simply refers to individual employee's knowledge, skills and expertise,
- **Organizational capital** represents institutionalized knowledge and codified experience stored in databases, routines, patents, manuals, structures, etc.
- **Social capital** resides in networks of relationships.

Andreou, Green, Stankosky (2007, p. 54) recognized even 8 different types of intangible assets. They can be seen at the bottom of the pyramid in Fig. 2 below. Australian professor of accounting Choong (2008, p. 632) identified four important areas – human capital, customer capital, structural capital, and intellectual property rights. Finally, Adams and Oleksak (2010) distinguished human capital, relationship capital, structural capital, and the fourth category, which they called "**Business recipe** is basically a combination of your market opportunity and your organization's strategy to take advantage of that opportunity" (p. 37).

2.3. Hierarchy of intangible factors of competitive advantage

The last mentioned category of "business recipe" caught attention to the strategy and market situation of the company. Similar idea is behind so called *Framework of Intangible Valuation Areas*, which is depicted in Fig. 2. It shows the pyramid with the central strategic goals of the company at the top. The criteria for selecting appropriate intangible assets are derived from these strategic goals in the middle of the pyramid. The bottom consists of particular intangible assets of intellectual capital.

Andreou and Bontis (2007) developed and on the sample of 84 high-tech US companies verified a new lowest layer of so called *Operational Knowledge Assets.* That is in agreement with Wiig (1997, p. 323) who claimed knowledge management to be more operational than strategic management of intellectual capital.

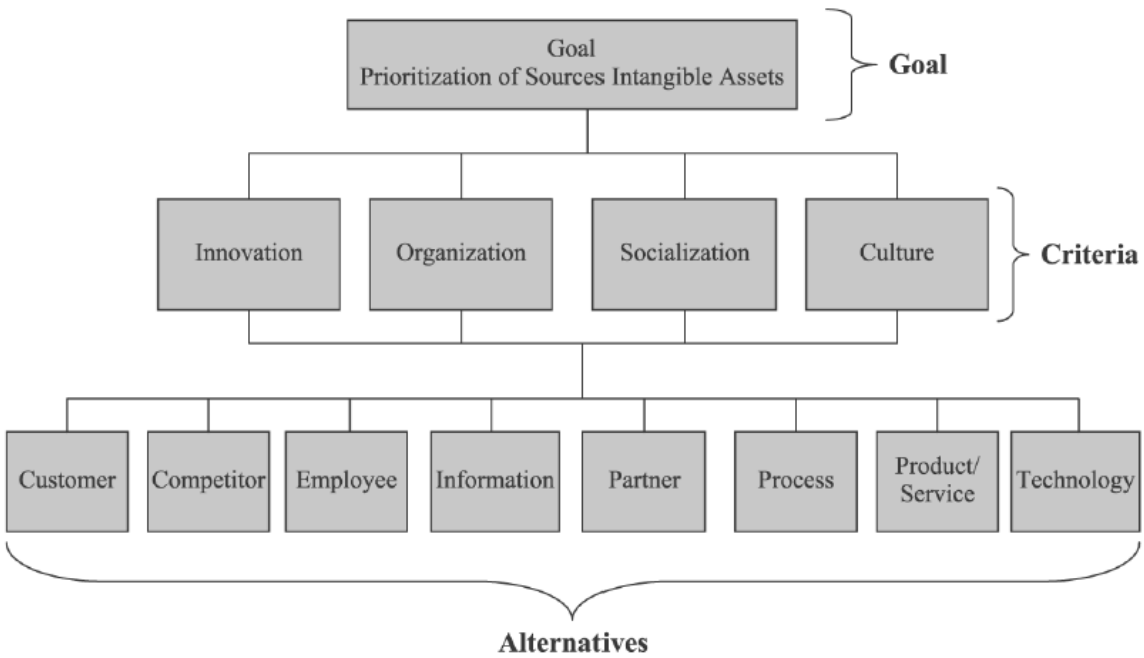

Fig. 2 – Framework of Intangible Valuation Areas; Source: Andreou, Green, Stankosky (2007, p. 55)

2.4. Primary and complementary intangible resources of competitive advantage

Big advocate of resource based theory – J. B. Barney (2007) – draws distinction between real intangible assets and second-order intangible assets that serve as a catalyst and intensify the impact of the real ones. Specifically, "Numerous components of a firm's organization influence its ability to exploit the full competitive potential of its resources and capabilities, including its formal reporting structure, its explicit management control systems, and its compensation policies. These components are often called **complementary resources and capabilities** as they have limited ability to generate competitive advantage in isolation. However, in combination with other resources and capabilities they can enable a firm to realize its full potential for competitive advantage." (p. 67)

Information and communication technology can be seen as another example of complementary intangible assets, besides the mentioned ones. Adams and Oleksak (2010) go even further, "IT fuelled the knowledge economy because it made movement, sharing, and storage of knowledge possible. IT also enables the creation and greater standardization of process (the magical form of structural capital). That means that the explosion in the value of knowledge and intangible capital has been facilitated and fuelled by IT. And if you want to optimize your intangible capital, you will have to optimize the underlying IT" (p. 48).

3. Conclusions

It was showed that answer to the basic question of strategic management – why certain companies outperform the other ones – is more and more often associated with effects of intangible assets. Due to short history of research in the field of intangible assets, there are still many confusions in terminology, structure or ways how they influence the performance of a company.

3.1. Brief synthesis of intangibles

The brief historic excursion revealed **many synonyms** for intangible assets such as invisible assets, intangible resources, capabilities, competences, intellectual capital etc.

The common ground of all intangible assets is **knowledge** in the broadest sense of the word.

The bundles of specific knowledge represent particular elements of intangible assets (=intellectual capital), such as human capital, structural capital subsuming organizational and social capital, relationship capital. All mentioned categories of intellectual capital represent still prevailing more or less **static view** on the imaginary balance sheet as introduced by Sveiby (1997). However, more contemporary sources start to emphasize a **more dynamic view** and consider strategic capital (=management capital, business recipe) to be part of intellectual capital. Innovativeness and innovations – especially innovations seen as emergent strategies in the Mintzberg's sense (Mintzberg, 1984, p. 24; 2007, p. 6), which correct and adapt the original deliberate strategy to the changed situation – are another example of such dynamic view.

Finally, the character of some intangibles causes the need for distinction between **primary and complementary intangible assets**. The latter enhance the company's value only in connection with primary ones otherwise the improvements of competitive advantage and performance cannot be expected.

3.2. Research implications

The impact of complementary intangible assets on company's performance should be assessed only with concurrent assessing of the primary intangible assets. This might be reason why many studies did not find any correlation between ICT and company's performance. Tippins and Sohi (2003) explain such findings as a consequence of studying solely ICT impact without context. In their research they proved statistically significant ties ICT capabilities – organizational learning – company's performance.

The second research implication lies in the fact, that strategy plays an important role in the selection and employment of intangible assets. Different intangible assets can be expected in cost leading company and different in company preferring differentiation strategy. In other words, strategy should be taken into account at least as a control variable in research of intangibles.

3.3. Practical implications

Senior managers are constantly challenged with formulation and implementation of company's strategy. This article might be helpful in seeking key factors of company's competitive advantage and performance, or in evaluating the company's strategic assets.

References

Adams, M., & Oleksak, M. (2010). Intangible capital: putting knowledge to work in the 21st-century organization. Praeger, Santa Barbara (Calif.), 2010, ISBN 978-0-313-38074-7

Alavi, M., & Leidner, D.E. (2001). Review. Knowledge management and knowledge management systems. Conceptual foundations and research issues. MIS Quarterly. Management Information Systems 25 (1), 107-136

Andreou, A.N., & Bontis, N. (2007). A model for resource allocation using operational knowledge assets. The Learning Organization, 14(4), 345-374.

Andreou, A.N., Green, A., & Stankosky, M. (2007). A framework of intangible valuation areas and antecedents. Journal of Intellectual Capital, 8 (1), 52-75.

Barney, J. B. (2007). Resource-Based Theory: Creating and Sustaining Competitive Advantage. Oxford University Press, Oxford (UK), 2007, ISBN 978–0–19–927768–1.

Choong, K.K. (2008). Intellectual capital: definitions, categorization and reporting models. Journal of Intellectual Capital, 9(4), 609-638.

Daum, J. H. (2003). Intangible Assets and Value Creation. John Wiley & Sons, Chichester, 2003, ISBN 0-470-84512-0

Edvinsson, L., & Malone, M.S. (1997): Intellectual Capital: the proven way to establish your company's real value by measuring its hidden brainpower. Judy Piatkus, London, 1997, ISBN 0-7499-1767-9.

Henderson, R., & Clark, K. B. (1990). Architectural innovation. the reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly, 35(1), 9-30.

Itami, H., & Roehl, T.W. (1987). Mobilizing Invisible Assets. Harvard University Press, Cambridge (Mass.), 1987, ISBN 0-674-57771-X

Kaplan, R. S., & Norton, D. P. (2004). Strategy maps. converting intangible assets into tangible outcomes. Harvard Business School, Boston (Mass.), 2004, ISBN 1591391342

Lev, B. (2001). Intangibles : Management, Measurement, and Reporting. The Brookings Institution, Washington, D.C., 2001, ISBN 0-8157-0093-8.

Marr, B. (2005). Perspectives on Intellectual Capital : Interdisciplinary Insights into Management, Measurement and Reporting. Elsevier, Boston (Mass.), 2005, ISBN 0-7506-7799-6.

Marwick, A.D. (2001). Knowledge management technology. IBM Systems Journal, 40 (4), 814- 830.

Mintzberg, H. (1994). The Rise and Fall of Strategic Planning: Reconceiving Roles for Planning, Plans, Planners. Free Press, New York, 1994, ISBN 0029216052.

Mintzberg, H. (2007). Tracking strategies: toward a general theory of strategy formation. Oxford University Press, Oxford (UK), 2007, ISBN 978–0–19–922850–8.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. The Academy of Management Review, 23 (2), 242-266.

Pettigrew, A., Thomas, H., & Whittington, R. (2002). Handbook of Strategy and Management. SAGE Publications, London, 2002, ISBN 0-7619-5893-2.

Prahalad, C.K., & Hamel, G. (1990). 'The Core Competence of the Corporation'. Harvard Business Review, 1990 (5-6), 79–91.

Roos, G., & Roos, J. (1997). Measuring your Company's Intellectual Performance. Long Range Planning, 30 (3), 413-426.

Subramaniam M., Youndt M.A. (2005). The influence of intellectual capital on the types of innovative capabilities. Academy of Management Journal, 48 (3), 450-463.

Sveiby, K.E. (1997). The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets.:Berrett-Koehler, San Francisco, 1997, ISBN 1576750148.

Tippins, M.J., & Sohi, R.S. (2003). IT competency and firm performance: is organizational learning a missing link? Strategic Management Journal, 24, 745-761.

Wiig, K.M. (1997). Integrating intellectual capital and knowledge management. Long Range Planning, 30(3), 399-405

Youndt, M.A., & Snell, S.A. (2004). Human Resource Configurations, Intellectual Capital, and Organizational Performance. Journal of Managerial Issues, 16 (3), 337–360.

APPROACH TO VALUATION OF ASSETS IN CZECH ACCOUNTING, COMPARISON TO IFRS AND IMPACTS ON CONTROLLING PROCESS OF SMES

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The International Financial Reporting Standards (IFRS), Czech accounting standards, accounting standards harmonization, process model of company management, controlling, SMEs (Small and medium sized enterprises).

Abstract

The International Financial Reporting Standards (IFRS) were chosen the main tool of the harmonisation strategy in the area of accounting legislation in member states of the European Union. Trust in financial markets plays a significant role in the decision making of all entities involved, and accounting should provide reliable data, which are a basis for such decision making.

The current valid legislation in the Czech Republic requires that those accounting units that issue securities registered at the regulated security market in the member states of the European Union apply the set of the IFRS standards. Thus, the obligation to report in such a way only applies to the above-mentioned companies. In spite of this fact the number of companies that compile their financial statements in compliance with the IFRS voluntarily is increasing. Due to this so-called double reporting there are differences between the financial statements prepared in compliance with the IFRS and those prepared in compliance with the Czech accounting legislation. Showing of assets and liabilities and their valuation that are used in a different way in the IFRS, this all brings a completely different picture of a company. A consequence of this may be a different asset structure, structure of liabilities and financial situation, as well as the fair market value of a company, which may appear to be very different taking these two points of view.

1. Introduction

Due to the global character of the world economy, which is growing increasingly stronger, the demands of investors, banks, rating agencies and other entities concerning comparability of company financial statements are growing as these financial statements are also the main source of information of the company's efficiency and financial stability. A process of accounting standards harmonization is under way in the member states of the European Union. This process is expected to result in the harmonization of national accounting legislation with the IFRS accounting standards, which are the main tool of the harmonization strategy (Dvořáková, 2008).

Trust in financial markets plays a significant role in the decision making of all entities involved, and accounting and especially reliable data that it should provide are a basis for such decision making. However, high-quality accounting data are necessary not only for decision making in financial markets, but also for various business decisions regardless of the size of the business entity. If we take into account provision of subsidies and other kinds of support, we can monitor certain positive responses of small and medium-sized companies concerning the harmonization.

The current valid legislation in the Czech Republic requires that accounting units that issue securities registered at the regulated security market in the member states of the European Union apply the set of the IFRS standards. After the amendment to the Act on Accounting with legal effect as at January 1, 2011, even those accounting units that are a controlled entity or an entity under the joint influence may use the IFRS provided that "as at the balance day they will be obliged to submit to the compilation of the consolidation financial statements using the IFRS governed by the law of the EU" (Jílek, Svobodová, 2013). Due to using the IFRS, it is possible to meaningfully compare companies from various countries and it is also easier to reveal threatening risks. Thus, the obligation to report in such a way only applies to the above-mentioned companies. In spite of this fact the number of companies that compile their financial statements both in compliance with Czech Accounting Standards and with the IFRS[9] is increasing according to the research by PricewaterhouseCoopers. There are several reasons for that. Even some small and medium-sized companies have adopted this method of reporting voluntarily, disregarding those that have been prescribed to do so by their parent company abroad. They have understood that even this method of "opening" to foreign markets and partners may be a certain competitive advantage for them, or that it may make it easier for them to receive finance from European funds. This trend is beginning to be especially visible in case of domestic companies that operate in the branches of new technologies or in the branches where it is possible to generate high added value and where it is possible to expect participation by foreign investors. This way companies clearly declare to potential investor that they are trustworthy and open to provide a highly reliable view of the company. Of course, their aim is to increase the price of possible capital interest.

It is logical that due to this so-called double reporting there are differences between the financial statements prepared in compliance with the IFRS and in compliance with Czech accounting legislation. If it was not like that, even though there may be such a case in the situation when a company only reports those items the reporting of which is the same in both the systems, both accounting systems would have to be identical, and then this whole double reporting process would be meaningless.

[9] We use as the basis the study by PwC „IFRS – The European investors´ view" published on http://www.ipoint.cz/zpravy/5259745-pwc-79-evropskych-investicnich-manazeru-povazuje-prechod-na-ifrs-za-vyznamny/?option=com_content&id=415&ent_id=5259745

"One of the major differences is specification of the area of users for whom the financial statements are intended and whose need of information primarily influences the main principles and assumptions. While the IFRS and their Conceptual Framework arise out of the needs of external users, especially investors, preparation of financial statements according to the Czech accounting regulations is mostly influenced by the need to identify the correct tax base for its collection. Showing of assets and liabilities, as well as their division and valuation that are used in a different way in the IFRS, this all brings a completely different picture of a company by means of financial statements compiled in this way. Comparing to "Czech" financial statements, reports compiled in compliance with the IFRS may include a very different asset structure and structure of liabilities and thus it may be deducted that even the indicators received by means of a financial analysis will have different values. We cannot do anything else but state that the financial situation of a company may appear to be very different taking these two different points of view"(Dlasková, 2013). And it is just the asset structure management that is one of the most important risk management tools in the modern conception of controlling of small and medium-sized companies. "The so-called balance controlling view is the most comprehensive view of the company on the long-term basis and it is possible to use it to deduce virtually everything that we need to maintain the company in a good shape" (Havlíček, 2012). The balance sheet gives clear information to bankers, investors and all creditors on how the company covers its debts. The task of controlling is not only to work with the balance sheet arising out of financial statements in compliance with the domestic regulations, which tend to be very misleading in small and medium-sized companies. It is usually necessary to revaluate the entries of the left side of the balance, i.e. of the value of assets, from the managerial point of view. Controlling must work on the assumption that the value of assets tends to be or may be distorted while the value of debts is stable, because we do not assume that creditors will stop requiring the relevant payment. For example in the period of a crisis when it is necessary to restructure a company as it does not settle its liabilities its debts will increase (by penalty) while the value of assets usually decreases in the period of a crisis. It is the most dangerous scenario in the life cycle of a company. After the global economic crisis, the most objective view possible of the value of assets is becoming one of the most frequent requirements by investors and owners. Even in case of small and medium-sized companies, the so-called balance rules as the key controlling tool are beginning to be a very important managerial tool in the conception of the so-called procedural model of company management, which is based on an interdisciplinary view of the controlling process including planning, management accounting and personnel management.[10]

According to the existing surveys in this area, the IFRS really bring a change to evaluation of the financial situation, and during a financial analysis of accounting statements compiled in compliance with the IFRS we can expect a picture of the company's management, financial stability and market value that will be different from the one that is made by means of an analysis of "Czech" accounting statements. The issue of international standards is enormous and the area of assets forms more than a half of these standards. In case of a majority of them the influence of valuation is not so considerable to be important for this article, or a company only rarely comes across applying them in practice. For this reason, we will especially deal with the area of selected assets, using which small and medium-sized companies come across very often and where the different methodology of valuation and charging to account may finally bring very significant differences and impacts on financial statements.

[10] Karel Havlíček has been long focussing on the procedural model of management of small and medium-sized companies based on management and controlling, e.g. in his publication **Management & controlling malé a střední firmy**. 1st edition. Prague: University of Finance and Administration, 2nd edition 2012, where he describes several views of balance rules, especially in chapter 5. p.92-94.

Article aims to describe current condition of Czech accounting legislation in comparison to IFRS in selected areas. Another objective is to describe the selected asset items, using which small and medium-sized companies come across very often and where the different methodology of valuation and charging to account may finally bring very significant differences and impacts on financial statements. Specifically, we outline the impact of financial leasing on balance sheet, the real effect of different amount of depreciation and how big are the differences that arise due to revaluation of fixed tangible assets. Due to the limited scope of the article, we will not consider the impact on the P&L and CF statements.

2. Current Condition of Czech Accounting Legislation in Comparison to IFRS in Selected Areas

One of the major differences is specification of the area of users for whom the financial statements are intended and whose need of information primarily influences the main principles and assumptions. While the IFRS and their Conceptual Framework arise out of the needs of external users, especially investors, preparation of financial statements according to the Czech accounting regulations is mostly influenced by the need to identify the correct tax base for its collection. Showing of assets and liabilities, as well as their division and valuation that are used in a different way in the IFRS, this all brings a completely different picture of a company by means of financial statements compiled in this way. Comparing to "Czech" financial statements, reports compiled in compliance with the IFRS may include a very different asset structure and structure of liabilities and thus it may be deducted that even the indicators received by means of a financial analysis will have different values. We cannot do anything else but state that the financial situation of a company may appear to be very different taking these two points of view (Dlasková, 2013).

For instance accounting of financial leasing has a very significant impact on accounting statements. According to the Czech law on accounting, assets that are acquired by an accounting unit in this way (a typical feature is transition of the ownership right to the assets on the user after the contractual relation termination) are reported and depreciated as assets by the accounting unit that provides it to be used by a different entity. Thus, Czech accounting regulations do not allow showing the fixed liabilities arising out of leasing in accounting. The picture of the real indebtedness of the leasee is thus completely distorted as the existing liability is not recorded in the leasee's balance sheet. In this area the IFRS respect different conditions for showing of an asset. In the so-called Conceptual Framework, an asset is defined as a "source controlled by an accounting unit which is expected to provide future economic benefits to the unit" (Jílek, Svobodová, 2013) and the leasee depreciates the acquired assets on this basis and also records the liability towards the leaser in their balance sheet.[11] In fact, the influence of leasing belongs to very important controlling topics of companies in the post-crisis period. During the economic crisis banks considerably reduced financing of investments in smaller companies. One of the possible solutions was to make use of financial leasing, which was relatively available. According to the survey by the Association of Small and Medium-Sized Enterprises and Crafts of the Czech Republic[12] project investment

[11] In case of international comparison, accounting statements are sometimes first "cleared" of possible leasing entries for these reasons.

[12] The Association of Small and Medium-Sized Enterprises and Crafts regularly conducts surveys with a sample of more than 500 enterprises focusing on financing small and medium-sized companies. Financing in the post-crisis period was a focus of the 9th survey of the Association of Small and Medium-Sized Enterprises and Crafts - Opinions of Entrepreneurs Concerning Approach of Banks to Entrepreneurs and Companies The survey interviews took place

financing was limited fundamentally during the global crisis and thus the interest in leasing increased several-fold. Thus, a great number of small and medium-sized companies will have a considerably distorted view of the real assets and liabilities in several next years as they do not include financial leasing although it belongs to investment assets which are expected to bring future benefits to the company. There is also another consequence of financial leasing as in case of many entities it results in major liabilities while the failure to settle them would threaten their existence. "While carrying out financial analyses, indebtedness indicators are considerably distorted and also the information value of all the indicators which are calculated applying the sum of total or fixed assets goes down.

Another item having a great influence is a different amount of depreciation, which e.g. while valuating a company applying the returns methods of discounted cash flow where decisive factors for calculation of the so-called "free cash flow indicator" are besides others the amount of depreciation and a change to the condition of liabilities, may lead to complete distortion of the company valuation" (Dlasková, 2010). Free cash flow FCF is one of the most important and globally most respected tools of financial controlling, the most objective calculation of which is very important for investors and company managers in order to be able to assess the opportunities and risks and thus to make strategic decisions. FCF expresses how much free money the company "produced" during a particular period. In fact it is the amount of money that could be taken out of the company without disturbing its anticipated development. It is an absolutely fundamental indicator, which managers, owners and investors use to quickly estimate the company's ability to generate at least minimum free cash necessary for minor investments or an unplanned expense in the form of a dividend or an irregular loan instalment (Havlíček, 2012).

Acquisition of some kinds of assets may be connected to the so-called costs of asset disassembly resulting from their removal or putting to the original condition, which arises out of legal or contractual obligations. According to the IFRS, it is necessary to account these costs as a provision, because the company incurs a liability in connection to future asset removal. Such a provision shall be discounted as at the moment of the asset acquisition to the current value (pursuant to IAS 37 - Provisions, Contingent Assets and Contingent Liabilities) and the current value of the provision enters the acquisition price of the asset. The difference between the nominal and current value of the provision is recognized as an interest during the period of the asset use (not evenly). According to the Czech accounting legislation, the determination itself whether or not it is a provision appears to be problematic, and the fact whether or not the accounting statements will really provide a realistic picture of the company's situation thus depends in a great extent on the accountant's experience and their willingness to adapt their professional experience to possible changes, as well as on the level of their knowledge. In the Czech accounting practice, there are various methods of accounting liabilities arising out of assets removal, and the IFRS provision for an asset removal and restoring the place in its original condition is quite often accounted as a provision created for possible risks and anticipated loss, however, without discounting the provision value to its current value. The Czech Accounting Standards do not require this discounting at all with the exclusion of financial institutions, which results in the fact that according to the IFRS and Czech Accounting Standards, they can assume completely different values during financial analyses of the cost indicators regarding foreign capital and other indicators (Dlasková, 2010). The same situation occurs in case of assets with the so-called "deferred payment", which means that longer maturity than is usual in these cases is arranged. This phenomenon is beginning to be quite usual in small and medium-sized companies, too. It is often connected with the sale of a part of the company

between March 4 and March 14, 2011, the press release was issued on April 20, 2011 and the complete survey results were published on April 20, 2011.

based on the sale of assets. What happens in this case is gradual settlement of the buyer's liabilities with regards to the assets proving that they are able to generate future revenue to the buyer. Then, the asset acquisition price is the current value of the future settlement, and the difference between the nominal and current value of the liability is again recognized as an interest for the period of the liability maturity (not evenly).

Important differences may also arise as a result of revaluation of fixed tangible assets - FTA (land, buildings and fixtures - within the meaning of the IAS 16). If a unit chooses the fair value model for revaluation, the assets the real value of which can be determined in a reliable way are shown in the revaluated amount which corresponds to the real value as at the revaluation date, and if the asset value increases as at the balance sheet date, the IFRS require the so-called balance sheet approach. "The increase in the value does not influence the economic results - it is reflected in other parts of the equity capital (e.g. in a special fund including valuation differences arising from revaluation). This increase shall be recorded separately because if the value decreases in the following period, it is first settled by discharging the original revaluation (to the debit of the fund lowering); only provided the original acquisition price of the asset decreases (prior to the first revaluation), this decrease shall be accounted as a cost, to the debit of the economic results" (Dvořáková, 2008). Czech accounting regulations do not accept this procedure and the fixed tangible assets continue to be reported in their acquisition price. As a result of this situation, the sum of assets may be very different from the sum of liabilities (the equity capital) with the IFRS and the Czech Accounting Standards.

3. Practical Impacts - Z-Score

According to the existing survey in this area, the IFRS really bring a change to the financial situation evaluation. Dana Kubíčková, who is a researcher of the research project called *"The Application of IAS/IFRS in Small and Medium-Sized Enterprises and Influence on Measurement of Their Efficiency"*, states in her contribution called „ Accounting Statements According to IFRS and Z-Score Bankruptcy Model [13]" due to the IFRS there are both positive and negative changes in the area of partial ratio indicators, as well as concerning the comprehensive evaluation using the Z-score bankruptcy model, where in case of more than 20% of companies the IFRS brought about deterioration of the final evaluation (classification within the scale), while in case of the other 80% of companies the final evaluation did not change, however, the indicator values decreased ranging from 2 to 35% of the original value." The above-mentioned research also implies that it would further be possible to identify the most threatened group of enterprises whose accounting statements could be most affected by these changes, e.g. depending on their line of business, legal form or method of financing. During a financial analysis of accounting statements prepared in compliance with the IFRS, we can expect a picture of the company's economic activities, financial stability, but also its market value that will be different from the one that is made by means of an analysis of "Czech" accounting statements.

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[13] Altman´s model, also called the Z-score, is based on a discrimination analysis. . Z = 1,2*X1 + 1,4*X2 + 3,3*X3 + 0,6*X4 + 1,0*X5 + 1,0*X6, a formula in the modification for the Czech Republic according to Inka Neumaierová and Ivan Neumaier

X1 = net working capital/total assets

X2= profit after taxation/total assets

X3= pre-tax profit and interest/total assets

X4 = accounting value of equity capital/total debts

X5= total sales/total assets

X6 = overdue liabilities/revenues

4. Conclusion

What does that really mean and who is this information important for? For small and medium-sized enterprises, among the main users of accounting statements are banks, which provide companies with capital for their business and development. After the last years of the financial crisis, the EU has been paying a lot of attention to the issue of financial markets, and major rules for their functioning are becoming stricter in this sector, they are becoming more regulated. Prevention and decrease of the credit risk is becoming the key aim of every bank institution. Every decision on whether or not a loan shall be granted to a particular applicant is preceded by a thorough loan analysis within risk management including a number of areas to be examined. The fundamental source of information for the loan analysis are accounting statements of the applicant, and the inspection of the client's credit reliability (solvency) based on these statements belongs to the most important tools used for the client's assessment both prior to granting the loan itself and during the loan relationship (Kašparovská, 2006). At present, clients are assessed according to their financial statements compiled in accordance with the Czech accounting legislation. It is unclear how the client's assessment will change after the obligatory reporting according to the IFRS in the Czech Republic is possibly implemented. There is a hypothesis that those clients who were assessed very positively according to the Czech accounting legislation could become risky for their banks (Dlasková, 2013).

Objective accounting data are also very important for existing or potential investors. Even here it is obvious that there will be some changes during the valuation of their financial interests, and it is just the homogenous view of financial statements based on the IFRS that could bring about a breakthrough in the view of enterprise valuation.

After all, these data are also fundamental for the company's managers, who apply the process approach to management of enterprises based on operative and strategic management and controlling, which is based on planning, managerial accounting and human resources management (Havlíček, Schlossberger, 2013). Statements that are based on the IFRS could be a more objective basis for both operating and strategic financial controlling of small and medium-sized companies.

A partial conclusion is also the recommendation that even small medium companies should already at this stage to use not only financial accounting, but also the management accounting, which could be a transition bridge between the current form of accounting and IFRS.

References

Dlasková,, G. (2013). Jste připraveni na možnou změnu bonity vaší firmy v očích vaší banky? Moderní řízení, Volume XLVIII (1), 30.

Dlasková, G. (2013). Vliv ocenění aktiv podle IFRS na výsledek hospodaření v porovnání s ČÚS, Diploma Thesis, the University of Finance and Administration.

Dvořáková,D.(2008). Finanční účetnictví a výkaznictví podle mezinárodních standardů IFRS, 2nd edition, Prague, Computer Press, 2008.

Havlíček, K. (2012). Management & controlling malé a střední firmy, 2nd edition, Prague, University of Finance and Administration, 2012.

Havlíček,K., Schlossberger, O. (2013). New Trends of Management of European SME´s. European Research Studies Journal, Volume XVI (Special Issue on SMEs), 43-56.

Jílek, J., Svobodová, J.(2013). Účetnictví podle mezinárodních standardů účetního výkaznictví (IFRS), Prague, Grada Publishing, 2013.

Kašparovská, V. et all (2006).Řízení obchodních bank, 1st edition, Prague,C. H. Beck, 2006.

MULTI-CRITERIA EVALUATION OF ALTERNATIVES UNDER RISK

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Managerial decision making, multi-criteria decision making under risk, evaluation of discrete alternatives, utility function, risk factors

Abstract

Multi-criteria evaluation of discrete alternatives under risk is used to select investment or research projects, projects to develop new products or technologies. The paper proposes a normative framework of multi-criteria decision making under risk. This framework provides an integration of the decision making tools with the MCDM methods. These methods include subjective probability distribution, probability trees, scenarios, the Monte Carlo simulation, and the rules of the decision making under risk. The proposed normative framework is demonstrated on the example of evaluation of five risk investment projects.

1. Introduction

The multi-criteria evaluation of alternatives belongs among the disciplines of managerial decision making. The managerial decision making theory offers a number of methods and tools to determine the optimal alternative or to set a preference order of alternatives. These approaches are mostly based on the principle that the consequences will happen with certainty. On the other hand, decision making under risk is usually based on single criterion evaluation. The conversion from the evaluation of alternatives under risk to the evaluation under certainty or single criterion assessment is the significant simplification of the evaluation approach. This simplification could lead to the choice of the high-risk alternative with the potential adverse impacts on the firm prosperity. The increasing importance of this problem is obvious particularly in the context of the current economic recession. The aim is to propose a normative framework focused on multi-criteria decision making under risk. This framework is based on the certain interconnection between tools of decision making under risk and methods of multi-criteria evaluation of alternatives.

2. Approaches to the Multi-criteria Evaluation of Alternatives under Risk

Approaches to the multi-criteria evaluation of alternatives under risk (cf. Keeney, Raiffa, 1993 p. 219; Goodwin, Wright, 2004 p. 95; Kepner, Tregoe, 2006, p. 94) can be separated into two groups.

The first less challenging group is formed by modifying methods of multi-criteria decision making (MCDM) under certainty. These modifications permit to respect a different risk level of alternatives at least in a simplified way. This group consists of approaches based on:

- the evaluation of the most beneficial alternatives in terms of risk,
- the integration of risk in evaluation criteria,
- the replacement of uncertain consequences of the alternatives by their mean values.

The second group includes the multi-criteria utility function under risk (MCUF) that offers the only tool of multi-criteria decision making under risk, which is based on a scientific theory.

These two groups of approaches can be extended through a combination of some decision making tools under risk such as, probabilistic trees, scenarios, Monte Carlo simulation, and decision matrix with MCDM. Each of the approaches mentioned above has its advantages and its disadvantages that can be viewed from the following perspectives: simplicity and comprehensibility, difficulty (demands on evaluators), level of simplification, suitability for various types of problems (Švecová, Fotr, Vrbová, 2012).

3. Normative Framework of the Risk Alternatives' Evaluation

3.1. Characteristic of the Normative Framework

As mentioned in the previous text, there are many approaches to the multi-criteria evaluation of the risk alternatives. It starts with the less difficult approaches based on simplified assignment and its conversion to the MCDM. On the other side it ends with the very difficult MCUF, which is theoretically well explained but also complicated to apply.

This section presents certain recommendations, the normative framework, for the mono-criteria and especially, the multi-criteria evaluation of the risk alternatives. The approach is based on an integration of the decision making tools under risk with the MCDM methods. These methods include subjective probability distribution, probability trees, scenarios, the Monte Carlo simulation, and the rules of the decision making under risk.

The initial assumption of this approach is a definition of a set of *"n"* risk alternatives and a selection of *"m"* criteria for these alternatives. These criteria can be both qualitative and quantitative. There exits the assumption to transform qualitative criteria to quantitative as well. This transformation can be undertaken in an expert way by using the subjective index or the point classification scale. The paired comparison methods may also be used. The goal is to determine the best alternative, with respect to the preference order of the alternatives and their associated risk levels. Fig. 1 displays the content of the normative framework for the risk alternatives' evaluation in term of its partial steps and the recommended tools. These steps are characterised in detail in the sections that follow.

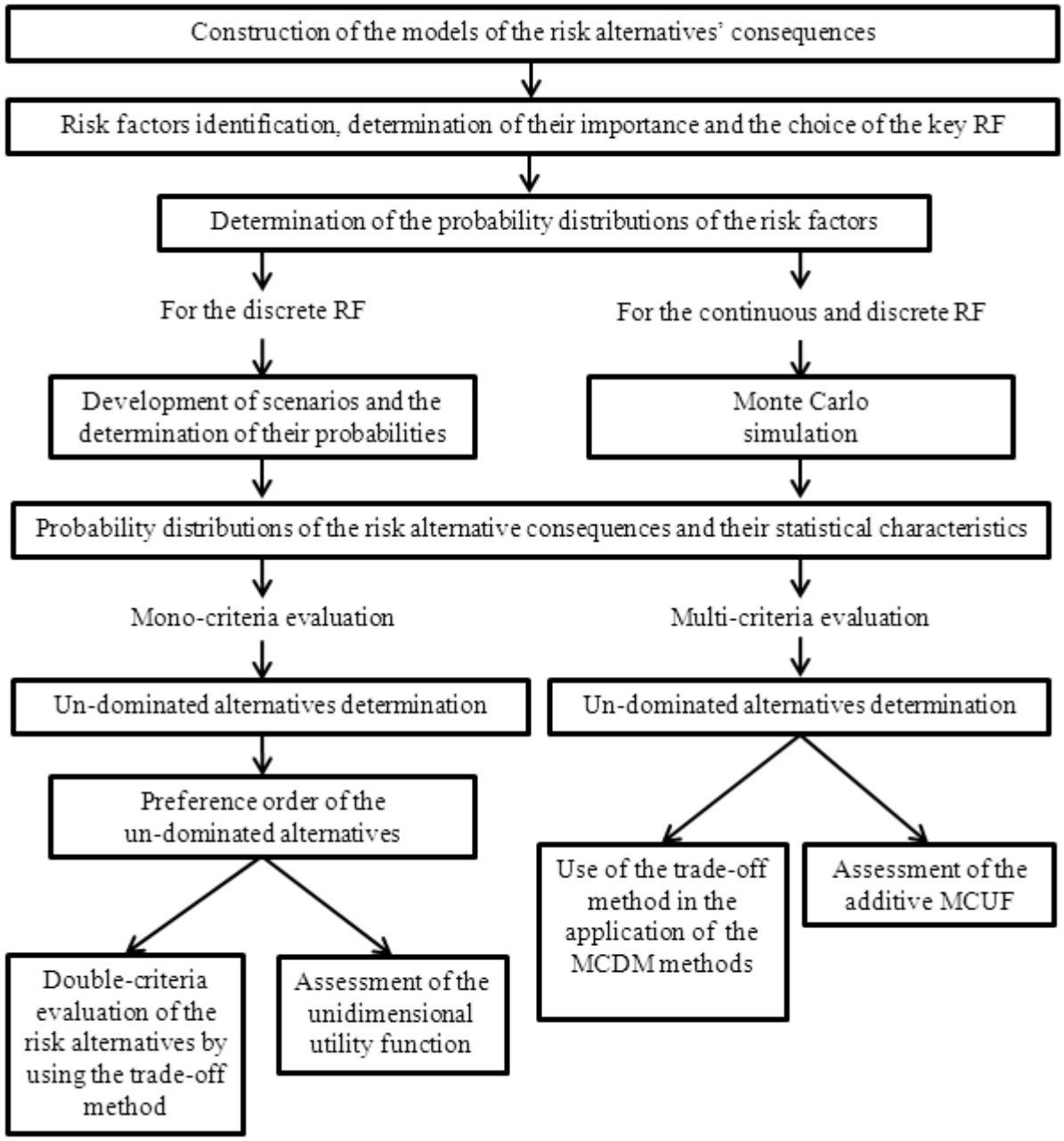

Fig. 1: Normative Framework of the Risk Alternatives' Evaluation; References: the authors

3.2. Construction of the Models of the Risk Alternatives' Consequences

The basic information inputs into the risk alternatives' evaluation are their consequences with regard to the unidimensional criteria. It necessitates constructing models that enable the determination of these consequences in dependence on the risk factors and other deterministic variables. These models differ according to the character of the alternatives and their criteria. For example, to evaluate investment projects as part of a programme, the evaluation uses economic criteria, such as, ROI, NPV, IRR, and others. Here the models will consist of financial plans of the projects and formulas for the calculation of the economic criteria.

As the set of criteria not only consists of the economic criteria but also of other types of criteria, it is necessary to create the individual consequences' models for each criterion, that is, for each group of criteria. The graphic tools (the cognitive maps, influence diagrams) can support the creation of these models.

In some cases, it is not possible or suitable to construct the models of risk alternatives' consequences (due to great complexity or lack of information) and therefore probability distributions of this group of consequences will be based on subjective probabilities.

3.3. Risk Factors Identification, Determination of Their Importance and Choice of the Key Risk Factors

The determination of sets of the risk factors (RF) for each consequence's model is usually based on the expert assessment of the character of the partial input variables into these models. In the case of the evaluation of the strategic alternatives whose consequences relate to the future in general, the majority of the input variables will be uncertain.

RF identification can be supported by suitable methods and tools. Among them are **lists** of the previously identified risk factors and other **tools** that support a detection and displaying of these factors.

- The first group consists of check lists, catalogues. Risk registers, which are one of the outputs of the enterprise risk management. Performed post-audits of the investment projects may also be included.
- The second group consists of interviews with experts, group discussions, brainstorming meetings and cognitive (mind) maps.

One problem is that a set of the identified RF is too large and consists of tens or even hundreds of the RF. The elaboration of such a high number of risk factors would be very difficult. Therefore, it is necessary to focus on the **important (key) factors** that contribute the highest consequences on the criteria of the risk alternatives. Less important risk factors can be treated as deterministic variables.

The risk assessment **matrixes (charts)** and the **sensitivity analysis** belong among the tools for setting an importance of the risk factors and determining the **key risk factors (KRF)**.

3.4. Determination of the Probability Distributions of the Risk Factors

These distributions can be determined either on the basis of **subjective** or **objective probabilities**.

- The **subjective probabilities** express an opinion, a belief or a persuasion of an expert in the field in which the factor is related. They are based on knowledge, intuition, former experiences or information. Various methods for the determination of these probabilities may be used to determine their distributions (Skinner, 2009, p. 162).
- If there are previous numeric data for certain risk factors, their **objective probability** distributions by using the statistic methods can be determined. Use of this approach is quite limited as the historical data are usually not available or due to the high changeability of the environment. It is therefore necessary to revise the probabilities or their parameters.

Considering the frequent mutual dependence of the risk factors, the probability distributions may have a character of the **conditional distributions**.

3.5. Determination of the Probability Distributions of the Risk Alternative Consequences and Their Statistical Characteristics

3.5.1. Application of Scenarios

Scenarios are possible to use for determination of the probability distribution of the consequences, if the number of KRFs is small (up to four RFs) (Heijden, 2005, p. 11; Cornelius 2005, p. 92). It is necessary to approximate the continuous RFs to discrete ones with usually three values. Scenarios can be developed by combining values of KRFs. The graphical tools are probability trees. The number of scenarios is given by the number of tree branches. The probability of scenario is product of the probabilities in given branch.

Knowledge of the probability distributions of the risk alternatives' consequences enables to determine statistics of these distributions in the form of the mean value of the consequences and characteristics of the risk (variance, standard deviation and coefficient of variation) for each alternative and criterion.

Most simple situation arises, when the set of the scenarios is the same for all alternatives and criteria. But in many cases it is too simplifying assumption, because scenarios can differ with regard to some alternatives and criteria in practice. This fact increases the difficulty in calculation of the determination of the consequences' probability distribution. It does not however change the essence of this approach.

3.5.2. Application of the Monte Carlo Simulation

The Monte Carlo simulation is better to use with more RFs or with more continuous RFs. The suitable software support is required, e.g. Crystal Ball or @Risk (Mun, 2004, p. 65).

One of the important outputs of the simulation is the probability distributions of the alternatives' consequences and their statistical characteristics. The Monte Carlo simulation output for the risk alternative represented by the investment project with regard to the NPV criterion is shown in the Fig. 2.

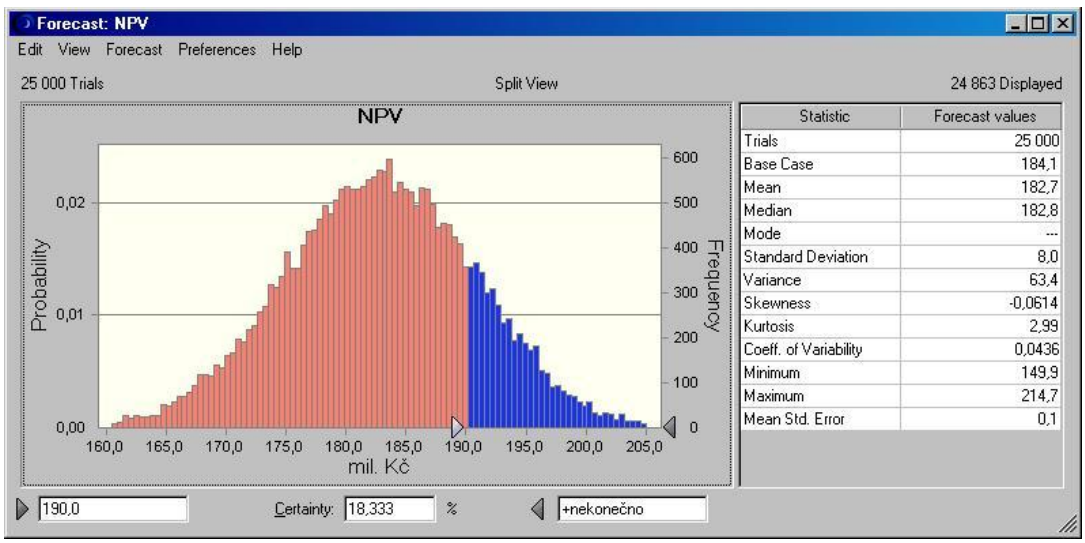

Fig. 2: Output from the Simulation – the Probability Distribution of NPV ; References: the authors

As with the scenarios, it is necessary to apply the simulation for each risk alternative and criterion. The advantage of the simulation is that it can be used for both the discrete and continuous risk

factors whereas their number is practically unlimited (in practice number of risk factors usually do not exceeded 100).

3.6. Risk Alternative Evaluation

Even if the multi-criteria evaluation of the risk alternatives is our main interest, the authors contribute a few comments on their mono-criteria evaluation as well.

3.6.1. Mono-criteria Evaluation

In this case, the inputs for the risk alternatives' evaluation are represented by their mean values of the consequences in relation to the selected criteria and by the risk expressed by the coefficient of variation. The recommended approach of this evaluation in two steps is:

- Determination of a **set of the un-dominated alternatives** by excluding the dominated alternatives while using the decision making rules under risk. These are rules of the mean value and variation coefficient, and rules of the stochastic dominance.
- Determination of the **preference order of the un-dominated alternatives**. There are two options to determine this order:
    - By using the **trade-off method** of the alternatives' assessment on the basis of **two sub-criteria**. The first sub-criterion is the mean value of the alternatives' consequences and the second is the coefficient of variation. This method converts alternatives' consequences related to a given sub-criterion to the same value by adjusting values of other sub-criteria while keeping the same utility of the alternative. Consequently, the given sub-criterion can be excluded. Then the preference order of the alternatives can be determined according to the decreasing mean values of the alternatives, the criterion of the yield type, or according to the increasing coefficient of variation of the alternatives for the risk adverse decision makers.
    - By assessing the **unidimensional value functions** for both criteria and by ordering the alternatives according to their decreasing utility values.

3.7. Multi-criteria Evaluation

The difficulty of this evaluation depends partly on the number of criteria, on the process or the method used for the evaluation itself. Both, the easier approach based on the MCDM methods and the approach based on the MCUF, are described. In both cases the assumption is that the probability distribution of the risk alternatives' consequences is known as well as their statistical characteristics.

3.7.1. Use of the MCDM Methods

The process of this evaluation is to a degree similar to the mono-criteria evaluation approach and can be divided in the following steps:

- The determination of a set of the **un-dominated alternatives** by excluding the dominated alternatives. On the basis of the decision making rules under risk the sets of the dominated alternatives for all criteria separately is determined. The set of the dominated alternatives in relation to the whole set of the criteria will be determined as an intersection of the partial (mono-criteria) sets of the dominated alternatives.

- The use of the **trade-off method for each pair of the sub-criteria** determined by the mean value and the coefficient of variation **for all criteria of this character**. The trade-off is aimed at achieving the same mean values or the coefficients of variation of the alternatives in relation to the individual criteria. Each alternative will be described for each criterion only by one vector of the consequences' mean values or by one vector of the variation coefficients. This process transforms an assignment of the multi-criteria decision making under risk to its deterministic equivalent, that is, the multi-criteria decision making under certainty.
- The **application** of the convenient **MCDM method** for the preference order of the risk alternatives.

3.7.2. Assessment of the Additive MCUF

The using of the **additive MCUF** is adequate (Stewart, 2006, p. 246). In this case mean value of total utility of each risk alternative is expressed as the weighted addition of the mean values of the unidimensional utilities. For this purpose unidimensional utility functions and weights of criteria is necessary to determine. The preference order of the risk alternatives by ordering these alternatives according to the decreasing mean values of the total utilities is gained.

The determination of the mean values of the unidimensional utilities is easier in the case of the discrete criteria. For the continuous criteria it is necessary to have the functional shape of the probability density or the distribution function of the risk alternatives' consequences in relation to these criteria.

4. Example of investment projects evaluation

Some steps of normative framework will be demonstrated on the example of evaluation of five risk investment projects (RIPs) in this section. The example is simplification of a real case of investment decision making where the simplification regards the number of criteria. The set of evaluation criteria includes two qualitative criteria (agreement of RIP with firm's strategy, support of key competences), and two financial stochastic criteria (net present value – NPV and return on investment – ROI). Table 1 presents the set of the criteria and the set of evaluated RIPs (named A, B, C, D, and E) and their consequences. The qualitative criteria are measured on the scale 1 to 10. Probability distributions of RIPs and their statistical characteristics (mean and coefficient of variation) were determined by application of Monte Carlo simulation based on models of NPV and ROI for each RIP.

Criteria	**A**	**B**	**C**	**D**	**E**
Agreement	7	8	4	5	6
Support	8	6	5	2	5
NPV – mean	86	175	92	54	107
NPV – coeff. of var.	0.12	0.14	0.14	0.10	0.18
ROI – mean	8	12	9	6	10
ROI – coeff. of var.	0.14	0.12	0.14	0.10	0.15

Table 1 Consequences of RIPs; References: the authors

Dominated RIPs can be determined from the Table 1. Projects C and E are dominated by the project B. The set of un-dominated RIP includes therefore projects A, B and D. Table 2 represents consequences for RIPs after trade-offs. The trade-offs aimed at achieving the same value of coefficient of variation for NPV and ROI for un-dominated projects A, B and D. The resulting values of coefficient of variation after trade-offs were 0.12 for NPV and 0.14 for ROI. The additive value function with linear unidimensional value functions was selected for multi-criteria evaluation of un-dominated RIPs. Table 2 presents weights of criteria and results of multi-criteria evaluation. The final preference order is B, A, D.

Criterion	**Weight**	**A**	**B**	**D**
Agreement	0.3	7	8	5
Support	0.15	8	6	7
NPV	0.35	86	125	75
ROI	0.2	8	15	11
Evaluation		**0.40**	**0.88**	**0.34**

Table 2 Consequences for RIPs after trade-offs; References: the authors

5. Conclusion

The economic crisis has indisputably tested companies' readiness from the view of the risk management, not only considering the operational risk management but especially the strategic planning and assessing the strategic alternatives under risk aggravated by the changing environment. The topic of the multi-criteria decision making under risk itself is marginalised in business practice, especially due to difficulties in using the methods and tools for support of the decision making under risk. The theory of the managerial decision making offers the potential approaches to the multi-criteria decision making under risk but the usability of these tools has certain limitations.

The convenient approach to the multi-criteria evaluation under risk is to **link the methods and tools of both multi-criteria decision making under risk and certainty**. This proposed concept, the normative framework, can be split into a few steps. The first two include the construction of the models of the risk alternatives' consequences, an identification of the key risk factors and a determination of their probability distribution. Further probability distributions of the risk alternatives using scenarios (discrete RF) or Monte Carlo simulation (mixed RF) are determined. Then the results can be used in both the mono-criteria and the multi-criteria evaluation. In the mono-criteria evaluation, the set of the un-dominated alternatives should be ordered either by using the trade-off method or by constructing the value functions. Within the multi-criteria evaluation, it is suggested to apply the trade-off method too and for ordering the alternatives to use one of the multi-criteria evaluation methods under risk. The most difficult is the assessment of the additive multi-criteria utility functions.

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References

Cornelius, P., Van De Putte, A., Romani, M. (2005). Three Decades of Scenario Planning in Shell. California Management Review, 48(1). 92-109.

Fotr, J., Švecová, L. (2006). Riziko a nejistota ve strategickém rozhodování. Politická ekonomie, 54(1), 283-298.

Goodwin, P., Wright, G. (2004). Decision Analysis For Management Judgement. Chichester: John Wiley & Sons, 2004, ISBN 978-0470714393.

Heijden, Van Der, K. (2005). Scenarios, The Art of Strategic Conversation. Chichester: John Wiley & Sons, 2005, ISBN 978-0470023686.

Keeney, R., Raiffa, H. (1993). Decisions with Multiple Objectives: Preferences and Value Trade-Offs. Cambridge: Cambridge University Press, 1993, ISBN 0-521-43883-7.

Kepner, Ch., H., Tregoe, B. B. (2006). The New Rational Manager: An Updated Edition For A New World. Princenton: Princeton Research Press, 2006, ISBN 978-0-9715627-1-4.

Mun, J. (2004). Applied Risk Analysis: Moving Beyond Uncertainty in Business. New York: John Wiley & Sons, 2004, ISBN 978-0471478850.

Skinner, D. (2009). Introduction to Decision Analysis. Gainesville: Probabilistic Publishing, 2009, ISBN 978-0964793866.

Stewart, T. (2006). Simplified approaches for multicriteria decision making under uncertainty. John Wiley & Sons: Journal of Multi-Criteria Decision Analysis, 4(4).

Švecová, L., Fotr, J., Vrbová, L. (2012). A Multi-criteria Evaluation of Alternatives under Risk. Praha 13.09.2012 – 15.09.2012. In: PAVELKA, Tomáš, LÖSTER, Tomáš (ed.). International Days of Statistics and Economics. Slaný : Melandrium, 2012, 1090–1100. ISBN 978-80-86175-86-7.

REWARDING OF EMPLOYEES – RESULTS OF SURVEY AND IDEAS FOR FURTHER RESEARCH

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Keywords

Total rewards, rewards for performance, performance management, performance measurement

Abstract

This paper presents results of our survey, which are relevant for our further empirical research. The survey confirmed that companies in the Czech Republic try to implement total rewards approach and extensively use short-term rewards for performance. These results together with continuing controversies and terminological confusion in contemporary literature on rewarding motivated us to continue with research in this area. A framework for empirical research of rewards for performance in a broader context of total rewards approach and basic properties of forthcoming large-scale survey are outlined here.

1. Introduction

Rewarding of employees and especially rewarding of executives has become a delicate topic lately. Controversies were further fuelled by recent corporate scandals as well as by global financial crisis. Yet, up-to-date large-scale empirical research on rewarding practices in the Czech Republic including inquiry into existing tendencies is largely missing. The aim of this paper is firstly to shortly present key results of our previous empirical research (see chapter 2) and secondly outline methodology of our forthcoming research (rest of the paper).

2. Brief presentation of methodology and analysis of results of our previous survey

In this chapter are analyzed results of our previous empirical research (survey) among large companies with seat in the Czech Republic, which took place during 2012-2013. Although the survey was primarily targeted at performance management and measurement, rewarding of workforce was also covered. Our survey was conducted with the help of a questionnaire which was prepared based on the extensive literature review of surveyed areas. The questionnaire was divided into 3 parts – part A addressed basic information about a given company and about its strategy, part B covered company's performance measurement and management system and part C was aimed at rewards system. The questionnaire was very comprehensive; it consisted of 72 questions (usually with lots of sub questions) on 28 pages of format A4.

We contacted by phone the 150 largest firms with seat in the Czech Republic. This telephone contact was realized with the aim to increase response rate by informing potential respondents about our research.

Consequently the questionnaire was distributed and collected via email, we did not utilize telephone for obtaining results, methods like computer-assisted telephones interviewing or computer aided web interviewing were not used. After elimination of the unusable questionnaires, we ended up with 19 filled-in questionnaires about performance measurement and management and 20 filled-in questionnaires about rewarding. Mean number of full time employees was among our respondents equal to 5 256 with standard deviation 8 990, skewness 2.7429, kurtosis 6.8792. Median value of full time employees was 1 730. These values suggest large differences between our respondents as for the number of their employees; nevertheless all of them were classified as "large companies".

Final results of this empirical research with focus on balanced scorecard were published in (Petera, Wagner, & Mensik, 2012a) and the overall analysis of results on rewards systems was given in (Petera, Wagner, & Mensik, 2012b). In this chapter we summarize results relevant from the viewpoint of total rewards approach and rewards for performance.

2.1. Total rewards approach (hereinafter abbreviated as TRA)

Our respondents were asked to express degree of agreement with 7 selected propositions, which we considered to be important characteristics and determinants of how thoroughly is TRA implemented. The agreement was measured on a seven-point Likert scale, where 1 meant "fully disagree" and 7 meant "fully agree." It is above the scope of this paper to address this topic in detail here, but it is possible to sum up that "index of implementation of TRA," which was designed as a simple arithmetic mean of all 7 propositions, equals to 5.14 with standard deviation 1.17. This overall result suggests that companies at least know about and try to implement TRA. Interestingly, according to our respondents (usually human resources manager or compensation manager) employees do not value TRA program much (mean value only 4.25 with standard deviation 1.07). We suppose that this may be partially because of weak communication of the TRA approach with employees.

Types of rewards in use were also examined and results can be found in Table 1.

Reward	**Number of companies using given type of reward**
benefits	16
work-life balance programs	13
recognition (e.g. diplomas, praises from supervisors)	9
career development	14
positive workplace	13

Table 1 Number of companies reporting that they use given type of reward (total number of companies = 20); Source: own survey

It is possible to conclude that next to compensation (which is defined as any type of monetary reward including base pay and various types of variable pay and obviously is used by all companies) our respondents use various other types of rewards, which is basically positive because various types of rewards are appropriate for various purposes.

2.2. Rewards for performance

In our survey we examined especially utilization of the following financial rewards for performance: bonus/pay for performance (R-1), merit pay (R-2), skill based pay (R-3), gain-sharing (R-4) and profit-sharing (R-5). Results are summarized in Table 2 (where N stands for number of companies).

Level of Management	R-1	R-2	R-3	R-4	R-5	N
CEO	100.00 %	31.58 %	0.00 %	21.05 %	15.79 %	19
other top-managers	95.00 %	30.00 %	0.00 %	25.00 %	15.00 %	20
middle mgmt.	90.00 %	40.00 %	20.00 %	20.00 %	10.00 %	20
line mgmt.	75.00 %	45.00 %	20.00 %	25.00 %	10.00 %	20
non-mgmt.	80.00 %	45.00 %	25.00 %	35.00 %	0.00 %	20

Table 2: Percentage of companies reporting that given managerial level is entitled to obtain given type of reward, N means number of companies where given managerial level exists; Source: own survey

Consequently, we asked about proportion (expressed on a seven-point Likert scale, where 1 means 0 % and 7 means 100 %) of employees of a given managerial level entitled to obtain rewards for performance and about intended change in this proportion. Some respondents did not specify which intention they have as for change of the discussed proportion and thus sum of responses "no change," "increase" and "decrease" is lower than 20. Last but not least we investigated opinion of our respondents about degree to which these rewards really influence behaviour of a given managerial level in desirable way. Results are summarized in Table 3.

Level of Management	Proportion of employees entitled to obtain rewards for performance			Intended change of proportion (number of companies)			Influence on behaviour	
	mean	median	std. dev.	no change	increase	decrease	mean	std. dev.
top mgmt.	6.37	7.00	1.61	16	2	0	5.50	1.36
middle mgmt.	6.11	7.00	1.41	14	4	0	5.10	1.25
line mgmt.	5.63	6.00	1.55	13	4	0	5.05	1.28
non-mgmt.	5.60	6.00	1.50	12	5	0	4.90	1.37

Table 3: Tendencies in usage of rewards for performance and their impact on employees' behaviour; Source: own survey

Obviously, utilization of rewards for performance is very high and it seems that companies want further increase numbers of employees with performance-based component of compensation. This goes for all managerial levels and the importance of optimal utilization of rewards for performance will therefore probably increase.

3. Discussion of consequences of our previous empirical study for future empirical research and outline of forthcoming's research methodology

3.1. Consequences of our previous empirical study for the further research

Analyses in chapter 2 uncovered several important facts. Firstly, our respondents were trying to implement principles of total rewards management, but they often failed to effectively communicate rewards philosophy to their employees. Secondly, all our respondents indicated that they utilize rewards for performance and some of them declared intention to further increase utilization of this type of reward. Unfortunately, we did not examine utilization of long-term incentives in our empirical research.

These results as well as controversies in the contemporary literature on rewarding (see e.g. chapter 3.3.2) persuaded us to continue with research in the discussed field.

In our further empirical research we want to pick up the threads of our empirical research described in chapter 2 with some substantial changes. We want to conduct a large-scale survey research among companies (defined as non-financial, profit-oriented organizations dealing with production and trade of goods and services) with the number of full-time employees above 250 and with their seat in the Czech Republic. Surveyed topics will include utilization of total rewards approach and utilization of various types of rewards with stress on rewards for performance. Methodology of examination of these topics is described in chapters 3.2 and 3.3 of this paper. Last but not least, we will examine future intentions of our respondents in the area of rewarding (e.g. whether they plan to increase or decrease utilization of short term and long term rewards for performance). We suppose to conduct this type of survey repetitively in the future to obtain a long-time series of data.

3.2. Rewarding employees – a broader picture, total rewards approach (TRA)

Howsoever we want to concentrate specifically on rewards for performance, we also propose that it is necessary to think about these rewards in a broader context in which rewards for performance exist. We will use total rewards approach as a tool for basic analysis of rewards system.

3.2.1. Features of total rewards approach (TRA)

Vast majority of practitioners, consultants and academics define total rewards broadly. For example Kaplan (2007, p. 16) defines total rewards as everything that employees value in their employment relationship. Nevertheless TRA is more than connected set of various types of rewards and should be viewed rather as a total-rewards continuum, which may be implemented to a various degree.

To improve our methodology of assessing to which degree is TRA implemented, we tried to identify the most important features of TRA mentioned in literature (because of significant number of bibliographical references, we did not include full list here, we can provide full list of references used for generating list of features upon request).

These features include: total rewards strategy should be defined and should support the overall business strategy (Kaplan, 2007, p. 18); total rewards strategy should include objectives, measures and competitive positioning (Kwon & Hein, 2013, p. 33); rewards should be managed in a truly integrated way (Gross, Bundy & Johnson, 2011, p. 11); TRA should be communicated with employees (Dobson, 2009, p. 17); components of total rewards should be at least competitive to market practices (Lyons & Ben-Ora, 2002, p. 36); mix of rewards should take into account workforce demographics (Lovewell, 2011, p. 41); total rewards approach should sharply

differentiate between top performers and poor performers (Sejen, 2006, p. 37); performance appraisal program should be put in place (Lyons & Ben-Ora, 2002, p. 36); job analysis should be conducted (Simmons, 2002, p. 52-55); rewards system should encourage desired culture and behaviours (Sejen, 2006, p. 37); procedures for evaluation of rewards system should be placed and rewards system should be changed according to the results of these procedures; cost effectiveness of total rewards program should be measured (Sejen, 2006, p. 38). We will examine to which extent are these features present in rewards systems of our respondents as well as to which degree they are considered to be desirable by our respondents.

3.2.2. Types of rewards

Another important factor influencing assessment to which degree is TRA implemented is set of reward types used by a given company. To ensure we will investigate rewards in use comprehensively, we looked at several total rewards models and their approaches to classification of rewards. Especially important were for us models described in Kwon and Hein (2013, p. 32-33), Gross and Friedman (2004, p. 9), O'Neal (1998, p. 7), (Kantor & Kao, 2004, p. 9-10), (Kaplan, 2007, p. 16), (Lovewell, 2011, p. 40), Sanders (2001, p. 67), Zingheim and Schuster (2006, p. 19), Armstrong (2010, p. 44-61) and WorldatWork (2007, p. 7-13).

Kwon and Hein (2013) differentiate experiential rewards (that are obtained through interaction with the company, e.g. leadership) and financial rewards. Experiential rewards are difficult to copy and so may become differentiators, which make company's rewards package unique. Another important finding is that different types of rewards are important for different goals - attraction, retention and engagement of employees (Kwon & Hein, 2013, p. 34.) and thus supplement each other.

Based on the above mentioned models we decided for classification, which at the highest level recognizes the following types of rewards: benefits; other non-financial rewards (especially perks, work-life balance programs, non-financial recognition, transferable skills training and promotions) and compensation (which can be further divided into fixed, i.e. base pay and variable pay). Obviously, all these types of rewards can be further classified according to whether they are dependent on performance or not. Such classification is important e.g. for finding out which types of rewards are in practice used as rewards for performance and which are awarded just for working for a company. We want to point out here that despite the fact that "variable pay" is often considered equal to "pay for performance", such approach is not accurate, because there are types of variable pay that are not dependent on performance. The most important types of such pay are firstly one-time rewards for achieving of certain qualification or skills and secondly bonuses independent on performance (e.g. sign-on bonus, referral bonus, retention bonus etc.).

3.3. Rewards for performance

3.3.1. Terminological considerations

Let's think about terms used in connection with rewards for performance in literature (e.g. incentives, variable pay, pay-for-performance, pay-at-risk) and let's search for their similarities and differences. These considerations are not autotelic – because we want to focus on rewards for performance, we need to identify, which components of total rewards can be seen as relevant from this viewpoint.

What is included under the term "rewards for performance?" One possible answer is that all components of total rewards, because they vary only as for intensity of their dependence on performance and as for speed at which they change with observed performance. Really, it is

difficult to imagine that a company would be willing to pay its employees for non-performance. Well, for practical reasons such definition is not very suitable and in fact obscures important differences between various kinds of rewards. We understand "rewards for performance" as an umbrella term which includes:

- rewards, which are awarded to an individual or group on the basis of subjective or objective (formula-based) evaluation of their performance and which do not influence base pay,
- changes in base pay as a consequence of performance appraisal for the previous period.

Term "incentives" is both in theory and practice often used as a synonym of "rewards for performance," but strictly speaking these two terms may also denote different things. Incentives are usually understand as a tool for influencing people's future behaviour in a specific way, while rewards for performance may be awarded without such intention.

"Variable pay" includes all types of pay that are not fixed. To illustrate terminological confusion in literature, we want to point out that even so seemingly unambiguous term is sometimes understood differently. Belcher (1996, p. 10) defines variable pay as narrowly as "An alternative compensation system that ties pay to business outcomes and supports a participative management process. Cash pay-outs are based on a predetermined measure or measures of group or organizational performance."

"Pay for performance" we understand as a subset of "rewards for performance" in a form of financial rewards.

"Pay at risk" is sometimes used as a synonym to variable pay, e.g. in (WorldatWork, 2007, p. 12), but some authors differentiate these terms, e.g. (Zingheim & Schuster, 2000, p. 55) understand pay at risk as a such type of variable pay under which people might make less in total cash if they are not successful.

Rest of this chapter outlines a draft of framework in the form of several crucial decisions, which any company has to make about whether and how implement rewards for performance. This framework will be, after some adjustments, used in our survey.

3.3.2. Decision whether or not and why use rewards for performance

This fundamental decision usually depends on psychological theory to which person responsible for rewarding inclines. In psychology, there is a long-lasting and continuing debate about influence of rewards on intrinsic motivation to perform activities. Research (Deci, 1971) showed that tangible extrinsic rewards undermined intrinsic motivation whereas verbal rewards enhanced it. More generally speaking, extrinsic and intrinsic motivation can be both positively and negatively interactive rather than additive. Consequently cognitive evaluation theory (Deci, 1975), hereinafter abbreviated as CET, was proposed to explain the effects of extrinsic motivators (rewards) on intrinsic motivation. CET was basically rather sceptical about influence of tangible incentives on motivation. On the other hand, Cameron, Banko and Pierce (2001) came to the conclusion that rewards do not have pervasive negative effects on intrinsic motivation. Because CET was not useful in work conditions, its improvement in the form of more comprehensive self-determination theory (Deci & Ryan, 1985), hereinafter abbreviated as SDT, was proposed. Finally, attempts to utilize SDT for explanation of work motivation were made (Gagne & Deci, 2005). Extremely negative attitudes towards rewards can be found in (Kohn, 1993) and pay for performance is questioned also in (Rost & Osterloh, 2009).

On the other hand, majority of literature on rewarding propose utilization of rewards for performance or at least of specific types of these rewards for specific groups of employees. It is

above the scope of this paper to discuss this fundamental topic in a more detail. We can just conclude, that according to the latest findings there are situations, in which pay for performance increases performance, but also situations, in which pay for performance decreases performance.

Also motivation for providing of rewards for performance may be various (e.g. increase of performance, change in behaviour of workforce in a specific way, increase of loyalty of workforce to the company, keeping pace with rewarding methods used by competitors).

3.3.3. Decision who will be eligible to obtain rewards for performance

Consequently, decision on who will be eligible to participate in various rewards for performance programs has to be made. Another question which has to be solved is how many incentive programs will be implemented (one plan or several plans for different individuals, groups, teams or organization-wide). Last but not least, there are some more specific areas of consideration like global compensation and key talent management, but we do not address these problems in this framework.

We decided to distinguish following positions of employees in our forthcoming survey: CEO, top management, middle management, lower management, purchases staff, sales staff, routine workforce in administration, routine workforce in support activities, routine workforce in manufacturing of products and providing services, routine workforce for contact with customers, highly educated/skilled professionals in supportive activities (e.g. accounting, finance, taxes), creative workforce for design and innovations of products and services, manufacturing technology, internal processes, creative workforce for customer's innovations.

This classification is motivated by specific features of mentioned positions and we will among our respondents investigate, which positions are eligible for different types of rewards.

3.3.4. Decision about type of rewards for performance

It is possible to classify rewards for performance variously. Because there is a huge terminological confusion in literature on rewarding performance, we will outline here our preferred classification. As the main classification criterion we use division of rewards to financial and non-financial.

Non-financial rewards for performance are usually used as a supplement of financial rewards and include especially various types of non-financial recognition (e.g. praises from supervisors, diplomas) and promotion-based incentives (Baker, Jensen, & Murphy, 1988, p. 599-605), which are nevertheless usually connected also with financial gains and increased reputation. Obviously, promotions are applicable only in hierarchical organizations which are growing; otherwise possibilities for promotions may become exhausted. Empirical research aimed at impacts of promotion of employees can be found e.g. in (Campbell, 2008) and (Gibbs, 2008). Analysis of promotions in context of tournament theory can be found e.g. in (Schottner & Thiele, 2010) and (Devaro, 2006).

Financial rewards for performance can be distinguished according to whether they influence base pay or not.

Rewards that are based on performance appraisal of an individual employee and lead to increase in base pay we denote as “merit base pay increases”. Performance appraisal should be rather comprehensive, usually on annual basis and comprise e.g. evaluation of quality and quantity of work, teamwork, cooperation, customer service etc. (WorldatWork, 2007, p. 314). Merit base pay increases have some advantages, but also disadvantages, see e.g. Eskew and Heneman (1996).

Financial rewards for performance which do not lead to base pay increase we define as "variable pay for performance." For the sake of completeness it is necessary to notice, that there is also variable pay independent on performance (see last paragraph of chapter 3.2.2).

Variable pay dependent on performance includes financial recognition (spot bonus), rewards for success in performing a specific task, short-term variable financial rewards and long-term variable financial rewards.

Spot bonus can be defined as relatively small amounts of money (e.g. 500 CZK and upwards) which are often granted to employees without in advance defined criteria and unexpectedly. Rewards for success in performing a specific task are awarded in relative isolation from the other rewards for performance. Short-term variable financial rewards for performance are granted on the basis of performance measurement for a period up to one year and are usually the most important type of rewards for performance. Long-term variable financial rewards for performance are granted on the basis of performance measurement for a period longer than one year, typically for 3-5 years. Both short-term and long-term rewards for performance may be granted based on measurement conducted at organizational, group/team or individual level or at combination of these levels.

Important types of short-term rewards based on measurement conducted at individual level are piece-rates and commissions. Comprehensive literature review on piece-rates can be found in (Shi, 2010). Commissions can be seen as a specific type of piece-rates provided to sales personnel. Short-term variable pay based on measurement conducted at organizational or group/team level can be classified variously. Zingheim and Schuster (2000, p. 153) recognize goal sharing/business goal plan, win sharing, gain sharing, cash profit sharing and combinations of these plans.

Last but not least, decision about form (cash or another) in which will rewards be awarded has to be made (this is relevant especially in case of rewards for long-term performance). Rewards in form of equity, e.g. stock options, full-value shares or stock purchase plans, are of the utmost importance in publicly traded companies and their advantages and disadvantages are in detail described in vast literature, e.g. (Kay & Putten, 2007). Importance of equity in private companies declines for many reasons, e.g. because of problems with valuation of equity of these companies as well as because of possible complications with equity's liquidity. Therefore we suppose that in private companies are crucial long-term rewards in the form of cash payments.

3.3.5. Decision about measures of performance

According to (Gibbs, Merchant, Van der Stede, & Vargus, 2009, p. 237) is performance measurement perhaps the most difficult challenge in the design and implementation of incentive systems. Basic decisions include especially decisions about types of measures (financial or non-financial or combination), evaluation period (e.g. weekly, monthly, quarterly, annually or for longer periods), line of sight, level of subjectivity used for providing rewards for performance and level at which measures will be evaluated (organization, group/team, individual). Unfortunately because of space limitations of this paper, we cannot address these problems here in detail.

3.3.6. Relative importance and timing of awards for performance

Finally, it is important to decide whether rewards for performance will be symbolic or substantial e.g. in relation to base pay and when rewards should be paid out (immediately or as deferred).

4. Conclusions

In this paper we presented results of our previous survey relevant for the forthcoming large-scale survey, in which we will primarily address utilization of the total rewards approach and rewards for performance. We also explained basic properties of this forthcoming survey and outlined a draft of a framework, which will be used for surveying of our respondents.

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References

Armstrong, M. (2010). Armstrong's handbook of reward management practice: improving performance through reward. London: Kogan Page.

Baker, G. P., Jensen, M. C., & Murphy, K. J. (1988). Compensation and incentives: Practice vs. theory. Journal of Finance, 43(3), 593-616.

Belcher, J. G. (1996). How to design & implement results-oriented variable pay system. New York: AMACOM.

Cameron, J., Banko, K. M., & Pierce, W. D. (2001). Pervasive negative effects of rewards on intrinsic motivation: the myth continues. The Behavior Analyst, 24(1), 1-44.

Campbell, D. (2008). Nonfinancial performance measures and promotion-based incentives. Journal of Accounting Research, 46(2), 297-332.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. Journal of Personality and Social Psychology, 18(1), 105–115.

Deci, E. L. (1975). Intrinsic motivation. New York: Plenum.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum.

DeVaro, J. (2006). Strategic promotion tournaments and worker performance. Strategic Management Journal, 27(8), 721-740.

Dobson, S. (2009). Optimizing total rewards in a downturn. Canadian HR Reporter, 22(14), 17.

Eskew, D., & Heneman, R. L. (1996). A survey of merit pay plan effectiveness: End of the line for merit pay or hope for improvement? Human Resource Planning, 19(2), 12-19.

Gagne, M., & Deci, E. L. (2005). Self-determination theory and work motivation. Journal of Organizational Behavior, 26(4), 331-362.

Gibbs, M. (2008). Discussion of nonfinancial performance measures and promotion-based incentives. Journal of Accounting Research, 46(2), 333-340.

Gibbs, M. J., Merchant, K. A., Van Der Stede, W. A., & Vargus, M. E. (2009). Performance measure properties and incentive system design. Industrial Relations, 48(2), 237-264.

Gross, S. E., & Friedman, H. M. (2004). Creating an effective total reward strategy: Holistic approach better supports business success. Benefits Quarterly, 20(3), 7-12.

Gross, S., Bundy, K., & Johnson, R. (2011). The ongoing integration of total rewards. Employment Relations Today (Wiley), 37(4), 11-17.

Kantor, R., & Kao, T. (2004). Total rewards. WorldatWork Journal, 13(3), 7-15.

Kaplan, S. L. (2007). Business strategy, people strategy and total rewards-connecting the dots. Benefits & Compensation Digest, 44(9), 1-19.

Kay, I. T., & Putten, S. (2007). Myths and realities of executive pay. Cambridge: Cambridge University Press.

Kohn, A. (1993). Why incentive plans cannot work. Harvard Business Review, 71(5), 54-63.

Kwon, J., & Hein, P. (2013). Employee benefits in a total rewards framework. Benefits Quarterly, 29(1), 32-38.

Lovewell, D. (2011). A totally rewarding strategy. Corporate Adviser, 39-42.

Lyons, F. H., & Ben-Ora, D. (2002). Total rewards strategy: The best foundation of pay for performance. Compensation & Benefits Review, 34(2), 34-40.

O'Neal, S. (1998). The phenomenon of total rewards. ACA Journal, 7(3), 6-18.

Petera, P., Wagner, J., & Mensik, M. (2012a). Strategic performance measurement systems implemented in the biggest Czech companies with focus on balanced scorecard - an empirical study. Journal of Competitiveness, 4(4), 67-85.

Petera, P., Wagner, J., & Mensik, M. (2012b) Research on the quality of rewards systems in Czech Companies. GSTF Journal on Business Review, 2(3), 197–203.

Rost, K., & Osterloh, M. (2009). Management fashion pay-for-performance for ceos. Schmalenbach Business Review (SBR), 61(2), 119-149.

Sanders, D. (2001). Beyond face value: Painting the total rewards portrait. WorldatWork Journal, 10(1), 63-69.

Schottner, A., & Thiele, V. (2010). Promotion tournaments and individual performance pay. Journal of Economics and Management Strategy, 19(3), 699-731.

Sejen, L. (2006). Total rewards: 10 steps to a more effective program. Workspan, 49(4), 36-39.

Shi, L. (2010). Incentive effect of piece-rate contracts: Evidence from two small field experiments. The B.E.Journal of Economic Analysis & Policy, 10(1), 1-32.

Simmons, D. C. (2002). Job analysis: The missing ingredient in the total rewards recipe. Workspan, 45(9), 52-55.

WorldatWork (Organization). (2007). The WorldatWork handbook of compensation, benefits & total rewards : A comprehensive guide for HR professionals. Chichester: Wiley.

Zingheim, P. K., & Schuster J. R. (2000). Pay people right! : Breakthrough reward strategies to create great companies. San Francisco: Jossey-Bass Publishers.

Zingheim, P. K., & Schuster, J. R. (2006). Career directions for total rewards professionals. Compensation and Benefits Review, 38(3), 18-23.

CONTINUOUS ASSURANCE – AN INHERENT PART OF ADVANCED CORPORATE PERFORMANCE

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Abstract

Paper stresses the fact, that the financial crisis and real time economy involves changes in the corporate management methods. The need to transform the traditional audit paradigm into the continuous one based on current information technology is becoming apparent. Paper explains the differences between the terms continuous assurance, continuous audit and monitoring and discusses the core conditions for their implementation. Special attention is paid to process management. The consequences of these changes are discussed, too. They reside in the need to provide new balance of the responsibilities between the three most important parties: business management, IT management and internal audit.

1. Introduction

The inherent part of each financial crisis solution is the pressure on the more rigorous assurance delivered with greater efficiency. Recently we can notice such pressures on different levels of management and different sectors of economy. Examples are the 'fiscal compact', under which countries in the euro zone are bound to write a 'golden rule' on balanced budgets into their national constitutions or equivalent laws, with automatic correction mechanisms if the rule is breached. Another example from the highest levels of management is the growing pressure on better European supervision of financial institutions, which are mainly controlled by national authorities even though the industry is increasingly engaged in cross-border activities.

The same activities we can notice at the national and enterprise levels of management, and even at the level of IT management within the organizations. (Král, 2013, p.4) states: " All successful business "fights" of the last years can be expressed generally in a shape "on time and by an adequate way we have reacted to threats which have been indicated by our information system in advance".

The pressures on better assurance management are generally driven by the following trends:

- Impact on process management

- Audit techniques and measures innovation (conventional techniques vs. automated checks, updated measurement theory)
- Better usage of existing and development of new IT tools (imbedded tools in ERP systems, GRC platforms, dedicated assurance tools)

Focusing on the enterprise level of management these trends are currently covered by approach called continuous assurance, auditing and monitoring and they are becoming an inherent part of corporate management activities.

2. What are Continuous Assurance, Auditing and Monitoring?

While going through the relevant sources (white papers, standards, books, web pages, etc.), we can notice that some confusion surrounds these terms. Although they are often lumped together, perhaps because they all are automated, ongoing processes, they have actually three distinct meanings.

Continuous assurance is the all-encompassing term which is "a combination of an IT audit and assurance professional's oversight of management's continuous monitoring and an IT audit and assurance professional's continuous auditing approach using CAATs that allows management and IT audit and assurance professionals to monitor controls and risk on a continuous basis and to gather selective audit evidence using technology" (G42, 2010).

The same meaning expressed by the help in other words presents (ACL, 2005): "Continuous assurance is the combination of activities performed by internal audit to independently evaluate internal controls and risk management, and to assess management's controls monitoring activities".

We can conclude, that continuous assurance is a combination of continuous activities (mainly IT auditing and monitoring) which is in responsibility of internal audit, it is provided by the help of CAAT and its aim is to assure business managers that process risks are continuously managed.

Continuous auditing (CA) is "a method used by auditors to perform audit-related activities on a continuous basis. Activities range from continuous control assessment to continuous risk assessment. Technology plays a key role in making it a viable option through automation. Continuous auditing changes the audit paradigm from periodic reviews of a sample of transactions to ongoing audit testing of 100 % of transactions. It becomes an integral part of modern auditing at many levels (IIA, 2005).

Examples of other definitions:

(KPMG, 2010): "CA is focused on obtaining audit evidence and indicators from systems, processes, transactions and controls which are collected on a frequent or continuous basis by assurance functions, such as internal auditors, often, although not always, assisted by analytical technology tools".

(DEL, 2010): "CA enables internal audit to continually gather from processes data that supports auditing activities".

Continuous monitoring (CM) of controls is "a process that management puts in place to ensure that its policies and procedures are adhered to, and that business processes are operating effectively. Continuous monitoring typically involves automated continuous testing of all transactions within a given business process against a suite of controls rules" (IIA, 2005).

Examples of other definitions:

(KPMG, 2010, p.3): "CM is a control mechanism, used by management, to ensure that controls and systems function as intended and that transactions are processed as prescribed. It detects anomalies by giving management the ability to set rules, tests and analytics to flag changes to, or circumvention of, controls and to identify unusual transactions that suggest control failure, fraud, waste or abuse".

(DEL, 2010, p.2): "CM enables management to continually review business process for adherence to and deviations from their intended levels of performance and effectiveness".

From the above definitions we can summarize, that CA and CM have some common and different features:

Common features of CA and CM:

- They are part of continuous assurance aiming to detect business process deviations against the control/business rules
- The objects are business processes/transactions/master data and related controls and risks
- They are provided on continuous basis (more frequent)
- The tested sample covers 100% of the population
- They are supported by IT tools.

A specific feature of CA is that it is method and it is used by internal audit (IT audit included). On the contrary the CM is a management process and it is used by management.

Fig. 1 shows the important components of the continuous assurance and their mutual relationships.

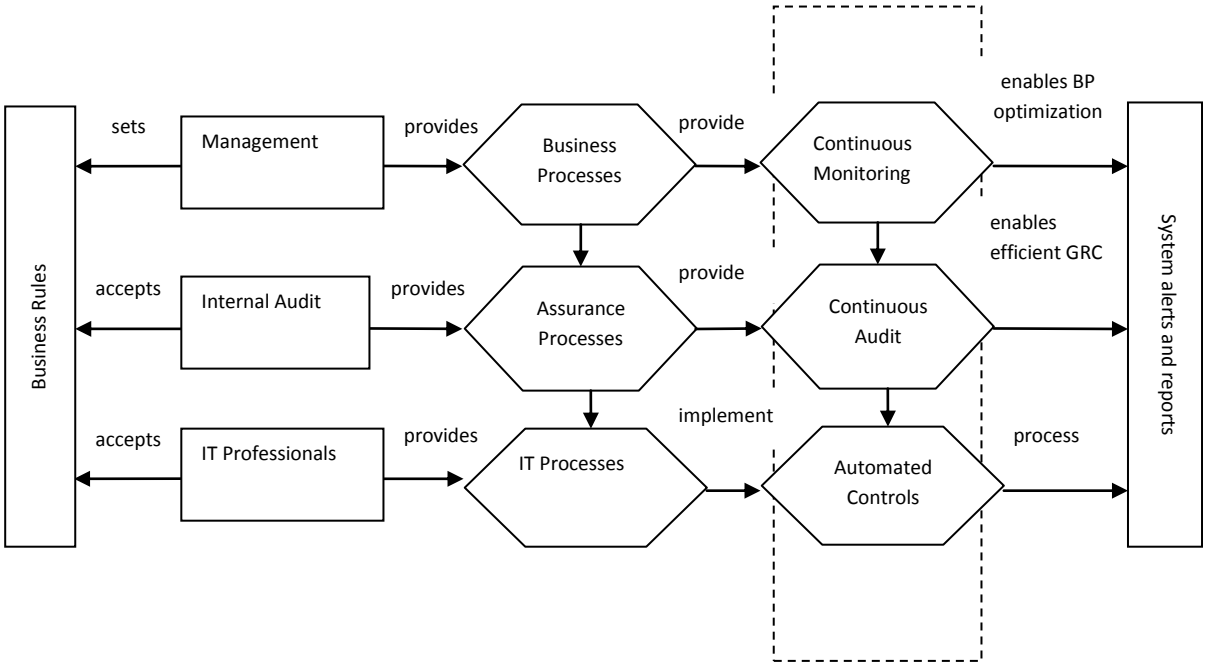

Fig. 1: Important components of the continuous assurance and their mutual relationships (GRC – Governance, Risk Compliance, BP-Business Process)

After the short explanation of what CA and CM are and what not, let us have look at the differences between the traditional auditing and continuous auditing, mainly from the financial audit point of view.

(IJA, 2011, p.4) summarizes that the traditional audit paradigm is outdated in the real time economy. Innovation of the traditional audit process is necessary to support real time assurance. Practitioners and academics are exploring continuous auditing as a potential successor to the traditional audit paradigm. Using technology and automation, continuous auditing methodology enhances the efficiency and effectiveness of the audit process to support real time assurance. Fig. 2Fig shows the differences of seven aspects of traditional and continuous auditing.

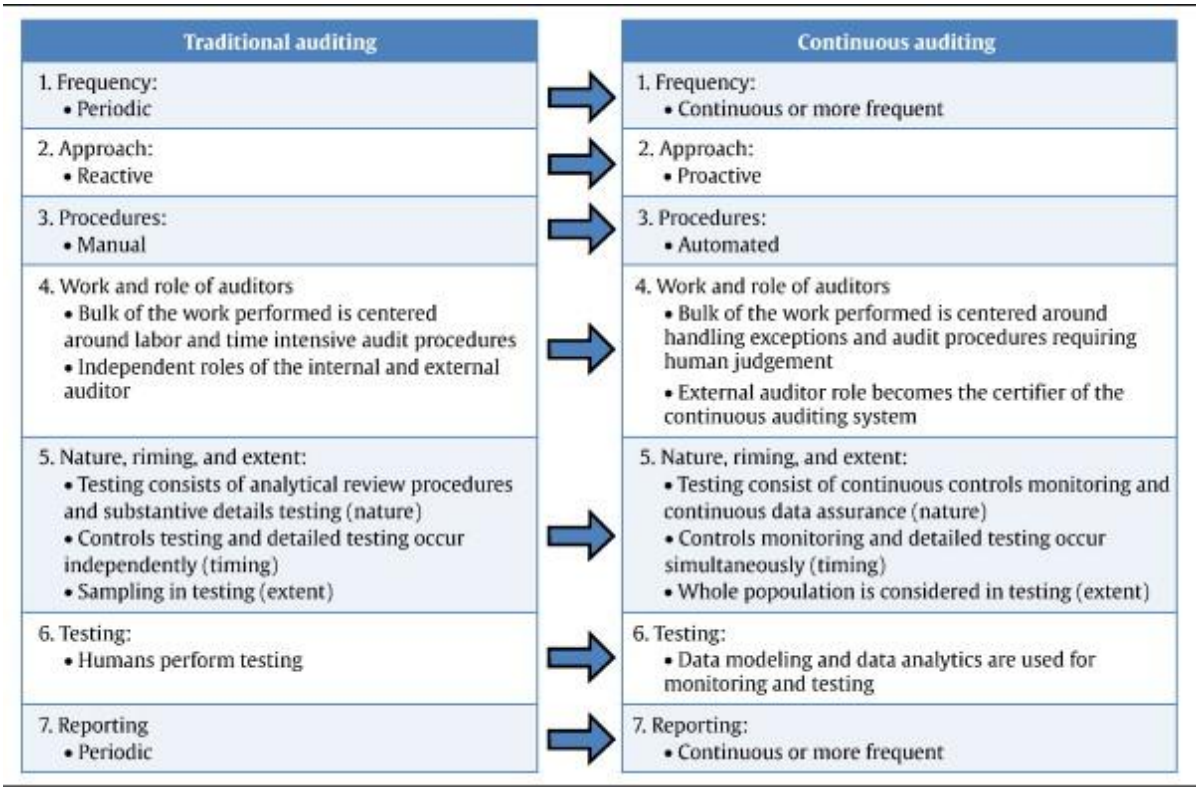

Fig. 2: Comparison of the traditional and continuous auditing (IJA, 2011).

CA and mainly CM are not only the advanced and more efficient methods and processes providing better assurance for a number of different stakeholders that their goals and expected outputs of business processes are not compromised by unacceptable risks, anomalies, exceptions, but in the same time they assume and provide a rationale for closer cooperation between management, internal audit and IT. Thus they represent the next step towards the bridging of the gap between these three sides.

CA needs closer cooperation with both the IT and business management. IT should cover the development, implementation and operating aspects of automated controls, while business management is expected to be responsible for definition of the standard process flow, unacceptable risks and related controls and their flexible change management.

CM is based on idea, that some part of the internal audit and IT responsibility can be transferred to business management, as the owners of business processes are in daily contact with these processes and can best and faster formulate criteria for their automatic monitoring. This idea to become real, must meet at least two important assumptions: first- business people must have user-friendly software tools enabling setting and changing these controls, second –the independence and objectivity of audit function cannot be threatened.

Therefore, during the planning stages of CM and CA implementation, business process owners, auditors and IT managers need to keep in mind the process' independence when designing its

structure. For instance, a typical internal audit department is structured so that areas of the department focus on different cycles or business activities. In addition, the department may be divided into financial and IT audit functions. Sometimes, however, IT audit activities are incorporated as part of existing IT operations. In organizations such as these, the development of continuous auditing is usually delayed because the activity may not get the necessary development priority. Regardless of whether IT audit activities are part of the organization's IT or internal audit department, the organization must maintain the process' independence as well as allocate resources in support of continuous audit activities.

3. Process Management as a Base for Control and Risk Management

Transition from functional management to process management is not a new phenomena and it was already widely discussed at different forums and in other publications all over the world. Currently we can identify three most important entries that are critical factors in the evolution of the BPM market (Gartner-2011, p.7-8):

- BPM certification — There is a growing need for skilled and experienced personnel to lead and participate in BPM activities. BPM certification represents one method to increase knowledge and experience, and aid recruiting managers in their selection processes.
- Intelligent business operations — This is a style of work in which near-real-time analytic and decision management technologies are integrated into the transaction executing and bookkeeping operational activities that run the business.
- Cloud BRM (Business Rule Monitoring) services — Business rules are actionable elements of business policy; they are "implicit and explicit business directives that define and describe guidance for taking a business action." When BRMS or business rule engine (BRE) functionality is provided as a core capability hosted in a cloud, it is called "cloud BRM services." Cloud BRM services are a type of platform as a service (PaaS).

This fact declares that the trends towards agile and continuous monitoring do not have its origin in the assurance area itself, but they have their roots in the broader background of the business process management discipline.

Practical application of BAM within the CM and CA are process-based risk and control management.

Risks and controls are two sides of one coin. Process-based risk management approach is currently next way how to provide risk assessment and represents a complementary approach to other more traditional ways of risk management asset-based, incident-based and checklist-based. But what is the implication for controls when providing process-based risk management? Continuous auditing tends to be dynamic (agile) in nature (i.e., the auditor can turn continuous audit processes on and off based on current system loads by reconfiguring these activities according to the internal audit plan). Therefore, by monitoring particular configurable items, continuous auditing provides an additional level of controls and acts as a meta control.

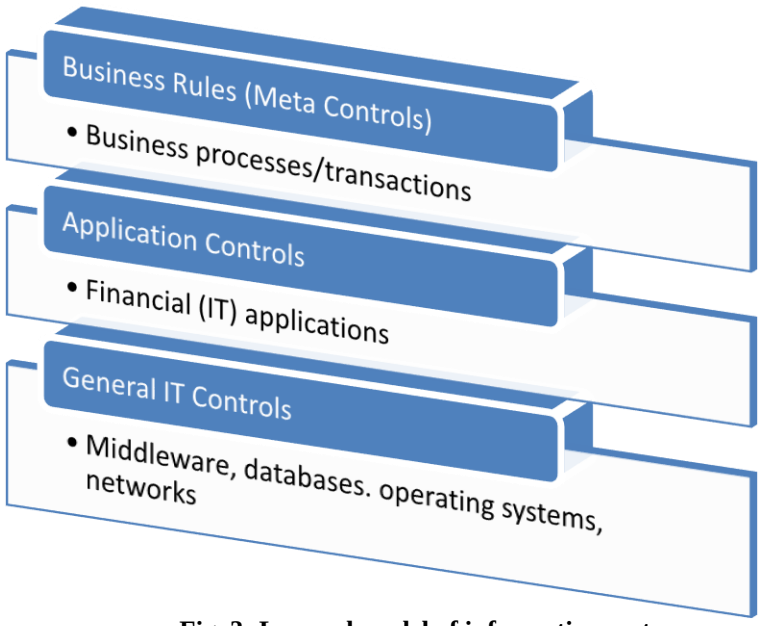

Fig. 3: Layered model of information systems

Fig. 3 gives a simplified picture of the layer model used in this audit approach. Each of the three layers represents a specific set of processes and resource types:

- The upper layer contains all the company's essential (manual) processes – typically broken down by responsible departments and sub-processes and individual activities.
- The second layer contains the automated parts of the business processes, the actual IT applications. With perhaps the exception of really small SMEs, most commercial transactions in practically all companies are handled via IT applications of this sort.
- The third layer contains the core IT systems. This term covers a multitude of possible platforms on which the actual IT applications in the second layer run. Examples of this would be actual data base management systems (e.g., Oracle, DB2), basic components of integrated IT applications (e.g., SAP Basis, Avaloq etc.), more technical processing systems (e.g., middleware) or IT infrastructure (mainframe, peripheral systems, servers as well as the relevant network components and technical operating and surveillance systems).

Each layer of this model includes the typical types of controls.

3.1. Business Rules

A business rule is a statement that defines or constrains some aspect of the business and either resolves to true or false or at least highlights deviation which requires further decision. For our purposes, this may be viewed from two perspectives. From the business perspective, it pertains to any of the constraints that apply to the behaviour of people in the enterprise, from restrictions on smoking to procedures for filling out a purchase order. From the information system perspective, it pertains to the facts which are recorded as data and constraints on changes to the values of those facts. That is, the concern is what data may or may not be recorded in the information system and what type of reporting should be in place in this case.

Business rule	Business perspective	IT perspective
No1	No invoices paid if the order, delivery note and invoice do not agree within a tolerance of 10%	Design Reference to the 3-way-match functionality of the ERP
No2	Segregation of duties between accounting staff responsible for accounts receivable and accounts payable. Nobody who pays invoices can conclude contracts with new suppliers.	Separate roles for all accounting staff responsible for accounts payable and accounts receivable and master data maintenance. Documentation of a function segregation matrix.

Fig. 4: Examples of two perspectives of business rule description

Business rules comparing the next layer of controls – application controls – need to be more flexible and adaptive to business process changes. In some cases may be informal or even unwritten, but as a part of continuous assurance they need to be writing down clearly and making sure that they don't conflict. They can be understood as a meta control to the next two traditional layers of control.

3.2. IT Application Controls

Controls embedded in business process applications are commonly referred to as application controls. The barrier between the meta layer and application level of controls is very narrow and we can say, that IT perspective of business rules is a bridge connecting these two layers. There exist examples of typical application controls that should be an inherent (embedded) part of applications. E.g. a standard bookkeeping application must contain the following functionalities/controls (non-exhaustive list) (ISACA, 2010, p. 3):

- Operations and transactions automatically dated with system date (Control: access protection for the system date)
- User identifications with authentication mechanisms (Controls: one way encryption of password, password syntax check, password validity check, logging of failed access attempts)
- Parametrisable authorizations (Control: access protection via profiles or individual authorizations)
- Change log for parameter and master data changes (security parameters, chart of accounts, creditor and debtor master data, etc.) (Controls: automatic storage of changed values in a history file (with date valid from/to, change date and identification of the user who carried out the change), access protection for parameters and history file)
- Delete prevention (Controls: the IT application should not have a delete function).
- Validation of input (Controls: selection lists, validation formulae etc.),
- Management of processing (Controls: job control, order of daily, monthly, end of year processing),
- Processing of transactions (Controls: workflow management, limit checks, four eyes principle and electronic signature, match controls between order/delivery/invoice),
- Output management (availability of reports, etc.).

Many of application controls are automated. Comparing the previous layer of controls – they are stable and represent the core part of automated controls.

3.3. General IT Controls

General controls are controls embedded in IT processes and services. Examples general controls areas include: Control Environment (Policies, Directives), Software Development, (IT) Operations (Back-up and recovery, Incident Management, Problem Management, Change Management), (IT) Security (Access Control, System Security) or Data Security Monitoring.

They are in responsibility of IT professionals and usually they are not objects for CM and CA.

4. Conclusion

Continuous auditing and monitoring are examples of new approaches that enable managers to react timely on different events which can cause business loss or can compromise achievement of business goals. The core conditions for their application are process oriented management supported by advanced information technology. They need to provide new perspective on corporate control systems and new definition of the liabilities and relationships between the business management, IT management, financial auditors and information systems auditors.

References

ACL, (2005) Continuous Auditing: Implications for Assurance, Monitoring, and Risk Assessment, IIA, A Summary of The IIA's Global Technology Audit Guide, White paper, 2005 ACL Services Ltd.

BPM, (2010) Business Process Management, Practical Guides to Successful implementations, J. Jeston, J. Nelis, ISBN: 978-0-75-068656-3, p. 11

Del, (2010) Deloitte, Continuous monitoring and continuous auditing – From idea to implementation, 2010, http://www.deloitte.com/view/en_US/us/Services/audit-enterprise-risk-services/dbf8f10c3f889210VgnVCM200000bb42f00aRCRD.htm

G42, (2010) G42 Continuous Assurance, ISACA Guideline, effective date May 2010, http://www.isaca.org/Knowledge-Center/Standards/Pages/IS-Auditing-Guideline-G42-Continuous-Assurance1.aspx

Gartner, (2011), Gartner, Reserch, Hype Cycle for Business Process Management, , John Dixon, Teresa Jones ID Number: G002 14214, 2011, http://www.adeptia.com/products/Hype_cycle_BPM_2011.pdf

IIA GTAG, (2005), ISBN : 0-89413-586-4, Publisher : The Institute of Internal Auditors, Publish Date : 2005 Authors : David Coderre

IJA, (2011) International Journal of Accounting Information Systems, Volume 12, Issue 2, June 2011, Innovation and practice of continuous auditing, David Y. Chan, Miklos A. Vasarhelyi , Pages 152–160,

ISACA, (2010) ISACA Journal, Volume 5, 2010, S. Ramanathan: A case for process-based approach to GRC

KPMG, (2010) Continuous auditing and monitoring: Are promised benefits now being realised?, 2010, http://www.kpmg.com/be/en/issuesandinsights/articlespublications/pages/continuous-auditing-and-monitoring.aspx

Král, (2013), Impact of Crisis on Corporate Performance Management Development, keynote paper IDIMT13, idimt.org

SHOULD WE THINK ABOUT ICT SUPPORT AND ASSESMENT OF MATURITY LEVEL FOR IMPLEMENTATION OF CORPORATE PERFORMANCE MANAGEMENT?

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Corporate Performance Management, maturity level, information technologies, business intelligence

Abstract

Managers require, more than ever, exact information about economic situation of their business. They require high-quality information not only about business as a whole but also about individual departments, divisions and activities.

This paper is devoted to the Corporate Performance Management (CPM) as one of approaches or tools that deliver information required by managers for management of companies. We identified knowledge domains which are supported by the CPM and later on we analyze trends in CPM and respond the question if we really need the CPM applications. The main part describes new approach that enables companies managers determine level of preparedness for an implementation of the CPM applications.

1. Introduction

In present economic situation with persisting apparent elements of economic crisis, managers require, more than ever, exact information about an economic situation of their business. They require good-quality information not only about business as a whole but also about individual departments, divisions and activities. In order to evaluate profit or loss of activities connected with individual department, it is necessary to identify a lot of parameters. Usually it is easy to identify parameters linked to companies' profits and companies costs because these are known but when companies want to make deeper analysis about detailed cost structures of each products, services etc. they have to analyze companies activities in higher detail and try to identify business processes, cost drivers, cost centers etc. (Kral, 2010) All of these activities are primarily connected with accounting and financial perception of performance management which is based on accounting methodologies like the Activity Base Costing (ABC) and others. But the CPM is not only accounting, management accounting but CPM is also frequently mentioned in a context of ICT and

especially in a context of the Business Intelligence (BI). (Howard, 2002) But what is the CPM and what is a purpose of the CPM?

The CPM is activities and solutions organizations use to become more successful and stay ahead of their competitors. The CPM is aimed to solve the most critical task of executives and managers.

Many research conducted in a past decade (e.g. Novotny, 2007; Novotny, 2009; Maryska, 2010; Parmenter, 2007; Remenyi, 2007) show that management and measuring of companies performance is difficult.

Before modern CPM solutions became available, companies usually struggled with fundamental financial processes such as month-end close and an annual budget. Approaches that solved these processes were usually labour-intensive and linked with a lot of errors because employees were using tools that were not designed for these processes. The best example is various spread sheets applications that were not used only in a past but also at present.

During time an advanced companies has developed their own companies' solutions with all disadvantages and advantages results from in-house solutions like high price, little or no best practices etc. One of prerequisites was BI that provides data required for analysis.

These in-house solutions were often accompany by a lot of kinds of reports that were running around organization, each telling their own version of truth, typically based on different sets of interpreted data, conflicting with one another because already existing reports never exactly fulfil needs of new users. These troubles were one of key factors that encourage companies to implement BI solutions that were the first step to implementation of the CPM applications.

The ICT perspective of the CPM has been started more and more important 10 years ago and its importance is still increasing. History of the CPM is closely connected with Business Intelligence (BI) tools and data warehouses because the first aims of the CPM were focused on **financial data consolidation** that comes to main general ledger from different separate general ledgers **and budgeting**. Perception and transformation from management and the BI to the CPM supported by the ICT is described by the Fig. 1.

Fig. 1. Shift from BI to CPM, source: (Trends Applied, 2013)

The CPM today covers areas as follows (Gartner, 3):

- Financial and Management Reporting and Disclosure,
- Budgeting,
- Strategic Planning and Forecasting:

  - Planning,
  - Forecasting,
  - Strategy Management,
- Profitability Modelling and Optimization.

These processes are described for example in (Gartner, 3; Vorisek et al, 2008).

2. Problem Formulation

One of key trends in current time is decision-making whether to implement any of available CPM systems. This decision-making is not done only in big companies, but also in small and especially in medium companies around a world – including the Czech Republic. The decision is usually closely connected to statements as follows:

- Managers usually don't know if company is ready for implementation of the CPM.
- Managers usually don't have sufficient information about current trends about the ICT and the CPM applications for supporting the CPM task.

Aim of this paper is to present last findings from surveys which scope was oriented on the usage of the ICT support for the CPM and mainly provide information how to identify level of readiness for implementation of the CPM applications.

3. Trends and Current situation in ICT

3.1. Performance Management and Corporate Performance Management

We have used abbreviation CPM but usage of this abbreviation is often vague and is mistaken with the Performance Management (PM).

Gartner (2) defines "performance management" as combination of methodologies and metrics that enables users to define monitor and optimize outcomes necessary to achieve organizational goals and objectives. In a past the PM was associated with either people management or performance monitoring.

The EPM (Enterprise Performance Management), the CPM and the BPM (Business Performance Management) can be described as a process of monitoring performance across an enterprise with goal of improving business performance. The CPM is a system or an application that contains processes, methodologies, metrics and technologies that are used to monitoring, assessment and control of business and its performance easily and faster. These applications have to be able support translation of strategically focused information into operational plans. These applications also integrate and analyze data from many sources not only internal like data warehouses but also from external data sources. CPM provides wider access to financial analytics, and to help develop strategies that deliver in regard to expectations of shareholders, investors and funding bodies. (Gartner, 1; Maryska, Novotny, 2013; Wade, Recardo, 2001)

We will use the term CPM only in following text.

The modern CPM covers domains that are presented in the Fig. 2.

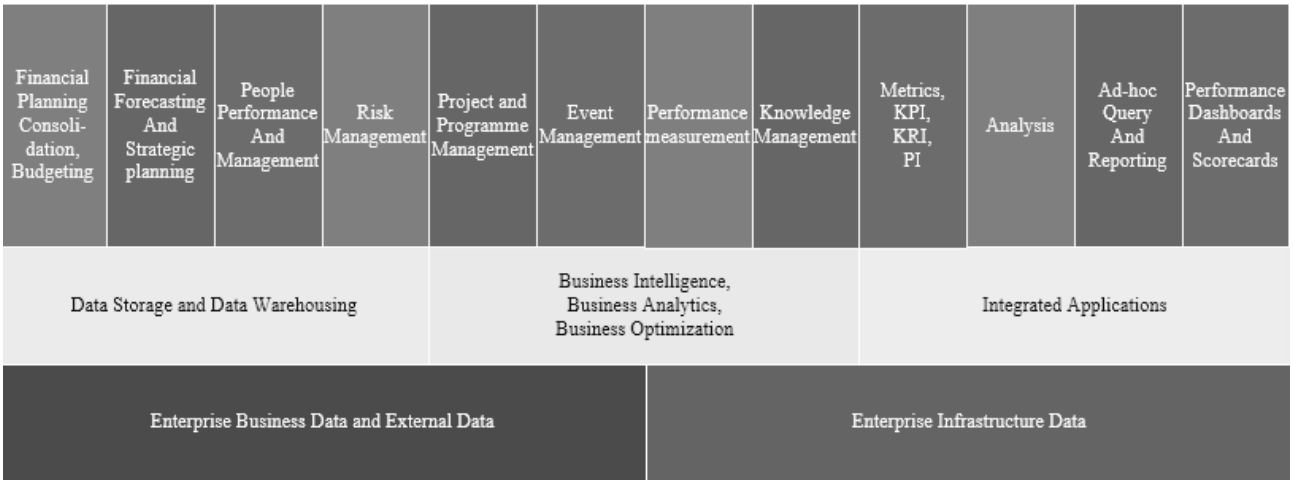

Fig. 2. Domain in aim of CPM, source: author

These processes are described for example in (Gartner, 3; Vorisek et al, 2008).

3.2. Do we need CPM applications?

We have already mentioned that the CPM applications cover budgeting, consolidation, reporting and other functions. These functions are not transactional and are not usually supported/ offered as a part of ERP or accounting systems. Some of application support multi-user processes (budget approvals, report distribution, etc.), but these are often based on spread sheets. Problems with approach „Excel base company/CPM“ include (Prophix, 2013):

- Productivity issues - Finance staff spend too much time with preparing data in spread sheets.
- Maintenance issues – no multi-user systems.
- Accuracy issues – errors in spread sheet files.

From this reason a lot of managers think about implementation of the CPM application. Importance of implementation of CPM applications is proved by several surveys made among companies by Gartner, Forrester and other research institutions. We provide results of researches realized between years 2006 and 2013 by Gartner (3) and Computerworld (2013).

These surveys were aimed on identification of technology priorities for company’s CIO. These surveys were both realized among more than 2.300 respondents (companies) in 41 countries globally and 36 industries.

In year 2008 the CIO identified that investments into Business Intelligence Applications (which are part of CPM) are CIO top priorities between years 2006-2008 (see Table 1). The second survey was realized in year 2011 and results are similar. The Analytics and Business Intelligence is again on the first place between years 2010 and 2013.

Technology priorities	**Rank**					
	2013	**2011**	**2010**	**2008**	**2007**	**2006**
Business Intelligence Applications	**1**	**1**	**5**	**1**	**1**	**1**
Mobile technologies	2	2	3	X	X	X
Technical Infrastructure	3	3	1	6	8	12

Collaboration Technologies	4	4	8	8	10	4
Legacy Application Modernization	5	5	x	4	3	10
IT management	6	6	4	X	X	X
Enterprise Applications (ERP, SCM, CRM)	7	7	x	2	2	x
Server and Storage Technologies (Virtualization)	8	10	2	3	5	9
Security Technologies	9	9	x	5	6	2
Document Management	X	X	X	9	9	x
Networking, Voice and Data Communications (VoIP)	X	X	X	7	4	8
Service-Oriented Technologies (SOA and SOBA)	X	X	X	10	7	6

Table 1. Domain in aim of the CPM, source: (Gartner, 3; Computerworld, 2013)

From last year to this year, there was no substantial change in the top three technology priorities. There is „Analytics and Business Intelligence“ on the first place among technology priorities of CEO for many years.

Similar results were identified by the Forrester Research that find out that Data Analytics and Insight, Cloud Services, Mobile technologies are the most important for year 2013. These technologies will form base for improving business results. (Forrester, 2013)

These findings are important for the C-level (CFO, CEO, CIO) in companies because as we have already mentioned the advanced CPM applications enable to companies achieve business advantage against companies that are still using CPM based on spread sheets or against companies which do not use CPM whatever.

3.3. Are we ready for implementation of CPM?

At beginning of the CPM journey the C-level managers have to analyze if company is ready for implementation of CPM applications. As we have already mentioned, one of crucial factor for the CPM is availability of data sources in adequate quality and adequate length of history.

This leads to question: “How we can recognize, if we are ready for CPM?”. In other ICT areas we can use Capability Maturity Model (CMM) but situation is more difficult in the CPM because there is no similar self-contained model that enables to rate company.

Only one model is approaching to the CMM (SEI_CMU, 2013). This is process of assessment based on (Aho, 2012). Based on our opinion is good to extend this model for another approach presented in (Paladino, 2011). Both of them prepare diverse approaches that are presented as follows. Supplements to those both approaches are metrics that are described in detail in (Parmenter, 2007).

The Aho (2012) prepare model that is divided into two parts:

- Definition of five maturity levels that are linked to traditional CMM model.
- Definition of nine dimensions that are assessed and assigned to adequate maturity level.

The Aho (2012) has defined nine dimensions as follows. From our point of view, these dimensions can (should) be extended for additional dimensions. Extension is bolded.

- Communication,
- Information,

- Intangible assets,
- Management and responsibility,
- Performance,
- Methods and tools,
- Scale and scope,
- Strategy and Business,
- Technology,
- **Organization Structure,**
- **Knowledge and Knowledge management.**

Aho (2012) further distinguishes five maturity levels that are presented in Table 3. These maturity levels are linked to maturity levels defined in CMM which simplifies its understandability.

There are also defined basic characteristic that defines maturity level that is reach by assessed characteristic.

Maturity level - CMM	**Maturity CPM**	**Description**
1 – Initial	Information silos	The solutions are local; there are no common standards, no shared resources or management. As a result the management does not get a clear and consistent picture of the organization as a whole. **Characteristics**: Poor quality data, No defined measures, Reports built on operational information systems
2 – Repeatable	Understan-ding the value	The organization understands the value of the PM for its business. Organizational goals and objectives are defined. **Characteristics**: Data marts, Budgeting Financially focused solution, Interactive reporting systems
3 – Defined	Fact-based decision-making	Decisions are more often made based on facts, rather than management instinct. The organization's data is stored in a centralized data warehouse. **Characteristics**: Management Dashboards, Strategy execution and monitoring, Planning and forecasting, KPI, Data warehouses
4 – Managed	Analytical business	Business becomes more analytical in key business areas. The metrics and scorecards are closely aligned to the organization's strategy. **Characteristics**: Balanced metrics, Strategy planning and Analysis, Enterprise data warehouse
5 – Optimized	Strategic tool	PM has become a strategic tool for management, and it is a central part of the organization's control and management system. PM is also strongly connected to the different phases of strategy implementation in organization. **Characteristics**: High quality data, Continuous strategic planning, Strategy scorecard, External data sources

Table 2: Maturity levels and capabilities, source: (Aho, 2012)

The second approach that should help companies to implement CPM is presented in (Paladino, 2011). Paladino (2011) distinguish five key principles:

- Establish & Deploy CPM Office,

- Refresh & Communicate Strategy,
- Cascade & Manage Strategy,
- Improve Performance,
- Manage & Leverage Knowledge.

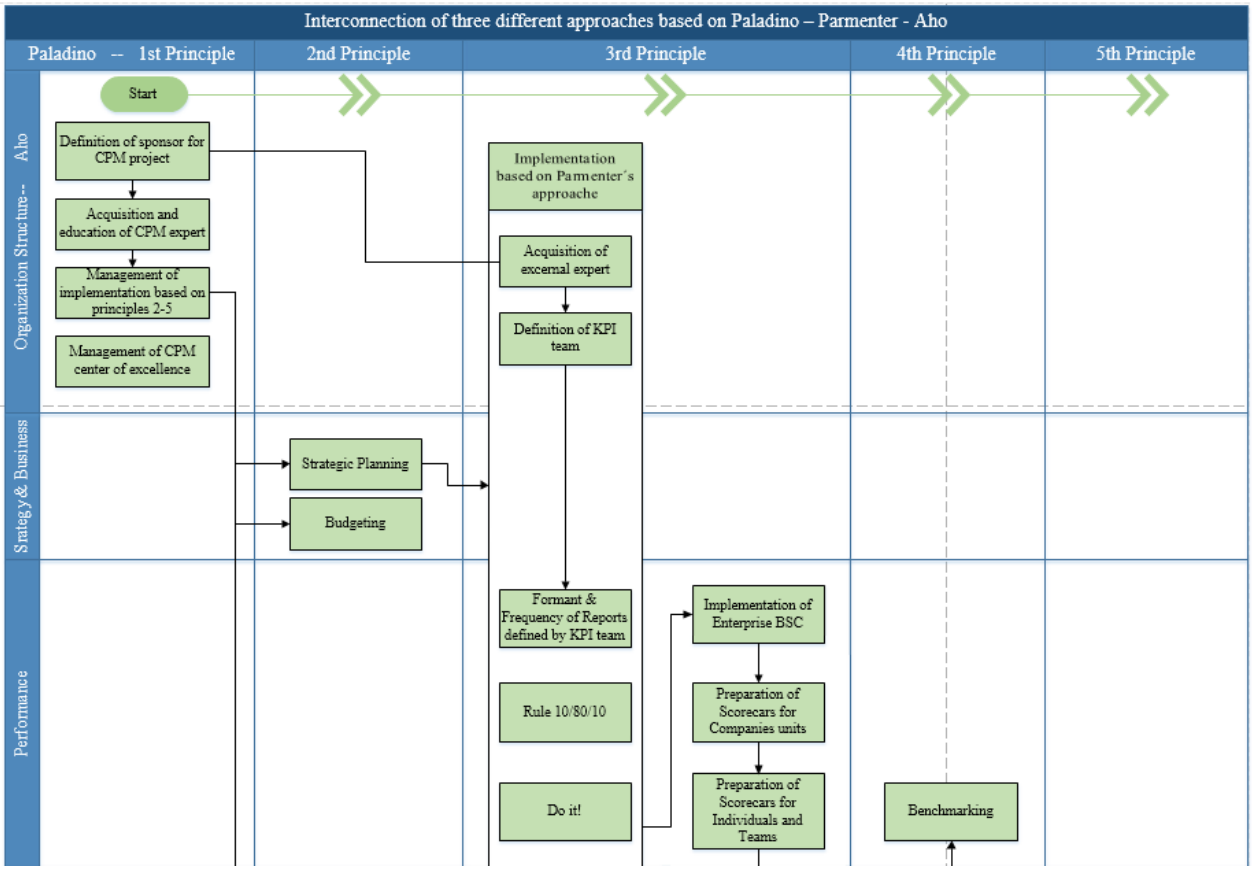

Fig. 3. Sample of CPM Maturity Implementation Model, source: (Dyntar, 2013; author)

These principles can be described as steps that are crucial for successful implementation of CPM into company. The Paladino (2011) defines these principles based on its experience from implementation of CPM into more than 100 companies.

The order how the principles are fulfilled is recommended not mandatory.

The supplement to above mentioned principles and approaches are metrics. From our point of view the most important facts about metrics are types of metrics (Key Performance Indicators (KPI), Key Result Indicators (KRI), Performance Indicators (PI)), Dimension of metrics, Units. (Parmenter, 2007).

Based on all above mentioned approaches was prepared model that interconnect both of these approaches. Part of this model is presented on the Fig. 3. We have combined approaches of Aho, Parmenter and Paladino and prepare a road map that should help successfully implement the CPM tool into company.

4. Conclusions

CPM is very significant activity among business activities and its importance keeps growing. It is especially very important activity from the point of view of company managers.

Business economics management cannot succeed without adequate procedures. If this type of management is not successful, company top management cannot be expected to support it and to consider it one of key departments keeping entire business vital. If it is not possible to prove benefits, company management shall see it as a simple cost item that should be minimized as much as possible.

Do we really need CPM applications? If a business wants to be successful and competitive not only in present but also in a future, it must accept and adequately respond to the trends in economics.

Businesses do not know real cost of individual business informatics activities and lack processes for tracking such cost. As a result, cost of business informatics is insufficiently and inaccurately reflected in the performance of a business.

It's important to know what should be done for successful implementation of CPM tools. One of very helpful tools can be our model, which helps to companies' managers determine where their company and its processes are and what they have to do to achieve higher level.

Acknowledgement

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References

Aho, M. (2012). What is your PMI? A Model for Assessing the Maturity of Performance Management in Organizations, PMA 2012 Conference, Cambridge.

Computerworld.(2013). The top 10 tech priorities of CIOs. Cit. 2012-01-05. URL: http://www.computerworld.com/s/article/9223502/The_top_10_tech_priorities_of_CIOs

Dyntar, L. (2013). Analýza, výběr a zavedení CPM řešení pro malou firmu. Diploma Thesis. VSE, 2013

Forrester. (2013). To Drive IT Spending, Target The Business! Cit. 2013-04-14. URL: http://blogs.forrester.com/fred_giron/13-04-14-to_drive_it_spending_target_the_business?cmpid =pr:soc:tw:SVM_Giron_4-16-2013

Gartner. (1). Enterprise Performance Management. Cit. 2013-04-25. URL: http://www.gartner.com/it-glossary/epm-enterprise-performance-management/

Gartner. (2). Performance Management. Cit. 2013-04-25. URL: http://www.gartner.com/it-glossary/performance-management/)

Gartner. (3). Iervolino, Ch., Van Decker, J., Chandler, N. Magic Quadrant for Corporate Performance Management Suites. 2013-02-14

Howard, D. (2002). Corporate Performance Management Enhances BI, (Online), cit: 20081228, source: http://www.gartner.com/resources/106700/106734/106734.pdf Kaplan, 2000

Kral, B. (2010). Manažerské účetnictví; Management Press, 2010; ISBN: 8072610627

Maryska, M. (2010). Referenční model řízení ekonomiky podnikové informatiky; doktorská disertační práce; VŠE, 2010

Maryska, M., Novotny, O. (2013). The reference model for managing business informatics economics based on the corporate performance management – proposal and implementation. Technology Analysis & Strategic

Management [online], 2013, Vol. 25/2. ISSN 0953-7325. URL: http://dx.doi.org/10.1080/09537325.2012.759206. eISSN 1465-3990

Novotny, O. (2007). IS/ICT Management Reference Model; In: Revista de Engenharia de Computacao e Sistemas Digitais, 2007; Vol. 3; ISSN: 16788435

Novotny, O. (2009). Performance reference model in the context of corporate performance management. Jindřichův Hradec 09.09.2009 – 11.09.2009. In: IDIMT-2009 System and Humans – A Complex Relationship. Linz : Trauner, 2009, s. 13–16. ISBN: 978-3-85499-624-8

Paladino, B., 2010. Innovative Corporate Performance Management: Five Key Principles to Accelerate Results. John Wiley & Sons. ISBN: 9780470912614.

Parmenter, D. (2007). Key Performance Indicators: Developing, Implementing, and Using Winning KPIs; Wiley., 2007; ISBN: 9780470095881

Prophix.(2013). Corporate Performance Management: Why Do You Need CPM Software? Cit. 2013-04-25. http://www.prophix.com/resources/white-papers/cpm/

Remenyi, D., Bannister, F. Money, A. (2007). The effective measurement and management of ICT cost and benefits; Elsevier, 2007; ISBN: 0750683287

SEI_CMU. (2013). Capability Maturity Model. Cit: 2013-04-25. URL: http://www.sei.cmu.edu/cmmi/

Trends Applied. (2013). Shift from BI to CPM. Cited: 2013-04-22. URL: http://www.trendsapplied.com/tag/performance-management/

Vorisek, J. et al. (2008). Principy a modely řízení podnikové informatiky. Praha. ISBN 978-80-245-1440-6.

Wade, D., Recardo, R. (2001). Corporate Performance Management; Butterworth-Heinemann, 2001; ISBN: 0877193860

ICT TODAY & TOMORROW

ICT TODAY AND TOMORROW – SOME ECO-TECHNOLOGICAL ASPECTS AND TRENDS

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Abstract

Evaluating status and future of ICT, means evaluating the technological and the economic aspects, and discuss some of the emerging options.

This perusal of the economic–technological scenario will demonstrate structural dynamics, emerging future developments and strategies for the scaling with and beyond Moore's law.

Complimenting this by the economic perspective is not only determining the financial feasibility of current projects but through the direction of investments into R&D, marketing and manufacturing furthermore the direction of future developments. This approach should contribute to a vision of options for ICT arising over the horizon.

1. Economic Overview

1.1. Eco -Technological Aspects and Trends

The semiconductor industry has been an amazing source of industrial innovation in recent history. Starting with the discovery of the transistor in Bell Labs in the 1940s, the development of the integrated circuit in the 1960s, the semiconductor industry has grown into a $300 billion giant and supports the even-larger ~$1.2 trillion electronic systems industry. It has driven incredible innovations from decoding the human genome, to enabling people to communicate verbally, in pictures, and in video almost anytime, anywhere. For the first few decades, the industry relied primarily on geometric scaling. The new millennium brought a shift, requiring many more innovations such as the shift to high-k dielectric materials, the move from aluminium to copper for on-chip interconnects or strained silicon. However, this is just the beginning - future innovations in materials and device structures will be even more exotic, involving fundamental shifts like using photons to exchange information instead of electrons, and perhaps new substrates like graphene, instead of the old warhorse silicon. (Pushkar, 2012)

Semiconductor technology and electronics are embedded in almost every aspect of our life. The semiconductor industry spends more on R&D than almost any other industry, and its spending is increasing rapidly, outpacing revenue growth.

The advent of disruptive transitions as nanotechnology and the rise of the global consumer as the main end-user are reshaping the industry.

Let us look how are some of the leading companies performing in this race?

Intel once holding a quasi-monopolistic position, has been confronted with emerging new markets and business opportunities, but Intel left them without any fight to its competitors. Up to now there is practically no tablet or smart phone with an Intel processor.

Trying to regain leadership Intel expects contribution from its Ivy bridge processors with only 25% energy consumption. Intel is working on near threshold technology that would enable a reduction of energy by another 80% and a variation of the working frequency by a factor of 10. Extrapolating this would result in a smart phone by 2017 with the computing power of a server rack of today. Some experts estimate Intel's advance in processor development up to three years.

Intel PC-processor revenue sank by 6 % However, the market for storage systems chips and corporate customers grow by 4 % but could not compensate the loss in the PC market. The market research company Gartner estimates a shrinking of the revenue by 4,9 % encompassing 90,3 mio notebooks und desktops. Its competitor IDC corresponding figures are shrinking of the revenue by 6,4 % encompassing 89,3 mio notebooks und desktops.

Actually, Intel is building its Processors Ivy Bridge and Haswell with a 22nm process and is getting ready to introduce next generation 14nm technology soon. In parallel intensive research, efforts are going on to find a way for a 10nm technology.

IBM is continuing to shift its emphasis to services and software, raising its share of revenue from this 68% in 2000 to 86% in 2012. Additionally since the beginning of 2000, IBM acquired more than 140 companies in strategic areas including analytics, cloud, security, and Smarter Commerce, and expects to spend $20 billion in acquisitions over the 2015 Road Map period. IBM invests one billion Dollars in the development of new flash technologies. It claims that SSD will drive down cost and maintenance of flash-based computer-centres equipped with Solid State Disks by 30%.

A newly rising fables star is ARM. It is licensing its processor designs to be manufactured by companies as Samsung, TSMC, and Globalfoundries. The power-saving chip architecture of the British development company ARM has gained the leadership, maintains a 95% market share of smart phones and tablets and licensed its 64-bit processor technology to 15 companies as AMD, NVIDIA or Samsung. (Intel, 2012), (IBM, 2012), (IBM, 2013)

1.2. Productivity paradox

Innovation has never been faster. In fact, if you look at the underlying statistics, productivity growth is doing pretty well. Productivity levels are at an all-time high, and in the 2000s, productivity growth was faster than it was in the 1990s, which was a great decade.

On the other hand, the median worker is doing worse. US- median households and workers have lower incomes today than in 1997, and the employment-to-population ratio has fallen. Similar developments are visible in the worldwide OECD statistics. That is the paradox of our era.

Nevertheless, there is no economic law that says that technological progress needs to benefit everybody, or even a majority of people. It is entirely possible for technology to advance, to make the pie bigger, and yet for some people to get a smaller share of that pie.

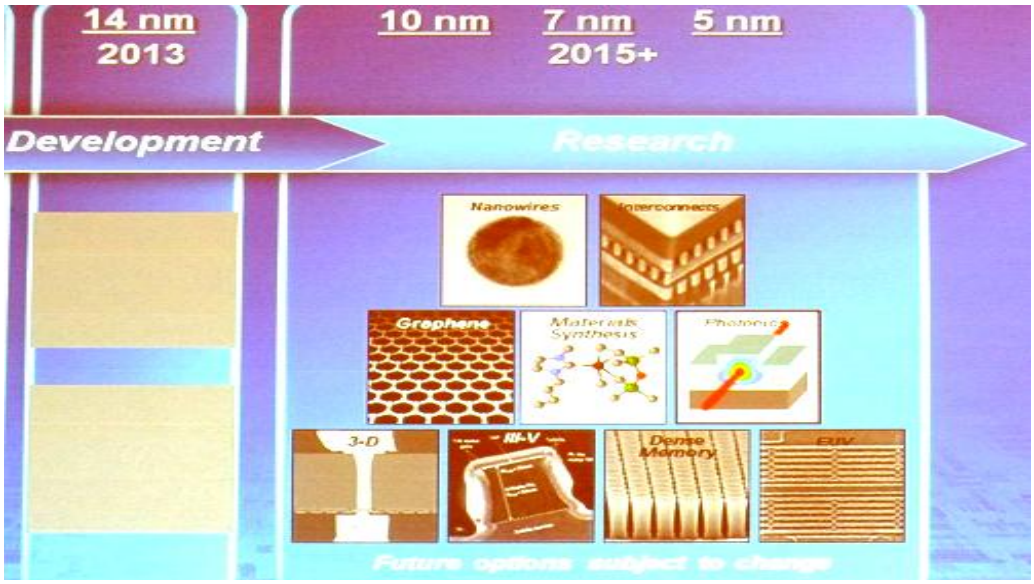
As you are aware approximately every two years, circuit line widths are driven smaller, device performance is improved, and cost is reduced, putting more processing power into a handheld smart phone than all Apollo space missions combined. Many are predicting that CMOS will soon reach the proverbial "brick wall" of the laws of physics, where conventional scaling becomes impossible or at least impractical. If this does happen, the results will not only be felt in the fab, but also will also negatively impact global economies that are influenced by demand for the latest and greatest technologies. (Pushkar, 2012)

2. Technology

2.1. CMOS Technology

Since its inception in 1992, a basic premise of the Roadmap has been that continued scaling of electronics would further reduce the cost per function (historically~25 -29% per year) and promote market growth for integrated circuits (historically averaging ~17% per year), but maturing to slower growth in more recent history.

One of the fundamental lessons derived for the past of the semiconductor industry comes for the observation that most of the innovations of the past ten years that have revolutionized the way CMOS transistors are manufactured nowadays were initiated 10–15 years before they were incorporated into the CMOS process, (e.g. strained silicon research began in the early 90s, high-k metal-gate was initiated in the mid-90s and multiple-gate transistors were pioneered in the late 90s).



Looking at the timeframe 2020–2025, we can see that many physical dimensions are expected to be crossing the 10nm threshold. It is expected that as dimensions approach the 5–7nm range it will be difficult to operate any transistor structure that is utilizing the MOS physics. Naturally, we expect that new devices, like the promising tunnel transistors, will allow a smooth transition from traditional CMOS to this new class of device miniaturization. However, the fundamental geometrical limits will be reached in the above timeframe. By utilizing the vertical dimension, it will be possible to stack layers of transistors on top of each other and this 3D approach will continue to increase the number of components per mm^2 when horizontal physical dimensions will no longer be amenable to any further reduction.

It seems then important to ask the fundamental question: “How will we be able to increase the computation and memory capacity when the device physical limits will be reached? “ It becomes necessary to re-examine how to can get more information into a finite amount of space. The semiconductor industry has thrived on Boolean logic. For many applications, the CMOS devices have been used as nothing more than an “on-off” switch. One way out of this dilemma would be to develop new techniques that allow the use of multiple (i.e. > 2) logic states in any given and finite location. This evokes the “magic of quantum computing” looming in distance. However, short of reaching this ultimate goal, it may be possible to increase the number of states to a moderate level

as e.g. 4–10 states and increase the number of "virtual transistors" by 2 every 2 years ("Multiple States Law").

2.2. RF and A/MS Technologies

RF and A/MS Technologies for Wireless Radio frequency and analogue mixed-signal technologies serve the rapidly growing wireless communications market and represent essential and critical technologies for the success of many semiconductor manufacturers. Communications products are becoming key drivers of volume manufacturing. Consumer products now account for over half of the demand for semiconductors. For example, 3G cellular phones now have much higher semiconductor content and now comprise 50 % of the cellular phone market compared to only 5 % of the market a few years ago. Since these products are very sensitive to cost, time-to-market and overall system cost will govern technology selection. (Bennett, 2011)

2.3. The race for the 450 mm wafer

The rationale for a transition to 450mm diameter wafer is productivity. This is the ability to decrease the manufacturing cost of each mm² of IC by the use of larger diameter wafers. Based on economic considerations, that to stay on this productivity curve, the industry needed to achieve 30% cost reduction and 50% cycle time improvement in manufacturing.

The European EEMI 450mm consortium initiative continued to make progress and reports of their plans for targets for 450mm development in new facilities in IMEC in Belgium

The private consortium initiative, the Global 450mm Consortium (G450C), of five major industry players, Intel, Samsung, TSMC, GLOBALFOUNDRIES, and IBM in cooperation with the state of New York, has begun to invest $4.4 billion to advance 450mm manufacturing and technology development.

At the SEMI Industry Strategy Symposium (ISS) this week, Intel demonstrated a fully patterned 450mm wafer. This wafer was created in intense collaboration Intel and several of its suppliers.

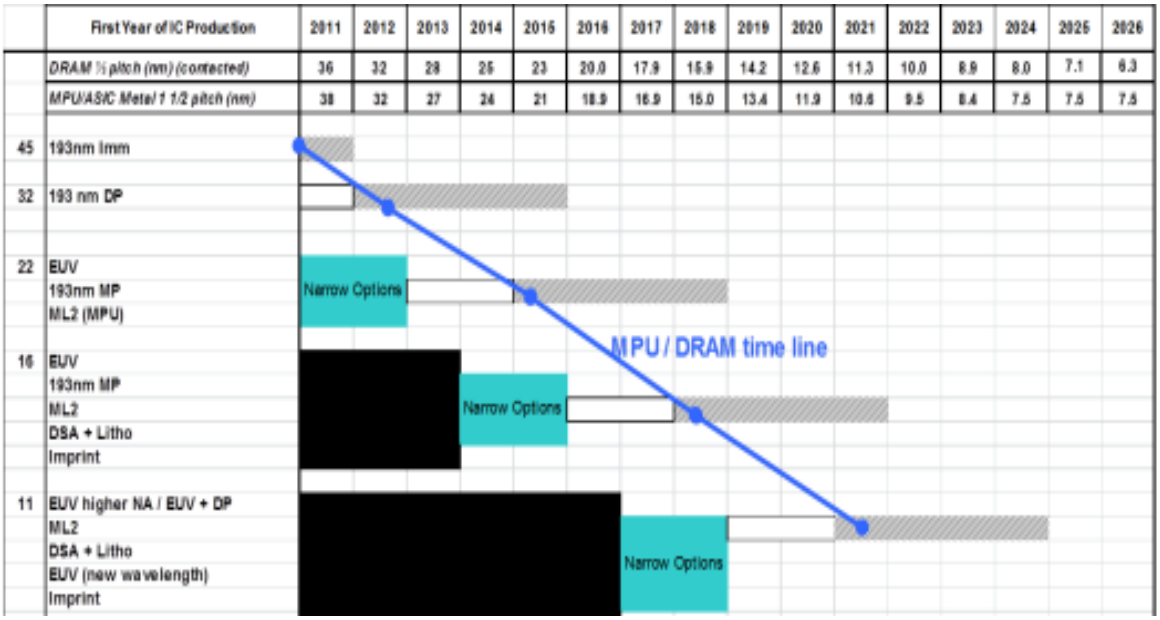
This "triumvirate" of functionality, higher performance, and lower power market benefits to consumers continued into the early 2000's; when, passing through nano-scale dimensions, the shrinking of technology began to approach molecular and atomic levels (in the case of gate and channel thickness and length)

The usual dimensional reduction of the scaling of printed and physical gate length of transistors is slowing but compensated by a trade-off with what became known as "Equivalent Scaling". This signifies the inclusion of process techniques such as e.g. gate strain, high-k, metal gate materials in the transistor gate; and more recently, transistor 3D architecture called multiple gate FET (MugFET) or FinFET.

On the near horizon, new channel materials, such as III/V Germanium, will also enter into manufacturing to benefit performance and power of devices. Additionally chip and system-level architectural and software design "Equivalent Scaling" such as SRAM memory architecture, CPU multiple-core, and power software management will enabled the chips, limited by slower voltage decreases and slower speed of operation, to still achieve the needed low power and high performance which are requirements of centralized Communications and Cloud Computing high performance and also the portability and mobility low power of the latest and future market applications. (ITRS, 2013)

2.4. Lithography

Lithography being a key technology for further implementation of the ambitions targets merits some attention.



Lithography TWG DRAM and MPU Potential Solutions (IBM, 2013)

Single optical exposure has reached its limit at roughly 40 nm half-pitch (hp) using 193nm wavelength (ArF) exposure tools. Today Flash devices with 32nm hp are manufactured using double patterning (DP) techniques to reduce half-pitch while keeping the existing exposure NA and wavelength.

For even smaller dimensions, extreme ultraviolet lithography (EUVL), multiple patterning (MP) or some non-optical lithography must be introduced. EUVL, which uses light with a wavelength of 13.5nm, is the clear preference of the semiconductor industry for patterning smaller dimensions. EUVL has been gaining significant momentum with several manufacturers running early EUV pilot lines and some manufacturers have announced plans to purchase production tools to be soon. The key technical issue remains whether power EUVL will be ready on time.

2.5. Emerging Technologies

2.5.1. Nano-imprint and e-beam direct write.

Further alternatives emerging technologies are nano-imprint and e-beam direct write. Nano-imprint is a technique like embossing. It requires onetime masks and has stringent defectivity needs since it is a contact printing technique.

Direct write e-beam is a mask-less lithography (ML) technique. Since masks can be quite expensive, direct write is especially appealing for prototyping and for small production volume parts. The biggest challenge is achieving sufficient throughput. Both technologies are under development, but none is yet available for use (ITRS, 2013).

There are prototype tools available, but so far, the semiconductor industry has not bought many of them. The key issue seems to be defects, especially defects after using a patterning template for many wafers.

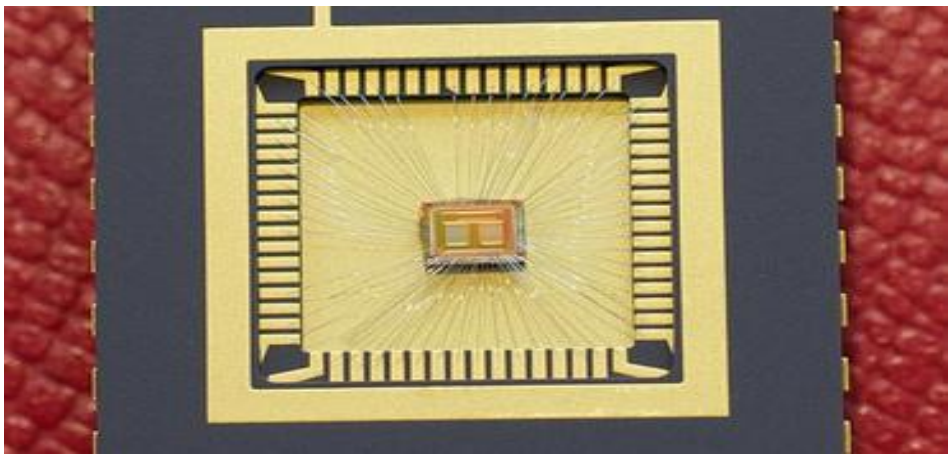
2.5.2. Directed Self-Assembly (“DSA”).

As the costs of lithography continue to escalate, a viable and complementary alternative may emerge in the form of directed self-assembly (“DSA”). In lithography, all the information for the patterning is transmitted “top down” from the mask, but cost scales with complexity. The DSA approach uses a “bottom up” chemical approach, similar to that used in nature, to drive complexity with a potentially compelling cost of ownership. (Wild, 2012)

In the long range, we have promising technological options ranging from carbon nanotubes to graphenes and the ultimate hope for quantum computing techniques.

2.5.3. Phase-Change Memory (PCM)

IBM's research division has announced a huge step forward in memory technology that could make existing Flash technology redundant. (2011). A PCM system is able to write and read data 100 times faster than Flash memory, and can carry out at least 10 million write cycles, compared with the 3-30000 cycles available today



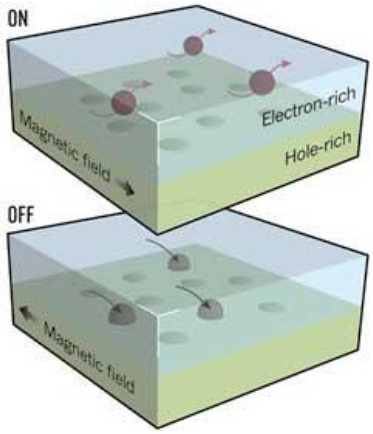
[IBM]

The PCM technology uses precise measurements in electrical resistance across materials to store and process multiple data points within a single memory cell, as opposed to single unit storage in use today. It is capable of storing four-bit combinations in this way – 00, 01, 10, and 11.

The announcement comes at a good time, as many analysts are worried that current memory technology is running out of steam on an engineering front. Architecture sizes are approaching as low as they can go, and the PCM system could offer a way forward.

2.5.4. Magnetic devices

You find not only electric field devices are in the research portfolio, but also new magnetic devices. In a circuit made of the semiconductor indium antimonite, a magnetic field can lift electrons over positively charged holes, switching the device on, or deflect them into the holes, turning it off.



[Nature magazine]

2.5.5. DNA Storage

There are two kinds of information to start with. The 0s and 1s that composed the digital version of the book, and the four chemicals in which DNA codes its genetic instructions: adenine (A), guanine (G), cytosine (C) and thymine (T).

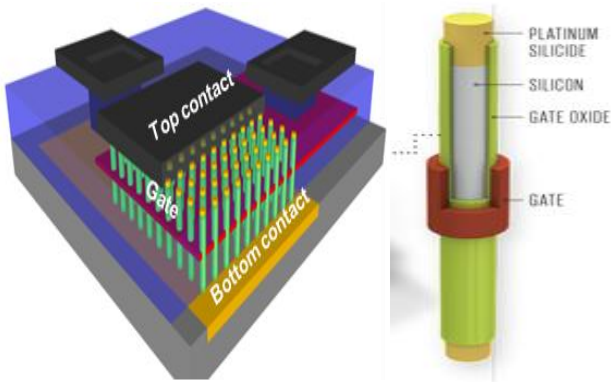
Next, the researchers translated the zeros into either the A or C of the DNA base pairs, and changed the ones into either the G or T. Then, using now-standard laboratory techniques, they created short strands of actual DNA that held the coded sequence, almost 55,000 strands in all. Each strand contained a portion of the text and an address that indicated where it occurred in the flow of the book. What they ended up with was a viscous liquid that held a billion copies of the book, could comfortably fit into test tube and could last for centuries without requiring, say, extreme precautions to preserve it, unlike some other experimental forms of storage. You can drop it wherever you want, in the desert or your backyard, and it will be there 400,000 years later. (Church, 2012)

The above developments come in addition to the ongoing R&D projects reviewed in previous lectures.

Large amounts of data create an additional demand for adequate processing performance. This development of storage technology is paralleled by processor technology.

2.5.6. Nanowire transistors

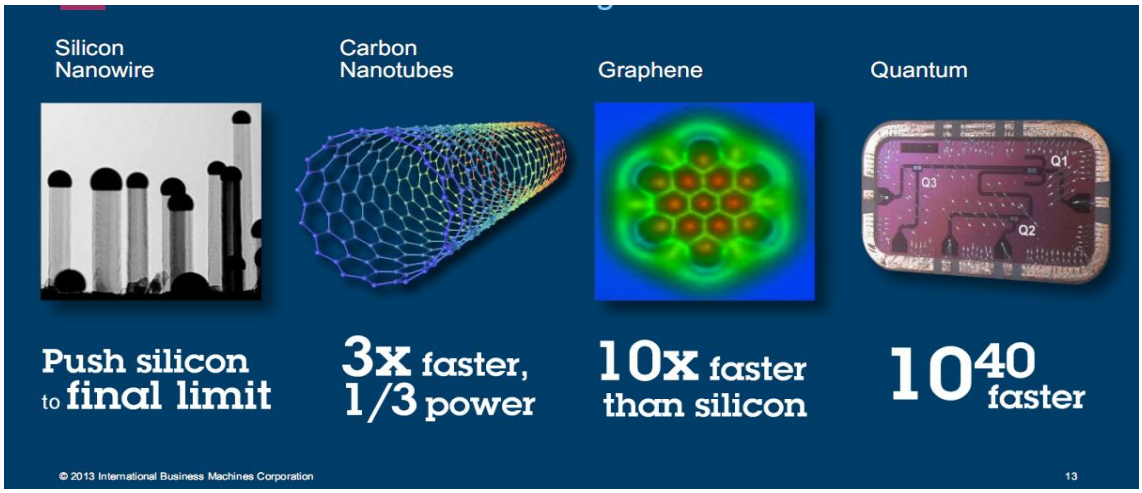
In parallel efforts as 3D-Nanowire transistors are made to keep Moore's Law alive. Researchers are additionally trying to develop ways to produce gate-all-around devices



The above diagram of a 3D nano-transistor is showing the gate surrounding the vertical nanowires and separating the contacts at the ends of each nanowire (Han, 2012).

It consists of an array of 225 doped-silicon nanowires, each 30 nm wide and 200 nm tall, vertically linking the two platinum contact planes that form the source and drain of the transistor. New is also the gate: a 14-nm-thick chromium layer surrounds each nanowire midway up its length. (Hellemans, 2013)

Summarizing, we see a promising array of future technological opportunities emerging.



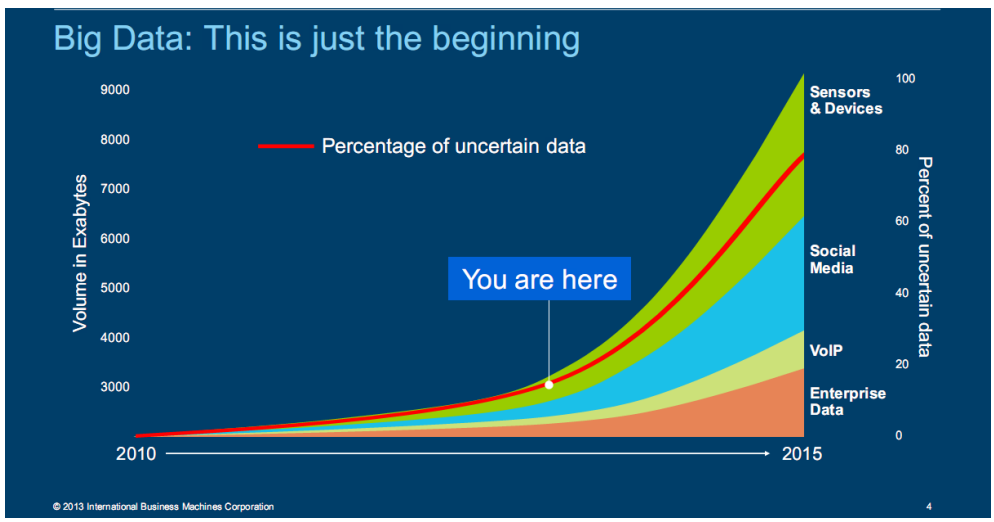
[Atomic and Nanoscale Logic, IBM]

Having perused some of the developments in the area of technology let us turn to emerging paradigms.

3. Emerging Paradigms

3.1. BIG DATA

The exponentially increasing amount of data made memory technology emerging as enabling key technology to future developments as Big Data. But this is just the beginning.



[IBM Investors briefing 2013]

3.2. Cognitive Computing

WATSON victory is the well known example. Jeopardy! was selected as test of the machine's capabilities because it relied on many human cognitive abilities traditionally seen beyond the capability of computers, such as the ability to discern double meanings of words, puns, rhymes, and inferred hints. All these combined with extremely rapid responses, and as the ability to process vast amounts of information to make complex and subtle logical connections.

- Jeopardy Quizshow in the US
- Capability to answer questions in natural language
- 4 years research project
- Human contestants were the two top Jeopardy winners

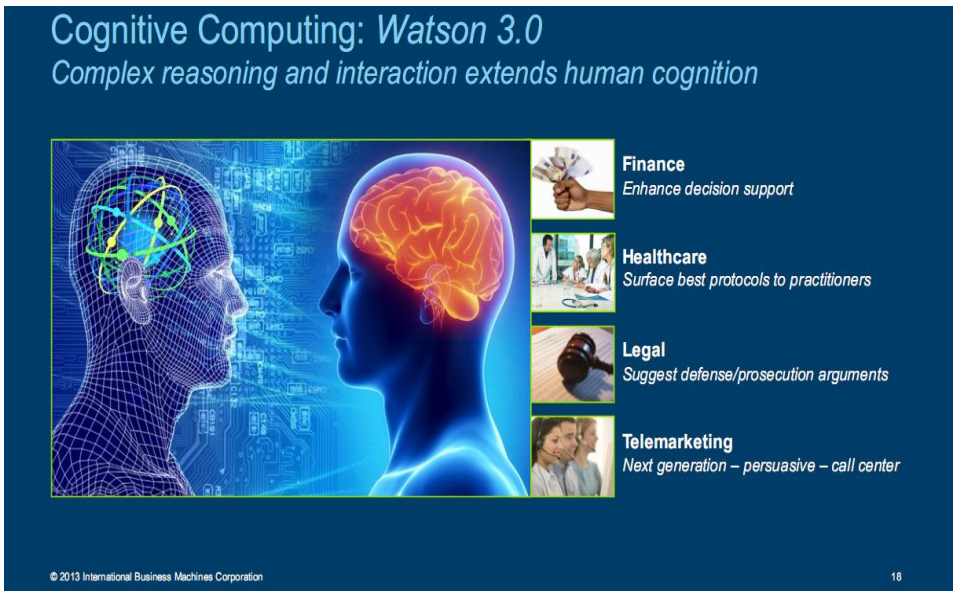
- 90 P570 systems
- DeepQA with 2880 processors
- 16 TB of memory
- No Internet connection allowed
- 200 mio pages scanned in
- Price money:

Winner: $1 mio, 2nd: $300K, 3rd: $200
Contestants give 50%, IBM 100% to charity

To meet this challenge, the Watson team focused on key capabilities as:

- Natural language processing,
- Hypothesis generation, and
- Evidence-based learning.

The technology behind Watson relies on analytics to understand what is being asked, to crunch through massive amounts of data and provide the best answer based on the evidence it finds. The success in Jeopardy triggered the search for new areas of applications:



[IBM]

4. Summary

We can be looking forward to another decennium of further continuation with fascinating alternatives emerging parallel to a consumer oriented, Big Data, and cognitive computing enriched scenario.

We will find Computing Everywhere, Unnoticeable, More Intelligent, and User oriented!

References

ARM Annual Report 2012, May 2013

Herbert S. Bennett, National Institute of Standards and Technology, John J. Pekarik, IBM, Margaret Huang, Freescale Semiconductor Communications Future Fab Intl. Vol. 36, January 2011

Church, The Wall Street Journal, Aug. 2012

FUTURE FAB, 2010 and 2012

X-L Han and G. Larrieu, CNRS, 2012

A. Hellemans, Apr. 2013.

P.A. Gargini, ITRS Issue 44

IDG Connect, 2012

INTEL Annual report, 2012

IBM Annual report, 2012

IBM Investors briefing, 2013

Global Technology Outlook IBM, May 2012

ITRS roadmap (ORTC) 2012, updates 2013

McKinsey Global Institute, May 2013

McKinsey Global Institute analysis, 2012

Pushkar P. Apte , Pravishyati Inc.,2012

Geoff Wild, AZ Electronic Materials, Apr. 2012

ZDNet 8815952, April 2013

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