



Department of System Analysis
University of Economics, Prague



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Responsible development of systems

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Responsible development of systems

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ALEXANDER GALBA

PREFACE - RESPONSIBLE DEVELOPMENT OF SYSTEMS

In the 20th and 21st century the limited human psychological, intellectual and physical abilities have been substantially transformed by sophisticated technologies. Some even say the human species in its current form does not represent the end of its development, but the beginning of a new evolutionary era based on technologies. However, the rapid development of technologies that overcome human limitations should be accompanied by the study of potential dangers and benefits of such technologies.

Science and technology reduce poverty, disability, malnutrition and improve the human body at the individual level. The quality of life is increased and mental and physical barriers are eliminated. Some scientists even think people can enhance themselves beyond what is naturally human. Artificial intelligence, virtual reality, 3D printing, internet of things etc. are the promises for the future.

Other thinkers are also concerned with the possible dangers of extremely rapid technological change and propose options for ensuring that advanced technology is used responsibly. There are existential risks to humanity's future welfare, including ones that could be created by emerging technologies. To name just a few of them, we are facing the problems of digital divide, social alienation, loss of privacy, lack of autonomy and creativity, unemployment etc.

We should responsibly design and implement new technologies and carefully watch the effects and implications of our technological development to support its potential and minimize its risks for human beings.

THE LIFE CYCLE OF MEDICAL IMAGING TECHNOLOGY

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ABSTRACT

Knowing the life cycle of medical technologies plays a crucial role in the continued performance of medical technology used to treat and cure patients. To this end, we analyzed the characteristics of the non-invasive medical technology lifecycle, taking as a case study the medical imaging technologies (MIT). This paper examines this issue in a chronological manner, starting from the discovery of X rays (1895), the origin of the first medical imaging technology or computer tomography (CT) up to the modern hybrid medical imaging (PET CT, PET MRI). PET represents the positron emission tomography, and MRI is the magnetic resonance imaging. Thus, it has been identified the stage of MIT (CT, PET, MRI, PET-CT, PET, MRI) life cycle and found that traditional imaging (CT, MRI, PET) suffered multiple incremental improvements over time, currently being in a mature stage, while in the coming years it is expected to enter into a slow decline due to the increasing use of the hybrids (PET-CT, PET-MRI). The life cycle of medical imaging technologies is found in various stages: a) initial phase for PET-MRI, b) growth phase for PET-CT and c) the maturity phase for CT, MRI and PET, taken separately. MIT hybrid type revolutionized medical technology that has not changed in its essence for 40 years, relying only on incremental changes.

KEY WORDS

life cycle of technology, medical imaging, non-invasive medical technology, MRI, PET, CT scan.

INTRODUCTION

Medical technology has been defined by the World Health Organization (WHO) as "the application of knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and to improve quality of life" (http://www.who.int/topics/technology_medical/en/).

Medical technology runs through four phases to marketing (Hazarika, 2013): Phase 1 - initial preclinical studies or laboratory which do not involve human subjects; Phase 2 - studies on small groups of human volunteers; Phase 3 - studies on large groups of patients, more research centers, to determine the efficacy, benefits and risks arising from the new technology; Phase 4 - studies and post-marketing analysis, follows the evolution of technology during the entire life cycle. These phases are tightly controlled by government authorities in each country.

There are two main features (Hazarika, 2013) important for medical technology development:

The first characteristic is that technological innovation in the medical field is a cumulative process. Progressive changes or modifications in the basic knowledge of certain technologies (incremental) at some point, not very different from existing versions, over a long period of time, give rise to radical results in many areas. In the scanner case, based on X-rays, subsequent amendments were gradual, but within six to seven decades of research in various fields, including computers, have created a new brand of technology based on X-rays, known as CT scan (computer tomography).

The second characteristic considers that a new technology can come from a discovery or the development of a technology that originally had a particular purpose or no medical purpose. For

example, medical magnetic resonance imaging (MRI) has its origins in basic research in physics on nuclear magnetic resonance (Hazarika, 2013).

In addition, in TIM case, computers hold an important role and computer technology is used to produce 3D images, to visualize anatomical structures and physiological delimitation. 3D images and the obtained data are sent to PACS (Picture Archiving and Communication Systems) network. PACS is a combination of hardware and software used for the storage, retrieval, management, distribution and presentation of images. Universal format for storing and transferring images is DICOM PACS (Digital Imaging and Communications in Medicine). The basic components of the PACS system outlined in Fig.1 are: a) a PACS server that consists of a computer (server) with large storage space on hard disk for data input, b) software for transfer and archiving of DICOM images and c) a PACS Client consisting of a computer with specialized software (DICOM viewer) to view the image in DICOM format. (<http://www.service-it.ro>, 2016).



Figure 1. PACS system for processing storage of images provided by the MIT .

THE LIFE CYCLE OF TECHNOLOGY (LCT)

The life cycle of a technology describes how the technology influences the life stages of products and the impact of technology in the business of research and development stage, including the stages of growth, maturity and the decline to technology. Life cycle describes also the commercial gains of a technology incorporated into a product or process. The life cycle of a technology actually describes the time travel of that technology. The technology is born and grows up to its inevitable decline and eventually to death.

Understanding the life cycle of a technology helps to predict the ability of recovering the investment made for the development of such technologies, and when to plan new projects. Thus, the life cycle of a technology is a useful tool for estimating future development of a specific technology and to take the decision of whether or not to invest in it.

The S-curve of technology's life cycle. S-curves are usually connected to "market adoption". The S curve concept is applied to the life cycle of technology and seeks to limit the performance that can be achieved by technology, as the performance may increase continuously and indefinitely (Cristensen, 1997; Foster, 1986a, 1986b; Ng et al., 2015; Sahl, 1981; Schilling, 2013; Sung, et al., 2015; Taylor and Taylor, 2012; Utterbach, 1994).

In **Fig.2a** is plotted the technology performance against the amount of effort and/or the money invested in a technology. It shows initially a slow improvement in performance, followed by an increase, then a decrease in performance. Improving performance in the early stages of technology is slow because the fundamentals of technology are still not well understood. But with a better understanding of technology, it begins to accelerate improvement, increasing the performance per unit of effort. At one point, the technology will reach its inherent limits.

Fig 2b shows the S-curve of lifecycle technology that signals a possible discontinuity in an emerging technology that replaces a mature technology. The beginning curve highlights the birth of new market

opportunities, while the end of the curve shows the death or obsolescence of the technology market. Usually at the end of an old S-curve emerges a new S curve. For example, the endoscopy invasive diagnostic is replaced by the non-invasive diagnosis based on medical imaging. In this situation there is a "breakthrough" technology in medical technology. Technological progress will generate a succession of S-curves. In Figure 2c an S-curve is used to describe the spread of technology.

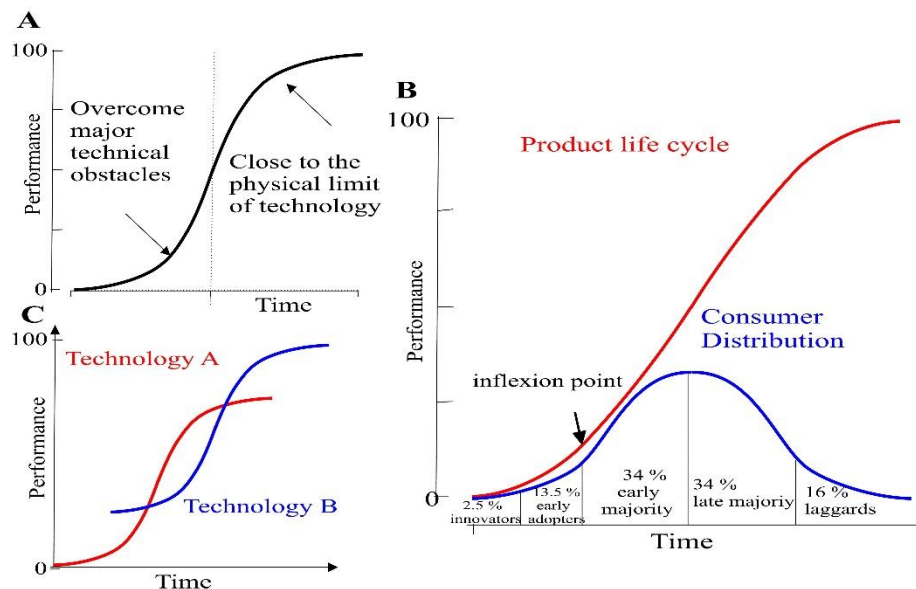


Figure 2. A. S-curve improves the performance of a technology. B. Technology adoption curve vs. S-curve. C, Double S curves describe the transition from one technology to another.

Unlike the S curve used to show performance technology (Ng et al. 2015), the S curve used to show the diffusion of technology is obtained by plotting a cumulative number of adopters of technology over time. Adoption is slow initially, when a new technology is introduced on the market and accelerates as the technology is better understood and used in mass until the market is saturated, so the rate of adoption will be in decline. Managers can use the model of S-curve as a tool to predict when a technology reaches its limits and it is used as a guide in the timing of when a company should move to a new technology or identify radical new technologies. S curve model limitations as a tool bar are:

1. First, it is rare when the true limits of a technology are known in advance, and there is a considerable disagreement among companies about the limitations of the technology;
2. Secondly, the S-curve of a technology is not set in stone. Unexpected changes occurred in the market for components and complementary technologies can shorten or extend the lifecycle of existing technologies;
3. Furthermore, the firms can influence the shape of the S curve through their activities of scientific research and development.

MATHEMATICAL MODELING OF LIFECYCLE TECHNOLOGY

The precise form of LCT depends on the type of product's sales curve, market, product policy, specifically the marketing mix and competition (Ionescu, 2014). The various analyzes carried out on concrete data sets revealed that such curves correspond to an exponential function $Y(t)$ as:

$$Y(t) = kt^a e^{-bt}$$

where $Y(t)$ represents the sales at time t , a and b are specific parameters of the product and market (**Fig.3**).

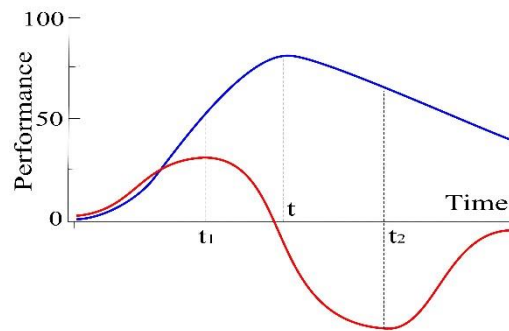


Figure 3. Features of the life cycle of technology (Ionescu, 2014).

THE STUDY OF THE LIFECYCLE OF MEDICAL IMAGING TECHNOLOGIES

Innovation in the field of X-rays has led to changes in the organization of healthcare in all countries, the specialty of radiology was established officially in 1930. X-ray Technology (Fig. 4) diffused rapidly and continued to generate the largest MIT income. Since the discovery of X rays, the new MIT are relying on the experience of the previous generation of potential adopters. New users of CT scanners had expectations based on their experience with X-ray scanners and the new users of MRI have expectations based on their experience in using the CT scan type.

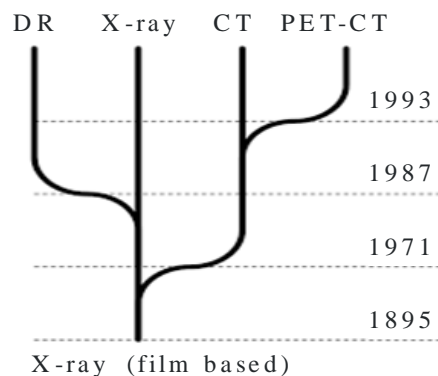


Figure 4. X-ray Imaging (Ng et al. 2015).

Medical imaging with computed tomography (CT). CT scanner is a diagnostic tool that combines X-ray equipment with a computer and a cathode ray tube to produce images of cross sections of the human body. In the early stages of this technology a large sum of money was spent on research and development and required many years to produce the first commercial prototype, which was marketed by company EMI Co. in 1972. Since then the technology underwent many incremental improvements (Figure 5) and is currently leading the seventh generation of CT scanners (Gould, 2014; <http://www.imaginis.com/ct-scan/brief-history-of-ct>; <http://www.impactscan.org/CThistory.htm>). Once the technology has reached a certain level of development, know-how and expertise began to spread. The S curve of this technology diffused rapidly because of the existence of a vacuum to market area; at present this technology is in a mature stage. Statistical data on this technology market in recent years shows that it is in balance with very small oscillations, the S-curve in the coming years is expected to show a decline of this technology.

Medical magnetic resonance imaging (MRI). MRI is the innovation in the field of medical imaging based on magnetic resonance imaging. The first image produced by an MRI scanner type Lauterbur was obtained in 1973. Prototypes of MRI scanners have been developed in the United States, England and the Netherlands, at the end of 1977 (<http://www.two-views.com/mri-imaging/history.html#sthash.TZ4MCV>

xg.dpbs). In 1980 it began the marketing of MRI scanner. Despite its technological potential, the initial distribution of the MRI scanners were slower than of the CT scanners. The cause of this situation is the existence of partial similarity of images obtained by the two types of technology, and the higher cost of MRI scanners compared to the CT scanners and the fact that new technology principles were not well understood (Brusco, 2015).

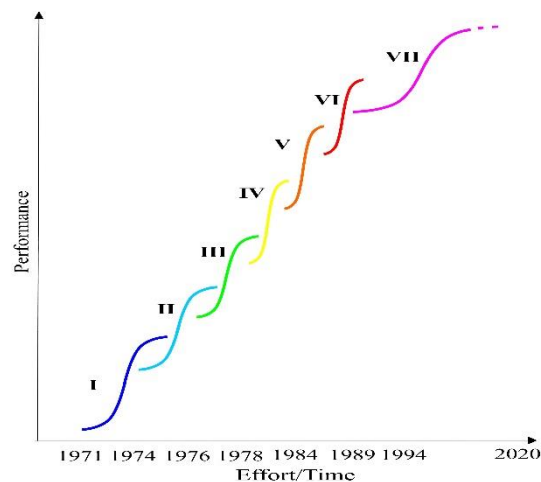


Figure 5. Multiple S curves on the evolution of computerized tomography (CT).

The introduction and dissemination of this technology were slowed because of the economic recession of the early 80s and after this period it was recorded a growth in MRI market (U.S. Congress, Office of Technology Assessment, 1995). Between 1993-1997 there was a slight slowdown in the adoption of MRI (Baker et al. 2004, 2008), because of the introduction of health care management activities in the US. But with a deeper understanding of the technology, its dissemination begins to accelerate. After 1997 this technology has been on the upward curve. MRI over time suffered a series of incremental improvements (Figure 6), achieving scanners increasingly more efficient, from 0.5 T (Tesla) to 3 T, while in the evaluation phase are the 7 T and in the research phase the 11,5-20 T (Garbutt, 2016). In the coming years it is expected a slow decline of this technology.

Medical imaging by positron emission tomography (PET). PET is a functional method by which images are created through isotopically labeled molecules with positron emission, which restores the body's biochemical processes. In 1953, the first PET image was obtained. The first PET scanner type was built for human studies by Edward Hoffman in 1973 (Hoffman et al., 1976; Hunter, 2016). In 1975 was commercialized the first PET scanner, since until now these PET scanners have undergone incremental innovations to improve performance.

Imaging technologies (CT, MRI and PET) provide information about the operating status of the body via a visual display. The three technologies had undergone incremental innovations, currently being in the mature stage of the LCT.

Hybrid medical imaging. In the late 90s there was a new approach to medical imaging, the hybrid medical imaging (Wagner, 2007). This type of imaging is defined as a fusion of two or more MITs in one new form of synergistic imaging (PET-CT, PET-MRI).

Hybrid imaging PET-CT. In 1999, it appeared the first prototype of hybrid imaging PET-CT, built by combining PET scanners PET with CT, that obtained images of functional (PET) along with morphological information (CT) within the same image (Fig. 7). The first hybrid scanner PET-CT was sold in 2001. Over the decade, this technology was improved by incremental innovations, this hibid is currently in the growth phase of the life cycle of technology (<http://www.itnonline.com/content/philips-showcases-nuclear-imaging-solutions-snmimi-2016>)

Hybrid imaging PET-MRI. PET-MRI is a high technology product obtained by incorporating PET scanners in MRI devices with magnetic field (Tesla) (figure 7b), resulting in the most accurate medical diagnostic imaging device. Development of hybrid PET-MRI in a single system started in the late 90s.

After a period of 15 years PET-MRI is available for sale. In 2008 it was created the first hybrid PET-MRI prototype by Siemens. In 2012, the company MR Solutions Ltd. developed the first PET-MRI scanner, the world's top high-performance magnetic field 3T. A stronger range than 7 Tesla followed in 2014 (<http://www.itnonline.com/content/philips-showcases-nuclear-imaging-solutions-snm-2016>).

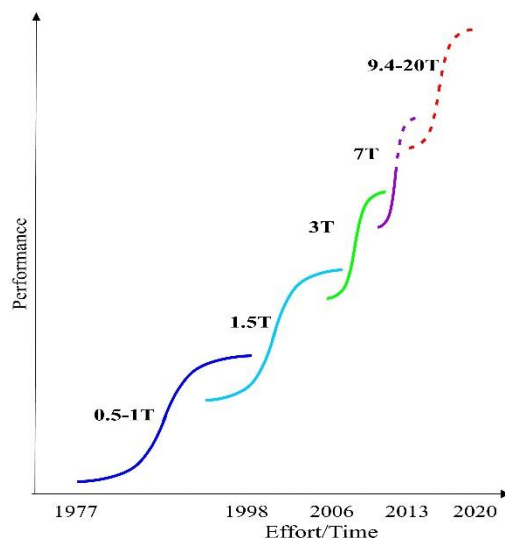


Figure 6. Multiple S curves on the evolution of magnetic resonance imaging (MRI).

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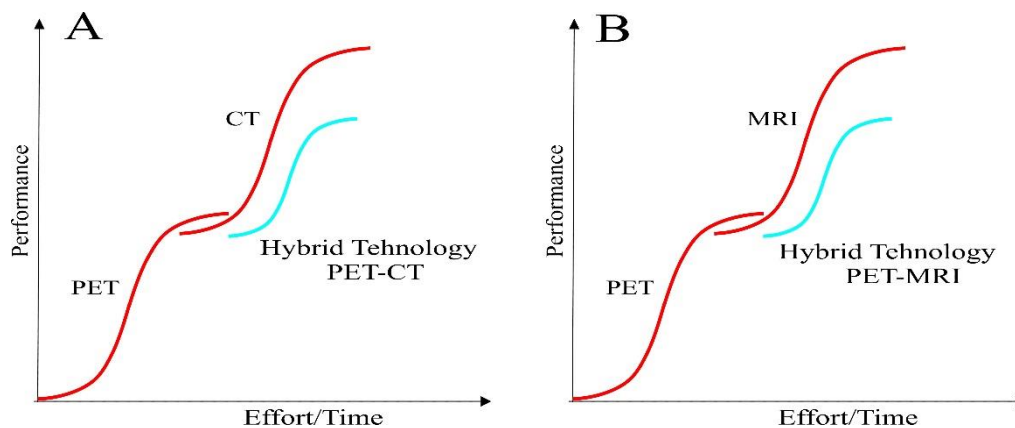


Figure 7. MIT S-curves for hybrid technologies PET-CT & PET-MRI.

Initiation of PET-MRI integration was based on the huge success of the combination of PET-CT. One of the reasons for the slow progress of this hybrid is the complexity of the technical integration of PET and MRI due to the presence of magnetic fields (<http://www.itnonline.com/content/jury-still-out-effectiveness-petmri-versus-petct>; <http://www.mrsolutions.com/news-events/news-item/mr-solutions-introduce-worlds-first-commercial-range-simultaneous-petmri-preclinical-scanners>) and another is the high cost of a PET-MRI scanner. Currently, hospitals are facing substantial costs for procurement of integrated PET-MRI technologies, including the construction or renovation necessary to match the physical demands of the combined system and installing medical equipment required during imaging procedures. This new hybrid technology has been accepted by innovators and early adopters, being now in "chasm" phase (Figure 8), and to overcome this obstacle is necessary to develop a market strategy so that to pass the early adopters and the technology to survive in order to enter the market. This technology

is in competition with the hybrid technology of PET-CT, these two technologies are found in a situation similar to that in the 80 -90, when MRI and CT scan competed.

THE ROLE OF LIFECYCLE ADOPTING TECHNOLOGY (LCAT)

It has been shown how to make the transition from a market dominated by a few customers (early visionaries) to a mass market dominated by a large group of customers who are pragmatic in orientation (Moore, 2014; Rogers, 2003). M. Rogers classified the technology life cycle stages as relative percentages of customers which adopt the technology in each stage. Initially are the innovators (2.5%) and early followers (13.5%) who are primarily concerned with the underlying technology and its performance. Then, comes successively the early majority (34%) and the late majority (34%) and finally the skeptics (16%); all of whom are more interested in solutions and comfort. Lifecycle on the adoption of technology takes the form of a bell curve used to understand how the acceptance of new technologies takes place. G. Moore relying on work by M. Rogers introduced the concept of chasm (fig. 8; gulf), that is located between the early followers and early majority, and it describes the point where a new technology "dies" or "survives", when it may or may not disappoint the adopters of new technology, depending on the performance of this technology to obtain revenue through its sales.

In 1995, Gartner coined the term "hype cycle" for the route of the new technologies-from the occurrence until maturity. Cycle expectations (hype) show the events happening around the introduction of new technologies or the discovery/innovation, tip inflated expectations, disillusionment (low confidence), lighting (slope productivity) and the plateau of productivity (<http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp>; Fenn, 1995). New technologies undergo through a cycle of adoption, when early adopters will adopt a new technology, but it can be blocked by a vacuum. This gap is referred to as the "death valley" and overlaps with the "chasm" (gap) that is found on the lifecycle adopting technology. Companies need financial resources to develop these new technologies until the performance will generate sufficient revenues. It is recommended for continuous investing of financial resources, that crossing the chasm ("death valley") should be done by segmenting the market, creating a niche in a larger market, where medical technology is recommended by the excellence in accuracy on diagnosis of a certain type of disease (eg. oncology, cardiology or neurology) and attacking competitors on small segments through proper positioning.

It is important for references that the number of customers who buy/use the technology to be growing. Once past this gulf ("death valley"), companies can afford to focus on other market segments. Sustainability depends on overcoming this technology to reach early majority. When most early starters use the technology, the hype cycle follows a slope of enlightenment (productivity), which will positively influence the decision of others to adopt this technology. Most late adopters (skeptics) then begin to adopt the technology.

Traditional medical imaging technologies CT, MRI and PET are shown when the maturity curve S, being adopted with delay (by skeptics) on the life cycle curve of technology adoption and along the cycle expectations (hype) is on the productivity plateau. It is expected to enter the decline phase, but this will happen slowly (Fig. 8).

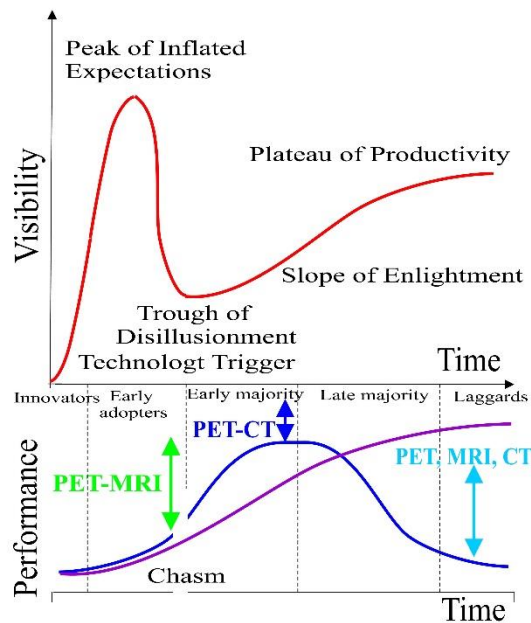


Figure 8. Hype cycle curve vs. S-curve LCAT and medical imaging technology

Hybrid medical imaging technologies PET-CT & PET-MRI. PET-CT is in the growth phase of the S-curve, adopted by the early majority and it is at the time of adoption by most late adopters in the life cycle curve on the adoption of technology, while along the cycle expectations (hype) is located on the slope of productivity (Fig. 8). Progressive development of this type of technology has the opposite effect on traditional TIM, increasing the pace of their decline.

PET-MRI is in the beginning phase of growth on the S-curve of the life cycle curve for adoption of technology, when it is accepted by early adopters and is facing the abyss. It should pass this stage to be adopted by the early majority and the expectations over the cycle (hype) that is in front of the "death valley"/low confidence (Fig. 8). It must exceed this valley in order to be on the slope of productivity, the future evolution of this type of technology depends on medical performance increase, medical cost reduction and the financial resources invested by government authorities, public companies/private and public.

In recent years, policymakers are trying to gather information about emerging medical technologies and healthcare before they reach the market. Pre-release information on the cost-benefit, risk, effectiveness are modeled (influenced) by mechanisms regulating medical devices and health technologies. There are government agencies, consortia of stakeholders who are actively involved in healthcare technology assessment (HTA). Companies that come with new technologies must know this trend and be prepared to overcome this obstacle. A strategy needs to be designed so as to survive the early adopters and technology would enter the market. In this situation is the hybrid PET-MRI technology (Beyer et. al., 2010; Kalamis, 2014a, 2014b; Vandenberghe et al., 2015). Global medical imaging market is expected to grow from 731.9 million dollars in 2015 to 1.0529 billion dollars respectively in 2021 at a CAGR of 6.30% between 2016 and 2021 (Fig. 9). The clinical use of medical imaging has grown rapidly in all phases of the clinical trial. This report studies the market potential of services and software for diagnostic imaging, and research and development (<http://www.marketresearchstore.com/news/global-clinical-trial-imaging-market-247software>; <http://www.marketsandmarkets.com>).

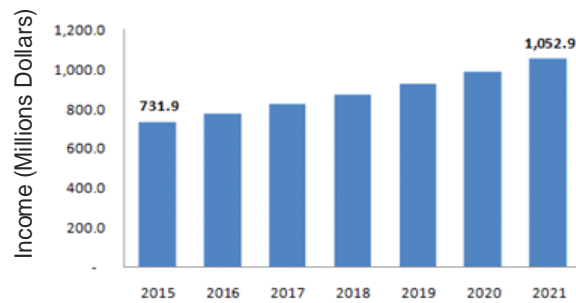


Figure 9. The global market for medical imaging during 2015-2021.
(<http://www.marketsandmarkets.com>).

CONCLUSION

Recently, medical imaging technology has become a tool increasingly specific, in both sensitivity and specificity, largely due to the creation of 3D images. 3D imaging helps significantly to understand diseases through: management, diagnosis, treatment and prevention, so that we can better assess pathology of disease and to intervene much earlier in their treatment. Accelerating the pace of innovation in medicine is inspiring hope for a better medical care. Now we can monitor the improvements in medical imaging allowing us to see even the biochemical changes that occur at the onset of disease. Medical imaging allows a broader understanding of human vision disease, by providing an accurate diagnosis. In the future, MIT innovations will play an important role in the development of medical science. In this article we studied the MIT of CT, MRI and PET, as well as the PET-CT hybrid and PET-MRI types. The life cycle of medical imaging technologies is found in various stages, like: a) the introduction of PET-MRI, b) the growing of PET-CT, and c) the maturity of CT, MRI and PET. The adoption of these technologies is carried out along a period of time, requiring preclinical and clinical studies on the efficacy and safety. Medical imaging technologies have diffused to new generations based on their previous experience. Users of CT scanners anticipated the "death valley" gap that new technologies are facing, based on their experience with X-rays; MRI users have relied on their experience in using CT scanners, while PET-MRI users were based on their experience in handling PET-CT scanners. In turn, all these technologies underwent numerous incremental innovations. An interesting case is the competition between CT and MRI, PET-CT and respectively PET-MRI. These differences can be summarized in four basic categories: i) scanning technology, ii) targeted anatomical region suitability, iii) safety, and iv) cost considerations. MITs are advanced and reliable technologies that have distinct advantages, but also have some disadvantages to be taken into account in the design and the development of elements for study protocol acquisition. Understanding how each technology works is a priority in designing a successful clinical trial.

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MODELING OF PEDAGOGICAL PROCESSES

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ABSTRACT

An effective management of socioeconomic systems such as educational ones in terms of system cybernetic approach predicts the usage of mathematic models combination. At some point creating of such models was an issue for the scientists from various countries for more than a hundred years. It allowed to create effective pedagogical technologies and means of teaching which includes program as well. The authors of the article suggested the model of management process learning based on the usage of the theory of machines and Kholmogorov's system of linear non homogeneous differential equations.

KEY WORDS

Management of educational systems and process, mathematical model, learning optimization.

Introduction

Management of various social systems as well as education management has been a difficult and currently important issue. Earlier, the management in the socio-economic sphere, paid attention to the scientists of many countries, in particular, the founders of cybernetic ideas of N. Wiener, W. Ashby, W. Forrester, A. Berg, V. Glushkov etc. Education – an integral part of the socio-economic sphere. Education has all the features of this area. The results of educational processes are important to society, and therefore require constant monitoring, analysis, improvement and adjustment.

The peculiarity of implementation of educational system management on the base of system-cybernetic approach is its function optimization. In other words, it is management of achieving goals to the best advantage. In order to choose the way to implement management, different options of anticipated “behavior” of such system should be compared with the help of evaluation, which characterizes the function quality or level and speed of getting closer to the global goal. In turn, such an assessment is part of the objective function or performance criterion (optimality) management processes.

The purpose of this article is to present author's interpretations of some concepts of education management and development of mathematical model to optimization of learning processes.

THE AUTHOR'S INTERPRETATION OF SOME CONCEPTS IN THE FIELD OF MANAGEMENT EDUCATION

Thesis 1. The goal function of management system in education is some formalized characteristic of effective factor of parameters functioning of the controlled object, which shows the quality of management processes implementation or level of goal management achievement. Synthesis of such function is a process of goal management formalization. The notion “goal function” is accepted relevantly and used by pedagogical society. As for the educational process, the notion has been used in publications of such researchers and teachers as G. Elnikova, V. Ortynsky, P. Tretyakov, G. Petrutchenya etc. Educational systems like all other systems (social, economic, biologic, technical etc.) are dynamic and constantly developing. Such development presupposes the changing of numeral parameters meanings of functioning and management. Furthermore, behavior correction and searching for relevant goal (goal identification).

H. Frank confirmed: “The education goal is the final behavior which is behavior of a person who finishes the educational process, regulated by a teacher or educational curriculum”. He explained the process of education goal achievement as formation of complex of relevant professional behavior depending on a certain concrete situation. As for the fact of education goal achievement, he suggested to implement with the help of making control of professional actions in certain simulated situations which may occur in the future practical activity of a graduator (Frank, 1969).

Human role definition is important in terms of education system control which has been created and functioned according to the satisfying the requirements of separate individuals and the whole social groups. Learners are the elements of this system as well. One of the main requirements to the control systems in social sphere is behavior adaptation for high level support of working life and effective functioning. And people are inherent properties that best contribute to the adaptation of control systems, namely:

- to change the programs and action algorithms quickly;
- to take effective decisions in cases with insufficiency of meaningful information about the controlled objects and environment;
- to find the most appropriate behavior pattern in abnormal and crisis situations;
- to get rid of definitely unacceptable decisions.

Along the numerous scientific researches it was proved that a person is the most flexible element of any system. That is why integration of control is quite natural and essential condition of success achievement in terms of social control implementation. Emelyanov S. и Nappelbaun E. pointed out the social systems in the following way “...the specific feature of conscious behavior is the result of planned or unplanned outside or inside formation. Moreover, they are always more complex than preconceived idea on the level of planning and formation. There are always unpredictable phenomena in behavior which cannot be predicted with the help of analysis and studying of separate elements function without paying attention to the interconnection between them (Emelyanov, 1981).

Thesis 2. The condition of educational process or system is a complex of meanings of their parameters which describe the most important aspects of “behavior” from the point of goal achievement (functioning). Such explanation of this notion emphasizes the researchers` choice of peculiarities complex which describe the system condition depends on the fixed target beforehand. In other words, the goal and its achievement have been an effective criterion of parameters choice characterizing the education process and systems relevantly. Their evaluation (meanings` identification) have been carried out occasionally, whereas the process of identification (evaluation) corresponds to the previously established procedure.

Educational system has been dynamic though its condition doesn't change with the influence of cause-and-effect connection. In case the system condition doesn't change for a certain period of time it's called

static. Educational systems can be relatively static due to their condition being artificially “fixed” or some deliberate idealization of the situation.

Thesis 3. The situation in education (pedagogical situation) – it a formalized description of quite changeable environment of educational (pedagogical) system with the help of parameters complex, fixed (evaluated) in a certain period of time. In terms of system cybernetic approach two method of explaining the notions “situation” and “condition” are given. Those are "terminal method" and "method goal achievement". The terminal method presupposes a system reflection with the usage of “input/output” conception (in particular the notions “input situation” and “output situation”). The method goal achievement concentrates on relationship two components, such as system of working out and taking decisions and situation. In addition, the situation is a system where decisions were implemented due to receiving the current information about its changes. As for the education, – it is socio-economic and political situation in the country (Glushkov, 1964).

Beforehand we suggested the authors` method of situation evaluation which is called positional. In this case the situation is analyzed depending on the place of location (position) of so called “observer” related to the system of control (inside or outside of it). An observer is an individual to the benefit of whom some processes are implemented. He is the one who determines the goals and evaluates the level of their achievement success. For instance, pedagogical society and entrepreneurship, society representatives and ordinary citizens evaluate government situation related to the current progress in education, the condition of educational processes and their role in different ways. As a rule, university teachers and students` opinion about control of functioning of process quality doesn't coincide with the evaluation of the whole society (Jablochnikov, 2011).

One of the reasons why it is so difficult to describe the educational systems and processes in a formal way is the existence of many “observers” in the sphere of education. There is a variety of opinions about the control system. Moreover, there are plenty of goals formulated by them. As a rule, the following methods of formalization are implemented to describe the changes of system condition and movement: verbal, graphic, logic, tabular, mathematic. The verbal one presupposes consequent enumeration of all peculiarities of system condition. The implementation of graphic method suggests the corresponding images of dynamic processes which are created by diagrams, graphics, phase picture etc. The logic method depicts the logic of actions and processes with the help of means of Math logic (logic equations, graphs, truth tables) and the theory of sets. Mathematic method uses mathematic models. We suggest that the above mentioned methods` complex is quite efficient. Moreover, we offer our own method of formalization – probabilistic method (or information-entropic balance), which was worked out and validated in one of our publications (Yablochnikov, 2011).

Thesis 4. Behavior of educational system – is its ability to transmit from one condition into another under certain circumstances and for a certain period of time. This notion is implemented when the rules of such kind are known beforehand. In this case it`s stated the system has behavior, character, algorithm or logic which should be defined (to work out or form its model).

Thesis 5. Equilibrium – is the peculiarity of educational system which has constant outside destabilization which demonstrates its activity in some parameters intervals or without them to keep some constant behavior for an unlimited period of time. For the majority of educational systems there should be an optimal condition of such equilibrium which develops gradually and constantly. Sudden and abrupt changes are not natural for educational systems due to the fact of being inert. The changes are harmful for systems.

Thesis 6. Stability of educational system – is its ability to return to the state of equilibrium with the help of existence of some inside reserve whilst derivation of outside indignation out of it. Complex systems possess such peculiarity when there are constant signals of control or if there are absolute signals declinations from the average meanings which don't exceed some critical level. Stable condition of equilibrium is a system with a sufficient level of relativity where it can return by itself. Along with that the condition of unstable equilibrium may exist.

Thesis 7. Management of educational processes (systems) – is a complex of coordinated and beforehand planned actions to transmit one object of control from one state (the initial state) into another (final) state which corresponds to a certain goal or moves to the goal.

Thesis 8. Management action – is a certain influence of the educational system elements on another in order to achieve a goal of having some state. Such influence can be understood as controlling influence of pedagogical, psychological, educational, administrative, economic, social character etc. As for the cognitive level, it is implementation of planned steps beforehand in terms of certain pedagogical methods (technologies), formation of learning motivation, usage of modern pedagogical technologies and means etc.

As creative control and socio evolutionary level of education sphere hierarchy, these are normative, administrative, control, financial, political influence and impact.

Thesis 9. Movement of dynamic educational system is a process of transition from some initial condition into another one which corresponds to a certain goal (global, local, transitive, current etc.) Goal achievement demands implementation of a complex of actions which can be implemented as a result of making a set of operations for a certain period of time such as:

- Getting new information about the object of management;
- Identification of its initial condition (initial parameters);
- Modeling and forecasting of process or object condition;
- Taking decision on management;
- Actions planning and their implementation;
- Evaluation of consequences of management decisions implementation;
- Comparison of planned results and establishment of the fact of achievement (or non achievement) of the goal by certain means;
- Goal correction and the beginning of a new cycle of management.

Any complex system as well as educational one is quite inertial. That is why between the moment of taking a decision about the process management (system) or the initial condition and the moment of achieving another condition because of management that takes some time. That period is characterized by periodicity of management formation actions. Nevertheless, unusual, stress and crisis situations may occur which demand out-of-order, unusual decisions or separate specific actions which can management the whole educational process. That is so called crisis or extreme management. As a rule, the goal is achieved due to implementation of a few cycles of a complex of management actions. In other words, during the movement to the goal the system goes through a set of transitive conditions which are moving to it. Implementing “movement” in n-dimensional space parameters, the controlled system describes a certain track which unites various transitive conditions relatively.

Thesis 10. Trajectory of movement of educational system is conditional line which unites a point of n-dimensional space with coordinates which correspond to transitive conditions where it is moving to the goal gradually (iteration). The system movement trajectory can be linear or non-linear which depends on conditions, methods, technologies, algorithms and means of management, the type of control system, parameters of environment, speed of development, process cycle, inner and outside factors.

Thesis 11. Space of movement of educational system – is n-dimensional informative space originated n orthogonal axis of coordinates which correspond to the complex of elected parameters by observers in order to implement the evaluation of educational system controlled part (the object of management). As for practice, 100% of orthogonal informative space parameters are impossible. The level of orthogonality is checked by the analysis of statistic data, testing of observations on possessing multicollinearity with the usage of Farrar-Glauber algorithm (criterion χ^2 , F-criterion, t-criterion) and method of the main components (Wenzel, 1988).

Thesis 12. The cycle of control of educational system – is a complex of actions implemented during dynamic educational system moving from its initial condition into the one which corresponds to its goal. The cycle may have sub cycles corresponding to transitive control management or processes of transitive (local) goal achievement. The time of control is a period of time when the whole management cycle of educational system is implemented on its way to the goal. If management actions lead to the changes of educational control system there is some function indicating correlation among parameters of controlled actions and dynamic changes (gradient) of condition parameters of the system in a formal way.

Such function has been a math model and the process of its synthesis is modeling (compulsive stage of control implementation on the base of system cybernetic approach). As for the theory of management, there is a approach of isomorphism which establishes some connection among mixed models that are isomorphic if there is one-valued transit from one model to another and vice a versa. In other case, the models are homomorphic.

Thesis 13. Math model of education (pedagogical) system (of educational process) – is a functional which unites dynamic of changes of management system (object of teaching) and parameters of controlling influence of control system with the help of mathematic. It also takes the changes of environment influence into consideration. To describe mathematic real educational system relevantly we have to implement some part of definite system of dynamic parameters which is a model of plurality of variables.

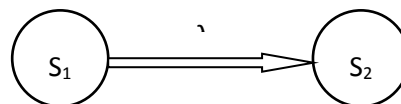
Thesis 15. The observed parameters are a complex of peculiarities of object control and environment where the numerical values can be some means. According to some moments of time they can definitely be the subject of control or the observer.

Thesis 16. Controlled parameters are a complex of peculiarities which include an effective part of goal function of educational system and acquire corresponding changes due to control process implementation.

MODELING OF EDUCATIONAL PROCESSES

According to the scientific sources, there are many *endeavours* of pedagogical system “behavior” modeling implementation and math processes implementation such as processes of learning. Quite famous models were suggested by the following scientists L. Thurstone, H. Gulliksen, R. Atkinson, R. Bush, F. Mosteller, U. Estes, K. Hall, Yu. Antamonov, V. Prisnyakov, V. Trapeznikov, V. Glushkov, V. Warshavsky, M. Novikov, L. Itelson. The authors of this article also synthesized two-goods model of pedagogical system control (Jablochnikov, 2010). In this case we worked out the model of learning process which is based on the model of H.Frank and work of Moor machine.

First of all we have to analyze the system of learning with two discrete conditions: S_1, S_2 . Constant positive parameter λ indicates intensification of transition from initial condition S_1 to the final S_2 . In other words, the system describes marked out graph of conditions which is illustrated in drawing 1.



Drawing. 1

Then as for relativity p_1 and p_2 , which characterize the dynamic of process of learning in each moment of time t , the equations are true:

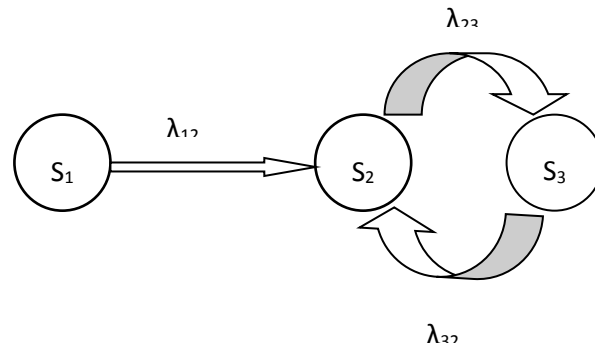
$$\begin{cases} \dot{p}_1 = -\lambda \cdot p_1, \\ p_1 + p_2 = 1. \end{cases} \quad (1)$$

Such model was analyzed from a different point of view in previous publications (Novikov, 1998, Antamonov, 1968). We have to mention that system equation solution (1) with initial condition $p_1(0) = 1$ (or the initial system condition– S_1) will be function $p_2(t) = 1 - e^{-\lambda \cdot t}$. That means after some time theoretically any learner can achieve condition S_2 , completely acquiring the educational program. Apparently, such situation is possible only for elementary basic actions where everyone is learning. Introduction of equation system instead of constant parameter λ *doesn't change* the main principle of immanency of learning condition. Actually, if we take the system of equation into consideration (2)

$$\begin{cases} \dot{p}_1 = \frac{-2t}{t^2 + 1} \cdot p_1, \\ p_1 + p_2 = 1, \end{cases} \quad (2)$$

solution of this system will be function $p_2(t) = \frac{t^2}{t^2 + 1}$, where the following is correct $\lim_{t \rightarrow +\infty} p_2(t) = 1$.

Consequently, the above mentioned models (1) and (2) don't describe the process of learning relatively. That is why the following situation occur. The situation when it is necessary to analyze the models considering three or more discrete conditions. These extra (transit) conditions reflect not complete but vice versa excessive acquisition of learners` curriculum (for instance, the intermediate level of acquisition of advanced). The system of learning is described by the graph of conditions depicted in the drawing (2).



Drawing. 2

Then the dynamics of relativity condition change and mutual transition from one into another one can be depicted with the help of Kholmogorov`s equations.

$$\begin{cases} \dot{p}_1 = -\lambda_{12} \cdot p_1, \\ \dot{p}_2 = (\lambda_{12} - \lambda_{32}) \cdot p_1 - (\lambda_{23} + \lambda_{32}) \cdot p_2 + \lambda_{32}, \\ p_1 + p_2 + p_3 = 1. \end{cases} \quad (3)$$

Presumably, the relativity at the beginning stage of learning satisfies the conditions $p_1(0) = 1, p_2(0) = 0$, then it is the solution of equation system (3) in the following functions:

$$\begin{cases} p_1 = e^{-\lambda_{12}t}, \\ p_2 = \frac{\lambda_{32}}{\lambda_{23} + \lambda_{32}} + \frac{\lambda_{12} - \lambda_{32}}{\lambda_{23} + \lambda_{32} - \lambda_{12}} \cdot e^{-\lambda_{12}t} - \frac{\lambda_{12} \cdot \lambda_{23}}{(\lambda_{23} + \lambda_{32}) \cdot (\lambda_{23} + \lambda_{32} - \lambda_{12})} \cdot e^{-(\lambda_{23} + \lambda_{32})t}, \\ p_3 = 1 - p_1 - p_2. \end{cases}$$

Consequently, if $t \rightarrow +\infty$ then $p_1(t) \rightarrow 0, p_2(t) \rightarrow \frac{\lambda_{32}}{\lambda_{23} + \lambda_{32}}, p_3(t) \rightarrow \frac{\lambda_{23}}{\lambda_{23} + \lambda_{32}}$.

In other words, there is always a probability that the system will will not transmit to condition S_3 , (for example, a learner will acquire some educational program partially but on a acceptable level (S_2)). The higher probability the more intensity of λ_{32} .

Carrying out the transition to the general math problem and correspondingly to n model conditions S_i ($i=1, \dots, n$), we get heteronomous linear system of non-homogeneous differential equations of Kholmogorov (Wenzel, 1988), which index generally will depend not only on time but also on some controlling parameters $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_k$.

Introducing the designating $\varepsilon = colon(\varepsilon_1, \varepsilon_2, \dots, \varepsilon_k), p = colon(p_1, p_2, \dots, p_{n-1})$, the system of Kholmogorov will be written:

$$\dot{p} = \Lambda(t, \varepsilon) \cdot p + L(t, \varepsilon), \quad (4)$$

where $\Lambda(t, \varepsilon) - (n-1) \times (n-1) - \text{matrix of coefficients}$

, $L(t, \varepsilon) = \text{colon}(0, 0, \dots, 0, l(t, \varepsilon))$, where $l(t, \varepsilon) - \text{scalar-valued function}$.

Components of vectorial parameter ε may reflect not only its characteristics of educational structure (such as parameters of its control), but also characteristics of some learners group such as individual characteristics of each participant of such a group.

If there is some meaning of parameter $\varepsilon = \varepsilon^*$ then it is

$$l(t, \varepsilon) = 0, \quad (5)$$

If it is $\varepsilon = \varepsilon^*$ it becomes a trivial solution $p=0$, or $p_n=1$ (probability of such program acquisition is equal to 1), as a matter of practice most likely it's not possible to achieve. Nevertheless, it is necessary to emphasize Kholmogorov's system (4) near the solution $\varepsilon = \varepsilon^*$ bifurcation equation (5), there is a possibility of completely new curves for real meanings of parameter.

Actually, let system (4) in some neighborhood of bifurcation equation $\varepsilon = \varepsilon^*$ possess the characteristic exponential dichotomy, not local continuability, existence and uniqueness of solutions, function $\Lambda(t, \varepsilon)$, $L(t, \varepsilon)$ uninterrupted and limited with their variable. Then system (4) has function of Green where solution is

$$p(t, \varepsilon) = \int_{-\infty}^{+\infty} G(t, s) \cdot L(s, \varepsilon) \cdot ds, \quad (6)$$

where $G(t, s) - \text{function of Green is limited and uninterrupted according to parameter}$ (Mitropolsky, 1990, Dalezky, 1970, Kuptsov, 1998). So, if the parameter meaning becomes less and we choose the corresponding initial data we may achieve the solution (6) close to equilibrium condition. In other words, parameter meanings can be selected in such way that probability p_1, p_2, \dots, p_{n-1} would be little. And probability p_n increases accordingly.

CONCLUSIONS

The approach of math model synthesis of educational processes suggested by the authors of the article affords to establish the complex of parameters relatively (psycho-pedagogical characteristics, personal characteristics), which make it possible to control pedagogical processes effectively according to some educational program. In this case the possibility of educational process goal achievement aims for one.

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THE SYNERGISTIC EFFECTS IN THE PROCESS MANAGEMENT OF TRADING INFORMATION SYSTEMS

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ABSTRACT

The study examined the use of features synergistic approach to trading systems. Management proposed to implement the use of information systems and process approach. The main synergistic effect is introduction in the process management and intelligent information systems. The models obtain maximum synergistic effect of management process of the trade systems. The mathematical model can determine performance indicator management of integrated information, material and financial flows in the logistics system. This index allows showing the efficiency of process management in trading systems.

KEY WORDS

Synergistic approach, the effect of economic efficiency, processes information, intelligent information system, trading system, process management.

INTRODUCTION

The question of increasing the efficiency of enterprises and their competitiveness has always been relevant. One of the resolution of these issues is the use of a synergistic approach to business management (Haken, 1993). Any company in a market economy is a specially structured and coordinated open the socio-economic system that interacts with the environment. Each socio-economic system is the social structure of the information component that tends to tune into more economical mode of operation due to the constant changes in the functions and processes. This socio-economic system to retain in its structure all compositional elements are in certain proportions, to achieve the greatest total capacity at all stages of the life cycle. Because the company for its survival must use the resources of the environment and constantly changing, adapting to external factors. The more information the company has on its internal and external environment, the greater the likelihood of its sustainable operation.

One of the main principles of effective development is the rational use of resources, which is achieved by forming synergy (Haken, 1983). Synergy Effect is effect of the joint action of all elements of the system, which increases the performance of the quality without increasing the quantity. This is because the company as an open system that is both material and information and informational material entities. As the material nature of the information the company operates to service the material basis of the system. This aimed material and energy exchange system with the environment and between different parts of the system, and information control flows of material substances in space and time. As information and material nature of the enterprise exists to implement the information functions of systems, that is to information base. Information functions include contact information between the individual components of the system. Thus, we can say that the foundation serves informational material and material - information. But it provides information component system unique look and actually makes enterprise system, creating it from the standard material blocks. The quantitative increase in each of the parameters of the system does not always mean improvement of its quality status. If the sum of the components in the formation of the system is not changed, but the quality of a whole increases, this increase is due to an increase in system volume information.

Concept of synergy in economic systems connected with violation of proportionality (Haken, 1982). Sometimes called the synergy effect of " $2 + 2 = 5$ " in order to emphasize that the company is in search of resource production and commodity-market combinations in which the resulting effect exceeds the effects components. This unit is an additional effect ($5 - 4 = 1$) which is due to synergism or synergistic effect.

It is known (Mikhailov, 1990) each organization based on the totality of its constituent elements. Thus, each element has its potential, its functions and consequently - possibilities. The task of management is to unite the efforts of individual elements into a single mechanism and system collaborates so that the result obtained exceeded the effect of single actions. A key element in some joint activities gives greater effectiveness, quality measurement that the obtained results will exceed the quantitative results in the summation components.

Result efforts on formation of commercial enterprises are known synergetic effects (A. S. Mikhailov, 1996), described by three variables: the increase in income; reduction of operating costs; decrease investment needs (due to internal effect).

In any corporate entities, there are three forms of synergy (Mikhailov, 1990). In the first form of expression understand the synergy effect association or team synergy. The second form - functional economies of scale or synergies. This type of synergy resulting from the expansion of the scale of business operations (activities). The third form of manifestation of synergies - is the effect of integration is targeted synergies. In our view, the synergy in all its forms is the main result of effective corporate commercial entities.

Based on the above, in synergistic effect management of trade enterprise will realize an increase in performance of the enterprise by integrating, integration, merger, restructuring trade processes in a single system. As a result of these changes the overall efficiency of the company will exceed the sum of the effects of each process separately through interaction processes.

PROBLEM FORMULATION

Effective performance is basing on establishing optimal proportions to use factors of trading systems, market linkages and joint responsibility of all elements of value chain for competitive products (goods and services). Important role played by development of processes involving all partners under constant external changes. The development of trading systems and their business activity involves, from our point of view, is taking into account of the basic provisions harmonization: the production and the distribution areas; form stability and environmental change; quality and value of the component distribution processes; the basic and providing functions or corresponding functions harmonies, structures and relationships trading system between the rulers or the ruled components trading systems; human relations between labor and management; interests and incentives.

In our opinion, the most important performance indicators of any commercial enterprise are the organizational level, innovation and marketing. In terms of efficient production synchronization of the buyer (and oriented to work with the customer departments) of executive and planning center management system provides different levels operational ability to identify opportunities to create competitive advantages. Violations of trade rhythm as a result of the requirements of customers, who are in real time in planning, makes managers at all levels to pay attention not only to their own activities, but also take into account the operational management of the factors of the crisis situation of the market and consumer characteristics of goods, products and services.

System related trading companies, which are basing on the account of and interaction with the buyer instead on domestic problems (Axelrod, 2000), can receive substantial benefits through systematic approach to assess the goods and services required to offer attractive market segments.

Currently manufacturers own decision on the choice of product and market niches, but these solutions tend (Davenport, 2005), isolated from executive departments system that will implement them. On the other hand, systems planning and resource management, "feel" of the market and critical information about the buyer is planning difficult for businesses and isolated as posted on various local subsystems (Figure 1).

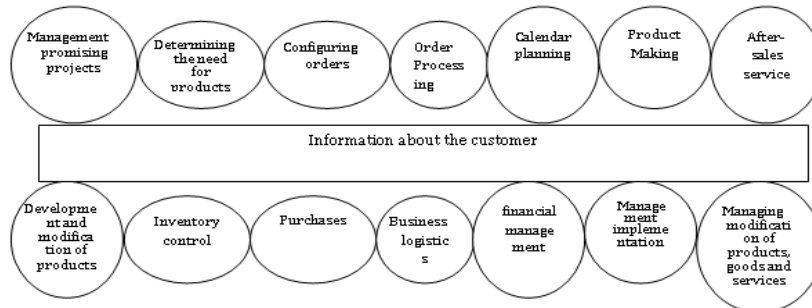


Figure 1: Customer the information system into the process management of commercial enterprise,

In terms of a civilized market with a developed legal framework made moving the focus from production planning to schedule of customer orders. Supply-side planning is a reflection of the requirements of customers (buyers) coming from units designed to work with them. Thus, business practice focused on market activity, not the production activity.

From the standpoint of process control of system approach is to ensure that the head of the process continuously or at intervals prescribed course of the process controls and coordinates decisions on process parameters, which are formed within the regulated criteria. According to the scheme of the process control algorithm (Figure 2) process manager is plan the allocation of resources to achieve these goals with maximum efficiency (Andersen, 2007). The implementation process of executing checked information, that comes from places control points. Director of operational management process is the process of changing the planned allocation of resources, changing plans, timing and requirements according to the results of the ongoing changes. Operation manager process depends on the external and internal environment. Therefore, his decision is subject to strong influence of uncertainty and requires significant of operational formalization, what is possible through the detailed process approach (Harrington, 1997).

Figure 2 is adapted algorithm trading process management information systems, which decomposes into components: strategic management of the entire enterprise from top management; case management by middle managers; operational management processes supervisors trade processes.

The approach is seen as an algorithm of actions of the head of trading process to an end. Numbers and names of elements of process control loop formed by terminology process approach in accordance with ISO 9000: 2001 (Figure 2) (Andersen, 2007).

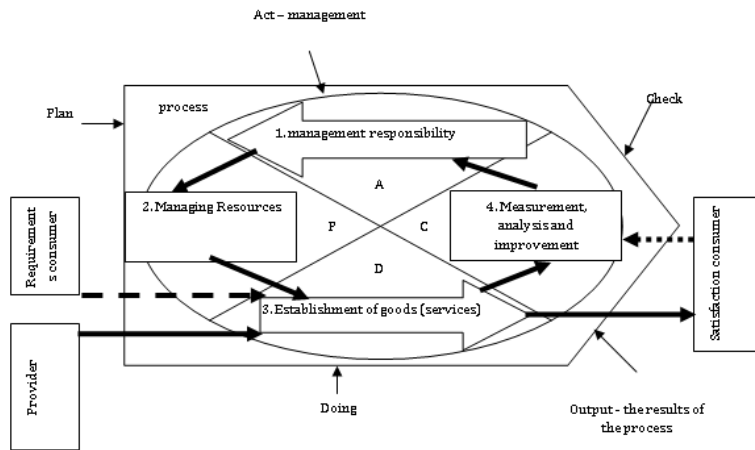


Figure 2. Adapted algorithm trade process management information system: A - active intervention in the process: C - checking the information: D - the implementation process: P - planning process. Source: Author

As used in the literature (Doomun, 2008) the term "limits of the process" establishes the area of responsibility and competence of the process. All values that cross these boundaries, "inputs", "outputs", "resources" must have its own data.

The system manages sales processes enterprise manager, which plans its activities; the responsibilities, authorities and relationships between processes. It is an analysis of the input parameters controls the process and set of commercial processes, deciding on the results of the analysis of their progress.

Thus, the top manager closes the second level of feedback management trading company. Scheme of interaction of components is showing for process management of trade enterprise in Figure 3

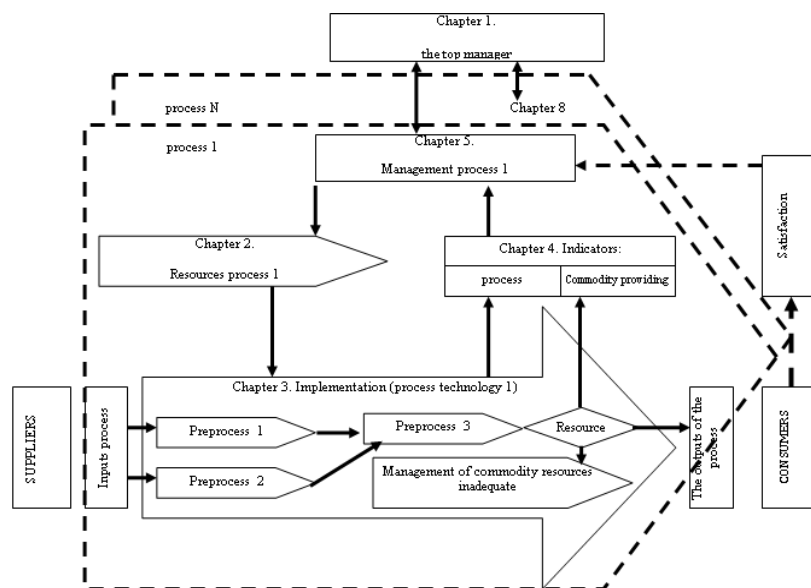


Figure 3. The scheme of interaction between the components of the trade process management information system, Source: Author based on (Davenport T. H. 1993)

(Davenport, 1993).

- According to the scheme above highlighted features such the process management of trade information system:
- commodity resources coming from the auxiliary processes outsourcing (as arrow "Resources" removed from the process);

- the ins and outs of the process depicted on the verge of the process and act as one of the signs for the formation of other processes of commercial enterprises. Input or output document is finished with quantitative indicators;
- control outputs of the process is ongoing and is one of the main sources of information on indicators (indicators characterizing the process);
- consumer satisfaction data that are outside the internal processes of commercial enterprises, but the owner of the process must have an appropriate system of data collection and use;
- limits the process should match the domain of authority, responsibility and jurisdiction of the owner of the process;
- top-manager managed all processes owned commercial enterprises.
- In this context, the manager process owned are developing the appropriate operational of cycle management, which should include:
 - the results of the monitoring process, control of commodity resources at the entrance and collect information about their performance, resource control and collect information about the performance of the whole process, obtaining timely, objective and adequate information on customer satisfaction (and in the process and preprocess sections);
 - regulated system results analysis process and approval of corrective actions;
 - the possibility of introducing amendments adopted on the basis of the description unstructured process.

Features the work and operations that make the content technology trade processes should be regulated in job, industry methodologies and standards.

THE MODELING OF BUSINESS PROCESS IN THE TRADING SYSTEM

Considering the management of trade enterprise as trade information system, the subject of our research is the system of trade and information flows in the company. As the flow of goods is guided by means of information provision based on the flow of information, goods traffic which precedes, accompanies and governs it as information procedures are also considered as a process.

The proposed engineering and process approach to effectively control the formation mechanism of trade now allow management to detail the entire economic system of enterprise management system to functional management processes from functional management to process management operation trading activities. This, in turn, means that the effectiveness of management of commercial enterprises depend on the efficiency of management smallest commercial transactions (Parmenter, 2007).

In the system of commercial enterprise, there are two types of processes: business and management. Economic processes are worth four basic trade processes: supply, the formation of commodity resources, sales, inventory. Administrative processes are worth five basic management functions: planning, analysis, accounting, control, regulation. Each of the basic management functions to achieve efficiency should be applied to the whole system, every process and every transaction.

Based on this formal description of concepts of effective management of trade now looks like:

$$GS = \sum_{i=1}^n TBP_i \quad (1)$$

$$US = \sum_{i=1}^n FUBP_i \quad (2)$$

$$TBP = \sum_{i=1}^n GO_i \quad (3)$$

$$UTBP = \sum_{i=1}^n FUGO_i \quad (4)$$

where *GS* - economic system; *TBP* - shopping business process; *US* - management system; *FUBP* - business process management functions; *GO* - business operation; *UTBP* - commercial business management process; *FUGO* - business operation management functions; *i* - quantitative characteristics.

Based on the presented concepts determine the effectiveness (bottom-up process) commercial enterprise formalized as follows:

$$E_{TC} = V_{GS} / D_{GS} \quad (5)$$

$$V_{GS} = \sum_{i=1}^n V_{TBP} \quad (6)$$

$$D_{GS} = \sum_{i=1}^n D_{TBP} \quad (7)$$

$$E_{TBP} = V_{TBP} / D_{TBP} \quad (8)$$

$$V_{TBP} = \sum_{i=1}^n V_{GO} \quad (9)$$

$$D_{TBP} = \sum_{i=1}^n D_{GO} \quad (10)$$

where *EGS* - efficiency of the economic system; *VGS* - the costs of the economic system; *DGS* - income economic system; *VTBP* - the cost of commercial business process; *DTBP* - income trading business process; *ETBP* - efficiency of commercial business process; *VGO* - the cost of business operations; *DGO* - income business transaction.

Thus, process management in a trading company as trade information system based on modeling management processes to maximize performance.

In our view, measure a synergistic effect can be the amount of income received from trading and other activities in process management of trade enterprise, less costs of rotation and "production" set the volume of trade turnover (excluding expenditure on salaries). We consider it appropriate to name the proposed measure net income of commercial enterprise.

Despite the fact that the value of net income redistribution exercise significant influence attitude (change of prices, tariffs), this indicator is most suitable as measuring the economic effects of trade. That should be noted the final economic results at commercial enterprises do not coincide with the result of the economic sector. This is due to the fact that at the enterprise level outcomes commercial activities not directly aimed at achieving national economic benefits, but they have only a partial effect. Given this, the authors recommend as an indicator of economic benefit commercial enterprises use the increase in net income, which is calculated using the formula:

$$\Delta E = [D_1 - (V_1 + K_1 * Z_1)] - [D_0 - (V_0 + K_0 * Z_0)] \quad (11)$$

where ΔE - economic impact; D_0 and D_1 - gross earnings in the reference and planning period; V_0 and V_1 - expenses rotation (excluding labor costs) in the base and the planning period; K_0 and K_1 - number of employees in the base and the planning period; Z_0 and Z_1 - average wages in the base period and expected.

In the practice of determining the effectiveness of control systems in the trade area are trying to calculate performance-based expert method. But the difficulty of expertise related to the recruitment of specialists and experts and making recommendations findings make distribution of this approach is rather limited.

In an analysis of 20 studied the relationship parametric performance management systems and studied 27 indicators of their effectiveness.

The following describes the main results of the implementation of the expert approach. This methodical analysis was conducted in three phases. The aim of the first phase were found overall trends differentiating performance management systems according to changes in their condition. This goal is quite satisfying method is analytical groupings.

The second stage is established that trend subject to quantitative description. These requirements are satisfied almost Calculation of pair correlation between changes in parametric performance management and performance of their operation.

The purpose of the third stage was a quantitative calculation of the subjective factor in the formation of final conclusions. This requirement corresponds to the method step regression analysis, which provides for selection of the most informative indicators based on the calculation of partial coefficients of determination and assessment of their significance.

Based on the analysis of differentiation of performance management systems under use different set of management can make certain conclusions. The introduction of collective forms of work organization based computer systems (25-75%), which definitely has a place in supermarkets, accompanied by the general trend of improvement of almost all indicators such as productivity, commodity turnover, resource efficiency, the impact of current assets (Table 1).

Performance indicators	Share means of information in the organization of work, %				
	Norm	to 40	to 50	to 60	more 60
Resource efficiency	100	115	125	150	170
Assets value of that advance in fixed and floating	100	110	137	145	160
Assets revolving funds	100	117	135	147	165
Assets of fixed assets	100	115	138	150	170
Productivity	100	125	150	160	180
Turnover of working capital	100	117	122	125	131
Profitability resources	100	125	133	137	145

The analysis of performance management system based on their provision of computer tools suggest that the main focus of the relationship in this case is productivity growth as the totality of workers and management staff (Table 2). Rising productivity makes revenue growth, resulting in increased profitability expenses.

The introduction of a systematic approach to managing the functionality of trading enterprise and automation of business processes accompanied by stable growth performance, resource impact, profitability use of all resources, productivity, return current expenses, turnover and working capital optimization of product flow and inventory.

The first level (D = 0,350)	The second level (D = 0,270 – 0,350)	The third level (D = 0,270)	The final phase of work to a
<ul style="list-style-type: none"> • Resources returns • Assets revolving funds • Operating ratio of a working capital • The return means that invested in payroll • The level of expenditure rotation • Consumption return 	<ul style="list-style-type: none"> • Assets value of investments in fixed and working capital • Stock capacity turnover • Return on working capital • Return on the wage bill • The power of the coefficient of performance targets 	<ul style="list-style-type: none"> • Assets of fixed assets • Return on assets 	

sufficient range of performance management systems become of step regression analysis. This method is known, allows to formalize the procedure for selecting the most significant indicators by calculating partial regression coefficients and coefficients of determination and determine their significance.

For this parametric specification management system were merged into three groups. Each group analyzed the correlation matrix and partial coefficients of determination of the factors included in the regression equation for each performance indicator.

Carrying step regression analysis allowed to divide all the performance indicators in terms of their information content into three groups (Table 2).

The analysis resulted in the table 3 shows that the introduction of computer systems to the most informative performance got many of the indicators are allocated based on an analysis by the method of analysis groupings, and correlation analysis.

Performance indicators	Number of facilities management	The amount of facilities management	First of all,
Productivity	-0,51	0,49	
The level of expenditure rotation	0,57	-0,20	
Capital productivity, current assets	0,0	0,00	

attention is drawn to the sustainable allocation for the three stages of analysis of indicators such as resource efficiency, capital working capital, spending rotation commodity turnover coefficient power of the performance targets. These figures are determined collectively and most informative in the strict formal selection. This fact indicates that these figures advisable to give priority to use in assessing the effectiveness of control systems.

Analysis of the correlation matrix coefficients steamy performance shows (table 3) is also a close connection indicators such as resource efficiency, capital costs, investments in fixed and working capital, capital assets.

Table 3 presents data characterizing density connection between changes in these structural factors. As the number of managed objects and scope of their activities reflected the relationship of performance indicators trade process management information system.

The analysis shows that the effect of the introduction of the content management aspect is seen differently. But now all of them can be summarized in three main areas to measure the effect of management: the cumulative effect derived from all economic activities; the share of cumulative effect, which is caused by the operation of control systems; the direct effect of managerial work.

DISCUSSION

Without going into polemics with authors about the legality and feasibility of using the first two lines can only note that the data completely reject methodological approaches to evaluating the effectiveness of management is not quite true that in certain situations they are eligible for use as a basic conceptual terms. Regarding the third direction of research management efficiency, the authors propose to consider

its basic position from the standpoint of forming integral indicator of the effectiveness of management of trade enterprise.

The authors hold to the opinion that this direction of research management efficiency involves two approaches: information and organizing. At the heart of the first of them is the idea of measuring the direct effect of control on the quantity and quality of information produced by the machine control particular company. Information, its quantity and quality, of course, is a direct product of administrative work, but the practical use of such a proposal is extremely difficult, because there is no objective basis for comparison of different types of information. In addition, the quantity and quality of information provided to even reduce to a common denominator, not give answers to questions about the effectiveness of information potential and its impact on economic outcomes of facility management.

Organizational approach to management effectiveness is based on the premise that the effect of control is the level of the production process. However, the main methodological shortcoming of this approach is that high levels of the production process creates only prerequisite for its effective functioning, but does not guarantee the same efficiency.

Definitely final performance of the control system must match, that carry a single methodological framework. The criterion of economic efficiency of the trade process management information system must meet the following requirements: to display the final results of economic activity targeted managed object and the degree of their achievement; record spending regulator to achieve a managed object goals.

Based on the existing requirements under the criteria of economic efficiency management should understand the results management system that achieves a managed object goals at minimum cost management.

Generalized model of economic efficiency management system that satisfies the above listed requirements can be formulated as follows:

$$E_p = \sqrt{\left(\frac{R_n}{R_{n-1}} \cdot \frac{P_n}{P_{n-1}}\right) \times \left(\frac{E_n}{E_{n-1}}\right)} \quad (12)$$

where: R_n, R_{n-1} - return (ratio of net profit to turnover) in the planning and the base period; P_n, P_{n-1} - productivity (the ratio of turnover by number of employees) in the planning and the base period; E_n, E_{n-1} - efficiency management system (ratio of net income to the cost of maintenance management system) in the planning and the base period.

This increase in economic efficiency of the trade process management information system can occur while performing one of the following four conditions: the effectiveness and efficiency of economic management while increasing; the effectiveness of economic activity increases and profitability management is stable; the effectiveness of economic activity is stable, and cost management increases; increasing efficiency of economic activities to a greater degree than the reduced level of economic management. Considered a generic process management performance indicator information system establishes trade value depending on the efficiency of business operations (collectively functional business processes) the level of enterprise cost management entity. Its practical meaning is expressed in the fact that it is aimed at achieving not only high-efficiency operation of its management components. In addition, it can be used to assess the dynamics of economic efficiency of a particular commercial enterprise, and for comparative assessment of different options for improving management systems.

CONCLUSION

Concluding consideration of synergy and building system performance process management trade information system, it should be noted that no matter how complete and comprehensive was the system performance, it is not able to answer questions about the outcome of performance management system (regardless of system integrators filling). This is due, firstly, the possible different orientation individual indicators. Second, due to the fact that any attempt to use a set of indicators to measure or assess the development of the functional process leads to a clash with another unsolved problem prioritization of

individual indicators. Really existing practical difficulties unambiguous assessment of management efficiency through a system of indicators put economics before the need to search index received such an assessment. Such studies are carried out widely enough and now to build and implement effective systems of trading activities.

The authors express confidence that is used in the trade process management and information systems standardized latest technology will become an effective tool for effective management of commercial enterprise.

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A SYNERGY OF CREATIVE PROBLEM SOLVING, SYSTEM DYNAMICS AND MULTI-CRITERIA DECISION MAKING

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ABSTRACT

The paper highlights the capacity of the mutual use of selected creative problem solving methods, system dynamics and multi-criteria decision-making methods when dealing with complex problems. It has already been shown that creative approaches are not limited to merely problem definitions and problem structuring, since they can also be used in typically analytical steps in the framework procedure of multi-criteria decision making. The goal of this paper is to explore the possibilities how to employ creative problem solving methods in system dynamics, and how to complete system dynamics with multi-criteria decision making. This paper shows that the creative problem solving methods based on questions can be used in structuring complex system dynamic problems with the selected mapping methods. It can be concluded that system dynamic models can help decision makers in enhancing understanding of system behavior over time; however, the evaluation of the consequences of different strategies showed by these models can be supported by multi-criteria decision making. The mutual assistance of creative, systems dynamic and multi-criteria decision methods is illustrated by contemporary interdisciplinary examples.

KEY WORDS

Creative problem solving, human resource management, mapping methods, multi-criteria decision making, questions based methods, system dynamics

INTRODUCTION

Creative problem solving (CPS) methods can be used in defining (identifying) and structuring complex dynamic problems (Čančer, 2010). Multi-criteria decision making (MCDM) methods that have already turned out to be very applicable in business practice can be used to complement intuition and practical experience in solving complex problems (Čančer, 2010, 2012). System dynamics (SD) models are frequently used to explain the dynamics of complex systems and their behavior in different fields (Pejić Bach et al., 2016). This paper highlights the capacity of the mutual use of CPS methods, SD and MCDM methods when dealing with complex problems.

It has already been shown that creative approaches are not limited to merely problem definitions and problem structuring, since they can also be used in typically analytical steps in the framework procedure of MCDM (Čančer, 2012). The goal of this paper is to explore the possibilities how to employ CPS in SD, and how to employ MCDM as the completion of SD. The paper thus deals with multimethodology

– “combining together more than one methodology ... within a particular intervention” (Mingers, Gill, 1997, p. 2). It presents several examples of CPS, SD and MCDM in economics and business, showing the mutual assistance of creative, system dynamics and multi-criteria decision tools and approaches.

CPS METHODS IN DEFINING/STRUCTURING SD PROBLEMS

CPS is the framework process of solving problems, which includes the techniques of creative and critical (e.g. decision) thinking with the aim of designing and developing new and useful outcomes (Čančer, 2010). According to Isaksen et al. (2011), the phases of CPS process include problem definition, generating ideas, choosing ideas and solution implementation.

To determine which CPS methods can be used in defining and structuring complex SD problems, we explored several methods and approaches for a mess, fact and problem finding and definition, based on visualization and questions.

MAPPING METHODS

Cognitive mapping can be used for both problem definition and solution finding (Cook, 1998). Mingers and Gill (1997) suggested that cognitive mapping could facilitate the structuring of complex mental models at an individual and group level. It includes many variations, e.g. fishbone diagrams, rich picturing, Post-it method. Santos et al. (2001) have already found very valuable the use of Post-its complemented with qualitative maps for structuring the ideas generated. Cognitive mapping can be very participative. Our experience says that participants often feel a real sense of ownership of their map.

Cognitive maps have nodes and arcs, also known as “causal concepts (constructs)” and “causal connection”, elements and beliefs, nodes and links, nodes and edges, and points and arrows. The nodes can represent a concept, variable, issue, entity or attribute and can be represented by a single word, phrase or paragraph. The arcs represent the relationships between the nodes. Cognitive maps can be represented by either undirected or directed graphs (maps). The type of directed cognitive maps are causal maps. (Scavarda et al., 2004)

Cognitive mapping has already been combined with SD, for example in the litigation/project management (Ackermann et al., 1997); the validated maps served as the raw material for developing an SD model.

As mentioned above, Scavarda et al. (2004) classified causal maps in the group of directed cognitive maps.

Causal mapping provides a structure to the merging of perspectives and avoids the danger of reducing the complexity by focusing on a small number of considerations (Eden, Ackermann, 2010, p. 242). Causal maps represents thoughts as a network of causal relations, representing concepts through nodes and causality through links between nodes (Schaffernicht, 2007, p. 7). A causal map consists of variables (not constructs or concepts) and links that may indicate a type of relationship and indication of strength. Causal maps are generally used for dealing with cause-effect relations embedded in deciders' thinking. Schaffernicht (2007) noted that in such diagrams, only structure is explicitly represented, while behavior has been abstracted away. A causal map, as opposed to other representations, will be more likely to capture feedback (Eden, Ackermann, 2010), a basic characteristic of complex social systems (Mildeová, Vojtko, 2006). Feedback represents the potential for dynamics in the situation – changes over time. Two possibilities for feedback are positive (or self-sustaining) and negative feedback. One of the current approaches to developing an SD model is based on causal loop diagrams (for other approaches see Pejić Bach, Čerić, 2007). A causal loop diagram (CLD) is a causal diagram that aids in visualizing how different variables in a system are interrelated.

As compiled by Chaib-draa (2002), causal maps have been used in the fields of international relations, administrative sciences, management sciences, and distributed group decision support (neural networks, multi-agent systems). Causal mapping has been used extensively in strategy and management science (Scavarda et al., 2004). Moreover, CLDs have been extensively used in (business) SD modelling in

information technology (IT): for dynamics of IT principles, infrastructure, architecture, applications, investments; for the dynamics of e-business infrastructure, knowledge management systems (knowledge management in e-business, in outsourcing relationship), outsourcing partnership quality governance (Gottschalk, 2007).

Causal maps are usually based on human “communications” collected by interviewing or found in documents such as corporate reports or memos (Chaib-draa, 2002). The widely accepted approaches for capturing cognitive data for a causal map are brainstorming and structured interviews. We suggest the use of CPS methods based on questions to elicit data from experts.

When used alone, CLDs do not allow participants to understand the dynamic behavior of factors affecting performance and do not allow a full assessment of the interconnections between these factors. For this reason, the translation of CLDs into a simulation model using the SD approach is necessary. CLDs have long been used in standard SD practice for simulation modelling; they can be transformed to stock and flow diagrams in order to describe complex systems.

The **stock and flow diagrams** were used as graphical language in SD. Stock variables are accumulators or stocks with a behavior determined by their own value “just before” (at each pint in time) and the sum of all connected flows. The behavior of a flow variable is defined for a period of time. Schaffernicht (2007)

CPS METHODS BASED ON QUESTIONS

In this paper, special attention is given to the methods based on questions whose aim is to define problems. The **W** technique is named after the first letter of the German words was (Eng. what), wie (Eng. how), wer (Eng. who), warum (Eng. why), welche (Eng. which), wann (Eng. when), etc. Based on the questions, the W technique is appropriate for problem definition, problem analysis, and finding the very heart of the problem. Since – compared with other techniques based on questions – the W technique enables the most extensive description of the problem, it is appropriate to facilitate problem structuring by mapping methods. The procedure of the W's technique starts with an explanation of the problem. Then we ask questions starting with why, what, how, what else, when, where, etc. The answers are noted down. One or more participants can perform the technique. The technique is simple to use; however, when using it for the analysis of a problem, it requires extensive and specific professional knowledge about the problem.

The derivatives of the W technique are the six-question technique or the **5Ws & H** technique (Cook, 1998), the **why** technique, and the **five whys** technique (Boulden, 2002). In practice, the why technique and the five whys technique are used to find the core of the problem and to seek possible solutions to problems. They are appropriate for the event approach to problem solving: when there is an event that cause a problem, we can use the why technique to find the cause of the problem. For example if we are in debts (the event that is a problem), then we may conclude that this is because the costs are too high (the event that is the cause of the problem). Then we can ask why the costs are too high (the event that is a problem). We might then conclude that this is because we bought used machines (the event that is the cause of the problem). Then we can look for the cause of our new problem and continue this process: Q: Why did we buy used machines? A: To produce semi-products. Q: Why do we want to produce semi-products? A: To build them into products at the end of the production process. Possible solution might be as follows: co-operators can produce semi-products; we can lease or sell the machinery.

Almost two decades ago, Kirkwood (1998) concluded that it is difficult to determine what to do to improve performance. The answer of the authors of this paper is that participants must orient their questions and answers towards seeking the solution; together with finding the very core of the problem, they can also find the solution of the problem. However, we agree that the why and the five whys techniques work well for solving simple problems. When we want to solve complex problems, systems approach should be adopted by focusing on the internal system structure and patterns of behavior.

MCDM METHODS COMPLEMENTARY TO SD

SD models are frequently developed and used to represent, analyze and explain the dynamics of complex systems. The dynamics of behavior of a system is defined by its structure and the interactions of its parts. The main goal of SD is to understand how this behavior is produced, and use this understanding to predict the consequences over time of policy changes on the system. Almost four decades ago, Gardiner and Ford (1980, p. 242) pointed out “the emphasis and focus (of SD models, explanation of the authors of this paper) is on developing models that show consequences, not on formally evaluating these consequences.” Formal evaluation of the consequences showed by SD models can be supported by MCDM. It has been widely recognized that MCDM methods can help decision makers learn about the problems they face, and consequently make better-informed and justifiable choices. Santos et al. (2001) concluded that SD and MCDM can play a major role in detailed analysis of the structure of the problem under study and the consideration of trade-offs (to understand the causes of poor performance and determine the proper action plan for performance improvement).

Araz (2013, p. 319) pointed out that “sole use of simulation models falls short in terms of incorporating policy decision makers' preferences into decision-making processes.” Araz (2013) developed a framework for public health preparedness exercise design that simulates disease spread with selected intervention strategies. The framework integrates an AHP model for MCDM with a simulation model to evaluate policy decision options based on criteria determined by decision makers. SD was used to model different policy interventions. MCDM was used to express preferences to alternatives (interventions strategies, policies) and judgments on criteria's importance.

Santos et al. (2001) argue that the integration between SD and multiple criteria analysis can address some issues which require further study if measurement systems are to be supporting the decision making process, and contribute to improve organizational performance. These issues are the identification of key performance factors (or performance drivers), a better understanding of the interrelationships and the consideration of trade-offs between performance measured, the dynamism of organizations and the dynamism of measurement systems. The integration of SD and MCDM can bring new insights to inform and support performance measurement and management. (Santos et al., 2001)

Pruyt (2006) looked at the combination of SD, multiple criteria decision analysis (MCDA) and ethics to support strategy selection in case of dynamically complex multi-dimensional societal issues, with special attention paid to the capacity of the multi-methodology. It was suggested that SD could be used to simulate the multi-dimensional behavior, and MCDA could then be used to describe, evaluate and choose between the strategies simulated with the SD models.

To summarize, MCDM can be used to evaluate policy decision options obtained by SD. We propose the use of the frame procedure of MCDM for the group of methods based on assigning weights (Čančer, 2012): problem definition and structuring, measuring local alternatives' values (by using value functions and pairwise comparisons), criteria weighting (by using the methods based on ordinal, interval and ratio scale), synthesis, ranking and sensitivity analysis.

EXAMPLE CASE OF THE MUTUAL USE OF CPS, SD AND MCDM

The nine pillars of technological advancement within Industry 4.0 (Big Data and Analytics, Autonomous Robots, Simulation, Horizontal and Vertical System Integration, Internet of Things, Cybersecurity, Cloud, Additive Manufacturing) on growing markets require highly educated employees. We briefly illustrated the use of the W technique to get the description of the problem:

- Q: What is the role of firms dealing with the pillars of Industry 4.0?
- A: They are believed to be the drivers of the new industrial revolution; they are expected to increase productivity, shift economics, foster industrial growth, and modify the profile of the workforce. (Rüßmann et al., 2015)
- Q: Who is the main resource in these firms?

- A: Highly qualified employees.
- Q: Who are highly qualified employees that do the work for these firms?
- A: Firms employ expert professionals; if there are not enough experts, they can employ trainees.
- Q: Which are the most important variables that influence employee satisfaction?
- A: Workload (number of projects/employee) and salary.
- Q: What is one of the main reasons for decreased productivity of the current employees and thus for employing new staff?
- A: Stress of the current employees.
- Q: How does stress effect the quality of work?
- A: It decreases it.
- ...
- Q: What else should be taken into consideration when developing this model?
- A: Demand and business success.
- Q: To summarize, which sectors should therefore be taken into consideration for managing highly qualified employees?
- A: Employee lifecycle, employee satisfaction, quality of service, demand and business success.

The W technique was therefore used to facilitate structuring the problem with cognitive map which was supportive of SD modelling.

The use of the why technique has been illustrated for finding the events – problems and events – causes in the employee satisfaction sector when drawing the causal diagram.

Problem: The quality of services is decreasing.

- Q: Why is the quality of services decreasing?
- A: Because of many mistakes.
- Q: Why are so many mistakes?
- A: Because of employee burnout.
- Q: Why are employees suffering from burnout?
- A: Because they are under stress.
- Q: Why are employees under stress?
- A: Because of the increased number of projects.
- Q: Why do they have to work on more project?
- A: Because the owner did not hire new trainees.

The causal diagrams were transformed in stock and flow diagrams for the following sectors: employee lifecycle, employee satisfaction, quality of service, demand and business success. The SD model has already been developed for identifying efficient human resource management (HRM) policies. We made two simulations: for the one-year period and for the five-year period.

MCDM has been employed to evaluate HRM policies: normal working conditions, stressful working conditions with an average salary, and stressful working conditions with a high salary. The criteria for evaluating these policies are employee satisfaction, quality of service and profit. We followed the frame procedure for MCDM (Čančer, 2012). The goal (selection of the most appropriate HRM policy when managing highly qualified employees), the criteria and the alternatives (the above mentioned HRM policies) were structured in problem hierarchy. The weights of criteria were determined by using the SWING method that is based on an interval scale. The data for entering MCDM process were obtained by SD model by using the SD results of the simulation for the one-year and for the five-year period. With respect to profit, the HRM policies were measured by increasing linear value function. The results in Table 1 show that with respect to profit, the 'stressful working conditions with an average salary' achieved the highest value and the 'normal working conditions' policy achieved the lowest value in the one-year period. The results with respect to profit for the five-year period, however, show that the 'normal working conditions' policy is the most appropriate policy and the 'stressful working conditions with an average salary' is the least appropriate policy (Table 1). With respect to employee satisfaction and quality of service, the HRM policies were measured by pairwise comparisons. The SD results

showed that major changes in employee satisfaction occurred in the period from six to nine months of the first year. For this reason, the values of the HRM policies with respect to employee satisfaction after the one-year period are equal to the ones after the five-year period (Table 1). With respect to quality of service, the values of the 'normal working conditions' policy and the 'stressful working conditions with a high salary' are slightly higher for the five-year period than for the one-year period (Table 1). With respect to multiple criteria, the 'stressful working conditions with an average salary' policy achieved the highest aggregate value in the one-year period, and the 'normal working conditions' policy achieved the highest value in the five-year period (Table 1).

HRM policy	Value with respect to profit		Value with respect to employee satisfaction		Value with respect to quality of service		Aggregate value		Rank	
	One year	Five years	One year	Five years	One year	Five years	One year	Five years	One year	Five years
Normal working conditions	0	1	0.648	0.648	0.588	0.626	0.397	0.761	2.	1.
Stressful working conditions with an average salary	1	0	0.122	0.122	0.118	0.072	0.426	0.058	1.	3.
Stressful working conditions with a high salary	0.603	0.624	0.230	0.230	0.294	0.301	0.388	0.398	3.	2.

Table 1 – The HRM policies' values obtained by MCDM (own calculations)

The gradient sensitivity analysis has been performed to analyze the effects of changes in criteria's weights on alternatives' ranking. The results showed that ranking of alternatives is very sensitive to changes in criteria's weights in the one-year period, but it is not sensitive in the five-year period. The MCDM model results confirmed that – with respect to multiple criteria – normal conditions policy is the best policy in management of highly qualified human resources in the long run.

CONCLUSIONS

The case presented in this paper represents an approach to face with risks to humanity's future welfare, including ones that could be created by emerging technologies, e.g. loss of creativity, stress, overloading, and unemployment.

This paper shows that the CPS based on questions can be used in structuring complex SD problems with mapping methods. Moreover, different methods of CPS can complement each other (e.g., the W technique can facilitate drawing cognitive maps). Among the CPS methods based on questions, the why and the five whys techniques are appropriate to facilitate the event approach to problem solving, and the W technique can facilitate the systems approach. SD models can help decision makers in enhancing understanding of system behavior over time, and MCDM enables explicit evaluation of this behavior.

Since the six-question technique is a structured method that examines a problem from multiple viewpoints (Cook, 1998), the authors of this paper consider it as further research possibility to facilitate problem structuring by mapping methods.

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LINKAGE BETWEEN THE FOURTH INDUSTRIAL REVOLUTION AND EDUCATION

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ABSTRACT

At the beginning of the 21st century, great social-economic changes took place in the context of industrial revolution. The changes will have an influence not only on production but they will impact also into all areas of human lives. The main trigger is starting the fourth industrial revolution which brings decentralized production management system, penetration of information technologies into the production and higher satisfaction of customer needs. According to the customer demands, the individual mass production will replace bulk mass production. Planning and production will be supported by robotic units with distributed control system. This is a production model diametrically different from the current one. It represents the transition from centralized to decentralized management, where the individual production robots organize and align themselves according to the requirements given by the product prototype. The product prototype will exist in abstract (digital) version and its features will be defined by a customer. The aim of the fourth industrial revolution is production optimization leading to economic savings, higher satisfaction of people and healthier environment. This will result in essential changes in production and society. Higher demands will be required regarding the knowledge of people, different ways of thinking, knowledge related to information technologies etc. To prepare people for this transformation, the change of study courses, broadband education comprising knowledge from different areas, changes in thinking patterns related to different judgment factors influencing addressed problems must be applied.

KEY WORDS

The fourth industrial revolution, Industry 4.0, systems thinking, critical thinking

INTRODUCTION

The beginning of the 21st century has been marked by starting robotization, information technologies, transmission networks, Internet and many other aspects. The most significant change influencing human development is the change in the production process. The fourth industrial revolution (Industry 4.0) is represented by the transition from mass production to individualized mass production. Individualized production is dependent on the development of a digital pattern of the future real product which serves as its image. The digital image is built according to customer's vision and communicated to the production through the internet. The digital image carries all details necessary for the production. According to the digital image, the production machines realize the production. In this concept, the production machines represent complex robotic units with proper level of intelligence and ability to communicate with their environment. The control of the machines is decentralized, the production system does not have any control center. The production is completed in accordance with requirements given by the digital image of the future product. The machine-product communication stays on supply and demand basis. The product (at the beginning as a semi-finished product) sends a request to machines connected to the network to do a certain task (e.g. to drill the hole). Only one or few machines from the group of machines are able to do this. The product selects the machine according to certain criteria (generally auction principle). Afterwards, the next step is to proceed to the selected machine. This is the way how the product is accomplished and sent to the customer.

The fourth industrial revolution resembles agents technologies. Agents technologies assume that agents (production units) communicate with the aim to fulfill the requirement for production which is defined by the pattern object. Agents mutually exchange information about their production options and probe to satisfy the requirements. Huge demands are imposed on the agents interface, data transmission systems and processing enormous amount of data. Here it is possible that the data have distributed character and information is processed by individual agents. The agent capable to fulfill the requirements communicates this information to its environment or on contrary informs its environment about the not being able to satisfy the requirements. Other agents provide their knowledge to resolve the situation occurred.

Industry 4.0 enables to individualize the production with preserving the character of mass volume production.

HISTORICAL OVERVIEW ON THE DEVELOPMENT OF THE INDUSTRY

Nowadays changes occur much faster than in the past. Some activities that in the past took one day are nowadays done in one hour and tomorrow they will be accomplished in few minutes. This era is symbolized with the boom of digital technologies. We are embraced by digitalization: WIFI, e-mail, the internet, social networks, smart phones, smart TVs, smart home appliances. In ordinary life we have moved from the bookstore to e-books, from yellow pages to the e-shops. Industry 4.0, also known as the digital industrial revolution has been becoming the nowadays phenomenon. The concept has appeared just recently and is expected to expand. Therefore we must get used to handle with frequently. It is based on the fact that people, machines, devices and products can mutually communicate and cooperate. The industry has existed for thousands of years since the construction of the first towns. But it was the first industrial revolution that shaped the industry into the form known nowadays. The first industrial revolution (1760-1840) was started by the invention of the steam machine and machines powered by water and steam. They transformed the manual work into the machine work. Factories were built and manpower moved from agriculture to production. The first significant rise in standard of living happened in the history. Other inventions like steam engine, electricity, combustion engine and airplane accelerated life and shortened the distance. The second industrial revolution started at the beginning of the 20th century and was identified by usage of electricity for introduction of mass, line production that significantly increased work productivity. It was a period of personalities like Henry Ford or Bat'a brothers, who succeeded to get the production into incomprehensible quantities at that time. The third industrial revolution appeared in the second half of the last century when the production started to become automated and robotized. Computers began to be implemented in workplace and enabled faster computing and measuring (Brettel, Malte, et al., 2014). Industrial production enters the breakthrough point – after the era of steam, electricity and computers, another technological improvement in the form of the fourth industrial revolution takes place. (Figure 1)

The term Industry 4.0 comprises varied definitions and features. This term indicates the way of usage of information and communication technologies that promise in industrial factories changes comparable with those mentioned above. The strategic line of Industry 4.0 originated in Germany as a reaction to the decrease in industrial production after removal of production capacities to cheaper countries. Because of the high price of manpower in the European industry and low work productivity, this European industrial leader started gradually losing its positions in the competitive struggle with China and other Asian countries. Leading German concerns like Siemens, Bosch, Schunk and Volkswagen joined the initiative to be able to compete with the cheapest manpower. They have proved that tools of Industry 4.0 will be more important for the increase in productivity in modern industry than the price of manpower.

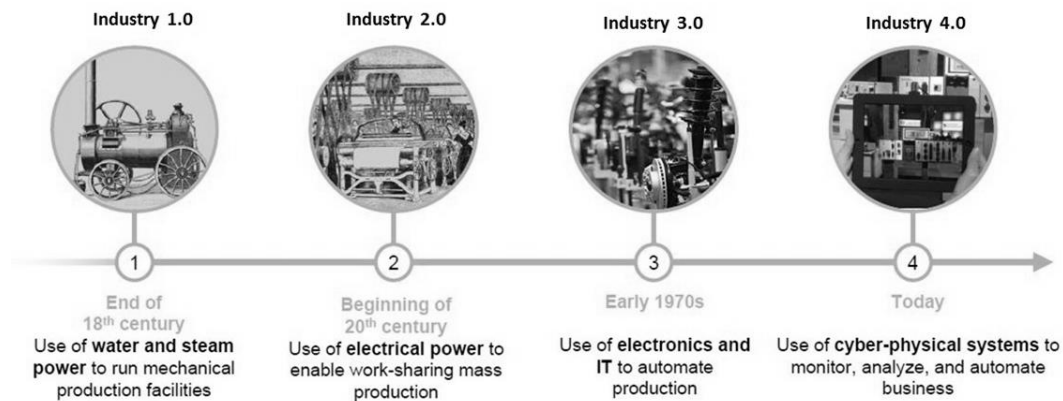


Figure 1 Development of industry

CONSEQUENCES OF INDUSTRY 4.0

Changes in production will be reflected in all areas of human life. (Mařík, 2016). The change in work organization will lead to changes in the society. New professions not known yet will appear. Regional and university education will play a significant role in this process. Important contribution of the state is expected in requalification. It is necessary to train new experts familiar with network and information technologies, their connection to control centers of production systems and on the other side the connection to customers, users. Industry 4.0 represents a new way of thinking comprising a wide spectrum of knowledge which will enable to analyze occurred situations from higher perspective. Particularly it is necessary to educate workers and customers in new principles of systems thinking.

As it has been already emphasized in the past the systems thinking does not appear spontaneously but it requires learning. The aim is to prepare schools (primary, high and universities) for these changes. However, it is not easy to implement new study programmes (or to expand the existing). It is necessary to be open-minded and confident about this change, to understand the requirements of the future, to overcome the ossified and accustomed thinking and substitute it with new principles.

From today's 10% of applied principles of Industry 4.0 this rate will grow to more than 60% in 5 to 10 years period. The implementation of the principles of Industry 4.0 into the study programmes is inevitable immediately because the reaction time of the school system to the change of the graduates' knowledge is at least 5 years. Industry 4.0 represents consistent decentralization of management.

It is necessary to educate people qualified in decision-making. Moreover they must be able to understand how automated systems connected to computer networks operate and integrate the performance. Education becomes the highest priority in Industry 4.0. Industry (and not only industry) must be considered from the point of complex distributed systems that do not need to have a central element. This will have an impact on economy and society. Human thinking must be prepared for this situation. Unfortunately the education system seems to get behind in this area not only in technical but also in social sciences, in the field of economics, philosophy, law etc.

LEGISLATIVE FRAMEWORK OF INDUSTRY 4.0

The application of the fourth industrial revolution is not spontaneous. A series of measures that support and allow applying the fundamentals of trends in progress is inevitable. Industry 4.0 will be reflected in all aspects of human activities. It will influence human life, make opinions and attitudes. Society needs to be well prepared for future changes and therefore it is inevitable to have analytical documents determining starting points for the near and distant future as well.

In the Czech Republic the team led by Prof. Dr. Vladimír Mařík was in charge of preparing a document characterizing starting points and aims of the fourth industrial revolution. This team has prepared the

document "The Industry 4.0 Initiative" approved by the Czech Government. The document represents 233 pages material. In this material, the analysis of particular areas connected to the fourth industrial revolution has been presented. Starting points, possibilities and sequence of solutions are defined regarding possible risks in the process of realization.

In Slovakia, the document "Smart Industry" of 39 pages has been created by the young team of the Ministry of Economy led by Zuzana Nehajová, General Director of the Directorate General for Innovation and Business Environment (Boložon, 2016). The document entitled "The concept of Intelligent Industry for Slovakia" (Mehajova a kol., 2016) has been still in the comment process. Several crucial comments have been raised. One of the comments connected to this paper claims that the document is not in compliance with the document in the course of completion "The Long-term Plan of Educational, Research and Development, and Additional Creative Activities for the Universities for Years 2016-2020". For instance the definition of educational requirements has been limited as follows: "The result should be the creation of more suitable, predictable and interdisciplinary schemes at all levels of education. Aiming at solving the shortage of expertise in particular areas and adjusting the education system to the present and future reality we need to highlight new, highly specialized skills as e-leadership for IT, informatics, coding, digital skills, subjects STEM (science, technology, technique and mathematics) on all levels. " (Mehajova a kol., 2016). The material is generally of declarative character and requires to be improved in more detailed way.

CONCLUSION

The new upcoming industrial revolution is based on the usage of modern information technologies in all areas of the industry. Stereotypical manual labor will be more often replaced by machines but on the other side the demand for specialized professions focused on digital technologies will increase. New jobs will be created mainly in the area of ICT programmers, experts of data analysis, and new technologies like nanotechnology, robotics, and artificial intelligence. If only a half of the expectations connected to Industry 4.0 come true, in the next five years the competitive environment will change significantly. It will bring a lot of new jobs, opportunities and changes in many sectors. For companies this will mean time saving, increase in effectivity and flexibility. The education and the lack of skilled professionals may become the main obstacle. Already nowadays we complain about the shortage of technical engineers, however, we will need them even more and even of completely different professional profile. Future graduates should have interdisciplinary thinking and systems overview on complex, distributed systems. It is inevitable to accept systematic measures for education support in science and technical study branches. The persistent minimalization of education in mathematics and physics is unreasonable. The Industry 4.0 must be incorporated into all education programmes at high schools and universities. However the present reality is completely different. In spite of high number of students graduated from universities, only a small percentage of them have studied mathematics, physics or informatics. Therefore it is required to communicate constantly with young people. The reason is that in the future 90% of all newly created jobs will require high knowledge in information technologies. The newly accredited study programme at the Czech Technical University in Prague originated as a reaction to the current status of education for the needs of upcoming digital revolution and interconnected technological changes should be considered as "the first milestone".

If we are able to manage this process quickly, the fourth industrial revolution will become prospective for the future. Otherwise, not only young skilled people but also companies will in few years sit into pilotless airplane and move to the place where they were able to react to new technological challenges and opportunities.

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NEURAL-DETERMINISTIC CLASSIFICATION OF FINANCIAL PARAMETERS AS A DECISION SUPPORT TOOL IN BUSINESS VALUATION

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ABSTRACT

Due to numerous specifics in company business operations, it is difficult to conduct the procedure of business valuation by using a single method within the existing valuation approach. In particular, this problem is evident in complex industries such as oil and gas industry, in which there is a need for a different approach to business valuation. Such an approach, apart from the application of expert opinions, requires the use of modern tools such as neural networks, which have proved to be particularly effective especially in the analysis and classification of data. This paper presents the use of neural networks in the classification of financial parameters that affect the value of the company in the oil and gas industry, to support the decision-making process in the business valuation.

KEY WORDS

business valuation, classification of financial parameters, application of neural networks

INTRODUCTION

Due to the complexity of operations in oil and gas industry enterprises, related to the specifics of the production process, production equipment and business operations (Raymond, Leffer, 2006), which result in accounting specifics (Wright, Gallun, 2008) and financial specifics (Johnston, Johnston, 2006), business valuation by using of one of the methods within the conventional approach (asset approach, income approach or market approach) is almost impossible, and usually requires a combination of several methods from different approaches (Brlečić Valčić et al., 2013).

Besides that, the complexity of the industry requires the analysis of indicators affecting the company's business and value creation, which is reflected in the quantification, identification and assessment of both the external (environmental) and internal (company) factors. The computational intelligence has been recognized as an effective tool and support for decision-making in the business valuation, primarily because of its proven effectiveness in identifying the factors that affect the revenue management (Tsai, Chiou, 2009), examining the financial and economic variables that affect the returns on shares (Thawornwong, Enke, 2004), an intelligent collection and classification of data useful for business valuation (Seng Lai, 2010), the assessment of client suitability and rating (Sarlija et al., 2006), as well as risk analysis and investment management (Burrell, Folarin, 1997) .

By comparing the various quantitative and qualitative factors, individually and in groups, it can be determined to what extent and by what criteria they affect the creation and accumulation of business value. Therefore, the neuro-deterministic phase of the modern approach to business valuation (Brlečić Valčić et al., 2013), which is used for the classification of financial parameters that affect the business value, is a must in the modern approach to the business valuation of oil and gas industry companies.

PROBLEM FORMULATION

Neuro-deterministic phase consists of (Brlečić Valčić, et al., 2013):

- quantification of the financial parameters with regard to the weighted average business value,
- analysis of the interdependence of all the selected parameters, as well as an analysis of their
- impact on the company value, and
- selection of all relevant factors for contemporary approach to assessing the value of the company.

Weighted average business value implies the combination of all three valuation approaches (asset approach, income approach and market approach). Therefore, the research was conducted within the target group of selected experts from the oil and gas industry and the field of business valuation, with the purpose of quantification of each valuation approach for each individual sector of the industry, i.e. Exploration and Production (E&P), Transportation and Storage (T&S), Refining and Marketing (R&M), Oil Field Services (OFS) and Integrated Majors (IM).

Based on expert opinions, individual approaches to business valuation were weighted and an indicator was created that serves as the basis to test the interdependence of parameters and models for the oil and gas industry valuation by a modern approach.

In order to examine the influence of selected financial parameters to the company value, based on expert opinion, the weighted average business value was defined according to the following formula:

$$BV_i = \alpha_i BV_{i,AA} + \beta_i BV_{i,IA} + \gamma_i BV_{i,MA},$$

whereby α_i , β_i and γ_i are the influences (percentage expressed) in individual sectors of oil and gas industry for the asset approach (AA), income approach (IA) and market approach (MA), respectively, given that:

$$i \in \{IM, E \& P, R \& M, OFS, T \& S\}.$$

If we consider only one sector of the industry, the formula can be simplified:

$$BV = \alpha BV_{AA} + \beta BV_{IA} + \gamma BV_{MA},$$

whereby BV_{AA} is the value of the company calculated by the asset approach, BV_{IA} is the value of the company obtained by the income approach, while BV_{MA} is the value of the company estimated by the market approach.

For the purpose of this paper, the value obtained by the asset approach is based on a combination of the asset approach according to the book value of capital and the capitalization of earnings approach. It is calculated according to the formula:

$$BV_{AA} = \frac{(\text{assets} - \text{liability}) + (\text{normalized earnings} / \text{WACC})}{2}$$

whereby the normalized earnings is obtained with a ten-year average net profit.

The value BV_{IA} obtained by the income approach is determined by the DCF method, while the value BV_{MA} (the market approach) is obtained according to the market value of issued shares, since the observed companies are traded companies. Data for evaluation was mostly collected from (Damodaran, 2013) and (Bloomberg Businessweek, 2013).

The impact of selected financial parameters on the business value of the companies in the oil and gas industry has been tested by using artificial neural networks. The observed 35 parameters are listed in Table 1.

The ranking of individual parameters (1 - 35) in Table 1, with regard to their impact on the weighted average business value BV, was made on the basis of the results obtained by feedforward neural networks (FFBPNN), generalized regression neural networks (GRNN) and simple linear regression (LR). For the evaluation of the performance of individual models, the determination coefficient has been used (Brlečić Valčić, 2014).

Simple linear regression was used to make the results obtained by neural networks comparable to a conventional statistical method, but also to identify the nonlinearity measure in the dependence between the weighted average business value BV and selected 35 parameters separately.

The observed parameters in Table 1 were divided into two groups. The first group (parameters 1 to 19, and parameter 36) consists of classic financial indicators expressed in the cash value (USD). The second group (parameters 20 to 37) consists of financial ratios (with the exception of 37), widely used in financial analyses.

In addition to standard financial ratios, the index of business excellence BEX has been observed, defined in (Belak, 2014), as an overall indicator, and its individual components ex1, ex2, ex3 and ex4.

Table 1. Selected financial parameters for analysis with regard to the company value

No.	Parameter
1.	Total assets
2.	Total liabilities
3.	Current assets
4.	Cash and cash equivalents
5.	Current liabilities
6.	Book value of equity
7.	Amortization
8.	Working capital
9.	Changes in non-cash working capital
10.	Net Cap Ex
11.	Net profit
12.	Total revenue
13.	EBIT
14.	$EBIT \times (1 - t)$
15.	EBITDA
16.	FCFF
17.	Invested capital
18.	Dividends
19.	Share price (31 December 2012)
20.	Country Marginal tax rate

21.	Current ratio
22.	Total assets over total revenue ratio
23.	Total revenue over non-current assets ratio
24.	Total revenues over short-term assets ratio
25.	Total revenues over capital ratio
26.	ROA
27.	ROE
28.	Net profit margin
29.	EV/EBIT
30.	ex_1
31.	ex_2
32.	ex_3
33.	ex_4
34.	BEX
35.	Cash / Firm Value
36.	Business value

Source: Brlečić Valčić, 2014

During the training of feedforward neural networks, the weights of the hidden and output layers are selected randomly, which means that every time they have different values. That is the reason why the response of two feedforward neural networks trained on the same learning set is different each time. In order to obtain a more reliable result of success with regard to the real possibilities of the networks that are trained, the usual practice of machine learning requires the retrial of feedforward neural networks training 50 to 60 times. It is recommended that the results of success are based on the averages of selected indicators.

For this reason training was repeated 50 times in the application of feedforward neural networks, for each pair of input-output variables. After that, the ranking of parameters was conducted separately according to the average determination coefficient \bar{R}^2 for all 50 models created, particularly according to the highest achieved coefficient of determination R_{\max}^2 corresponding to the most successful model. This whole process was repeated in two cases, for 10 or 20 neurons in the hidden layer.

During training phase, hyperbolic tangent sigmoid (*tansig*) transfer function was used in the hidden layer and linear (*purelin*) transfer function was used in the output layer. The networks were trained using the Levenberg-Marquardt learning algorithm.

As mentioned above, due to the random selection during the initialization of weight coefficients, the response of all 3500 trained feedforward neural networks (50 neural networks for each of the 35 input parameters for 10 and 20 neurons in the hidden layer) is somewhat is different. Therefore, the average determination coefficient \bar{R}^2 is certainly somewhat more representative compared to the assessment of the most successful models selected according to the maximum determination coefficient R_{\max}^2 .

ANALYSIS AND DISCUSSION OF RESULTS

The results obtained by processing the expert opinions, shown in Table 2, show the greatest impact of the asset approach to the valuation, but also a different dispersion of individual approaches per sectors. The asset approach has the greatest impact on the Exploration and Production sector (E&P), and the lowest on the Oil Fields Services (OFS) sector. The income approach has the greatest percentage of

impact recorded in the OFS sector, and lowest in the E&P sector. The impact of the market approach is greatest in the OFS sector, and lowest in the E&P sector.

Table 2. Impact of individual approaches to valuation (by industry sectors)

Valuation approach	Influence by oil and gas industry sectors				
	IM	E&P	R&M	OFS	T&S
Asset	29.00 %	35.76 %	22.70 %	18.21 %	27.64 %
Income	37.39 %	34.83 %	43.26 %	48.02 %	41.38 %
Market	33.61 %	29.41 %	34.04 %	33.77 %	30.98 %

Source: Brlečić Valčić, 2014

The ranking of individual parameters with regard to their impact on BV was obtained by applying a feedforward neural network according to the average and maximum determination coefficient, separately for 10 and 20 neurons in the hidden layer, as shown in Table 3.

Table 3: Ranking of individual parameters with regard to their influence on business value BV

FFBPNN - 10 neurons in the hidden layer				FFBPNN - 20 neurons in the hidden layer				GRNN		Linear regression	
#	\bar{R}^2	#	R^2_{\max}	#	\bar{R}^2	#	R^2_{\max}	#	R^2	#	R^2
6	0.9851	15	0.9898	15	0.9879	1	0.9903	1	1.0000	1	0.9393
1	0.9812	6	0.9882	6	0.9877	6	0.9901	2	0.9998	17	0.9199
15	0.9798	1	0.9854	13	0.9839	15	0.9900	6	0.9995	15	0.8870
17	0.9789	17	0.9836	1	0.9830	14	0.9878	12	0.9995	7	0.8862
13	0.9789	14	0.9835	17	0.9824	13	0.9873	3	0.9992	10	0.8803
14	0.9701	13	0.9828	10	0.9795	17	0.9860	15	0.9992	2	0.8689
10	0.9698	10	0.9777	14	0.9773	11	0.9836	13	0.9985	6	0.8674
11	0.9667	11	0.9755	18	0.9755	10	0.9835	10	0.9973	5	0.8304
2	0.9616	18	0.9736	11	0.9734	2	0.9817	14	0.9958	13	0.8292
18	0.9592	2	0.9734	2	0.9661	18	0.9795	17	0.9951	3	0.8058
7	0.9545	7	0.9712	7	0.9655	7	0.9742	11	0.9950	14	0.7930
3	0.9434	3	0.9580	3	0.9506	5	0.9644	5	0.9922	12	0.7887
5	0.9427	5	0.9555	5	0.9481	8	0.9595	7	0.9908	4	0.7865
8	0.9340	8	0.9522	8	0.9466	3	0.9595	18	0.9860	11	0.7859
4	0.9186	12	0.9412	4	0.9281	12	0.9472	8	0.9822	18	0.7747
12	0.9008	4	0.9276	12	0.9253	4	0.9376	4	0.9688	8	0.0711
16	0.8159	16	0.8752	16	0.8473	16	0.8952	16	0.9649	16	0.0551
9	0.7867	9	0.8289	9	0.8087	9	0.8530	9	0.9081	9	0.0208
33	0.3022	33	0.5760	33	0.3291	25	0.6607	19	0.0319	29	0.0185
24	0.2914	22	0.4762	24	0.3072	22	0.6396	29	0.0263	21	0.0107
27	0.2483	25	0.4571	22	0.2997	33	0.6091	25	0.0060	23	0.0089

22	0.2434	24	0.4378	32	0.2718	31	0.4880	23	0.0043	25	0.0077
25	0.2120	31	0.4049	27	0.2525	24	0.4566	31	0.0014	30	0.0056
34	0.1960	34	0.3890	25	0.2474	19	0.3996	24	0.0005	22	0.0053
32	0.1954	27	0.3160	34	0.1740	34	0.3964	21	0.0004	32	0.0025
28	0.1745	21	0.3096	28	0.1692	23	0.3319	34	0.0003	26	0.0019
23	0.1200	19	0.3011	23	0.1625	29	0.3227	22	0.0003	31	0.0010
29	0.1088	28	0.2937	29	0.1623	27	0.3168	33	0.0001	34	0.0006
19	0.0895	29	0.2874	31	0.1477	28	0.3098	28	0.0000	24	0.0006
21	0.0887	23	0.2852	21	0.1313	32	0.3036	30	0.0000	27	0.0005
20	0.0866	32	0.2751	35	0.1252	21	0.2955	32	0.0000	35	0.0004
35	0.0844	35	0.1258	19	0.0933	35	0.1344	27	0.0000	28	0.0003
26	0.0804	26	0.1007	26	0.0929	30	0.1090	26	0.0000	33	0.0002
31	0.0705	20	0.0866	20	0.0866	26	0.1012	35	0.0000	19	0.0002
30	0.0425	30	0.0765	30	0.0739	20	0.0866	20	0.0000	20	0.0000

Source: Brlečić Valčić, 2014

From the results, it is clear that neural networks are more suitable than classical regression approach. By analyses carried out by neural networks parameters were set on which the business value depends significantly. The measure of this dependence is directly related to the evaluation of the performance of each model based on neural networks. Based on those rating a ranking was performed, which allows an easy identification of the most significant parameters. So on the one hand, 16 most important parameters can be singled out as follows: EBITDA, book value of equity, EBIT, total assets, invested capital, Net Cap Ex, EBITx(1-t), dividends, net profit, total liabilities, amortization, current assets, current liabilities, working capital, cash and cash equivalents, total revenue. On the other hand it is important to emphasize that apart from the ranking and selection of parameters, the great importance of neural networks lies in the quantification of the relationship between certain parameters and weighted average business value.

CONCLUSION

Based on the analysis and research, the necessity of the modern approach to business valuation was stressed, allowing the integration of all three classical methodological approaches of business valuation: asset approach, income approach and market approach. This was confirmed by expert opinion analysis in the field of oil and gas industry business valuation, enabling the proper weighting of each approach to the business valuation by industry sectors.

Neuro-deterministic phase, in which by applying the approximation and classification neural network the impact of certain quantitative parameters on the business value is examined and this relationship is quantified, proved to be essential in decision support within the modern approach to business valuation of companies in the oil and gas industry.

Limitations of the research are related to the fact that the analysis was performed only within the oil and gas industry. Thus, for the future research it is suggested to increase the input and target set with additional companies in order to even better evaluate possible risks and limits of the proposed approach. The same applies for the training and testing of the neuro-deterministic phase and classification phase of financial parameters within other industries.

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APPLICATION OF GST ASPECTS IN A SYSTEM OF EARLY WARNING ABOUT A HIGH RISK OF TRAFFIC ACCIDENT

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ABSTRACT

The purpose of this paper is to describe a model of a system of an early warning about a high risk of traffic accident using principles of General System Theory (GST). The place of this system in the system hierarchy of traffic safety authorities is discussed first, followed by a description of its operation principles and a definition of its elements. Last but not least, inputs, outputs and separate processes taking place in the early warning system are described. Isomorphism is being searched for in relation to Bertalanffy's concept of GST and the characterization of the system from the perspective of hard and soft systems is discussed.

KEY WORDS

Early warning system, general system theory, data-mining.

INTRODUCTION

Virtually every driver encounters a traffic accident during their lifetime. One might assume that because of various advanced technologies which are commonly installed in today's modern vehicles, the overall number of traffic accidents would decrease. Unfortunately, traffic-accident rate statistics indicate an opposite trend. The number of traffic accidents has been steadily increasing in the last few years. We already pointed this unfavorable trend out for example in (Lamr & Skrbek, 2016). Traffic accident rate statistics for the period of January 2016 to October 2016, available on the web of the Czech Automobile Club (2016) clearly show another annual increase. The total number of traffic accidents in this period increased by 5261 which is a 7 % increase compared to the same period in 2015. These unfavorable statistics are not limited to Czech Republic only, as proved by large-scale traffic collisions which occurred in Slovenia and Egypt at the end of January 2016. ("Four die in Slovenian 50-car pile-up", 2016).

Reckless drivers who do not respect traffic regulations but also disciplined drivers may fail to notice or realize various dangerous locations on roads. We presume that if drivers received a warning message with high reliability and in time they would very likely respect such warning. We therefore assume that informing drivers about locations of possible problems can improve the situation. The concept of the system including several features which are already operational is currently designed within a dissertation thesis. However, such system should be operated by a higher authority, for example the Ministry of Transportation.

We will try to outline the place of the described system in the system hierarchy in the following text and charts, define its connections with other, already existing systems, characterize its elements and their relations and define system objectives and processes necessary for meeting them.

We believe that applying principles of GST and systematic approach will lead to a robust design of the early warning system, so that it is universal and can be easily modified for different tasks.

SYSTEM OF EARLY WARNING ABOUT A HIGH RISK OF TRAFFIC ACCIDENT

The system can be defined as a purposefully partially ordered set of elements and a set of their relations with a dynamic behavior which altogether define properties of the whole. While decomposing the system it is possible to designate a sub-system. By sub-system we understand a sub-set of system elements and relations, which is, for a certain reason, separated from the system and understood as a new system or element. Every system therefore contains elements and relations, which create the base of the system's structure (Bertalanfy, 1968).

In order to operate the early warning system effectively and to ensure its further development it should belong to (be a sub-system) of a higher authority, such as the Ministry of Transportation, Ministry of the Interior or the Police of the Czech Republic (PCR). Due to the fact that traffic accident data, available to the Ministry of Transportation, are an integral part of the system it appears logical to designate this ministry as the main administrator of the system. However, Ministry of Transportation receives these data from the PCR, which records data from every traffic accident (since 2008 about every traffic accident with damage over 100 000 Kč), The Police would contribute to the system not only by providing the data but also by being responsible for their quality, form and completeness of attributes which are recorded during the investigation of traffic accidents. For these reasons it is nearly impossible to exclude the Police from the operation of the early warning system. The ideas described in this paragraph are visualized in Fig. 1.

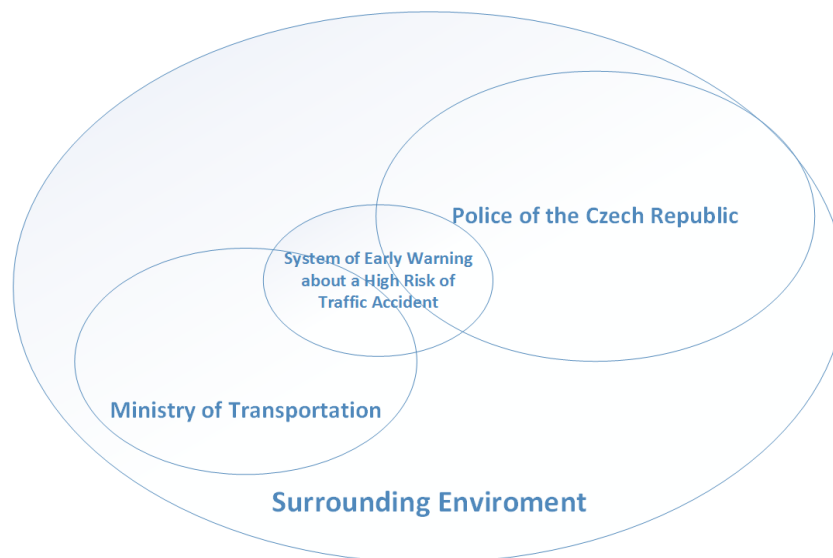


Figure 1. - System of early warning about a high risk of traffic accident and its place in the system hierarchy of traffic safety authorities

As mentioned earlier, the system of early warning about a high risk of traffic accident (hereinafter only early warning system) is subject to certain suprasystems. On the other hand it itself is comprised of certain elements and relations between them and some processes can be defined as subsystems of the early warning system. Boundaries of the system are the inputs from external data sources on one side, and the warning of a driver in real time and place on the other one.

This conceptual design of our system can be described in a single sentence as a complex system which uses custom models to predict the risk of a traffic accident in real time based on an actual location of a vehicle and other attributes. This early warning system comprises of two main parts. The first, control part, gather, processes and distributes traffic accident data. Another important task of this part is the creation and distribution of prediction models. The second one, called user part, evaluates actual situation in real time and informs drivers in case of a high risk of traffic accident. The imaginary boundary between the control part and the user part is not shown in Figure 2 (Lamr & Skrbek, 2015b).

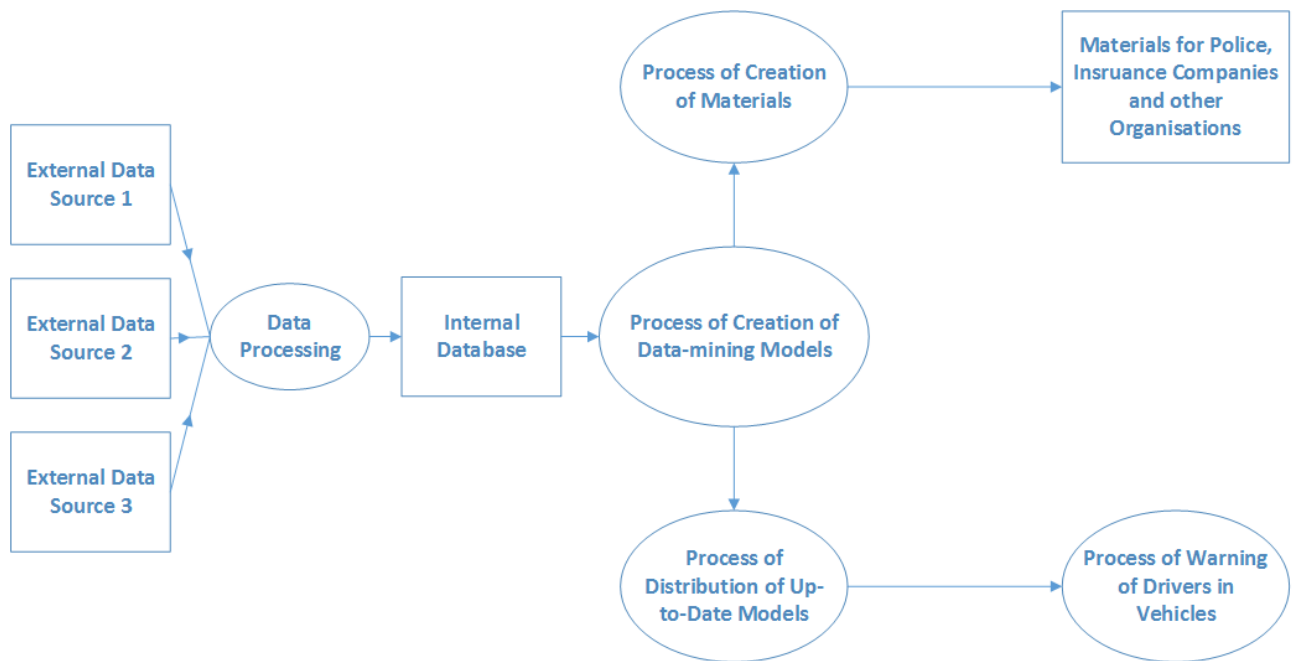


Figure 2. - Elements of the early warning system

In the early warning system, data from external sources (Figure 2) represent for example the database of traffic accidents created by PCR. However, this database does not necessarily need to be the only data source of the system. Approximately 600 000 traffic accident records from the Czech Republic are currently available and every record contains 44 attributes. These attributes, such as GPS coordinates, time and date of the accident, cause of accident, culpability, number of people slightly or severely injured or killed, describe the circumstances of the accident. Other available attributes which could potentially be used for the creation of prediction models are information about the technical road condition, visibility and weather conditions. (Lamr & Skrbek, 2015a). It is necessary to process the data from potential other data sources due to their diversity (data processing process) and store them to an internal database of the system.

The subsystem which creates data mining models is crucial for the early warning system, because these models are later used to predict dangerous locations under actual circumstances. Even though it would be feasible to make this system as automatic as possible, so that its character was close to a hard system, it is impossible to implement in the case of modeling and it will always be necessary to include a human factor interacting with the process. During the process of creation of data-mining models it is necessary to load traffic accident information from the database and to create a so-called modeling matrix (denormalize the data). The data in the modeling matrix undergo analysis for example by data-mining tools and subsequently they are subjected to various algorithms in order to locate patterns useful for future predictions.

After these models are created it is necessary to distribute them to the user part of the system, which is performed by the up-to-date model distribution process. The transmission of information should be possible by several alternative transmission channels.

The user part of the system (driver warning process) assumes the utilization of prediction models in a special device inside the vehicle (client), which evaluates the risk of accident related to time, location, road condition, vehicle condition, weather and other attributes reflecting the actual situation. Most of this information is commonly available in modern vehicles, as they are equipped with various sensors. The device in the vehicle compares the actual situation with prediction results and in case of a high similarity between the situation and the prediction it warns the driver. The driver is warned if multiple accidents happened in that specific location and under similar circumstances in the past (Lamr & Skrbek, 2015b).

INPUTS AND OUTPUTS OF THE SYSTEM

Based on observations of organic systems Bertalanffy (1968) concluded that all systems are opened because they cannot exist without exchanging mass and energy with their environment. The exchange of mass and energy occurs in two directions. Streams called inputs flow in the direction from the environment towards the system, and so called outputs flow from the system outwards into the environment. Certain differences between inputs and outputs occur because of processes which convert or transform inputs, or use some of their components necessary for the existence of the system. In other words, by inputs we understand a set of relations or variables through which the environment affects the system. An output of the system is a set of relations or variables through which the system affects the environment. If we want to define the most important inputs entering the early warning system we should first specify extraordinary events, accidents and other circumstances (Figure 3) which are, by character, rather unpredictable and could be likened to soft systems. However, these extraordinary events usually occur under specific circumstances, which can be roughly described by a set of specific attributes.

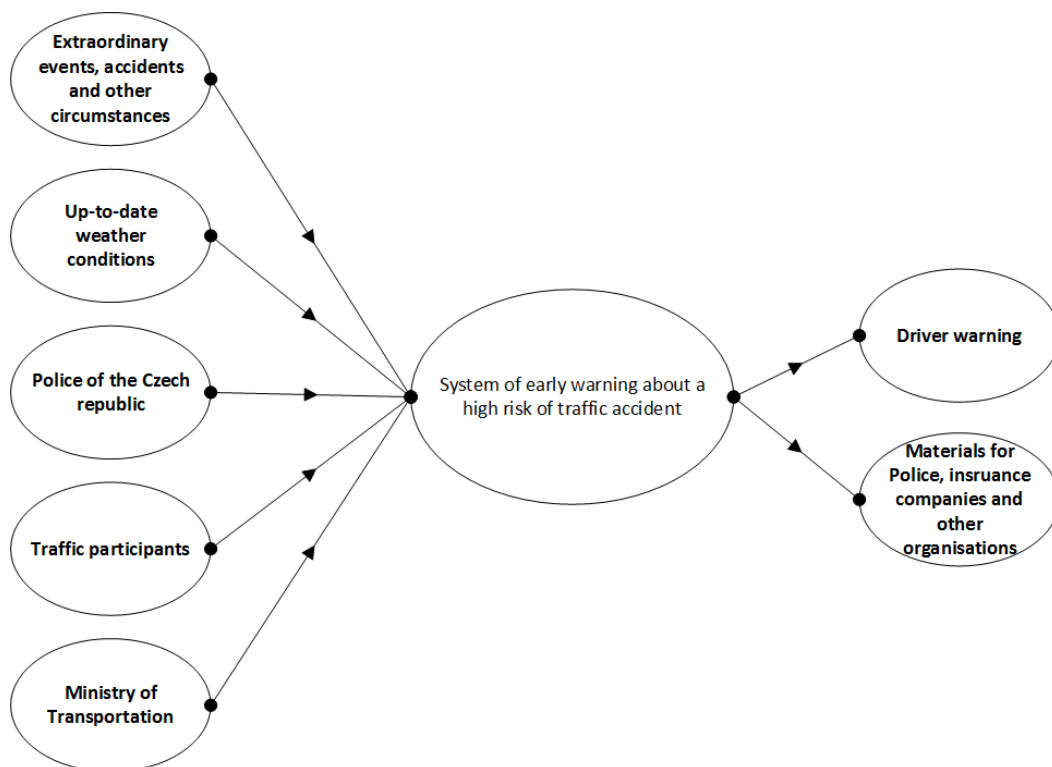


Figure 3. – Inputs and Outputs of the system

PCR is another input of the system, which creates a so called traffic accident record. The police officer is the main factor determining the quality of the record while marking all important circumstances describing an accident. The total number and kind of these attributes are defined by higher authorities within the PCR. Increasing the number of recorded attributes and a precise specification of their importance would increase the accuracy of prediction models. Ministry of Transportation also enters the system together with the PCR as a hypothetical system operator.

Weather conditions, other circumstances and traffic participants enter the system not only from the point of view of historical data, which are used for the self-learning off the system but also actively in real time when the device inside a vehicle evaluates the actual situation and compares it with prediction results.

Another very important output of the system are various materials or details for the police, insurance companies and other organization's and should make it easier for these subjects to make a decision in adequate situations, therefore, these outputs are inputs for other systems at the same time. The main output of the early warning system, however, should be the warning for a driver when they are in a

potentially dangerous situation. When the prediction results are highly similar to the actual situation, the device in the vehicle warns the driver in a suitable way.

ISOMORPHISM, SYSTEM OBJECTIVES AND EVALUATION FROM THE POINT OF VIEW OF HARD AND SOFT SYSTEMS

Mutual correspondence between objects which also preserves relations between these objects is called isomorphism. If we try to find a similar system comparable to the early warning system in the world, we will find tsunami warning systems as an example. Similar system as the one described in this paper could also be utilized to find patterns in data during terrorist attacks and warn people heading towards the dangerous location, however, with completely different input data.

If we continue searching for isomorphism we will also find similar systems between certain mammals. We will use a generalized scheme to describe the correspondence between the early warning system and the early warning system used by certain mammals in risky situations. This scheme is shown in fig.4. Similar behavior as the one used in the early warning system can be observed for example between meerkats, marmots and ibexes.

Meerkats, for example, are social animals living in groups of 10-30 members. At any moment, there is at least one meerkat keeping guard in the middle of the group and looking for predators, including raptors. These guards stand upright on humps or bushes and in case of a threat they make warning signals by screeching or clucking. The bigger the reported threat is, the more urgent and sharp sounds they make are. The early warning system used by these mammals can be compared to the one described in this paper. Both systems operate with pre-learned patterns. These patterns are the potential danger observed by guards in the environment in the case of meerkats. In the case of the system described in this paper they are patterns of dangerous locations and situations related to them. In both cases, up-to-date data enter the system in real time and place and they are compared to pre-learned patterns. The system described in this paper as well as the pack guard processes the incoming data, compares it with pre-learned patterns and evaluates the risk of the situation. In the case of a high similarity with the pre-learned patterns, the guard in meerkat pack issues an adequate warning. The early warning system creates a warning message for the driver through the device in the vehicle similarly to the meerkats behavior. Figure 4 does not depict the update of patterns used for comparison with up-to-date data. In the case of meerkats and other mammals with similar behavior, these are mainly new potential dangers the pack leader encountered and in the future it will become a part of the updated patterns of dangerous behavior. This is the equivalent of updated data from the traffic accident database in our early warning system.

The behavior of systems always leads to meeting a certain objective or objectives. Multiple objectives of a given system can coexist at the same time at all levels of system hierarchy. Every system is affected by several intentions. It is affected by the intention of the of the suprasystem, the intention of separate parts of the system and also by its own intention. The purpose of the early warning system is increasing traffic safety. Ministry of Transportation, together with PCR also share the objective of the early warning system, which is the increase of traffic safety and other aspects related to it, such as the decrease of deaths and injuries. and they are a parent system to the early warning system. Because these two agencies can be considered a higher system, the early warning system should be operated by them.

Systems are divided to hard and soft systems in the GST. These two system types require a different analytical approach and can be used for a different level of modeling of current or future behaviour. Tasks occurring in soft systems can not be easily structured or automated, because elements of these systems are affected by many factors, some of which are not quantifiable. Their operation requires frequent human interventions. Processes occurring in hard systems solve structured tasks which can easily be algorithmized. Once these systems are designed they operate automatically and do not require human intervention. Every system inclines to one of these two categories, but these designations are complementary and can be applied to a single system simultaneously. The early warning system belongs rather between hard systems, because we are able to quantify the quality of inputs, processes which occur within the system can be structured and its task can be algorithmized. Even though the principle

of the designed system does not require frequent modifications or human intervention it also features certain characteristics of soft systems. Some parts of the system, such as the process of prediction model creation or the preparation of data matrix (in the case that the data format changes) require human intervention. By their very nature, traffic accidents themselves are a summary of factors, some of which cannot be quantified.

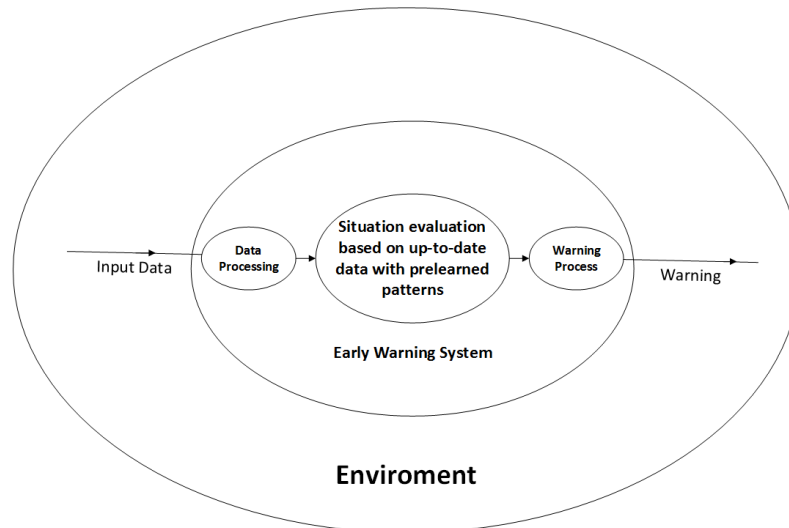


Figure 4. - Generalized chart of early warning system

Functions, which shift the system towards a certain value are called feedback. These functions continuously monitor a given value, compare it to a control value and affect it so that it develops towards a set value. The early warning system can be labeled as a cybernetic system according to Boulding's classification and therefore it is possible to trace feedback within certain subsystems of the early warning system as well as in the system as a whole. The example of feedback in a subsystem of model creation can be the necessity of evaluation of models which were created based on data, and subsequent modification of the modeling matrix if it is necessary.

CONCLUSION

The system of early warning about a high risk of traffic accident should contribute to increased traffic safety especially in situations where drivers find themselves in unfamiliar areas. It is possible to use data mining approaches and algorithms to create models capable of identifying dangerous locations on roads because of the availability of historical data on traffic accidents. Using principles of general system theory makes finding isomorphism's and unifying scientific fields possible. We believe that applying systematic approach and general system theory will lead to a solution in a well generalized form.

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SYSTEMS APPROACH FOR LEAN THINKING IN MANUFACTURING

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ABSTRACT

Current modern period and demand from the business side caused that the companies with manufacturing specialization stuck in the cycle of the constant improvements. This cycle pushes them into continual process innovation and evolves contemporary methods and technologies to reach the competitive advantage on the market. Companies should be much more flexible and adaptable to customer's criteria.

The pressure from the competition forced them to strategical decision-making which may influence the whole enterprise development and effectiveness. The decision-making process should be comprehensively and systemically effective based on the systems approach.

Nowadays, one of the most used methods in production process is Lean Management. Lean Management is, slightly short, the way how to recognize and eliminate wasteful activities in the production systems and supply chains. The purpose of Lean Management is to maximize the speed of flow of products and material within the logistics processes with minimal defects.

This article is focused on comparing the systems approach and Lean Six Sigma methodology used in the manufacturing. This research compares steps of both methodologies, their tools, and proposes some necessary extensions.

KEY WORDS

Logistics, Manufacturing, Systems Approach, Lean Management, Six Sigma.

INTRODUCTION

In the past, system thinking was developed in the different areas in the relatively same time. The systems thinking was mostly connected with biology, physics, and social sciences. Development of systems thinking can be also documented since antiquity, when Aristoteles had said, "The whole is more than a collection of its parts." Subsequently, the basic concept of the system thinking became the word system (Votruba, Kalika, Klečáková, 2004, pp. 6-7).

The word system became the main milestone of the Systems Science which was growing. This word is still used daily. The different forms of system are researched. The system must be seen from different purposes. The system consists of its own elements with its relations. The system is characterized by its own behavior. Von Bertalanffy (1974) believed that systems theory should be an important tool in science and practice. According this idea, every technical system can be built successfully. That is idea of so called "hard system methodology". The system theory should also serve as a management tool. Therefore, Checkland's methodology adds a social point of view and is called "soft system methodology". Checkland's approach and methodology is based on the fact that during examining a problematic system behavior there are a number of possible solutions to be confirmed from human (social) perspectives.

Lean Six Sigma is a methodology incorporating human perspective and collaborative team effort to improve manufacture performance by systematical removing waste combined Lean manufacturing and Six Sigma methodology. Six Sigma originated as a strategic initiative of the US company Motorola in 1987. The starting point was the fact that small total revenues may be in the chain of processes although the revenues of the individual steps are high. Based on this finding, Six Sigma methodology started his hitherto unbroken "triumphant campaign" in early 90's (Topper, 2008).

SYSTEMS APPROACHES

Systems approach represents consistent and comprehensive approach for solving complex problems in which the components and processes are connected and have their internal and external relationships. To make a system working does not mean only to see its main components but also to understand its relations and other impacts which could affect and change the system. The Table 1 describes the main steps of two types of systems approach – hard and soft systems methodologies.

Hard Systems Methodology

Hard systems thinking is a complex way of thinking, especially for engineers whose role is ensuring effective achievement of defined needs. The basic issue is the knowledge what is needed, the way how to achieve it, and the method how to use it especially for structured problems (Daellenbach, McNickle, Dye, 2012).

Hard Systems Approach	Soft Systems Approach
Analysis and symbolic description of the problem	Rich picture
Definition of system elements and relations	CATWOE
Creation of system model OR/MS	Conceptual models of solution
Selection of solution after model experiments	Selected solution after evaluation by interviews and other discussions
Implementation of technically optimal solution	Implementation of socially acceptable solutions

Table 2 – Hard and Soft Systems Approaches

Hard methodology is classic approach of Systems Engineering. It is designed for solving real-world problems mainly technical. The system is proposed to achieve the hard objectives. It has an extensive and proven methods based on System Theory, operational research, applied mathematics, and computer sciences. The advantages of this methodology are transferability, objectivity, and algorithms-based and automated-based solutions process. The solution is technically optimal.

The disadvantage is possible deformation of the problem content. It lies in the fact that "hard" approach is somewhat aggressive and do not allow to design accurately system of a real problem because "hard" view of the problem does not include social view. Another disadvantage is high complexity and uncertainty (Votruba, Kalika, Klečáková, 2004, p. 170).

Soft Systems Methodology

Soft systems methodology emphasizes need of full recognition and capture of human perspectives together with their properties at the expense of formal precision and rigorosity. Transferability of this methodology is possible only at the level of examples (it cannot be used as a immediate solution but only as an example). The disadvantage of this methodology consists in its non-homogeneity making impossible to determine neither a degree of fulfillment of the criteria due to inability to assess

quantitatively its effects and nor formal methods to control the process solution (Votruba, Kalika, Klečáková, 2004, p. 171).

The aim of soft methodology represents improvement in social orientation by activating a learning cycle for people who need to deal with some situation (Brozova, 2015). The solution has to be socially acceptable.

According to Votruba, Kalika, and Klečáková (2004 s.174-177), the soft system methodology is inherently recommendation and procedure for generalizing of the experience with soft systems solutions in practice.

LEAN SIX SIGMA

Lean approach has its roots in the postwar Japan especially in Toyota company where it originated in the 50's of the last century as an alternative to mass production in environment that required high level of flexibility and lacked funding for costly investments.

Lean Management is a wide method of control which, most often in connection with Lean, is used as a concept or thinking which has to be accepted in an organization or company. Lean is based on several basic principles. The first one is an effort of the whole organization to continuously improve in all areas and to avoid unnecessary wastage. The second principle means to best meet needs of customers regardless the way how to reach them. Lean approach is often used with different attributes depending on the particular area of application. Lean management is often combined with Six Sigma tools. (Frajtová, 2016, p. 36).

The Lean Six Sigma concepts were first published in the book titled *Lean Six Sigma: Combining Six Sigma with Lean Speed* by Michael George and Robert Lawrence Jr. in 2002. The Lean Six Sigma utilizes the DMAIC phases similar to that of Six Sigma. Lean Six Sigma projects comprise aspects of Lean focus on waste elimination and the Six Sigma focus on reducing defects based on the qualitative (CTQ) characteristics.

The DMAIC toolkit of Lean Six Sigma comprises all the Lean and Six Sigma tools. There are two common models used by the Six Sigma's business executives and professionals for improvement of processes and quality within the company. The DMAIC method or model is more common. Every phase in this model has an important purpose and different procedures that are used to secure the correct results. The abbreviation DMAIC means Define, Measure, Analyze, Improve, and Control. (Aveta Business Institute, 2010).

Application of Lean Thinking in business processes

In every business process, Lean Thinking aims to explore individual processes, qualify waste, identify causes of waste, and develop and implement solutions. Analysis of processes includes a mapping process using various techniques such as graphs depending on nature of the process. Waste analysis and its categorization led on creation of seven different types of waste. Waste analysis based on time often reveals the main causes of waste.

Lean thinking applies various tools for solving problems associated with full quality control (Total Quality Control - TQC) to identify the causes of failure and offer solutions. Application of Lean thinking is the means by which many companies keep their processes under control. The companies try to minimize waste, fault and downtime and maximize simplicity by system approach. (Frajtová, 2016, p. 37-38).

COMPARISON OF THE STEPS OF BOTH APPROACHES

Comparison of the steps of the systems approach and Six Sigma methodology is in the Table 2.

Description or definition of the problem is different for both methodologies. The problem definition in system approach consists of hard or soft system methodologies describing the basic elements: inputs, outputs, environment, behavior, and subsystems. Consequently, the system is graphically displayed. The

Six Sigma's problem definition consists of goal, resources and customers without its definition as system elements or its graphical depicting.

In the second phase of both methods, the defined system is analyzed and designed. Hard system models are used for technical improvement. Soft system models and approaches are often used for improvement of human activity. From the perspective of Lean Six Sigma, the used tools tend to measuring and analyzing problems while no specific tool for selection of an appropriate or optimal solution is used in this phase.

The third phase of system approach, the selection of socially acceptable solutions and technically optimal solution, is based on modeling and quantitative and qualitative analysis. There is a need to solve the problem and to select the best solution. Lean Six Sigma process misses this step. The necessity of this decision step is obvious. Problem analysis is not solution process. Specific tools – solution methods have to be included in the whole DMAIC process. Therefore, we propose the extension of DMAIC to DMASIC adding the step Solution. Missing step – Solution – is highlighted in the Table 2.

Implementation of the solution is an essential final step in problem-solving process. Every excellent solution it is unnecessary without any implementation.

The last step is a control process. This step is not applied in systems approach. It could be perceived as another decision-making process or problem to be solved. In the DMAIC process, control and monitoring represents the last step of checking whether the objectives were achieved or solution has not been successful.

	Systems Approach	Six Sigma - DMAIC
Problem	Defining problem using systems methodologies	Defining of problem
Model and solution	Analysis using systems methodologies	Measuring and Analysis using Lean tools
Final decision	Proposed solution using systems model	Solution
Implementation	Implementation of proposed solution	Implementation of selected targets based on analysis
Control	Control as another decision-making problem	Control and monitoring

Table 3 – Comparison of systems approach and Six Sigma methodology

CONCLUSION

From our point of view, the main difference of both processes consists in the fact that systems approach represents a comprehensive view on the system while Lean Six Sigma strives for improving of individual processes inside the system. Lean Six Sigma examines the processes in depth but not from systems perspective.

Although the practices of these two approaches are very close one important step is missing in each of them. "Solution" step is missing in Lean Six Sigma and "Control" step is missing in system approach.

The most important difference consists in the fact that Six Sigma does not include "Solution" step consists of specific solving methods. This methodology defines the problem and, then, individual processes are measured and analyzed and the solutions resulting from the analysis are implemented. There are neither proposed solution methods nor problem solutions which could be implemented. Only

analysis cannot result in choosing the solution. Skipping this step deteriorates such well-known and highly used method.

On the other hand, system approach does not include the step “Control”. For defining and analyzing problem uses soft or hard systems methodologies, including solving methods, solution design and implementation. There is no inspection process and the chosen solution is not checked. In the systems methodology, this last step is usually defined as another decision problem and, thus, the whole process of system approach starts from the beginning.

Therefore, we propose to extend Six Sigma’s DMAIC tool to DMASIC one where S is a symbol of Solution.

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DEVELOPMENT VALUES HUMAN LIFE THROUGH THE LEARNING PROCESS AS A MEANS OF RESTORING THE QUALITY OF LIFE

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ABSTRACT

The value of human life currently ranks among the topics which are often and endlessly discussed by general public as well as by experts circles of various scientific directions. And it also belongs to subjects that have been perpetually dividing society into two camps. The first one consists of those for whom life is sacred, refusing any human interference and influence of its length. The second one is a group of those for whom quality of life is more important and when, in their view, a human life does not happen to be good enough and further suffering only „derogates“ its dignity, such life is allowed to be terminated. Natural law, which exists in every human, bears up those who stand on the side of life and its dignity, on the side of those who believe the human was created in the image and likeness of God. Therefore, it is important to talk about the value and dignity of human life, especially with children and young people who currently receive a great amount of often conflicting information which they cannot properly evaluate.

Besides family, which is supposed to be the first source of information on fundamental issues of human life, the young people acquire information that may affect their thinking and acting also in school, principally during religious and ethical education lessons.

KEYWORDS

dignity, ethics, human life, youth, religion, quality of life, knowledge, understanding

INTRODUCTION

The need for formation of young people's perspectives in various, ethically and morally ambiguous situations is essential, because that is the only way they will be able to make right decisions and to adopt the right attitude based on moral values in their adult lives, once they are confronted with problems of bioethics. However, it is important to provide them with information, where human life is not considered a „property“ that could be freely disposed of as something that has value only if it has been involved in the production of material goods. We must offer them a vision of the human who deserves respect at all times and in every stage of life. A view of the uniqueness and dignity of human life from the moment of conception to its natural end.

Attributes of quality of life

Potůček (2002, p. 227) in generalizations development of value orientation of Czech society. notes:

"a) decline in the importance of value orientation in general (weight loss questions about quality, content or the meaning of life)

b) increase the weight hedonistic, individualistic to selfishly oriented value orientation,

c) significant weight loss altruistic oriented value orientation, value orientations associated with solidarity. "

The author also notes a growing market for subsisting empty, devoid of humanity. According Pullmann, Kompiša, Bochníčková "problem of quality of life is essentially a problem of values." (2007)

Essential for quality of life, we see the normative understanding. In the subjective dimension of quality of life leads us to the satisfaction of the individual, the objective dimension of the common good. Applying statement, expressed Hubý (2001) and Mezřický (2005) in connection with redundancy indicators of quality of life, we need to pronounce the opposite order of the causal chain. Arbitrary determination of the common good as a benchmark in the spatial dimension of quality of life will enable us to identify indicators expressing its implementation.

For the first can be considered an indicator expressing atavistic human desire for a long life: to live long (in terms of life expectancy, which is the general expression of physical and mental health, lifestyle etc.). Due to the fact that one lives in paired Community, the second indicator is to live in a marriage (voiced by the absence of divorce). The third indicator expresses the human desire to be surrounded by beautiful, in the broadest sense. For aesthetic categories is unknown measurable standards, and expressed against beautiful harmonious environment, represented indikátoromžít' preserved environment (in terms of the absence of any pollution indicators). Procreation is necessary to preserve the family, in terms of Buchanan finding it more urgent than our biological civilization sequel (2004). We express this fourth indicator, which is to have children (in terms of natural increase). The fifth indicator, usually allowing the realization of the individual. It is to be educated (expressed in terms of population with university education). The sixth indicator expresses the realization: being employed (expressed lack of them in employment). The seventh indicator reflects, in our opinion, the fulfillment of human life, metaphorically expressed as "obolus bring into the treasury of mankind": to be generative (expressed support others).

The first three indicators are pointing to the inner world of man. The other three are community, connecting the inner and outer world. Have children to be educated and employed is nice, most of us are quite interesting, and perhaps some understanding egoistic. Druhoplánovo not "benefit" from these indicators have others. The seventh indicator expresses our activities, all of which have a tangible benefit others. It is directed to the outside world humans. According to Ericson is the eighth highest stage of personal development (1950, In Krivohlavý, 2004). Of Ericson acceptance of the postulate that, for a large part of Czech society Potůček generalization of value orientations (2002) was not entirely true. A huge wave of solidarity that rose after the disaster caused by the tsunami a few years ago and which was manifested by collected amounts of aid, higher per capita than in more affluent countries, it is proof of that. (Muragaš, 2007)

As the six attributes of quality of life Murgaš notes the presence of education, especially higher education. Education without values, and a barrel of dignity šudského not life right obsahovost' and change only the ownership changes kvalitaívneho statement as a member of society.

ADOLESCENCE PERIOD

„For John Paul II., youth is not only a time of life, accounting for a specific number of years. He perceives it primarily as an utterly unique wealth of man, as it simultaneously represents the time which had been given to every human by Providence as a task. After all, during the beautiful, but also inquiet years of youth, the man reveals his human, unrepeatable «I» and associated features and capabilities. Step by step, he forms an own identity, looks for answers to basic life issues, and plans, makes first particular decisions, which will essentially affect his whole life“ (Stanček, 2007).

In biological terms, we can consider the period of adolescence as a life period flanked on one hand by first signs of sexual maturity and a significant acceleration of body growth and on the other hand by reaching full sexual adulthood and completion of somatic growth. Simultaneously with biological changes, a young person experiences significant **psychological** changes demonstrating an overall emotional lability, an onset of a grown-up way of thinking and attainment of universal development. These changes are also accompanied by new **social** inclusion of individuals, whereas society expects them to behave and to perform in a different manner as well as to adopt new social roles. The course of the psychological changes and social status of the young person are influenced by many social, economic and cultural factors as well as by educational attitudes of parents, teachers and others. Although there is a problem to synchronize the age of adolescence, since it is different for boys and for girls, in terms of

today's advanced society, we can define the boundaries of adolescence by lower limit of 11 to 12 years and by upper limit of 20 to 22 years (Langmeier, 1998).

This period, however, needs some further subdivision because there is a huge distinction between being 11, which is considered being a child, and being a 22 year old adult. Most often this division distinguishes as follows:

1. The period of puberty - approximately from 11 to 15 years old. During this period, the first signs of sexual maturation show up and the physical growth accelerates.
2. The period of adolescence - approximately from 15 to 22 years old. Teenagers gradually reach full sexual maturity and the physical growth is completed, too. The position of an individual in society is significantly changed by transition from elementary school to further studies, which changes the self-perception.

Although the physical changes during adolescence period are most visible, the changes occur also in a cognitive and emotional development as well as in the area of socialization. For a young person, in order to successfully integrate and to actively participate in social life, there are decisive developmental **processes of individualization and identity formation** during adolescence period.

The process of individualization gradually develops with an adolescent in four stages (differentiation, experimentation, stabilization and psychological independence), through which the adolescent differs from other people, and is acknowledged as an independent and free entity (Glasová, 2006). Continuously, it leads to emancipation from family and to significant relations networking with contemporaries. In recent decades, a faster onset of physical maturation has manifested itself more significantly. Yet, it still does not ensure the emotional and social maturity. There is a discrepancy between the physical and social maturity, which is manifested as a postponement of marriage entry until after one graduates and acquires a job. There also exists a serious discrepancy between the values of younger and older generations, being notably caused by breakthrough scientific and technical changes which increasingly bring along more frequent differences in opinions, values and attitudes. The older generation has been putting itself to a position of traditions guardians, which has been rejected by young people as an obstacle to progress (Langmeier, 1998). Not even in Slovak law system is the term „youth“ defined. Similar terms are used in laws being related to the age limit of life which is near to the age of youth. Under the Civil Code, the crucial age is when a person reaches the age of majority, which is at 18. The Criminal Code uses the term „juvenile“ from 14 to 18 years and a person who is not criminally accountable - in this sense, a child under 14

years. The Labour Code uses the term „adolescent employee“ - an employee under 18 years. Social security legislation laws operate with the term „dependent child under 25“. The Social Protection Law applies the term „child under 18 years“ and „young adults from 18 to 25 years“ (Legislatíva pre, 2014).

In sociology and other social sciences, which deal with a category of „youth“, a content of this concept differs from the content of the conception of puberty and adolescence. From the perspective of sociology, the youth can be understood as an assigned status or socially formed category, though less than a simple biological form of being young. As a socio-cultural category, youth is a phenomenon of last centuries and its origin is connected with a process of industrialization, as manufacturing required professional training and an increased demand for higher education. Hence, such a time and social space had to be created, in which this training could be performed, which in practice means a constant lengthening of the youth period. Every individual, thus also a young man, is a part of society and within the society, he implements and achieves his objectives and meets his needs. The society affects him either positively or negatively (Štefaňák, 2009). Out of many definitions of youth, we have chosen the definition of Miroslava Debnáriková, which is very concise. The youth is defined as: „*a socio-demographic group of population aged between 15 and 30 years with typical features and characteristics, specific interests and requirements and value orientations, which distinguish itself from other age groups. It is not a homogeneous group: its attitudes, interests and requirements primarily depend on young people's affiliation to a social group*“ (Debnáriková, 2009).

The subject of values in teaching process

„There is no doubt that the first and the fundamental cultural reality has been a spiritually grown-up human, hence a perfectly mannered human, the one being able to educate himself and also others. The primary and essential role of general system of education and of every culture is the upbringing, which lies in the fact that the man becomes more human, in order to be able „to be“ more and not only „to have“ more. And then through everything he has and owns, he could all along become a more solid person“ (Tobiáš, 2007). The words of pope John Paul II. reflect very exactly a nature and aims of education of young people – to be a human being with the meaning, values and moral ideals. If we want young people to be that way, we need to educate them – to show them the importance of a proper attitude, also and predominantly in matters of morality, in issues of dignity and value of man as an object of all activities of society. The issue of value orientations of young people still poses an actual problem, being discussed in pedagogy, philosophy, ethics, sociology and psychology, as it is an interdisciplinary category. However, the value orientation is primarily a result of education in families, schools and in the nearest young person's neighbourhood. The term „value“ is defined differently, depending on in which scientific field it is mentioned. The term is used for „quality labelling of objects and phenomena, regardless of whether the person or people attribute the value to it. At the same time, however, the concept of value is used to indicate richness, significance, subjective relevance to a particular person. We can look at values from three angles:

- the value as the quality of things, toward which human efforts are oriented (aimed at meeting the needs of a human being),
- the value as a positive valuation of human ties (relationships),
- the value as a general criterion, based on which different objects are evaluated“ (Gajdošová, 2005).

In 1990, Austrian bishops issued a pastoral letter titled *Sozialhirtenbrief der katholischen Bischöfe Österreichs*, in which they expressed their attitude toward social

problems. They consider it very important to educate young people so that the young people can realize their responsibility for their own future as well as be confident that their responsibility and involvement in economic and social life are appreciated. It is necessary to guide them, in order to prevent them from recognizing the aim of society barely in a constant escalation of welfare, yet to guide them to learn deeper truths, values and goals, through which they are capable of exceeding their selfishness, meaning a human dignity, justice, solidarity and responsibility for the visible world (Mordel, 2008).

Young people grow up in social relations. If they want to master their lives, they must learn how to cope with challenges that are placed upon them, to solve problems and various life situations. During adolescence, the young person is inevitably confronted with certain boundaries – social regulations, rules, standards, practices and laws. An important place in the system of factors which influence adolescence and maturation of the young man's personality, belongs to all human and particularly moral values. What defines the social norms and rules, is simultaneously also a definition of what is right and what is good. Factors that define certain restrictions, and that guide attitudes and behaviors of an adolescent, are called *social limits*. The social limits are rules and expectations derived from the values and norms directing the young man, though if necessary, also restricting his behavior. By means of the social limits and rules of the social world defining the boundaries in acting and by protection of their freedom, the young people learn and, consciously or unconsciously, also sort their values. They demonstrate a specific attitude towards values, learn to distinguish between the good and what threatens them. Foundations of these attitudes are acquired mainly in the family from childhood and depend on the attitudes and value orientation of parents (Potočárová, 2006).

Decision making about what is ethical and what is not, has never been as difficult as today. Young people who have not yet developed well-defined opinions and who have not yet been indoctrinated, whether in their families or in the educational process by proper views on life, are confronted with a multiplicity of information or misinformation offered by the latest information technologies. As early as with primary school children, spending most of their free time with a PC and online social networks, they have been losing respect for life and as such, they do not regard it as something unique and special.

Computer games have been presenting the loss of life as something normal, having thus had an impact on reducing the age limit at which attacks on others appear. Will these young people have any efforts and willingness to protect human life when becoming adults, unless they are presented the truth about murders of unborn children and old people?(Brođáni, 2008). The greatest impact on the formation and development of young person's values has a family. Parents bear the main accountability for the education of their children, and for the values that they hand over to them. However, the current era is increasingly focused on material values and many parents spend more time and efforts with their jobs than with their families and children, in an effort to financially provide for the family. It happens that children are more influenced by their environment, school and peers and receive values of people they are frequently in contact with. There is a space opening here to influence the youth through teaching subjects. The ones dealing most with the issue of values in human life probably are the subjects of **Ethics** and **Religious education**, which are compulsory courses in the first and in the second year of secondary schools.

The subject of Religious education/Religion aims to positively influence the values orientation of students so that they become people of high moral standing, who shall be responsible to each other, to other individuals and to the whole society. The Religion subject teaches students to think critically, not to let someone manipulate with them and to understand themselves and others. While allowing them to clarify a moral view and to distinguish between what is accepted by society and what is the true moral good. To human life as the highest value is dedicated a topic of *Values of life*, which among other things aims

at the following: to ask fundamental existential questions, to draw conclusions, based on the biblical text, for life of humans as a man and a woman in their indissoluble community, to defend the right of humans to live from the moment of conception, to assess the value of family and to name its threats at present, to realize dignity of human life as the first value which we are responsible for.

There is a **Fullness of life** topic dedicated to issues of human suffering, illness and death, in which students focus on the theme of the right to dignified dying, palliative care and its borders, but also the Christian sense of suffering. This topic is also devoted to the moral aspect of euthanasia. The aim of this topic is to lead students to ask questions about life and death, to show them perceptions of the old age, unsoundness and human suffering, to compare them with the Christian view of the man's value and to draw conclusions for their lives. At the same time, to interpret the Church's teaching about death and the afterlife, to explain the importance of the Sacrament of the Sick, to be familiar with Christian funeral rites and to recognize a sign of the Christian faith in the resurrection of the dead in them. The explanation of this subject will help students solve problems in the light of the Church's teaching with an emphasis on ethical approach to the sick and elderly. They are able to perceive the situation of the old and sick person, and to know the values that they can be offered by such a person. The process also involves teaching about responsibility of young generations for generations of the old and sick people who require their respect and gratitude.

The students are explained a hospice care, which preserves dignified dying of the man, recognizing the value of each human life and being suitable as an alternative to the option of euthanasia (Učebné osnovy).

The education towards values and towards respect for life is a goal of the second compulsory optional subject - Ethics. The subject is primarily focused on education for sociability, which is reflected in moral attitudes and behavior of pupils regulation. Development of ethical attitudes and pro-social behavior is primary for the ethical education.

It also includes the development of social skills (open communication, empathy, positive evaluation of others), as well as the promotion of mental hygiene, participates in the primary prevention of behavioral and learning disorders (ISCED 3A). Ethics is intended to allow students at the appropriate level to name, explain and develop basic ethical attitudes such as self-control, positive self-evaluation and evaluation of others, communication skills, creative solving of interpersonal relationships, etc. In the teaching process, students are supposed to adopt moral values, to cultivate a positive attitude towards life and people, to be able to judge morally, to make decisions and to take responsibility for their decisions and actions. Within lessons of Ethics the students will explore communication and communication skills,

dignity and the value of a human person, the ethics of sexual life, relationships in the family, but also the philosophical generalization of the ethical values. There are some additional objectives to be explained to the students, such as important values and ethical standards related to life and health, family life, parenting and sexuality. The area of dignity and value of the human person involves obtaining positive experience supporting the basic confidence in oneself, autonomy and initiative. The curriculum includes exercises focused on a positive self-evaluation as well as the evaluation of others, creative solving of common situations in interpersonal relationships, esteem, and respect for other races, ethnic groups and disabled people, understanding of others, searching for positive role models in everyday life.

In the context of Ethics, it is important to make students familiar with bioethical issues, particularly with the issues relating to moral aspects of abortion, euthanasia, relationships to the sick and disabled persons, etc. The aim of Ethics is to educate the personality with its own identity and its own value orientation in which the respect for life has a significant position. Teaching Ethics is not meant to lead to a robotic memorization, but, it should provide the student with a dignified way how to become familiar with the issues, so that he understands it,

so that he is able to take a critical position, as well as to solve moral dilemmas of bioethics, and as a result he concludes and argues morally (Mlynárová, 2014).

Ethical and religious education have a significant place in the formation of values, as well as opinions of the students addressing ethical issues in fields of health and disease, in issues of birth control, and in many other areas. It is important that young people are offered the information from the fields of religion, ethics, bioethics, which helps find answers to questions relating to ethics as well as morality, helps find the right solutions to numerous borderline situations, though above all, the bioethics tries to focus its efforts of everyone involved on achieving the most important objective which is and must always be – the good of a person.

CONCLUSION

If we want to have not only educated but also morally formed youth, the emphasis should be placed on the development of moral values in families that have a major impact in shaping the attitudes of young people. A school still remains an important factor in building the positive attitude towards life, yet also towards the adoption of suffering and pain. Through education in the areas of moral and ethics, it helps young people find their ways through the issue of bioethics problems. Equally important is the formation of public opinion by media that influence young people's attitudes on matters of people's rights to make decisions about their lives, on pain and suffering, but especially on the question of dignity and the value of every human life. Society has been having an impact on the attitudes of young people, as through the adoption of laws, it can help protect the inviolability of life, or vice versa, it may facilitate its termination with impunity. It is important to create such a social environment, in which people cherish their lives and receive life as a gift. They will then appreciate the lives of other people, too, even if marked by pain and suffering.

Correct value-oriented education is the foundation of a person's ability to find a job and is a manifestation of a proper understanding of the activity, which is called human labor. She itself is only when human knowledge when it turns into knowledge and it relates to improving the quality of life of the individual worker but also a man to whom the work is the work of man meant.

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SYSTEMATIC ANALYSIS OF SOCIAL MEDIA IN 2016 US ELECTIONS

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ABSTRACT

The aim of the paper is to provide overview of social media power and based on social media data explain the results of United States president election 2016. The history of using social media for political purposes dates from 2004, and now, presence in social media has become a standard of election campaigns. However, not everyone realize it, and not everyone can use power of this tool rightly, so it can turn against the candidate. On the example of Hillary Clinton and Donald Trump social media battle will be demonstrated, that power of social media is much stronger than traditional media power. I'm comparing Republican and Democrat campaigns, and on the end of the essay the results of the US election is bringing out as a proof of analysis results. The idea of essay is supported even the some of the candidates, and evidence of that claim finish that paper.

KEYWORDS

US election 2016, president election, social media, Facebook, Hillary Clinton, Donald Trump, United States

INTRODUCTION

The Internet has become an integral part of our lives. Since the rise of the Internet in the early 1990s, the world's networked population has grown from the low millions to the low billions. Can you imagine your life without the Internet? I cannot. The usual spheres of our life like education, shopping and banking during the time take more and more part on the internet. Sooner or later it had to happen with politics, and they start to use Internet in their's proposals.

HISTORY OF SOCIAL MEDIA IN ELECTIONS

The first case of using the internet for political purposes was detected in 2004. Democrat Howard Dean served as the Governor of Vermont from 1991 to 2003 and decided to run for president for the 2004 election. Than Dean was credited with organizing the first campaign website, acting as a virtual headquarters for fundraising and volunteer recruitment. Dean's campaign was also viewed as a success for his ability to raise large amounts of money in small increments. In January 2004, his campaign had raised \$41 million from supporters mostly online.

The same year, when had been launched Facebook, Democrat John Kerry in the 2004 presidential election take advantage from Mark Zuckerberg by making him responsible for "get out the vote" and mobilization efforts.

The 2008 Obama Presidential campaign made history. That was the first election in which candidates utilized the Internet and social media as a tool for their campaigns. Barack Obama was the first to use the Internet to organize supporters, advertise, and communicate with individuals in a way that had been impossible in previous elections. And how we know now, Barack Obama has chosen the right tactics,

which helped him to become the president of US in 2012. That was a big step for 2007 considering the fact, that Twitter had only just started and there wasn't even an iPhone yet.

Four years later (US election 2012), the media landscape looks a lot different. There are an ever-increasing number of social media tools and a rapidly growing user base across all demographics. Current measures of American adults who use social networks are at 69%; that's up significantly from the 37% of those who had social network profiles in 2008. And also politicians were now on social networking sites like Twitter, Instagram, YouTube and other new social media tools and mobile apps. If we have a look on Obama and Romney campaign's presence on social media, we will see the clear difference. When Barack Obama had over 20 million followers on Twitter, Romney had just 1.2 million. On Facebook Obama had over 29 million likes on his page and Romney had 7.9 million likes. On Instagram Obama had 1.4 million followers and Romney had 38,000 followers. (Wikipedia., 2016) So, based on the facts above, we could easily predict the result of the 2012 US election.

2016 ELECTIONS

In 3rd quarter of 2016 Facebook has 178 million active users daily just from US. The population of USA is near 320 million people. It means that more than one half of population (55%) use the Facebook daily. Based on that fact we can claim that social media can influence US election voters. (Statistics, 2016)

The most popular content type in 2016 on Facebook is video content. So candidates had to aim mostly on post videos. In contrast of last election in 2012 there is a new tool on Facebook called FB Live, which allow to posts live video sessions on Facebook, and people can write the comments during the live steaming. Previously, there were two types of publishers that best managed to use this tool to grab engagement:

1. News publishers with the resources to experiment with video
2. Viral publishers

And now we welcome a third – the Politicians.

In the case of the 2016 US Presidential Election we see the much more different play on politician area. As Facebook has become a key delivery network for news institutes, viral sites, and celebrities, so too it has become a way of spreading political messages. The idea of politician fades away and instead it we have candidates as celebrities. With such a significant amount of people getting their news from Facebook, it would be not smart to underestimate the importance of winning the battle on Facebook.

HILLARY CLINTON VS DONALD TRUMP CAMPAIGN

HILLARY CLINTON

In April 2016 was announced a program called "Barrier Breakers" intended to rival the largely online volunteer efforts of Sanders and Trump supporters. With \$1 million in funding, Correct the Record employed paid staff described as "former reporters, bloggers, public affairs specialists, designers" to post "exclusively positive content." (Wikipedia, 2016)

On June 9, 2016, as a response to Donald Trump's tweet regarding Obama's endorsement to Clinton, Hillary Clinton wrote with a three word tweet: "Delete your account". By the end of the June that post had reached 1,000,000 interactions and become her most retweeted tweet of all time.

DONALD TRUMP

The Trump presidential campaign benefited from large numbers of supporters who were active on social media from the beginning of the campaign. Trump had already more than 5.5 million Twitter followers and 4.5 million Facebook fans in 2015. He has a presence across YouTube, Vine, Instagram and Periscope. (Parkinson, 2015)

The following table including the basic information about accounts in different social networks of both politicians valid for 15th of October 2016.

Social network name	Hillary Clinton	Donald Trump
Facebook	5.8 million likes	10.5 million likes
Twitter	8.6 million followers More frequently updated than their Facebook account. Have a tendency to use Twitter for rapid response.	11 million followers Famously features controversial tweets written personally by the candidate.
YouTube	18 million views Much less frequently updated. The campaign has a mix of campaign ads, attack pieces, and longer, more personal videos.	8 million views A range of different types of content, including several direct-to-camera videos.
Instagram	2 million users Mix of photos and videos	2.4 million users Mix of photos and videos
Pinterest	11,800 followers Isn't as popular as other social sites, features special selection of grandmother related content and plenty of campaign merchandise photos	-----
LinkedIn	500,000 followers That is place for a candidate looking to tout her extensive experience.	-----
Medium	150,000 followers Medium isn't a traditional social network for creating and sharing of information, ideas, career interests	-----

Table 1: Comparison of Trump and Hillary social media statistics

On their official social media accounts Trump and Clinton have very different strategies. While Trump is still getting more engagement overall on most social media channels, looking at interactions on a per post basis, Clinton more than holds her own.

Trump talks to his audience like he's having a conversation with them with few links or pictures to distract from his words. By and large, this has helped him during the campaign with Trump's Twitter usage in particular capturing the attention of many.

Clinton by contrast uses social media in a more "traditional" way, crafting campaign sound bites, adding links and inserting images.

DARK SIDE OF SOCIAL MEDIA

As a result of their social media strategies here are two the most popular posts on Facebook from each of the candidates:



Most popular posts on Facebook made by candidates (source: www.facebook.com)

Donald Trump's title references to dark side of social media, when something is sharing without willing the person to who related that content. The social media is a big power that can help candidate to reach a fame and respect but sometimes it can also play against politician. In that case Donald Trump references to the Hillary Clinton email controversy.¹

The main content provider of posts against Hillary Clinton is Donald Trump. In contrast against Trump were made a huge number of campaigns with famous names on it. In this election year unprecedented numbers of celebrities are using the tools of internet video and social media to voice their unfiltered political leanings, which generally speaking against Trump and for Hillary Clinton. Increasingly celebs have been using YouTube, Twitter, Facebook, Instagram and other platforms to express their political viewpoints, both ways - earnestly and humorously. There are a lot of examples in the internet, but the large part of this content based on the vulgar slang, that Donald Trump use in his speeches.

And here is a difference: bad manners of Trump and crime case of Clinton.

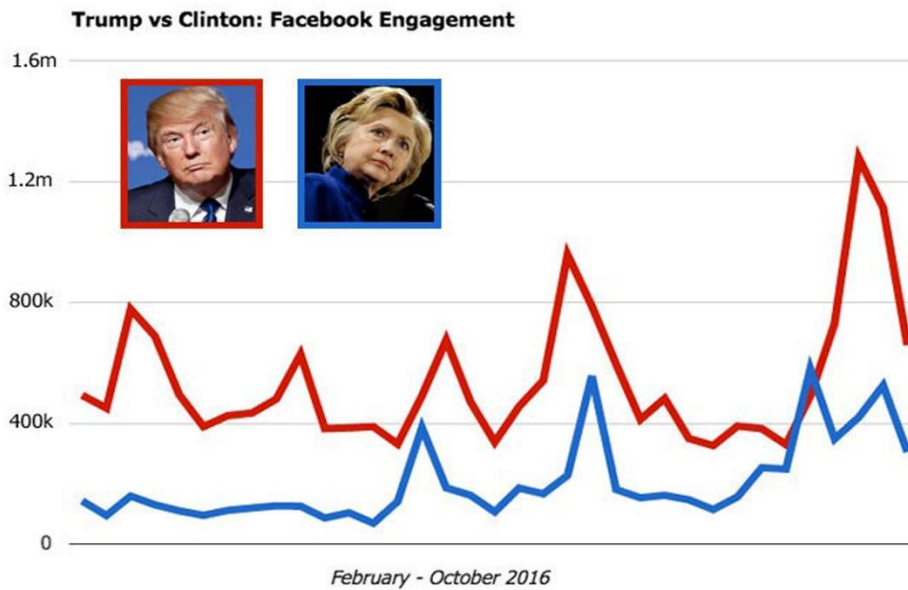
PREDICTION OF RESULTS IN US ELECTION 2016

First of all let's see the basics of how choosing a president works in US. To win the election, Hillary Clinton or Donald Trump needed to pick up at least 270 (out of a total of 538) votes in what's called the Electoral College. Electoral votes are allocated through a winner-take-all system in 48 states. Two states, Nebraska and Maine, allocate some electoral votes by district. (Wikipedia, 2016)

If we compare Facebook page likes of candidates, we'll see that Trump has a significantly larger Facebook page – **11.8m** against Clinton's **7.7m** page likes (1th of November). But there are some

¹ In March 2015, it became publicly known that Hillary Clinton, during her tenure as United States Secretary of State, had used her family's private email server for official communications, rather than official State Department email accounts maintained on federal servers. (Wikipedia, 2016)

metrics that give overview independent on scale of Facebook page. It means that more number of likes doesn't necessarily mean anything. On the diagram below we can see weekly engagement scores² for total FB engagement across all posts (including likes, reactions, comments and shares) from the Facebook pages of the two candidates for the period from February to October.

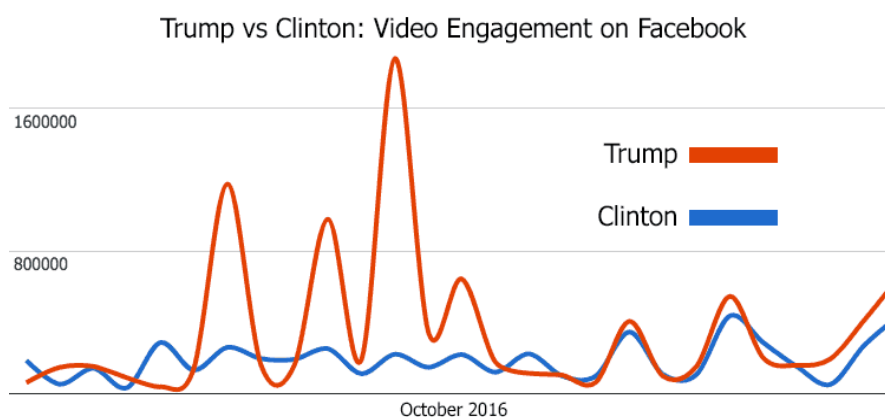


Facebook stats (source: www.ezyinsights.com) pic.1

It is pretty clear that Donald Trump is the winner in terms of engagement power. Just ones Clinton was able to overtake Trump, it was during the second Presidential debate. That most popular post being simply a photo of Clinton with the title - "I'm with her".

As I mentioned before, the most popular content on Facebook this year is video content. Let's have a look at the charts below and compare how candidates manage this part of battle on the most popular social network. For more realistic prediction let's see the newest statistics, what means over the month of October, the period tightly before the Election Day. (November 8, 2016)

Overview of native video engagement for October 2016:



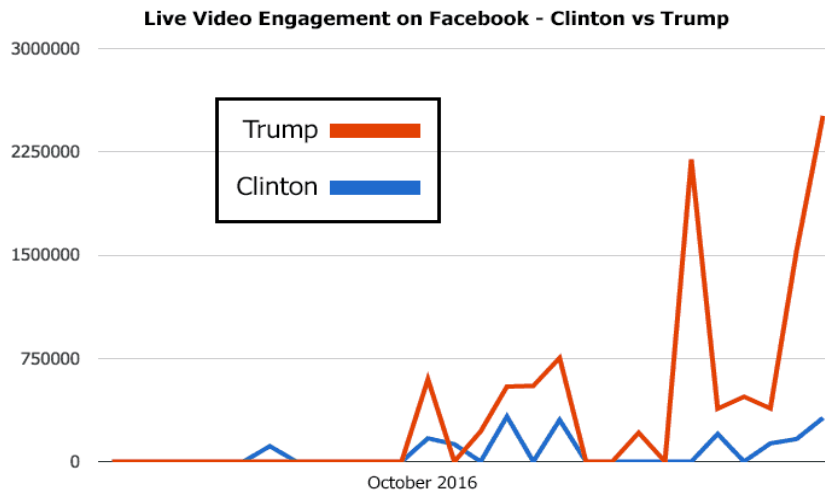
Facebook video stats (source: www.ezyinsights.com) pic.2

² Engagement Rate is a metric that become today's standard for measuring social media success.

$$\text{Engagement Rate} = \frac{\text{Likes} + \text{Shares} + \text{Comments}}{\text{Fans}}$$

One more time we became convinced in domination of Donald Trump during the first half of October. But in the second half of the month Hillary Clinton balanced out with Trump. The main reason of that situation is explained by the chart below. So Trump instead of posting native video aimed on the new tool in that US election - FB Live videos, and result is totally clear.

Overview of video engagement:



Facebook FB Live stats (source: www.ezyinsights.com) 1

From the other side it is hardly a surprise. When we look at Trump's activity on Facebook, we'll find that he streamed 33 live video sessions over the month of October. In comparison, his opponent Hillary Clinton has only posted 11 live video sessions.

The Clinton's page is the more conservative one, with a steady rudimentary strategy that is more about issues and less about simple messages, while the older candidate Donald Trump's team is posting content in a more modern and dynamic way. Here is one assertion that I can claim without a doubt, Donald Trump's internet campaign is more successful than Hillary Clinton's. Based on it I firmly can say that Trump is a leader of that race, and he has a big changes to win President Election.

AFTER THE ELECTION DAY.

Republican Donald Trump has won the US presidency with at least 306 electoral votes, securing more than the 270 he needed to succeed Barack Obama. His Democratic rival Hillary Clinton had 232 electoral votes, a crushing defeat for the former secretary of state.

After being elected Donald J. Trump gave his first post-election television interview on "60 Minutes" show.

"The fact that I have such power in terms of numbers with Facebook, Twitter, Instagram, etc....I think it helped me win all of these races where they're spending much more money than I spent." Trump said on CBS' 60 Minutes on Sunday after win.

So the president-elect specified that social networks helped him win without him needing to spend as much as the Clinton campaign on other advertising, both digital and traditional. "I think that social media has more power than the money they spent," he told. (Trump, 2016)

CONCLUSION

Social media's influence in this presidential election is stronger than it has ever been. If before the 2016 presidential primaries, social media were just a method of communication and organization, nowadays it is a place, where people can act on politicians by just sharing it around. So for politicians is not necessary to spend a lot of money on media to reach millions of people anymore. On the other

side the same millions of people by similar channel (social media) can obtain some content connected to politician which just maligns the reputation of politician.

So people have an overview of bad and good things about politicians, they can see their friends opinions and opinions of famous people in social networks. And based on that all information that can make their own mature decision about who to vote for.

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HOW TIME CHANGES HUMAN RESOURCES' S VIEW ON SOCIAL NETWORKING SITES AS RECRUITING TOOL IN THE CZECH REPUBLIC

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ABSTRACT

Purpose – The main aim of this research was to elicit the viewpoint of HR professionals (Human Resources) about using SNS (Social Networking Sites) for recruitment, and the actual extent of their use in practice. Furthermore, this paper assesses whether they are becoming the main means of attracting new employees, comparing developments in their use between years 2012 and 2015 in the Czech Republic in relation to other tools available.

Design/methodology/approach – A survey questionnaire was employed using both closed and open-ended questions in which respondents could evaluate and express their views on SNS and other forms of recruitment, as well as state personal experience. The structure of the questions were the same in both years of the study (in 2012 and 2015).

The target group of the study were recruiters and other persons directly involved in recruitment.

Analysis was via descriptive statistics and hypothesis testing; two of which were confirmed on the reliability implications reaching more than 70% of respondents and one of them was evaluated by t-test.

Findings – Results found that the number of recruiters' using Social Networking Sites to publish job posts in search of new employees doubled compared to the year 2012. However, the most widely used method for hiring new employees is still advertising on job boards which remains static in its adoption. Regarding Social Networking Sites, LinkedIn is the most commonly used platform with a sizeable increase in SNS adoption and use in marketing between both years. The hypothesis that the information obtained from SNS can influence the decisions about the admission of candidates was confirmed by 280 respondents. The biggest advantages of Social Networking Sites is perceived as primarily; 'the current trend', 'speed', 'advertising job offers for free' and 'the possibility of recruiting candidates'. Based on a comparison with the results from 2012 and 2015, we can also say that there has been an increase in the frequency in using Social Networking Sites by companies in the Czech Republic.

Practical implications – The motivation for the research is to determine whether SNS can be used for serious and practical business purposes. Our findings confirm the rising importance of social networking sites usage as a new recruiting technology. However, as a major player in the field of recruitment, job boards (eg. Jobs.cz) are still important. The expectation is that in the near future, this will change and SNS's will replace the job boards.

Originality/value – This paper shows the development of using SNS by Human Resources departments in the process of hiring new employees over time. It also maps influence of SNS on recruiter's behavior and customs.

KEYWORDS

Human Resources, Social Networking Sites, Job Boards, New Trends

INTRODUCTION

Social networking sites offer a unique set of affordances in a single platform for recruiters. The first of these is the search for suitable candidates, because the platform enables accessibility of thousands of people in one place. HR professionals uniquely have the chance to search for passive candidates¹ with advanced features and filters on SNS.

Secondly, candidates actively seeking work can be targeted through advertised job offers, and recruiters can furthermore benefit from having an active presence on these platforms such as a Facebook company 'Page'. In this regard, these sites offer unique affordances in that information sharing of published job posts that reach suitable job seekers can take place at no cost to the recruiter.

Social networking sites also aid independent and objective verification of candidate information, whether through monitoring of professional assessment on candidate profile or screening profiles on less formal SNS, where people behave naturally.

METHODOLOGY OF THE RESEARCH

This study involved a quantitative survey questionnaire which contained 20 question items, including a question used to filter/exclude inappropriate participants for the survey. Survey responses elicited perceived usefulness of SNS. The Survey also captured use of SNS in comparison with other forms of hiring new employees (e.g. ads in newspapers, take head-hunters, use staffing agencies). The survey contained both closed and open-ended questions in which respondents could evaluate and express their own viewpoint on SNS, as well as state their personal experience. The final section of the questionnaire captured key demographic characteristics (i.e. age, gender, size of company, economic sector, region). The structure of the questions were the same in both years 2012 and 2015.

The target group of this study was recruiters and other persons directly involved in recruitment. To ensure the greatest return; the questionnaires were distributed in two different forms. Firstly, questionnaires were sent out by e-mail to target HR departments, whereby E-mails were obtained from the websites of companies principally in Prague and the surrounding region. Companies were chosen randomly. Secondly, distribution was via postings in HR groups on SNS. These were chosen as the 10 biggest (only czech) groups from Facebook and LinkedIn. The first wave of survey was conducted in early 2012. The total response rate was 62%. In this phase, 285 recruiters participated in the survey. For the second phase of the survey, the same email list was used to recruit participants, and was carried out in early 2015. The total response rate of the questionnaires was 79%, with 369 recruiters participating in the study. Always has been used condition unique IP addresses of respondents which should ensure that each respondent fill out only once the questionnaire. In total therefore, the research participated 654 HR Specialists from the Czech Republic.

RESULTS OF RESEARCH

This section presents an evaluation of the questionnaires by comparing the results between the years, 2012 and 2015. For questions with open answers; these were often a different formulation of the same answers and those were merged with the name, "another method".

The demographic section allowed comparison for gender, age, company size (illustrated in Tables 1 and 2), locality and economic sector of the company. Table 1 shows that although there was a disproportional amount of females in the sample, caused by disproportional distribution of females in HR field (Ulrych, 2014), there was a greater proportion of males in the 2015 sample collected 2012 particularly in the age categories 25-34 and 35-44.

¹ An experienced and talented person who not actively seek a new job, but is ready to alter its current job if he gets better offer. (Kociánová, 2010)

Gender	Number	18 - 24 age	25 - 34 age	35 - 44 age	45 - 54 age	More than 55 age
Female 2012	206	5%	33%	19%	5%	4%
Female 2015	293	2%	28%	15%	4%	1%
Male 2012	79	3%	12%	6%	7%	4%
Male 2015	76	4%	20%	20%	4%	2%

Table 1: Age of respondents in correlation with gender, Source: Questionnaires by authors

The size of companies which respondents represented were divided by sizes: micro, small, medium and large. For some categories, their representation in the questionnaire are almost equal, see table 2.

Size of company	Number	Micro company (1 – 9 employees)	Small company (10 – 99 employees)	Midsize company (100 – 499 employees)	Large company (500 and more employees)
Number in % in 2012	286	5,49%	16,76%	37,36%	40,38%
Number in % in 2015	368	9,93%	37,59%	26,95%	25,53%

Table 2: Size of companies, Source: Questionnaires by authors

Economic sector and city/region from where respondents came from are largely influenced by where the questionnaires were sent. Therefore, participants are most abundant in Prague at almost 70%. Economic sectors such as Consulting, Information Technology and Services together account for approximately 43%. Other sectors in comparison, represented relatively insignificant amounts ranging from 2% to 5%.

For the question, "**What is the most common ways of finding new employees?**", the most frequent answer in 2015 was that respondents use advertising on job boards (91.84 %), which remained approximately unchanged since 2012. As can be seen in Table 3, the biggest change in 2015 related to using a publication ad on SNS (60 %). Compared to 2012, we can see a clear doubling of its use. This could be explained by a general increase in internet and use SNS (reference), as well as an increasing trend towards social media use by business.

In self-evaluating the effectiveness of various methods of job advertising, the most effective proved to be job portals according to participants, followed by the website of the company, as well as SNS (see table 3 above).

To examine in more detail the use of SNS, respondents answered additional questions regarding purpose and platform of use. The largest number of respondents, (43,14 % respondents in 2012 and 66,3 % respondents in 2015) use SNS to advertise jobs. Also important are activities such as marketing, public relations and personal marketing in both years. Three quarters of all respondents (74 %) checked candidate profiles on SNS in 2015, while in 2012 it was only half of them (52 %). In 2012 information from SNS matters (include options "very important" and "important") to 50% of respondents, which rose to 71% in 2015. These results illustrate that SNS are important not only in attracting candidates but also their growing role in verifying information.

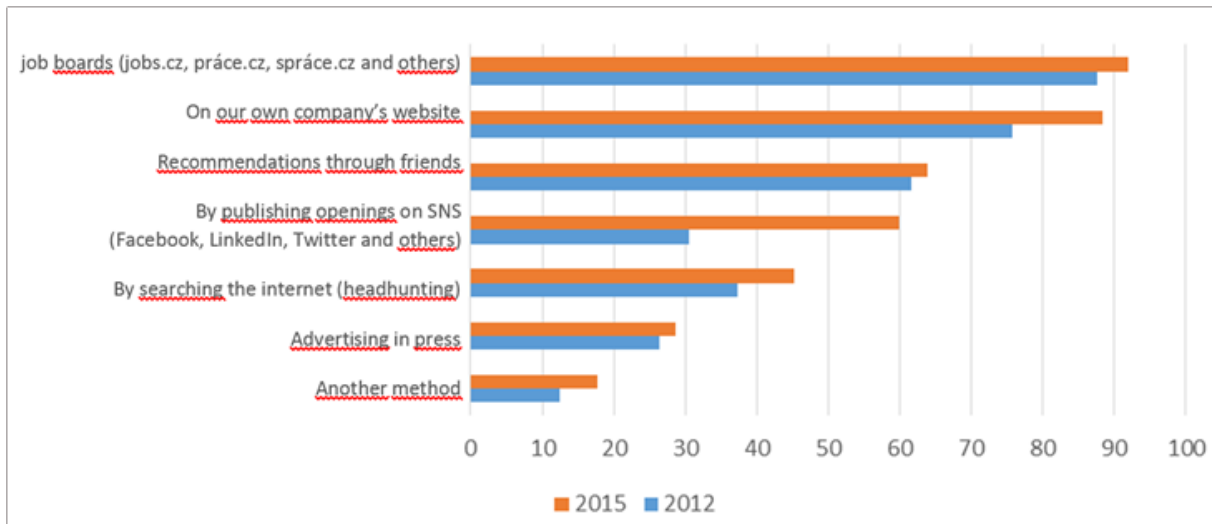


Table 3: Methods how HR specialist search for new employees (in %), Source: Questionnaires by authors

Regarding the most frequently used SNS platform for recruitment, the most commonly reported was LinkedIn, whilst the least often used is Twitter. The ranking was the same in 2012, though the frequency of use has improved across all SNS. For example, LinkedIn was rated an average of 2.8 in 2015 from an average of 4.2 in 2012 (on a scale of 1 to 5 where 1 represented most frequently use and 5 represented respondents who had never used SNS).

In the question probing the future of using Social Networking Sites as recruiting tool in the Czech Republic, those who thought SNS has no future has fallen over the last three years from 7% to 1% (converted to numbers that opinion had only 3 persons). Division into other categories remained approximately the same.

Furthermore, companies with a profile presence on SNS has risen to 73.79% in 2015, which represents an almost 40% increase over 2012.

A significant turnaround compared to 2012 occurred in the question concerning SNS being able to replace job boards. Whilst three years ago, 60% of participants responded that it is “rather possible” or “not possible at all”, today that number has fallen by half. This change can be seen to be helped by the fact that people are now more aware of the advantages of this medium. In this regards, one of the biggest perceived advantages of SNS concerns it been seen as the current trend (64.5%). Table 4 provides a breakdown of response categories on advantages of SNS. As can be seen some of the biggest changes between years concerns respondents increased likelihood to view SNS as a marketing tool, and an efficient means to display candidate information. Thus, although both advantages of use and adoption of SNS are growing amongst recruiters, it is interesting that Job boards remain virtually unchanged as the most common tool, though most believe SNS can replace Job Boards. This suggests that recruiting practices may be constrained by completeness of available candidates on SNS, whereby prior candidate practices of searching Job Boards, currently continues to necessitate its use. SNS currently largely affords complementary means of sourcing candidates and offering new affordances in their screening.

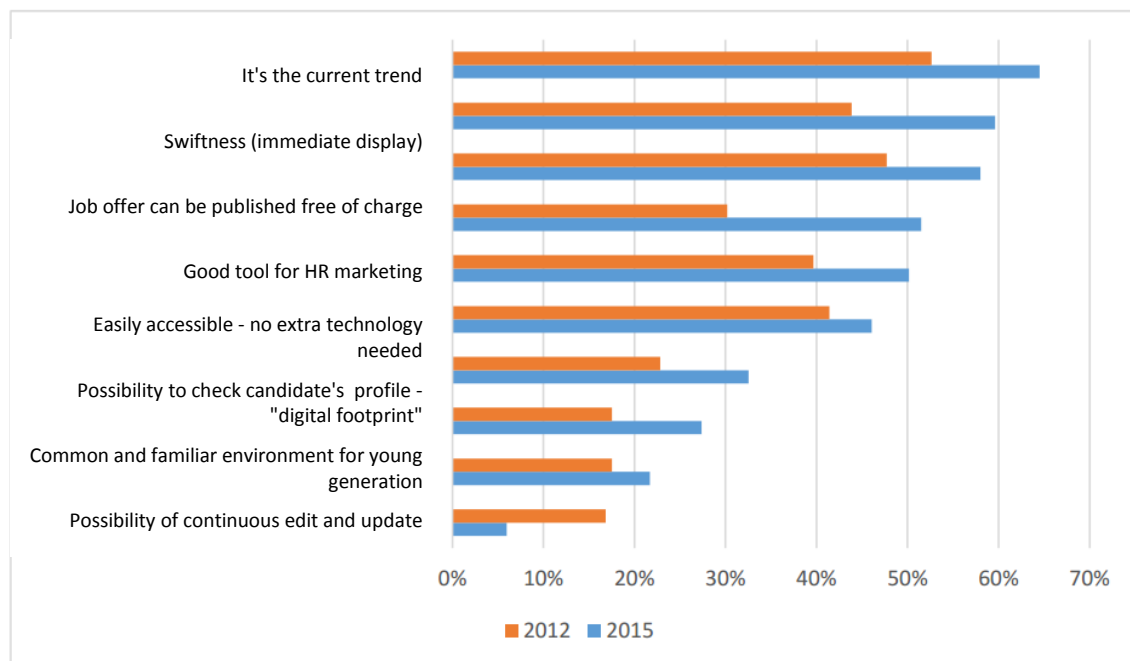


Table 4: Advantages of SNS in recruitment, Source: Questionnaires by authors

Evaluation of hypotheses

In this section of the paper, we evaluated hypotheses H1 and H2, which were confirmed if the reliability implications reach at least 70%.

H1: The survey confirmed (by 235 respondents in 2015) that information from SNS has an influence in the final decision of HR professionals, who privately use SNS at least once a week, whether hire a new employee or not. Same hypothesis in 2012 (supported by 117 respondents) was rejected, because reliability of implication was only 62 %.

Antecedent: Do you personally use social networks? – Daily or Several times a week.

Succedent: On a scale of 1-5, such information about the candidates obtained from SNS is important to you when deciding on their hire - 1 - most important 2 – important.

Reliability of implication in 2012 (confidence): 62 %

	Succedent	Non Succedent
Antecedent	117	71
Non Antecedent	24	142

Table 5: Evaluation H1 in 2012, source: authors

Reliability of implication in 2015 (confidence): 74 %

	Succedent	Non succedent
Antecedent	235	82
Non antecedent	27	25

Table 6: Evaluation H1 in 2015, source: authors It means that recruiters who use SNS themselves and also in their personal live perceive the information contained in the candidates profiles as relevant for the recruitment process and the process of accepting them also take into account more in 2015 than 2012.

H2: Confirmed hypothesis (supported by 237 respondents in 2015) is, that HR professionals managed to get new employees thanks to using SNS. Same hypothesis in 2012 (supported by 83 respondents) was rejected, because reliability of implication was only 44 %.

Antecedent: Do you personally use social networks? – Daily or Several times a week.

Succedent: How many candidates that you subsequently accepted, did you first learn from SNS? 1-5 employees, 6-10 employees, 11-15 employees, and 16 more employees

Reliability of implication in 2012
(confidence): 44 %

	Succedent	Non Succedent
Antecedent	83	105
Non Antecedent	14	152

Table 7: Evaluation H2 in 2012, source: authors

Reliability of implication in 2015
(confidence): 75%

	Succedent	Non succedent
Antecedent	237	80
Non antecedent	15	37

Table 8: Evaluation H2 in 2015, source: authors

Three years later, it is clearly seen a positive shift towards social networks in terms of recruitment.

To test the last hypothesis was used paired t-test, which confirmed that since 2012, there has been frequent and useful use of SNS for recruiting new employees until the year 2015. In the test, we take into account the differences in the measured values and the pair test the hypothesis that the difference in mean paired measurements is zero.

Question	Answer	2012	2015
How do you search for a new employee?"	Publishing positions on SNS	30,45 %	60 %
For what your company uses SNS?	Advertising jobs	43,14 %	66,3 %
	Personal marketing	37,25 %	59,34 %
	Public relations	60,78 %	62,64 %

Table 9: Paired t-test, Source: authors

The formula for 1 Paired t-test

$$t = \frac{x_d}{s_d/\sqrt{n_d}}$$
 arithmetic mean (xd) = 19,17
 deviation (sd) = 11,9976
 Number of pairs (nd) = 4 t = 3,19
 The significance level of 5% c = 3,18

LIMITATIONS OF THE STUDY

Our research was focused on the Czech Republic only; most of respondents were from Prague. The survey was conducted in Czech language – therefore even foreigners and expats living and working here were excluded from the pool of respondents. Hence, the study reflects just and only Czech point of view, which can be different from the global one. Another limitation of the study is self-selection of the respondents, which could further skew the results.

CONCLUSION

This paper is focused on the use of social networks for recruitment during the years 2012 and 2015.

Our survey confirmed that HR professionals from large companies are interested in the social networks' data and believe that social networks are the future: either as a supplement or even main method of finding candidates. The reason may be the fact that large companies are often part of the multinational chains. And if the chain comes, for example, from the USA, the employees in the Czech Republic can be affected significantly by the overall corporate culture. Interesting fact is, that even the recruiters, who still did not accept any employee based on a contact from the social networks, sometime check the of candidates' online profiles.

Based on a comparison with the results from 2012 and 2015 we can say that during this three years there has been an increase in the frequency and the use of SNS by companies in the Czech Republic for HR purposes.

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COGNITIVE LOSS AND SOCIAL MEDIA – SYSTEMIC PROBLEM?

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ABSTRACT

We live in an era of information technologies. Now it is hard to imagine a person, living in a modern world, who does not have a phone or cannot use a computer. Today phones have a whole bunch of functions, replacing physical objects like calendar, calculator, alarm clock, diary and many other things.

For the past years social media has become an essential part of our lives. It enables us to reach people who are in the other part of the world, giving us the power to get over time and distance. It also gives us an unlimited access to information.

Our everyday life is stocked with information. Google found that humans have created more information in the past five years than in all of human history. If we will write all that information on 3x5 index cards, your personal share of it would wrap around the earth twice and the pile of cards would reach to the moon 3 times.[6]

Social media follows us everywhere. If 10 years ago we had internet only at home or cybercafés, now we have Wi-Fi in almost all public places and also have cellular internet. Using social media we feel so connected to our family and friends. Moreover, we use it for fun or as a way to relax. We are running away to social media while having a spare minute or while having a hard work to have some rest. But is it a good place to run away?

KEY WORDS

social media, cognitive loss, social media addiction

SOCIAL MEDIA ADDICTION

Nowadays we barely hear about social media addiction while 5 years ago it was one of the most popular topics to discuss. We have got so used to having social media in our life, that we no longer consider it as an addiction. A lot of people still denies the fact that they are addicted while the other part admits being addicted and feeling fine about it. Social media gives us a lot more freedom. We can do whatever we want without letting others know. We can read, watch the content we want and even participate in events we would never participate in our normal lives. Nevertheless, not only the information we give or receive is changed, our communication is also liable to change. Social media offers privacy, which we do not have while physical contact or even while phone calling. With texting, we have more time to decide, it does not require an immediate answer, we can forward the message, if we need an advice, or just ignore it. It also allows us dealing with more things at once, which gives us the feeling of completing more things at a short period of time and this gives us satisfaction.

WHY IS SOCIAL MEDIA SO ADDICTIVE?

But why is social media so addictive? Let's look how our brain reacts on a simple situation – receiving a message.

Text messages appear on the screen or in a form of notification, which immediately catches our attention. Even if we are trying to ignore it, it will bother us, because our brain is in a constant demand of information and the thought of having a new unknown information ready for us to receive will not allow us to concentrate on anything else. Received text activates novelty centres in our brain. After responding brain rewards us for completion a task (even if this task was so small and not life-changing). This rewarding delivers a shot of dopamine, the hormone of pleasure, which you will want more and more.

[1]

It was shown in a famous experiment done by neuroscientists Peter Milner and James Olds. They placed a small electrode in the rats' brains in the nucleus accumbens, a small structure of the limbic system, which regulates dopamine production. Olds and Miner called this area "pleasure centre". This is the area, which reacts when gamblers win a bet, drug addicts take cocaine, or people have orgasms. Neuroscientists put a lever in the cage, which by pressing it sent an electrical signal to their "pleasure centres". Rats did nothing else but pressing the lever all day long, forgetting about the primary needs of eating and sleeping. They rejected tasty food after days of starvation, they even ignored the opportunity for sex. All rats cared about was pushing the lever, until they died of starvation and exhaustion. [1]

If you think that humans and rats have not so much in common then let's have a look on some accidents involving humans. One of the first known deaths from video games Jeff Dailey (19 years old) and Peter Burkowski (18 years old), who died from video game Berzerk. A few seconds after hitting records in the game both young men died of a heart attack. [7] Chris Staniforth (20 years old) died in May 2011 from deep vein thrombosis after playing xbox continuously for 12 hours. [8] Or a Taiwanese man Hsieh, who died after his 3 day online gaming binge in the internet café. [9]

While each responding to an email or updating Facebook, Twitter, Instagram and other social media feed our brain gets a shot of hormones as a reward for accomplishing the task, we feel better and feel more socially connected. However, the limbic system is driven by novelty-seeking portion of brain, not by the planning, scheduling, higher-level thought centres, which are located in the prefrontal cortex. Hence, the feeling of satisfaction of an accomplishment is not real, because actually there was no accomplishment, but our brain does not distinguish the feeling of real and fake accomplishment. That is why we get the same praise for such small things as updating our feed and time-consuming things. As our brain is always seeking for the easiest way to get pleasure, it will prefer getting pleasure out of updating feed rather than doing much harder things. This is the main reason why we are addicted. [1]

MULTITASKING

As we all have this sort of addiction we constantly implanting social media in our daily basis. Checking our mail while standing in a queue, playing video games while watching TV, while spending time with friends checking instagram of other friends, always have a Facebook tab open in a browser. Does it sound familiar? We do not even realize how, when having a spare minute, we are already updating Facebook or even worse doing that while work. At this moment we are multitasking. While multitasking we are feeling great that we can accomplish a lot of things at one small period of time, be more productive and at the same time save our time. But is it actually right?

Starting with the definition, multitasking is dealing with more than one task at the same time. It can be of two types – concurrent or sequential. Figure 1 illustrates this characterization on a timeline ranging from in intervals from seconds to hours.

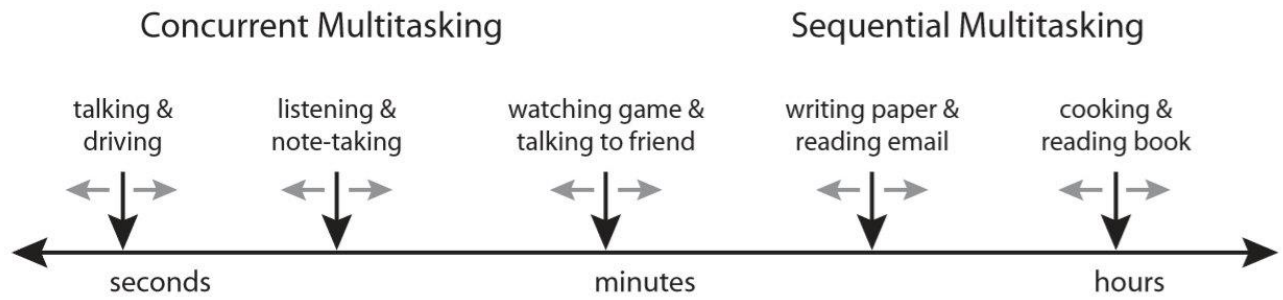


Figure 1 Concurrent vs sequential multitasking [2]

Concurrent multitasking is a harder form of multitasking in which two or more things are concurring for our attention. It is scientifically proved that our brain cannot concentrate on two things at one time. What it does - it switches from one task to another in milliseconds. Let's take talking and driving as an example. One second we are watching the road, another second we keep on talking the phone. Our brain switches from one task to another constantly to keep on controlling the road and at the same time do not miss what the other person is talking about. Brain is in such a rush to manage these two things going simultaneously.

A variant of a sequential multitasking is , for example, for work we need to download a huge file, so we have 3 spare minutes and we decide to check our emails, then we realize that we need to make a phone call, we call, now the file is downloaded, we put it into the folder with document and think "I have such a mess here, I need to sort it", we are cleaning in documents' folder and only then we are back to work. At this variant, the interval of switching from task to task is much bigger. We feel so productive that we have not lost these 3 minutes and have done so many things we needed to do. But were we actually productive? We have done many little tasks, but are we done with them for today or will we be in need of complete them later again? And do not forget that we still have a work to do. Will we be still productive in work? [2]

BURNING OUT BRAIN'S NUTRITION

When we shift our attention from one activity to another our brain burns up oxygenated glucose, the same fuel we need to stay on a task. And when we continuously switching our attention from one thing to another, what we do when multitasking, it causes the prefrontal cortex and striatum to burn though nutrients in our brain so quickly that we feel exhausted and disoriented in a short time.

Oxygenated glucose depletion leads to compromises in both cognitive and physical performance. Continuous task switching can cause anxiety, raising level of the stress hormone cortisol, which results in aggressive, impulsive behavior.

With the increase of the stress hormone, there is an increase in production of fight-or-flight hormone adrenaline, which can cause brain overstimulation. All these reactions can cause mental fog or scrambled thinking.

However, if we are staying on one task, we reach the central executive mode, which is controlled by the anterior cingulate and the striatum in our brain. This state needs less energy than multitasking and indeed reduces our need for glucose. [1]

PRODUCTIVITY WHILE MULTITASKING

The Stanford university made a research in which were compared groups of people depending on their tendency to multitask. The research found that heavy multitaskers, who constantly multitask and think that this boots their productivity, actually were slower in switching from task to task as they had problems with filtering out the irrelevant information as well as organizing their work. At the same time, people who preferred to do one task at a time were good at organizing and were able to do everything on time.

Studies suggest your productivity while multitasking can be reduced by as much as 40 percent rather than finishing one task after another. [1]

MULTITASKING ADDICTION

Nevertheless, despite feeling tired, exhausted or even aggressive we will keep on multitasking, because multitasking itself is very addictive. It creates a dopamine-addiction feedback loop, rewarding our brain every time we lose focus. Our brain is constantly looking for external stimulation. The prefrontal cortex has a novelty bias, meaning that our attention can be easily caught by something new, mostly bright, shiny objects.

When we update social media, respond to texts, check email or answer the phone our novelty- seeking, reward-seeking centres of our brain cause a burst of endogenous opioids. That is why it feels so good that we cannot help but switch our attention to it denying staying on a task. [1]

NATIVE EXIT FROM CONCENTRATION

However, what about the situation when while deep concentration at work we have thoughts which take us out from work for a couple of minutes? This state is called mind-wandering or day dreaming. Our attention has two states: central executive, a state when we concentrate our attention by a willpower, and day dreaming, a state when our brain generates thoughts by itself. The second state of attention is very important. First, it is native for our brain to be in this condition. When we are stressed, it is natural for our brain to cool down by going day dreaming. This is the way how our brain relaxes without our control. Second, the most creative, genius ideas, important decisions come to us exactly in this state. So when we are checking our emails or updating our social media while standing in a line, or waiting for a bus, or waiting for the file to be downloaded we prevent ourselves to go day dreaming, which is unhealthy, because do not have a natural uncontrolled rest. [2,6]

DECISION-MAKING

Another aspect of multitasking is that in most cases it requires decision-making. Nevertheless, our brain needs the same amount of energy to make little or big decisions. Therefore, when you are deciding on where to invest your money, decisions about your career or what university to attend, your brain uses the same shot of energy as when we decide whether we should stay on a task or take a break, answer an email or ignore it or how we should respond to this email. Decision-making is a hard process for our brain and it involves a huge neural resources depletion. It is such a nutrition loss when we spend it on little, not important decisions. [1]

OPPORTUNITY TO MULTITASK'S INFLUENCE

Just having the opportunity to multitask has an influence on our attention. The professor of psychology Glenn Wilson calls it “info-mania”. He did a research in which a group of people completed an IQ test. Then they completed this test once again, but having one unread email in their inbox. The results sound impossible. In situation when you have to concentrate on a task, but you have an opportunity to multitask can reduce your effective IQ by 10 points. This is more than the cognitive loss from a marijuana pot-smoking. [1]

Having a mobile phone on the working space or a social media tab open on your browser will decrease your performance at work. Furthermore, if someone near you has a phone on working space it will distract you attention as well.

MULTITASKING AND LEARNING

Multitasking does such a shocking affect when we do it while learning. The research done by Russ Poldrack, a neuroscientist at Stanford, found that learning information while multitasking makes new information go to the wrong part of the brain called striatum, which specializes on storing new procedures and skills, not on storing ideas and facts. The right direction for the new-learned information

is hippocampus, in which information is organized and categorized. So when you are, for example, watching YouTube and studying at the same time, your brain will remember the information, but when it comes to retelling it will be hard to call to memory. You will remember that you have read this, maybe even the page or what the picture was near by, but not the concrete fact. Our brain will use other parts of the brain to try to remember this fact, which lead to overstimulation hence to exhaustions and anxiety. [1]

MULTITASKING LOWERS OUR EQ

We are wondering why people with average IQ can outperform people with higher IQ (which is happening in 70% of the time). In 1995 we first heard the answer to this question. It was proved that not only IQ influence our performance, but also our EQ – emotional intelligence.

On the Figure 2 is shown that EQ is made up with four factors: self-awareness, self-management, social awareness and relationship management.



- **Self-Awareness** is knowing your emotions; the ability to recognize them as they happen.
- **Self-Management** is the ability to control your emotions using self-awareness to stay emotionally flexible.
- **Social Awareness** is your ability to notice and understand emotions of other people.
- **Relationship Management** is the ability to create good interrelations based on social and self-awareness.

Figure 2 what is EQ [4]

by TalentSmart, having tested over a million people, found that 90% of top performers have high EQs. Moreover, their income is higher than the income of people with lower EQs. [4]

EQ is responsible for interactions with other people as well as dealing with ourselves. The research done

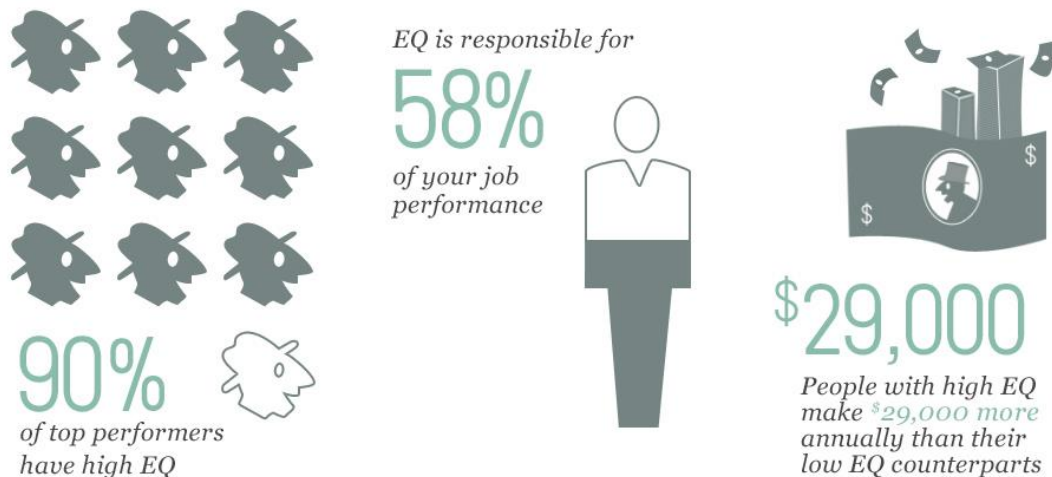


Figure 3 The importance of EQ [5]

Multitasking inhibit our cognitive abilities and does damage to the anterior cingulate cortex, the region responsible for EQ. Consequently, multitasking will lower your EQ in the process. [3]

DOES MULTITASKING LEAD TO PERMANENT DAMAGE?

It was long discussed whether multitasking leads to temporary or permanent damage. The latest research at the University of Sussex suggests permanent damage. During research different groups of people were compared on how much time they are multitasking and then there was a comparison of their MRI

scans of their brain. The results showed that a heavy multitasker's anterior cingulate cortex had less brain density. Anterior cingulate cortex is responsible for empathy, cognitive and emotional control. Although, more research is needed to complete this theory, multitasking definitely has negative effects on our brain. [1]

CONCLUSION

Social media has a huge impact on our life. Despite a lot of benefits it gives us, we should regulate its influence. We should control our addiction and not allow it control us. Multitasking is proved to be harmful to us. It is only an illusion that we can do everything at once. As our brain can concentrate only on one thing at a time, we should manage our tasks and have at least an hour of concentration on one task. Only in this way we can be productive. If we need a break during work it always better to go day-dreaming, read a book or listen to music. Having our head stuck with a bunch of irrelevant information from social media will never give our brain a decent rest. Multitasking depletes our brain's nutrition and lead to quick exhaustion, anxiety or even aggressiveness. Moreover, multitasking can lead to permanent damage. To stay productive and still have the ability to be successful at work we should give up multitasking right now. Although it is really hard to beat the social media addiction, the results of giving up multitasking will be totally worth it.

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FACEBOOK PROMOTION THROUGH THE BRAND PAGE

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ABSTRACT

The aim of the paper is to consider a Facebook users' psychology as something that helps brands to improve social marketing strategy. We would like to understand how do they decide whether give a like to one brand page and don't give it to another. It is extremely important not just to talk about data, but use them like a tool, sum it up and be able to correct marketing plan.

Paper stats with definitions of terms "social media" and "social network" and its main characteristics and how people do interact with brands. For a better understanding a part about Social media marketing summarizes the reasons why people use Facebook first.

Paper also summarizes the main characteristics and metrics used to measure the human interactions and involvement on the brand Facebook pages.

KEY WORDS

facebook, social media, social network, social marketing, psychology

INTRODUCTION

Paper focuses on the meaning of a social media for users and for businesses as well. How do people behave on social networks like Facebook? Why they ignore one post and give "like" to another?

The main purpose of this essay is providing helpful recommendations based on real data for businesses that want to use social media marketing. Mixing correct content strategy with advertisement can be incredibly useful in case you want to increase brand knowledge and to build relationship with your customers.

DEFINITION OF SOCIAL MEDIA AND SOCIAL NETWORK

Nowadays, almost no one can imagine how to stay in touch with friends without social media. It is a powerful and worldwide tool that allows everyone to make their one profiles, upload photos and videos, and interact with friends and family. Social networking is a tool to join groups, learn about latest news and events, play games, chat and to share the ideas.

But let's see, how we can define the term "social media". For example: "Social media is form of electronic communication (such as Web sites) through which people create online communities to share information, ideas, personal messages, etc." [1]

We can also define the term "social media" as a very transparent and interactive form of public relations. [2]

Social network is an online community of people with a common interest who use a website or other technologies to communicate with each other and share information, resources, etc.

Facebook is a popular free social networking website that allows registered users to create profiles, upload photos and video, send messages and keep in touch with friends, family and colleagues. [3]

Facebook includes following features:

Groups - allows members with common interest to interact with each other by posting contributions and writing comments.

Events - allows to organize an event and invite guests there. It also allows guest to show whether he is interested in this event or not.

Pages - allows brands, celebrities and entrepreneur to create public page which could be promoted by paid advertisement.

The last form of connection on Facebook is the most important is to consider page as a marketing tool. It is the way how to stay in touch with a customer.

User can give a “like” to your page, then he becomes your “fan”. It means that he will see your contributions, receive notifications and so on. It helps to build relationship with him, to inform about your product, to remind that you still exist.

Of course, user have possibility to interact with your page by giving “likes”, commenting or sharing contributions, photos or another type of content (like gifs, videos, presentations). They can also create their own content, for example using “hashtags” - special symbol “#” that helps to find a determined word in the news feed, if you allow them to do it.

FACEBOOK USERS' PSYCHOLOGY

There are a lot of brand pages on Facebook. which want to attract people to their product or service. For companies people have special commercial and PR value. So that they should create brand posts (brand content), which connect consumers with the company. On Facebook users see brand posts in their Newsfeed or visit concrete pages, which they can “like”. [5] People self-identify as Fans by indicating which brands they have “Liked” on Facebook. [6]

Brand Fan value is defined by activity of fans on pages – “superfans” tend to be brand users first, spend more, engage more, advocate more and demonstrate more loyalty. [6]

The audiences' action of liking, sharing and commenting are used as a measure of the e-WOM performance of brand posts that strengthens the reach and impact of brand posts. Companies look for the way to get more responses, strengthen brand awareness. [5]

Facebook is a great tool, which provides marketers with rich consumer data, and opportunity to cultivate long-term brand relationships based on individualized communication. [6]

To attract more people to brand pages companies should also know why they do become fans, which in sum with the user's view on content can help them choose the social network strategy. People, who are responsible for brand page and social network strategy armed with this knowledge have a great tool to work with Fans and the strategy to improve social marketing impact.

Likes

Everyday lots of people like or dislike something on Facebook. What is really interesting – why do they do that? All that likes or dislikes have some reasons that are psychologically explained. For marketers the facts are surely critical, because, they define the behavior of people (potential clients of firms) toward the brand fan page and their WOM in social networks.

Let's look at the thing from user's point of view. **What does Like on Facebook mean?**

According to Facebook's Help Center:

"Like" is a way to give positive feedback or to connect with things you care about on Facebook. You can like content that your friends post to give them feedback or like a Page that you want to connect with on Facebook. [7]

On the network people mostly give their likes for videos and photos of their friends. According to Pew Research 47 % use Facebook exactly for that reason, for 46 % of Facebook users is the most important to share some content, 39 % appreciate humorous content. [8]

Reasons for Facebook use, men vs. women

% of male/female Facebook users who cite the following as "major reasons" why they use Facebook

	Men	Women
Women are more likely than men to cite these as major reasons for using Facebook:		
Seeing photos or videos	39	54
Sharing with many people at once	42	50
Seeing entertaining or funny posts	35	43
Learning about ways to help others	25	35
Receiving support from people in your network	16	29
Men and women are equally likely to cite these as major reasons for using Facebook:		
Receiving updates or comments	39	39
Keeping up with news and current events	31	31
Getting feedback on content you have posted	16	17

Pew Research Center's Internet Project survey, August 7-September 16, 2013.

PEW RESEARCH CENTER

Pic. 1 Pew research. Reason to use Facebook[8]

Not lot of Facebook users create their own content, but mostly they prefer to like their friend's content. [8] From psychological sight Like also expresses empathy to another person or his content in online environment, which help to make one feel supported. [7]

- 44% of Facebook users "like" content posted by their friends at least once a day, with 29% doing so several times per day
- 31% comment on other people's photos on a daily basis, with 15% doing so several times per day
- 10% change or update their own status on Facebook on a daily basis, with 4% updating their status several times per day
- Some 25% of Facebook users say that they never change or update their own Facebook status [8]

For companies likes have a special meaning. Like expresses positive association with the published content (in online) or objects (offline). One can say Like is kind of digital footprint. By giving a Like person expresses his preference – books, sports, webs ect. Likes also explain consumer behavior. [11] According to research Likes can help us to make a diagnostic of personality. Likes given to the concrete objects show the personality through its preferences – people that are interested in new things and

experience tend to like Salvador Dalí, meditation, or TED talks and that type of content; or extraverts tend to like partying or dancing and another activities. [11]

Shares

Facebook provides users also with the function “share”. Everyone can share the content by just one click, which defines the virality of the content on social websites.

From the chart below one can say, that the main reason to share the content for Facebook users is a desire to show some interesting content to their friends. Important things and funny things took the second place. For commercial reasons is also useful to know that 37% of people sharing content want to show what they associate them with to let others know what they believe in and who they really are. [12]

	To share interesting things	To share important things	To share funny things	To let others know what I believe in and who I really am	To recommend a product, service, movie, book, etc.	To add my support to a cause, an organization or a belief	To share unique things	To let others know what I'm doing	To add to a thread or conversation	To show I'm in the know	Other reasons
Global Average	61%	43%	43%	37%	30%	29%	26%	22%	20%	11%	10%
Argentina	60%	48%	41%	39%	33%	48%	16%	13%	24%	9%	11%
Australia	62%	42%	53%	27%	28%	35%	29%	30%	27%	5%	12%
Belgium	43%	28%	44%	21%	22%	24%	12%	13%	16%	8%	16%
Brazil	63%	57%	43%	60%	41%	35%	17%	16%	21%	17%	10%
Canada	65%	42%	51%	32%	27%	32%	33%	28%	26%	7%	9%
China	76%	38%	38%	38%	24%	12%	43%	27%	21%	10%	7%
France	45%	30%	44%	21%	30%	26%	10%	11%	20%	11%	15%
Germany	47%	33%	29%	30%	27%	26%	18%	20%	26%	8%	14%
Great Britain	65%	35%	52%	28%	24%	30%	21%	36%	32%	5%	7%
Hungary	56%	51%	37%	35%	27%	25%	26%	10%	16%	1%	14%
India	63%	56%	40%	52%	39%	33%	44%	26%	19%	19%	6%
Indonesia	76%	58%	36%	40%	40%	14%	47%	29%	10%	9%	6%
Italy	52%	39%	39%	42%	25%	29%	10%	11%	5%	6%	8%
Japan	48%	15%	35%	19%	16%	6%	13%	31%	9%	11%	14%
Mexico	59%	43%	42%	45%	35%	38%	17%	12%	18%	9%	8%
Poland	54%	34%	37%	22%	29%	24%	21%	16%	24%	9%	9%
Russia	68%	43%	40%	39%	31%	24%	28%	28%	23%	18%	8%
Saudi Arabia	46%	21%	33%	65%	20%	29%	29%	25%	23%	20%	10%
South Africa	74%	51%	58%	44%	36%	43%	44%	32%	26%	12%	9%
South Korea	57%	34%	38%	26%	16%	5%	15%	29%	3%	5%	10%
Spain	66%	46%	44%	25%	30%	39%	16%	14%	19%	9%	11%
Sweden	58%	34%	48%	29%	20%	23%	16%	32%	29%	5%	13%
Turkey	71%	67%	56%	33%	46%	36%	35%	20%	26%	33%	5%
United States	65%	43%	49%	32%	29%	32%	37%	34%	26%	10%	11%

Pic.2 Global “Sharers” on Social Media [12]

Comments

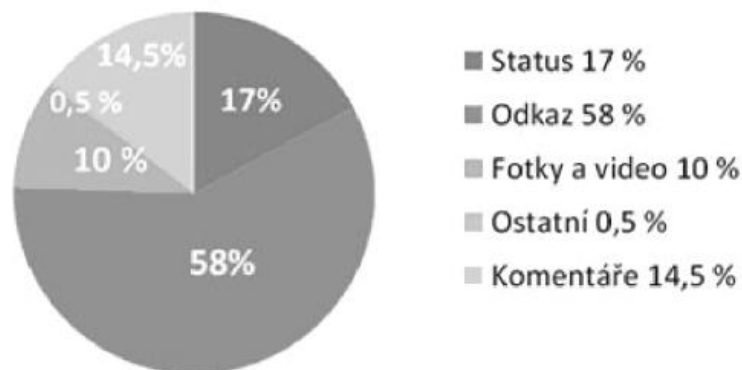
According to a Pew Research study users prefer to “like” their friends’ content on the second place rather than to comment on photos more frequently than change their own status. [8]

Comments are a powerful emotional driver. Comments can help you to express your feelings and meaning on Facebook. For communities comments are a signal, that people (fans) are engaged, replying to fans' comments they keep the conversation going.

Comments on Facebook are also used as likes to show your personality, because all you comment appears in your Timeline and you friend timeline.

For instance, in the Czech Republic 14,5 % posts on the site are comments. [9]

POSTS OF FACEBOOK USERS ACCORDING TO TYPE



Source: (Appeltauerová et al., 2011)

Note: Status (17%), Link (58%), Photos and video (10%), Others (0.5%), Comments (14.5%)

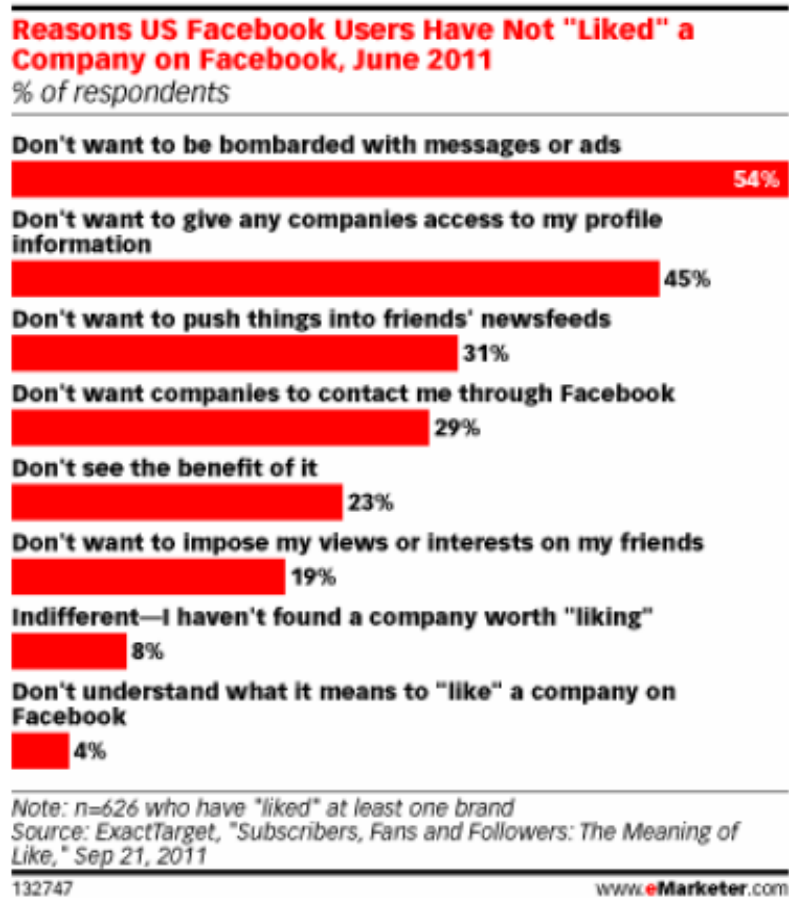
Pic. 3 Post of Facebook users according to type [9]

Users' view on brand pages on Facebook

As a reason for not liking a brand page according to the research by eMarketer can be defined:

1. A lot of Advertising on the page and sales content
2. Using personal information by the page
3. Sharing an liking content of exact page is shared to your friend's newsfeed which is taken as wasting their newsfeed
4. etc. [10]

For brand pages it means they should avoid such type of communication with the users, which can feel them unsatisfied or bombarded by certain page.



Pic. 4 Reasons US Facebook Users Have not "Liked" a Company on Facebook [10]

On the other hand, consumers became Facebook Fans of some brand for different reasons. Mostly people became a brand page fans after trying their service or product to support the brand and show his preference. [6]

So it means that firms should focus on existing fans of the page, who are also probably their client and try to keep them satisfied by page content. Because all marketers know that it is much more important to keep existing clients than attract new once.

Nevertheless when attracting new fans, it's extremely important to find high quality fans. That means that fans should be valuable to the brand's product or service. Communication with that type of fans is more effective, because the right audience brings greater numbers of other high quality fans, which enlarge the WOM effect and strengthens your brand image, brand position and sells. [6]



Pic. 5 Reasons for Becoming a Brand Fan on Facebook [6]

MARKETING TAKEAWAYS

To sum it up, companies should monitor customer satisfaction on Facebook and improve their strategies. Companies should understand the reasons of customers and draw their content according to these "rules".

"Like" is:

1. Positive feedback
2. Expresses empathy
3. Shows our preferences and self - identification
4. "Payment" to the page to get something back

"Share" means:

1. Possibility to show some interesting content, important and funny things
2. Possibility to show what believe in
3. Possibility to recommend some product or service

"Comment" helps user to tell his or her opinion.

In order the audience of your page to like your brand posts, your content should be appropriate for theirs needs and preferences, make them feel that they identify themselves with the stories in posts.

For instance:

1. Provide fans with more discounts, coupons (customers - fans should be sure to get some benefits from supporting your page)
2. Make regular updates (make a content which give them a chance to show themselves, share their positive experience from your product or service, provide their friends with useful and interesting stories, it also builds your image)
3. Find your right audience
4. Communicate with the customers, ask them questions and let them talk (make a platform for comments, because it can help your page to build a strong community of fans)

5. Explain the brand vision, characteristics of the products etc.
6. Convert existing users in your future clients (build a long term relation with them, their loyalty will bring to you even more quality clients)

As an addition to my own takeaways I would like to write important conclusions by Wondwesen Tafesse [5]:

7. Publish more photos and videos on your page (it can help you to enhance the vividness of your posts, which according to the study has a positive impact on your page)
8. Do not make your post too interactive, brand posts loaded with too many interactivity tools can disaffect the audience.
9. Brand post should bring new interesting information, not that one, which is on every page, (fresh stories bring a higher engagement of the audience and is associated with positive emotions)
10. Brand pages should have united identity (consistetness of the name, logo, slogan, aesthetic features and so on, because consumers have a chance to identify themselves with brands)
11. Humorous, entertaining content is more interesting for users than informational
12. Minimize sales content and advertising

CONCLUSION

There are a lot of reasons to use Facebook as a marketing tool. It provides a huge number of opportunities of advertising your product or service. Creating events, fan pages or groups you can connect your brand with a target audience and achieve their active interactions. It is becoming faster and easier way to stay in touch with clients, to solve their problems with your product and to let them leave a review. It is just a reality.

But you should always think of marketing strategy first. If you will post random contributions without any plan it will hardly help your business to expand. Try to understand your audience, their preferences and values, learn, why they do behave like this, experiment with content and then you will receive great results. I assume that our work is valuable for entrepreneurs who want to be keep up with the times.

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