

Advances in Informatics, Information Management and Administration

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Summary

This publication was created with objective of providing doctoral students a common platform allowing them to present the results obtained during their past year research. The present publication gathers the most interesting results of doctoral research in the areas of Informatics, Information Management and Administration.

The first chapter of the Informatics section focuses on solving compatibility problems with programmes created for previous versions of Microsoft operating systems. It introduces and explains options of troubleshooting using original extensions in Microsoft Windows 7. The main emphasis is placed on educational software and on designing an optimal solution to these compatibility issues. The second chapter describes the possibilities of ensuring high availability in computer networks and methods for optimization of a given network topology in environments with high requirements for network speed, its throughput, and overall time of convergence.

The aim of the third chapter is to create a model of synchronization logic for individual structures and for the overall behaviour of threads based on their interaction. Description of the structures and the procedures in this chapter is carried out on the basis of the terminology of the C # programming language. Fourth chapter presents a social simulation of the growth and collapse of the Celtic society in Central Europe in the Late Iron Age. To achieve this objective, the authors implement a CeltSIM modelling framework. This set of models represents a multiple-scenario approach: the scenarios describe different aspects of the oppida occupation: population increase or decrease, food-production strategies, landscape changes or economic interactions between oppida and their hinterlands. Fifth chapter aims to create a functional model of artificial life. This model is based on fuzzy cognitive maps (FCM). The ecosystem simulation provides limited resources to thousands of individuals interacting with the environment.

Chapter six lists the basic issues concerning the distribution of malicious software and the basic principles of protection. The chapter presents the

results of measurement of selected criteria of the eight best known antivirus programs. Chapter seven is dedicated to automation and visualisation. Visualisation might be considered as a tool helping industrial managers to cope with issues related to automation better, because it is based on graphic representation of enormous volumes of data. This chapter is focused on two particular software applications, WinCC and Intouch.

Last two chapters of the Informatics section deal with problems related to e-commerce and web design. They describe the current trends in the development of online shops (e-shops) in terms of user-friendly applications and marketing methods. The chapter contains theories about content organization and navigation of the website, including real examples.

The Information and Knowledge management section of this publication is dedicated to practices of lean management allowing the companies to find savings in their processes, especially in the manufacturing ones. One of the chapters presented in this section also offers ideas concerning management of customer knowledge with the help of social media. This section also covers the research in the area of information dissemination during critical situations and in traffic. Chapter fourteen proposes a new approach for project scheduling using genetic algorithm that is based on four fitness functions which are: minimization of project delays, project costs, project penalties and finally minimization of switching resources within projects.

The last section is devoted to problematic related to administration. This section discusses a wide range of topics including further education of employees, their motivation for self-education and the effectiveness of educational programs designed for the top management of international companies. Last two chapters focus on innovations implemented by small and medium sized enterprises (SMEs) in the area of ecological and marketing strategies.

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Informatics

1. From Compatibility Troubleshooting In Windows 7 to Virtualization

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Abstract: *The article deals with options of solving program compatibility created for previous versions of Microsoft operating systems. It introduces and explains options of troubleshooting using original extensions in Microsoft Windows 7. Focus is placed on education software and designing an optimal solution to compatibility problems.*

Key words: *virtualization, compatibility, XP MOD*

JEL Classification: *C88, C99.*

1.1. Introduction

In the last few years, operating systems by Microsoft, still the most widespread operation system, have seen a significant progress. After several years of stagnation the operating system Windows Vista started dynamic development. After almost two years Vista's successor, Windows 7, took over and later came with a new core called R2. Such development unfortunately results in many user programs developed for Windows XP platform and older having significant problems in modern operating systems. These problems also greatly concern education materials spread here. Their development is very often behind the development of operating systems (Marc et al., 2001).

Another significant factor is also the financial side of the issue. For these reasons and authors' experience, options of solving compatibility issues, with regard to principles of function of suggested solutions, are introduced.

Experiences gained while teaching and researching were used as a source for this article.

To solve the aforementioned issues in general, it is not possible to restrict the selection for one usable technology only. Even though one could vindicate the statement that one universal solution utilizing virtualization technology exists. It is very often sufficient to use significantly simpler approaches with lower requirements for skills and used technology. The simplest option is utilizing integrated functions of the operating system for searching for a solution in sources provided by knowledge databases by the operating system manufacturer.

This option is mentioned in the article along with its utilization and function. A more sophisticated option might be utilization of the integrated troubleshooting service, called the compatibility mode, which can be considered a solution in some cases. The last introduced possible solution is deployment of operating system virtualization technology with focus on cost minimization, maintaining user comfort, and simplicity of operation.

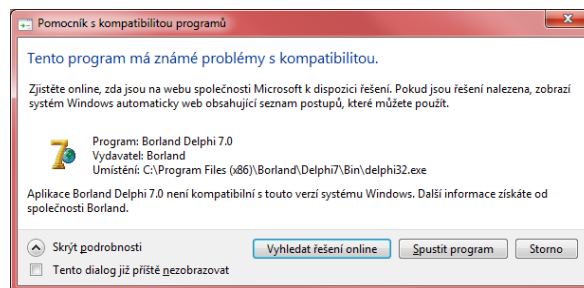
1.2. The issue of compatibility

In majority of original material by operation system Windows 7 creators, for example, (Novák et al., 2010), (Tulloch et al., 2010) and (McLean et al., 2010) it is possible to find a statement about majority of applications developed for older versions of Microsoft operation systems running without any problems. However, authors' own experience show that compatibility problems occur very frequently while using the operating system Windows 7 in education.

It is necessary to realize that a number of programs used in the field of education have been developed before the arrival of modern operating systems like Windows 7. From didactic point of view the contents of such educational applications are often of high quality and the affected institution is thus losing quality software tools which it will not be able to use because of upgrading to new operating systems.

Some applications can even be 16bit and their operation in systems is then virtually impossible in the standard mode and it is possible to bypass them using virtualization, which is briefly mentioned at the end of this article. When one attempts to install or even run such problematic application, the operation system reacts by displaying an error message (Pic. 1). Three options of solution, behind which a series of steps the common user might not even notice is hidden, are automatically offered. That logically does not apply to the last option which is cancelling the request.

Fig.1.1. Windows compatibility problems error message



Source: (Microsoft, 2014)

If the Run option is selected even in spite of displayed compatibility problems message, there is no guarantee the application will run smoothly, fully; there is also no guarantee the application will install correctly. Very often the application can be installed without any other errors, but it cannot be run afterwards. This situation may be caused by several different causations with the same resulting effect.

On Microsoft operating systems every single installation more or less affects the operating system itself. That is why the majority of modern applications (installed according to standards) automatically requests creating a system restore point. But applications developed for older version of operating system do not contain such safety measure and can therefore negatively and irreversibly affect the operating system itself.

According to Windows operating systems creators, creating the system restore point means creating a partial backup of key components of the

operating system, i.e. an image of the current state of the system. If the old installation does not offer system restore point and the operation system warns its user as described above, it is appropriate to create the system restore point by using an integrated guide. However, not even creating the system restore point guarantees a reliable option to go back to the previous state of the system. The reason being that the application installed in old ways can violate recommended access rights to the operating system.

1.3. Solution searching in knowledge database

Operating system creators obliged common user requests calling for technical support and integrated the option of using already prepared solutions to frequently occurring issues into the system interface. As it is obvious, the operating system will try to find a solution online without user interference by using available information.

There are several component steps hidden behind this seemingly simple and clear process. First, the operating system searches for manufacturer identifier and links the user to the support as the developers suppose application update for new versions of operating systems. However, a solution searching algorithm is run and then displays found solutions as options of further process.

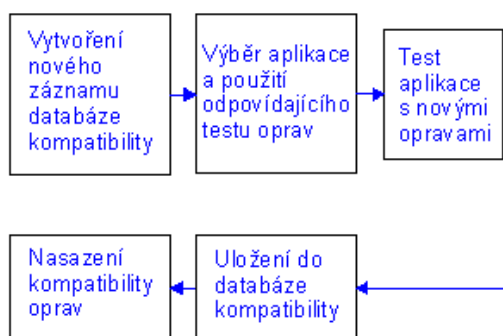
If a suitable solution is found, the operating system generates a repair of the incompatible code, which was caught by API calling from the application itself, in order for the application to function the same as in the previous version of the operating system (Tulloch et al., 2010), (Hipson, 2002).

Several options, from blocking Windows 7 new functions not supported by the application or with which the application cannot work to lower version of the operation system behaviour emulation, are hidden behind this general statement (e.g. in Win32 API set version).

Reports about blocking, called AppHelp, are created before the solution is logged into a solution database as a new record as an *.sdb file. The created file then contains all solutions and reports. The operating system then tries to run the application with the added solutions, which are tested.

If the tests are successful, the whole pack of solutions in form of a *.sdb file is saved into the database, from where it is called with every further launch of the application (Tulloch et al., 2010), (McLean et al., 2010).

Fig.1.2. Block schematic of using the compatibility mode



Source: authors' own experience

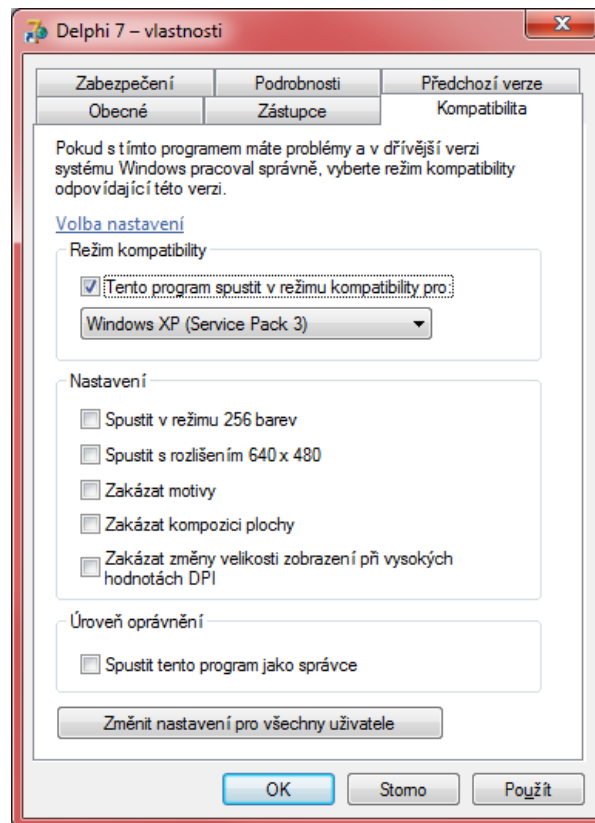
For the above described process to be successful, close cooperation of application authors and Microsoft is required, which is not usual mainly in the environment of educational software. Very often the license owner can lose the ability to use older programs (Marc et al., 2001). Therefore it is recommended to consider using other options, which are not commonly used despite being easily obtainable.

1.4. Compatibility mode

The most common option to solve compatibility issues is changing properties of a shortcut of the program. This method is suitable if Windows 7 installation was performed correctly, but the application is not running as expected as in the previous version of the operating system. This solution is based on the possibility to affect the properties of program, represented by its shortcut, by transferred launch parameters.

More detailed information can be found in (Tulloch et al., 2010). The change to the properties of a selected program shortcut can be done by right-clicking on the shortcut and selecting the Properties option (Pic. 3), in which the Compatibility tab can be selected.

Fig.1.3. Shortcut properties - Compatibility tab



Source: (Microsoft, 2014)

Here, the Windows 7 operating system offers the option to run the program in a compatibility mode. It is possible to choose the last version of the operating system in which the program functioned correctly last from the combo. If the compatibility option is inactive (gray), the application is 64bit

and therefore it is not possible to use the compatibility mode. In the middle part of the window the user can define more parameters for launching the application.

The option to launch the program in 256 colour mode serves for programs which do not support more colours. Another option is restricting the resolution in which the program is launched. This solution solves issues with graphics of applications developed typically for older version of the OS. Disabling motives is primarily intended for solving rare errors and can be found in the upper options bar of the program (for example FoxPro). Disabling screen composition is another variant of solving application graphic interface during normal run of the application.

The last option enables disabling the change of a windows size of the application during its run. In the lower part it is possible to enable launching the application as Administrator, which is required by many older applications (security risks of such behaviour are beyond the scope of this article). If the chosen combination of compatibility settings solved the problems, it is recommended to additionally enable the option of *Change settings for all user* options. This elegant and simple solution has its limitations. It is a solution that efficiently solves problems with the graphic interface.

Abovementioned solution is applicable and the authors have used it in solving problems with application software on a high school where they teach and administer the computer network. This method was successfully deployed in solving two problems with educational software. In the first case the issue was adjusting displaying using the compatibility mode for video recordings of physics experiments. The second case was using the compatibility mode for debugging the optimal run of the program for language learning support.

If the program installation is not correct or impossible, or issues with incorrect run of the application prevail, it is necessary to select another approach to solution. This situation is not an isolated phenomenon, especially with electronic teaching materials and whole e-learning modules. But even here there is an effective and simple solution.

1.5. Windows XP MODE

The solution that effectively solves continuous issues with compatibility is deployment of virtualization utilizing Windows XP MODE. However, this solution has its restrictions in editions of Windows 7 operating systems. Without additional licensing solution, Windows XP integration into Windows 7 can be done only in editions Professional, Enterprise, and Ultimate. The licensing solution is a freely downloadable Windows 7 extension of a licensed copy of Windows XP SP3.

Considering the utilized technology, it is full utilization of virtualization with a bit copy of Windows XP SP3 realized via a Windows Virtual PC virtualization tool. General options of deploying the Virtual PC in teaching have already been described in (Dostál, 2008) and therefore focus will be placed only on the utilization of Windows Virtual PC for solving compatibility issues.

The basic aim of this tool's deployment is a parallel run of more operating systems on one computer and the possibility of switching between those operating systems without having to restart the machine. At the beginning of 2010 this solution was restricted by hardware support of virtualization. Approximately in the middle of the year 2010 Microsoft offered an update for Windows XP MODE, which offers using this tool for hardware, which does not primarily support virtualization, as well.

In order for the tool to be used it has to be installed first. Windows Virtual PC is available for download for free at w7io.com/0502. After installing Windows Virtual PC it is necessary to also download Windows XP MODE itself or its update. After verifying the legality of its host operating system, Windows XP MODE automatically implements itself into the Windows Virtual PC.

Windows XP MODE is after restart available in the following path: Start - All Programs - Windows Virtual PC - Windows XP MODE. Windows Virtual PC itself is automatically saved in `C:\Users\<user>\Virtual Machines`. A copy of a virtual WindowsXPMODE.vhd disc is also stored in that file. It is possible to set selected features of a virtual computer before launching by simply selecting Settings on the main menu, which is available by right-clicking the mouse on a given file.

After launching the WindowsXPmode.vhd a virtual computer with licensed version of Windows XP SP3 is launched. This system is assigned a virtual disc which is a part of the WindowsXPMode.vhd file. Windows Virtual PC is automatically set to share optical drives and can therefore be fully utilized just like on the host operating system. Connecting to and communicating with exchange discs and other devices connected via USB function similarly. After the external disc, for example, is ready on the host operating system, it is installed also in the virtual environment, just like when working normally in Windows XP. Another option for data sharing with the host operating system is full access to its logical discs.

Upon launching the Computer shortcut, there is *other* section in the list of available sections, where all discs, including the virtual ones, are listed. They are addressed as X disc in Computer Name. One then works with these discs just like when using a remote desktop. One of the few restrictions is consequent from this solution. It is not possible to install some programs in the remote desktop mode and it is therefore necessary to first save the installation to a disc of the virtual machine or to launch it via a memory device in USB interface, or optical drive.

Working with a virtual computer is as simply as working with a physical machine and it is very comfortable for the user. The virtual machine is, from the user interface point of view, one designated window on a host machine desktop containing its own desktop, its own Start button, and other usual elements. All programs installed on Windows Virtual PC are accessible from the host system via Start - All Programs - Windows Virtual PC - Windows XP MODE, which increases user comfort and simplifies operation. (Pic.4)

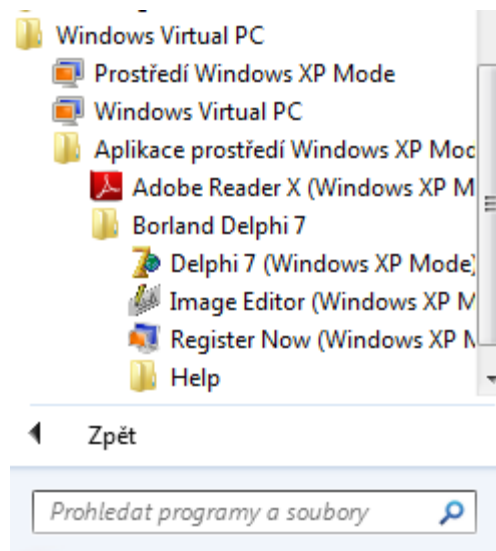
It is sufficient to launch the application; the host operation system automatically launches Virtual PC (vpc.exe) process in the background, in which the thread of the launched program will be running. In case the program running in the virtual machine is launched this way, directly from the host system, the user can see only the desired application (its graphic interface) and not the whole virtual system, which is, in reality, running in the background.

It is obvious that the virtual computer needs a part of system tools and some time to launch to run smoothly. Based on their experience the authors dare

to say that the increase in processor performance is not higher than +10% when deployed for educational purposes. Memory requirements usually do not exceed 512MB on the virtual machine. It is then safe to state that this approach can be used on a common modern computer with a sufficient performance reserve and it is even possible to observe an increase in response speed of a loaded system in contrast with older machines, on which the programs ran natively in the past. The authors have a long-time experience with this method. They use it in teaching programming at high school.

They use older products by Borland (Borland Delphi 7), which showed significant compatibility issues. Seamless mode is also commonly used to work with older hardware devices just as scanners and printers. Last but not least, deployment of virtualization as a tool for solving compatibility issues is included in teaching at high school, particularly in subject 'Computer systems' and in subject 'Operating systems' at university.

Fig.1.4. Windows XP MODE Application



Source: (Microsoft, 2014)

1.6. 64bit version of the Windows system

With today's rapid increase in operation memory size requirements in commonly available machines, a massive deployment of 64bit versions of operating systems, including Microsoft Windows, is seen. Adequate run of 32bit programs on Windows 7 in their 64bit variant is then solved by 32bit system emulation. These programs are installed into %root%FileSystem32, from where they are called by the emulated 32bit mode ensuring their run. Usually, there are no problems running 32bit applications. Contrarily, working with older external devices, to which 64bit drivers are not available, can be very complicated, or even impossible. If the system is not able to work with such elements, it is recommended to use abovementioned Windows XP MODE, which is by substance 32bit and can provide the solution in many cases. Older devices on an USB bus are a typical example.

1.7. Virtualization on operating system level

In case there is no possibility to solve issues by using compatibility tools on the operating system level, there is only one option to how to solve issues with launching specialized applications left. This option is virtualization, which enables eliminating the interference on (virtualizing) physical sources and operating systems tools from application or another operating system.

The virtualization concept was first developed by IBM in 1960s. However, during the 80s and 90s desktop computers and x86 servers became more accessible and therefore there was not much focus placed on virtualization and its development. Nowadays there are various types of virtualization - from full virtualization, para-virtual (partial) virtualization, to virtualization of applications itself, and many more, which are mostly used for virtualization of server infrastructure organization.

Several tools were developed for needs of teaching information technologies, more precisely for teaching operating systems or program equipment, and some of them are freely distributable or usable in non-commercial environment. Another significant factor affecting selection of virtualization technologies is the possibility to install them on Microsoft

operating systems, particularly on Windows XP and Windows 7 versions in their 32bit version.

Maximal support of wide range of hardware components is also a significant factor. The user should be minimally limited by used hardware while working on a virtual machine. Last but not least is focus on user interface; let it be while creating virtual machines or their later configuration and usage. For isolating applications and operating systems it is possible to use the following tools, which are available for "free" to schools:

- Oracle VirtualBox
- Microsoft VirtualPC
- VMware Player

Using these tools is, in context of this article, the last option how to ensure the functionality of applications, or rather their compatibility with hardware and software equipment, or rather the software and hardware compatibility. Preparation of the virtual tools, operating system, or applications is in the beginning more time demanding than installation of the application itself. Central solution for administration of virtual machines on end stations then provides increase in speed, security, and overall control over distribution of application contents.

1.8. Conclusion

In many articles, but also in authors' own experience, many users of new Windows 7 versions address abovementioned problems. Focus in this article was placed on showing examples of selected options of how to deploy not only didactic and e-learning software designated for older version of operating systems, but also peripheral devices, which can encounter problems with new version of operating systems. Above described methods are actively used by the authors and they can recommend them for their simplicity and efficiency. Component focus was also placed on principles of these approaches run in the background of Windows 7 operating system to provide the user with at least rough general idea about what is happening in their operating system.

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2. Optimization of Highly Available Computer Network Environment

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Abstract: *This article introduces the initial motivation for options of ensuring high availability in computer networks and methods for optimization of a given network topology in environments with high requirements for network speed, its throughput, and overall time of convergence. The basis of such environments are protocols for turning off links on the second network layer of an ISO/OSI model with added appropriately converging routing protocols of the third layer and techniques ensuring redundancy on the level of a default gateway for connected end stations. Through optimal timer configuration and by using modern protocols it is possible to achieve a network with short time of convergence and high throughput.*

Keywords: *computer network, Spanning Tree, LACP, OSPF, EIGRP, HSRP, GLBP.*

JEL Classification: *C89.*

2.1. Introduction

With high performance applications, which are critical for any environment nowadays, grow requirements for their availability. In case of a system or connectivity outage, which prevents the user from using the provided service, financial loss immediately occurs in all spheres - commercial, education, or non-profitable. Such financial losses can be either primary, caused by decrease in sales, or secondary, in which case there is need to pay employees even though they cannot do their work. It is possible to prevent such outages by implementing a complex environment, which will provide high availability to services.

Requirements for availability of individual systems, which the organization uses, are dependent mostly on their importance and the nature of the organization. For a logging system, availability of 95% can be accepted, availability of 99% can be tolerated for a surveillance camera system, but for online banking even 99.99% is too little. Support systems for sales in stone stores will have different requirements (e.g. 5x12 - 7am to 7pm on working days), different requirements will also be for e-shops(e.g. 7x18 - daily from 6am to 12pm), or for banking, stock, or army systems. These key systems strictly require a 24/7 operating mode. (Bigelow, 2008).

Critical network environments are nowadays equipped by elements for ensuring high availability, redundant parts, which can mutually fill in for each other in case of an outage and thus keep the network working. In case of some non-conceptually designed network infrastructures it is possible to find options for improving network operability in terms of speed and route throughput for lowering overall computer network convergence time by using advanced techniques of design.

2.2. Issue of the link layer

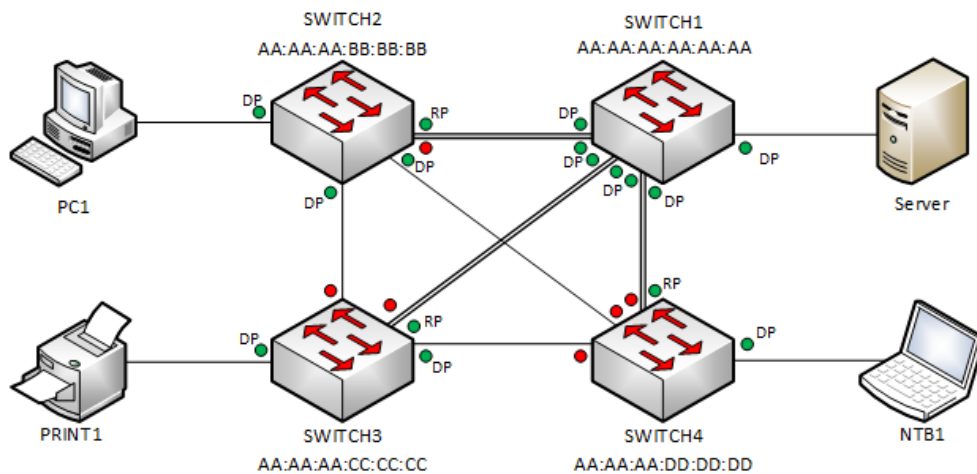
Providing high availability of local networks, where stations and servers communicate on the second layer of the ISO/OSI model, is realized mostly by a higher number of (backup) links, which can be either blocked or used simultaneously in special modes. It is possible to speak of a technique of switching off or aggregating links. By, preferably, connecting both technologies it is possible to achieve a computer network capable of providing a sufficient level of resistance to outages of individual links.

2.2.1. Switching off links

The fundamental condition of smooth operation of computer networks is preventing active loops, in which frames would be uncontrollably distributed in every direction, and very soon the network would become unstable, internal memory of switches and of the network devices would be overloaded, and the network would be completely inoperative. Such state is usually called a broadcast storm and it occurs when there is a loop in the second layer of a network. Another liquidating element for a network with a

loop is MAC Address Flapping (Hucaby, 2010). This term marks constant and frequent re-writing of a MAC address in a switch table as the frames of this source address appear on various input interfaces of a switch.

Fig.2.1. Example topology with Spanning Tree protocol



Source: authors' own experience

A computer network can be interpreted as a general graph. At one moment it is possible to maintain a network operable in one VLAN only when no loop occurs; in terms of graphs it is possible to maintain a network assuming that it will meet requirements of the definition of a tree. Protocols that enable providing of a network topology tree structure, which corresponds with the general graph, are called Spanning Tree.

The oldest protocol standard for the second layer of a network is the IEEE 802.1D, Spanning Tree Protocol (STP) protocol. This protocol is very often activated automatically in default settings of network elements. A network with this protocol is operative, the STP protocol intervenes when a loop occurs and by switching off the link, on which the loop has occurred using an internal algorithm, it brings the network into the correct tree state. In a highly redundant environment, only the STP function is not sufficient, just

as shown on Pic. 1, in the target convergent state there are too many unused "dead" backups represented by at least one red signal light at the end of the link in a topology. (Hucaby, 2010).

It is appropriate to substitute the STP protocol by a variant with lower direction and faster convergence - in case of a network without VLAN, Rapid Spanning Tree Protocol (RSTP), which substitutes STP in the IEEE 802.1d-2004 standard, or in case of networks with more VLANs, the Multiple Spanning Tree Protocol (MST), which is the IEEE 802.1s standard, are the most suitable options of substitution. (Hucaby, 2010).

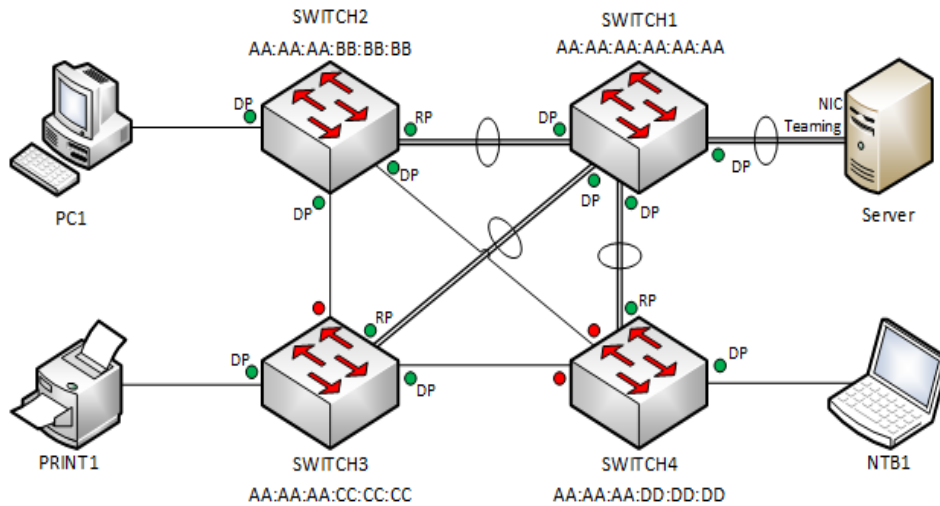
2.2.2. Aggregating links

Contrary to switching off links, the method of aggregating links is more efficient as their transmit capacity is utilized and in case of an outage of one of the links, such link is only removed from the functional logical bundle. This approach cannot be fully separated from Spanning Tree protocols as the aggregating links method is functional only when the loops are created by doubled links. However, most networks apply models for eliminating the Single Point of Failure, when loops occur not only between two directly connected switches. In this approach it is definitely needed to deploy any STP protocol for eliminating logical loops in a network. Ether channel, Link Aggregation, NIC Teaming, Channel Bonding, etc., are some of the technologies permitting aggregating links (Bouška, 2009).

Open standard for aggregating links is Link Aggregation Control Protocol (LACP), which is defined in IEEE 802.1ax. Considering its behaviour and features it is possible to talk about it as primary proprietary ancestor of the Cisco PAgP protocol. Balancing load above aggregated links is not performed by using static algorithms in both protocols, but it is actually configurable based on addresses of the second and the third layer. Based on process analysis it is recommended to optimize this parameter to achieve optimal load of all used links.

It is possible to use aggregated links in a computer network not only to interconnect network elements, but it is also possible to connect important end stations, servers, or data fields, as shown in Pic. 2.

Fig.2.2. Example topology with Spanning Tree protocol and LACP



Source: authors' own experience

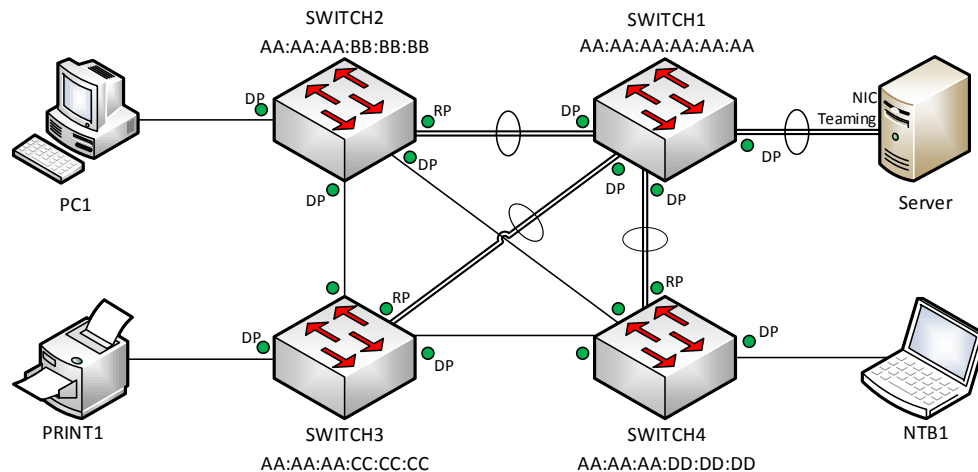
2.2.3. Correlated accesses

Solution, which joins aggregating links with switching them off to correctly secure looplessness of the logic topology, is able to create a redundant, robust, highly performing, and available environment for networks of any size, provided the basic rules of network design are kept. An example of a converged topology utilizing STP and LACP is shown in Pic. 2.

Variant containing more Spanning Tree processes, one for each VLAN, can also be considered a part of the modern take on a local network. Just as shown in Pic. 3, such variant enables to achieve a network in which all links are used simultaneously. However, in this case it is necessary to consider the efficiency of such approach.

Considering link aggregation without the function of any STP protocol is possible only when connecting a network element to an end station, or in specialized environments like data centres, where protocols like Fabric Route or TRILL are implemented.

Fig.2.3. Example topology with Spanning Tree protocol and LACP with multiple VLAN access utilization



Source: authors' own experience

2.3. Debugging link layer protocol behaviour

By setting the configurable parameters of individual utilized protocols optimally, it is possible to achieve faster convergence in the given network, which results in general increase in availability of services in the network while using minimum time necessary for transition to the convergent state. One of the most important configurable settings are STP timers and LACP balance options.

2.3.1. STP Timers

It is possible to debug two basic timers, RSTP: Hello and Max-age, to achieve faster convergence. Setting a lower Hello on switches and appropriately decreasing Max-age results in faster detection of a faulty link or a non-corresponding neighbour. It is also possible to decrease Forward Delay, which sets time necessary for the port to transition from the Learning state to the Forwarding state. Default timer values are shown in Tab. 1.

Tab.2.1. STP Timers

Timer	Default value	Minimum	Maximum
Hello	2	1	10
Max-age	20	6	40
Forward	15	4	30

Source: (Tiso, 2011).

The Hello timer sets how often the switch reports to its neighbours on its interface. Also, setting every timer indirectly affects link load. Furthermore, generating a higher number of BPDU results in increase in switch CPU load. RSTP timers for majority of applications are sufficient even in their default settings, unlike timers with STP. In extreme applications it is possible to shorten Hello to as short as 1 second. Max-age shorter than 10 seconds is reasonable only rarely, 6 seconds are then a minimum. (Tiso, 2011)

2.3.2. Traffic division between links in LACP

Static balancing is not used in protocols for aggregating links; however, methods of traffic division, based on the source or on the destination, are deployed. These methods are the basic identifiers in current local networks, which are based on Ethernet and IP protocols.

This fact has to be taken into consideration during optimization. If a majority of traffic is directed towards one station (server) in the network, it is optimal to balance the load by a source address.

If a bigger volume of traffic on the server can be assumed, destination address might be a better solution in such case. It is also necessary to consider the appropriateness of the address of the second and third layer. Technologies deployed in the network, among which is, for example, NAT, affect such consideration directly.

2.3.3. Broadcast domain

Broadcast domain is such an area, where each device is reachable by all-direction broadcasting (e.g. all ports of a switch in one IP network), and which is framed by a device communicating on the third layer (routers). Its disproportionate growth can result in uncontrollable amount of network traffic in the local network, which might result in inoperability of said network. For such environments it is necessary to consider maximum of tens of devices in one network segment, which are available via tools of the second network layer. (Hicks, 2004)

2.4. Routed environment

Even in internal networks it is necessary to deploy routing in such places just like server access or access to sources in another VLAN. L3 access is necessary in case an access to another VLAN is required for reasons of different addressing space and frequent need of filtration rules applications. With access to servers and other sensitive sources, it is necessary to apply filtering security rules on various layers - from filtering incoming addresses to protocol check, which enable communication with the secured area. In such cases even filtration of application data using IPS and IDS techniques can be deployed. (Ranjbar, 2010).

Because of lowering of L3+ switch prices, routing on the distribution layer is being preferred, and not only in Cisco Enterprise Model. The advantage of this solution is mainly additional reduction of the broadcast domain and the option of default gateway redundancy. The condition of deploying routing in the distribution layer of a hierarchical model is the restriction of a VLAN against one access router, which cannot always be guaranteed, not even with dogmatic compliance to design recommendations.

Routing can be divided based on its type to:

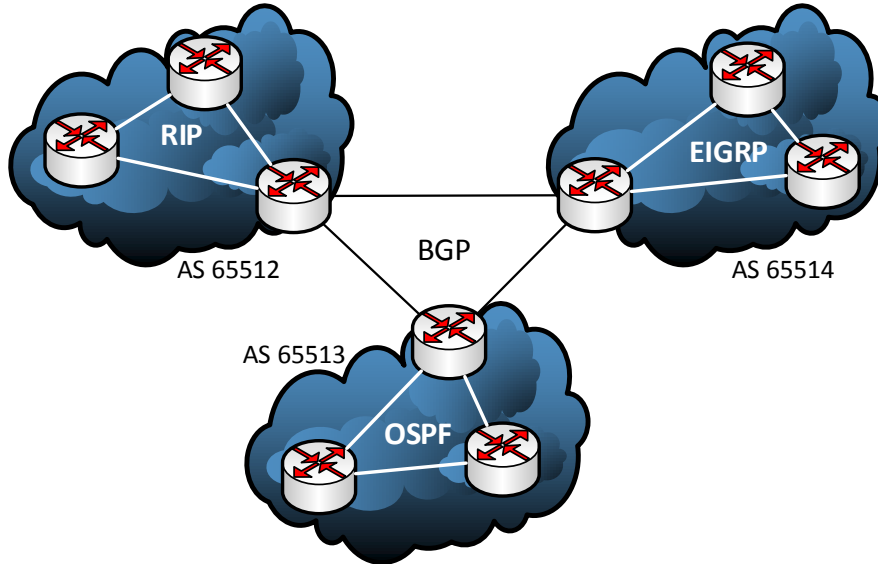
- **Static**, where the sequential directions of traffic from the router are given by routing rules.

- **Dynamic** routing of traffic and distribution of routing information is done by routing protocols which can further be divided into:
 - distance vector for which the information direction and finish metric are essential,
 - link state which work with the whole network typology, from which they search for optimal routes for individual destinations using algorithms for computing the shortest route.
- **Default**, by which another direction points to the default gateway in a local subnet, which decides about another traffic routing.

Another important protocol division is division based on usage of protocols used in one autonomous system (big company, ISP, etc.), and protocol used for distribution of routing information among autonomous systems (AS). There can be maximum of 64511 autonomous systems which are assigned numbers by IANA. Local AS with numbers 64512 - AS 65534 are available for testing purposes. Thus two groups of protocols called Interior Gateway protocols (IGP, inside AS) and Exterior Gateway Protocols (EGP, outside AS) exist. This article discusses only IGP protocols. A picture below illustrates usage of routing in the Internet via an EGP protocol BGP including deployed IGP protocols.

The most common type of traffic in local networks that does not end in the local network is traffic to local stations, which is directed to the default gateway. If it is needed to perform routing of traffic to an L3 device, both EIGRP (distance vector protocol substitute) and OSPF (link state protocol) are used.

Or if the traffic is routed between two or more VLAN, it is often not necessary to deploy a routing protocol and the administrator can only apply rules of routing via directly connected networks (so called sub-interface assigned to particular VLAN are used for such purposes on Cisco devices). EIGRP and OSPF are advanced classless protocols, which makes their deployment in contemporary networks easier.

Fig.2.4. IGP and EGP protocol and autonomous systems.

Source: authors' own experience

From a historical point of view, an important routing protocol is the RIP protocol. Nowadays, the IS-IS protocol (on basis of which the TRILL protocol was built) is seeing a boom. Also, the BGP protocol is used for routing the Internet.

2.4.1. EIGRP

Enhanced Interior Gateway Routing Protocol is a proprietary Cisco routing distance vector protocol (in 2013 it was released as an open standard in information RFC). It builds on Cisco IGRP, which is not used anymore. It uses the DUAL algorithm (Diffusing Update Based Algorithm), which is the only one that can guarantee looplessness in the topology, to compute the route. To transmit its traffic information it directly uses the IP protocol, in which it supports both CIDR and VLSM. (Savaga, 2013)

As an advanced protocol it sends update information only when necessary (when initializing the topology, the routers exchange their whole routing table, but when a change is made, they exchange only the updated parts), and furthermore it behaves well towards the transfer links and it does not

load the transfer capacity more than to 50% of the defined link speed. It creates adjacency with its neighbours (directly connected routers), thanks to which it is possible to check whether the neighbour is still available or whether there has been a change necessary to project into the routing mechanism.

EIGRP is a modular protocol, which is a big advantage over OSPF as it can transfer information not only to the IP protocol, but also to IPv6, AppleTalk, or IPX without the need of big changes. The option to set non-equivalent load balance and auto-summarization support can be added to the list of advantages. (Savaga, 2013)

To decide about the quality of a link the EIGRP uses metrics composed of bandwidth and delay in its default settings. This composed metrics can be expanded by load and reliability. Each of these metrics is taken from a particular link, or from manual configuration. The formula for computing the metrics contains K values, which define coefficients by which individual values are multiplied. Default settings are $K1 = K3 = 1$ and $K2 = K4 = K5 = 0$. These K values can be changed in the router configuration, but it is imperative to keep in mind that these values have to be identical in all neighbours to establish a neighbour bond. The complete formula to compute the resulting metrics is the following:

$$\left(K1 * bandwidth + \frac{K2 * bandwidth}{256 - load} + K3 * delay \right) * \left(\frac{K5}{K4 + reliability} \right) * 256$$

While counting with default K values this long and rather difficult formula (several divisions) shrinks to: $metric = (bandwidth + delay) * 256$. (Savaga, 2013).

To establish a neighbour bond, Hello uses packets - for two routers to become neighbours it is necessary for both to state the same parameter of K values in the Hello packet, to be in the same subnet and AS, to possess the same version of EIGRP (there is only one here for now), and to authenticate using the same MD5 hash. A multicast on 224.0.0.10 address is used to exchange information if possible.

EIGRP achieves a loopless network using several router states, routing information, and sufficient conditions. Basic terms for this protocol are:

- **Successor (S)** is the shortest route to the destination (according to the chosen metrics) saved to the routing table.
- **Feasible Successor (FS)** is a route to the destination, which is worse than with the Successor, but it still complies with Feasibility Condition. This route is saved into the EIGRP protocol topology table and it is ready to replace the primary route in case of a Successor outage without the need to re-compute the topology.
- **Reported Distance (RD)**, which labels the given distance from the neighbour router into the destination network through Successors. Sometimes it is also called Advertised Distance (AD).
- **Feasible Distance (FD)** is the shortest route from the router with running EIGRP process to the destination network through Successors.
- **Feasibility Condition (FC)** states the $RD < FD$ relationship and it is used when selecting the Successor and the Feasible Successor. If the RD complies with this condition, it can be considered a route outside a loop.

To maintain information EIGRP uses the routing table (which contains information about the current routing in the scope of one router and can contain information from more protocols), the topology table in which it stores information for its uses (all routing records complying with FC), and the neighbour table. (Savaga, 2013)

2.4.2. OSPF

Unlike the EIGRP, with OSPF it is necessary to distinguish versions according to the used protocol of the third layer. OSPF version 2 is used in IPv4 networks, whereas IPv6 utilizes OSPFv3. Thus this protocol is not modular. OSPF was developed from the start as an open standard defined for IPv4 in RFC 2328 and for IPv6 in RFC 5340. OSPF is a protocol with link state, in which one can see the behaviour different from before mentioned EIGRP. Considering its long-term openness, and wide and

quality implementation across manufacturers, it is currently the most widespread IGP protocol in large companies and many ISPs.

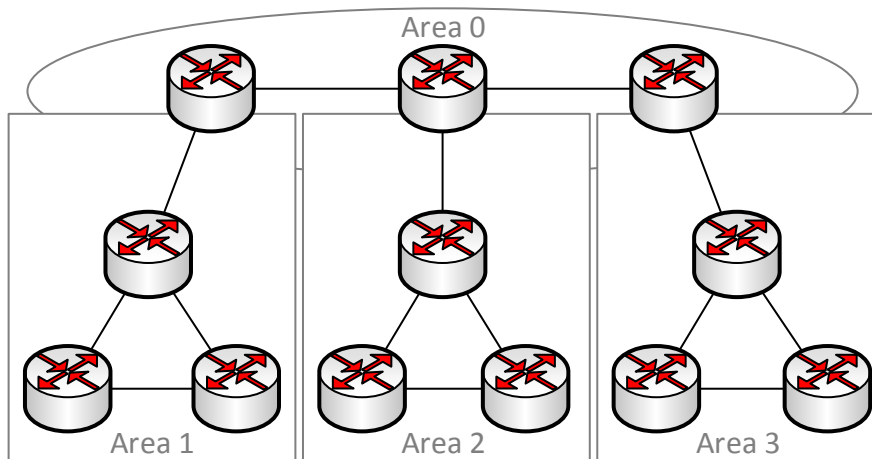
OSPF integrates neighbour relationships of routers utilizing regular Hello messages. These messages must contain identical number and type of area, subnet and mask, Hello and Dead timer, and possible authentication data (plain text or MD5 hash). Price of the OSPF link is counted as $cost = 100 \text{ Mbps} / bandwidth$, which is not sufficient nowadays and thus various platforms enable to set custom referential speed different from 100 Mb/s.

OSPF utilizes the SPF Dijkstra's algorithm for its traffic, thanks to which it creates a graph of a tree in the computer network. To send information, OSPF utilizes multicast according to the type of information. It uses 224.0.0.2 for all available routers, 224.0.0.6 for DR and BDR, and 224.0.0.5 for all routers in the given subnet. DR and BDR are types of leading routers in OSPF (Designated Router and Backup Designated Router) which are used in some types of multi-access networks for saving computing performance and the used bandwidth. DR sends routing information and changes, BDR is its backup, it watches the DR and in case the DR outages, the BDR fills in for it. These two functions go through selection between routers. The defining criterion is priority (the higher the better), which can be configured manually or the highest IPv4 address of a local interface is used.

Two basic service packets, DBD and LSA, have to be distinguished with OSPF. Unlike EIGRP, OSPF has one table more - Link state Database, which contains information about the whole topology and it is identical for all routers in one area. Discussing more about the principles of this protocol is in terms of its complexity beyond the scope of this article and additional information can be found in an appropriate RFC. (Tiso, 2011).

OSPF works with Areas, logically bound parts of networks connecting to 0 areas, which always serves as the core network. Summarization of routing information can occur on the border of individual Areas thus reducing the routing table. Furthermore, re-computing of the topology in case of a change in one Area does not have to affect another Area thanks to the summarization. Unlike EIGRP, automatic summarization is not supported in OSPF and it is necessary to define the rules manually.

Fig.2.5. OSPF network divided into 4 Areas



Source: authors' own experience

The way of designing networks using Areas is very modular - it is not difficult to add or remove an Area. It is imperative to keep in mind that each Area must be connected to Area 0 either directly (as shown in Pic. 4 above), or indirectly using virtual links. Several types of Areas defined in RFC exist in OSPF, in which various types of information and network topology updates are transmitted:

- **standard Area** in which all routing information including summary and external (imported from another protocol) are present,
- **Backbone Area** (Area 0), which serves to connect all other Areas and in smaller networks only this Area exists,
- **Stub Area**, which does not take routing information from other AS, into which only the default route directs,
- **Totally Stubby Area**, which does not accept routes outside its Area.

Other proprietary expansions of OSPF defining another Areas, for example Cisco NSSA (Not-so-Stubby Area) and other also exist. But because they are not a part of the standard, this article does not discuss them.

2.4.3. Convergence acceleration

Both protocols contain timers, thanks to which it is possible to accelerate convergence. Optimal setting based on individual requests of each computer network can bring benefits. Each non-standard setting has to be thoroughly tested and documented to prevent unwanted phenomena like Port Flapping (repeated periodic port switching between states, when it neither sends nor receives user data). (Ranjbar, 2010)

Hello and Dead are important intervals for OSPF. The first one defines how often the neighbours send a Hello packet (in seconds); the other defines time after which it declares a neighbour unavailable as it has not received a Hello packet from it, also in seconds. Default settings for multi-access network are 10 seconds for Hello, for Dead it is four times the value of the Hello interval.

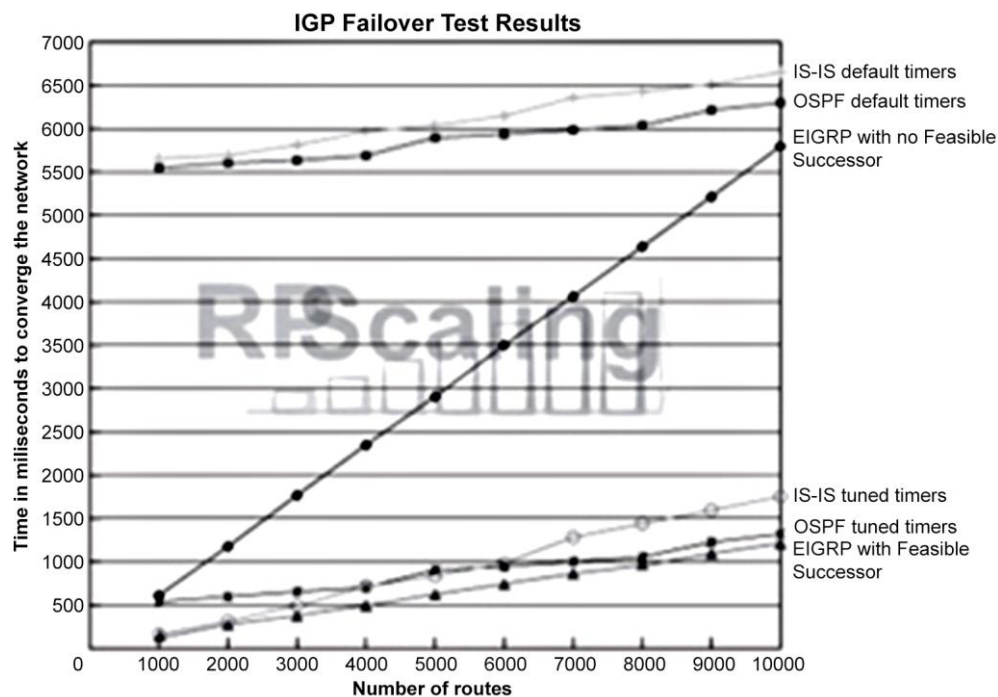
In NBMA (non-broadcast multi-access) networks, which are generally slower, the Hello interval is 30 seconds and the Dead interval is then changed accordingly. These two intervals can be based on the quality of the link lowered to units of seconds, which can contribute to faster detection of an unavailable neighbour and faster network convergence. (Tiso, 2011).

Security of such setting is imperative to consider in order for a very short interval to not cause Flapping interface, which is a state in which it goes from the off state to the on state and vice versa in regular short intervals. Another imperative requirement is to ensure the sameness of Hello and Dead intervals among neighbours as their sameness is a compulsory part of establishing neighbourhood. Further settings can adjust even the time schemes of LSA packet distribution which can save the band for other communication. (Ranjbar, 2010).

Unlike OSPF, EIGRP does not require for the neighbours to have the same Hello and Hold timers (Hold timer is the same as Dead with OSPF), even though it is not the best practice. It is not recommended to set the Hello timer lower than 2 seconds and the Hold timer in all cases shorter than three

times of the Hello timer. Very short period of convergence can be achieved when there is a Feasible Successor on the route available to be switched only by changing routing information in the routing table. (Savaga, 2013)

Fig.2.6. Speed of individual protocol convergence



Source: (Tiso, 2010)

2.5. Redundancy of a default gateway

Default gateway is a key element in a network when stations, servers, and other devices need to initiate connections outside their subnet and do not have any other routing information defined. Default gateway is a point providing transfer of data traffic in the right direction. From that it is obvious that it is one of the most important points in both user and server areas, and for increasing overall availability of any service outside the given subnet, securing default gateway redundancy is absolutely key for the user.

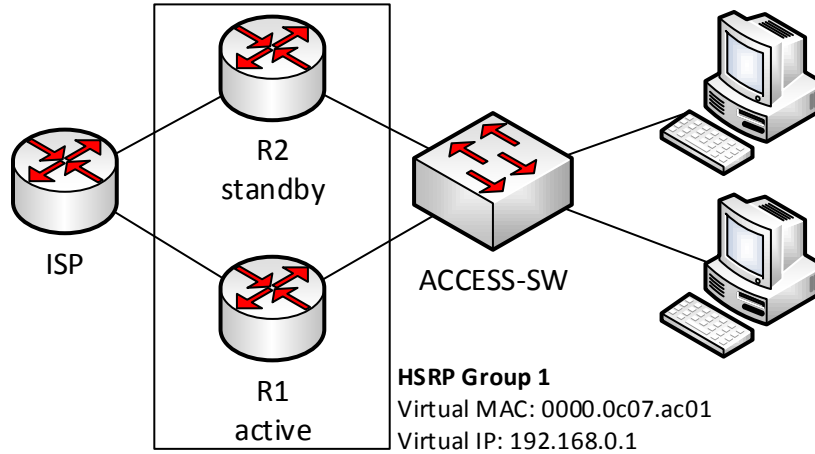
HSRP, VRRP, and GLBP belong among key protocols. As this area is still fairly new, still valid patents impeding protocol implementation among various manufacturers exist (mainly the Cisco company, which first introduced the HSRP protocol). These are, for example, VRRP, CARP, and other First Hop Redundancy protocols (FHRP).

2.5.1. HSRP and VRRP

Hot Standby Router Protocol is a Cisco proprietary protocol for securing high availability of the default gateway. That is why more physical routers are aggregated into one group sharing one virtual MAC and IP address. This IP address is then set for hosts as the address of the default gateway. Network topology using HSRP is shown in Pic. 7. Virtual MAC address is always in 000.0c07.acXX form, where XX is a number of the HSRP group in which the router belongs. Routers in HSRP communicate with each other using group transmission on 224.0.0.102 address and 1985 UDP port, it is then necessary for them to be connected on the second layer. In one HSRP group there can be more than two routers and their roles are then the following: (Bouška, 2008)

- **Active** is a router, which possesses virtual MAC and IP address and sends user data.
- **Standby** watches over the Active router and if there is an outage, it declares itself the Active, assumes the virtual MAC and IP addresses and starts providing traffic. Surveillance is performed using Hello packets standardly sent every 3 seconds. Assuming the Active state occurs after Hold time lapses and no Hello packet arrives in this time. In its default the Hold time is equal to 10 seconds.
- **Listen** are other routers in the HSRP group.

Fig.2.7. Redundancy of the default gateway using HSRP.



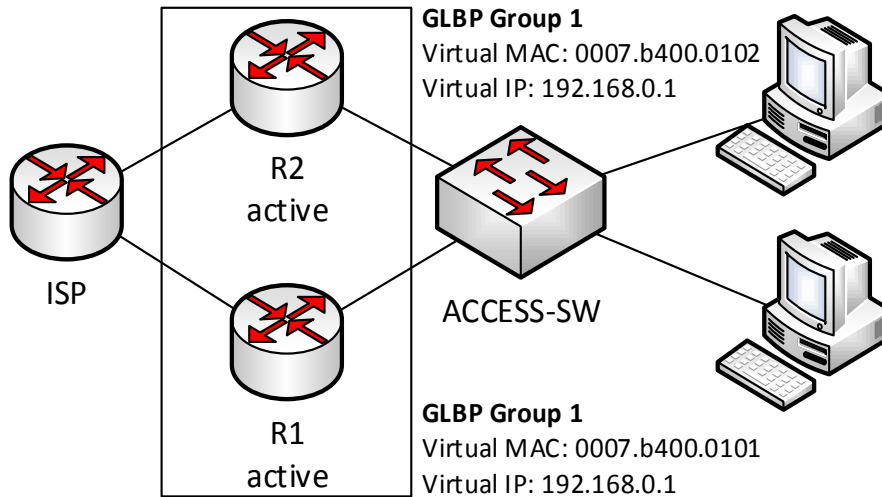
Source: authors' own experience

In such topology one router participates just as a backup without being actively used. Options that would provide load to the second router are two:

1. Utilizing various HSRP groups for various VLAN, where a part of a VLAN can be associated with one HSRP group (HSRP is launched by a command on L3 interface of a router, therefore there is no problem associating other sub-interface, mentioned earlier, with another HSRP group).
2. Utilizing GLBP protocol, which enables balancing load in scope of one group of routers.

Virtual Router Redundancy Protocol, which is also mentioned in this chapter's title, is a practical copy of HSRP, which IETF standardized in RFC 5798. Routers communicate with each other on multicast 224.0.0.18 address and VRRP group utilizes virtual MAC address 000.5e00.01XX, where just like with HSRP XX is a part of the group. Even though VRRP originates from HSRP and it is practically identical, these two protocols are not mutually compatible.

Fig.2.8. Redundancy of the default gateway in GLBP protocol in Active - Active state



Source: authors' own experience

2.5.2. GLBP

Gateway Load Balancing Protocol brings, as its name suggests, load balancing to the area of gateway redundancy. The balancing does not take place on the static layer, but according to source IP address. GLBP utilizes one virtual IP address, but more virtual MAC addresses in the format 0007.b400.01XX, which are assigned to guests and which are assigned to various routers in the GLBP group. Just like HSRP, routers communicate with each other on a multicast address 224.0.0.102 and UDP port 3222 and send each other a Hello packet every 3 seconds. (Hucaby, 2010)

One router, so called Active Virtual Forwarder (AVF), is managing all other routers based on manually defined priority (the higher the better, default value is 100), because all routers transfer contents among them. This router also assigns maximum of 4 virtual MAC addresses in a group. Schema of topology with functional GLBP is shown in the picture above. (Hucaby, 2010)

2.6. Conclusion

By specifying needs of a particular computer network it is possible to find places suitable for optimization. If the needs of the environment are critical, possible steps for increasing availability of individual parts are searching for unused backup links or devices, which can be brought to an active state by appropriate approach to aggregating links in combination with any Spanning Tree. Link aggregation can also be used for high-speed server connection or other critical parts of computing infrastructure. Another possible extension, in case of larger networks and in case of some design accesses of hierarchical network models, is utilization of IP routing, which can result in decrease of size of the L2 domain, which can lead to increase of compactness and predictability of the network behaviour.

By using a concept of routing protocol convergence optimization in the area of a network layer, mainly by using summarization and individual timer settings reconfiguration, it is possible to achieve very efficient environment with routing communication.

For default gateway redundancy, which enables the access to unknown networks, it is appropriate to use standardized HSRP protocol possible to use on advanced routers. This way it is possible to achieve significantly higher user comfort in case of an outage, and also optimal utilization of sources in case of utilizing the GLBP protocol, which enables to balance load above more routers in the role of the default gateway at the same time.

By combining all abovementioned approaches it is possible to achieve maximal availability in the area of a local network, which can be utilized in medium sized and large corporate environments, which require nonstop traffic.

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3. Modelling of the Thread Synchronisation in the Operating System Using Coloured Petri Nets

Martin Ibl

Abstract: *Synchronisation of threads deals with the basic concepts of communication between threads and structures that allow safe simultaneous operations of multiple threads. Description of the structures and the procedures in this chapter are carried out on the basis of the terminology of the C # programming language. With that is achieved uniform interpretability and traceability of each synchronization structures. The aim of this chapter is to model synchronization logic of individual structures and the overall behaviour of the interaction between threads. At the same time there will be abstracted from the planning logic of the scheduler.*

Keywords: *Synchronisation, Coloured Petri Nets, Verification, Modelling.*

JEL Classification: *C61, C63.*

3.1. Introduction

For the past several decades in the area of operating systems (and other related disciplines, such as programming) has developed a series of powerful synchronization tools, which over time have moved into other disciplines. In the area of operating systems they are primarily tools such as Semaphore, Mutex, Monitor or Lock (Tanenbaum, 2008, Tanenbaum and Woodhull, 2006). In conjunction with the synchronization in the field of programming has been developed a series of techniques that inherit these tools.

By that was the issue of synchronization tools spread into the general public usage. In the last 10 years, with the advent of the multi-core processors, this has intensified since the relatively all modern computers contain option for parallel run-time applications. By that is put more emphasis on the

developers to use the architectures which make use of the maximum available resources.

The main issue with these tools is a way to use them, because nothing guarantees that they will be used in the right way (Albahari et al., 2012). By using these tools, there is a high risk that the deadlock occurs (deadlock) during the runtime of the system. There are a number of standards and recommendations, which restrict the use of these tools (primitives) according to pre-defined templates, but that relatively constrained the hand of developers who are then forced to use these standard procedures, so that they can be at least a little bit sure about correctness of their architectures.

Petri nets (Petri, 1962, Jensen, 2009) allow to model complex systems containing concurrency, parallel processing and synchronization. Their main advantage is the exact mathematical basis that allows performing sophisticated analysis (verification and performance) on the proposed models. In addition, the portfolio of Petri nets is divided into different development branches from which has been developed a series of definitions that offer varying degrees of sophisticated analytical methods for verification or performance analysis.

The aim of this chapter is to present the basic group of synchronization tools and using coloured Petri nets to introduce their modelling and verification powers. Modelling is done with the use of coloured Petri nets in the software CPNTools (Jensen et al., 2012).

3.2. Description of the issue

Thread synchronization deals with the basic concepts of threads communication and structures, which allow safe simultaneous operations of multiple threads.

3.2.1. Simple blocking

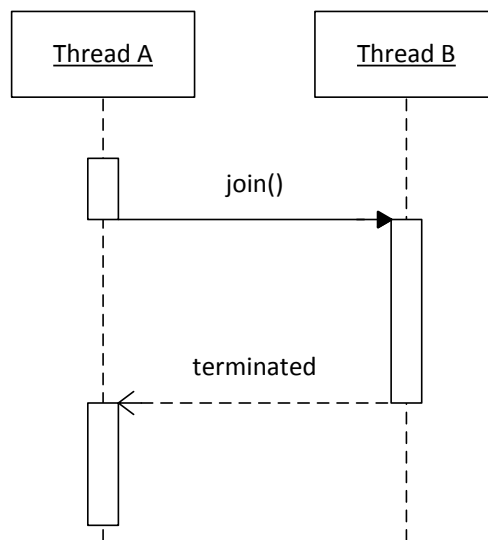
Basic synchronization tools are a variety of lock structures that allow deferring the work of one thread to another. Blocking is possible to generalize on the following three facts:

- Thread is waiting (is blocked) for the other thread to complete its work (Join).
- Thread is blocked for a specific amount of time (Sleep).
- Thread is waiting (is blocked) for a signal from another thread (Wait).

3.2.2. Method Join

The Join method allows blocking the thread until the other thread completes its action (goes into the state "Stopped"). Then the thread is unblocked and again continues its activities. Figure 1 illustrates the case where "Thread A" applies the Join method to "Thread B". This pause the activity of "Threads A" (the state will change to "Blocked") until "Thread B" is terminated.

Fig.3.1. The method JOIN

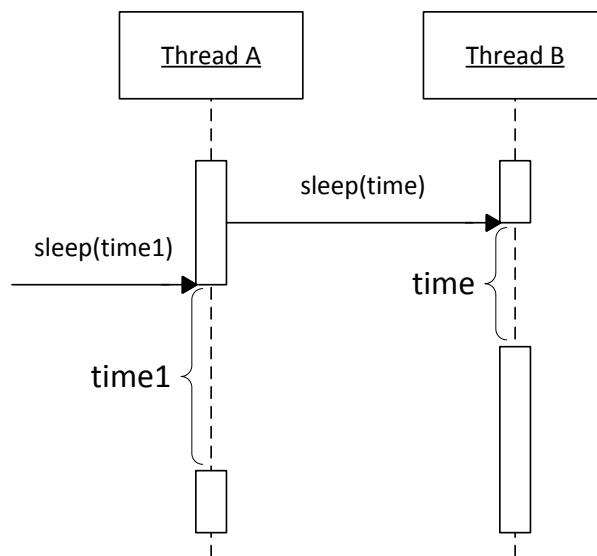


Source: (Ibl, 2011)

3.2.3. Method Sleep

Another blocking synchronisation structure is the Sleep method, which allows to pause the thread for a predefined amount of time. Unlike the Join method the thread can call the Sleep method on itself. Principle of this method is illustrated in figure 2.

Fig.3.2. The method SLEEP



Source: (Ibl, 2011)

3.2.4. Locking

Another group of synchronisation tools are locking structures that explicitly ensure that shared resources are not used in an inappropriate manner (inconsistently). Problems with shared resources may arise in two situations:

- Computer supports multiprocessing (parallel processing).
- Operations are not performed atomically (can be interrupted).

Parallel processing has a number of problems associated with the provision of mutual exclusivity in the use of shared resources. These problems are usually solved with the active waiting, disable interrupts, etc. With that is related the fact that in modern computers (using pre-emption) are not operations performed atomically. Since interrupts may occur substantially any time the shared resource must be locked for all time when the thread using it (even if it was interrupted). The part of the code that works with shared resources is called the "critical section". On the other hand, the fact that there may be inconsistency is called the "Race condition".

Locking will be explained on the construct of high-level programming language called "Monitor". This is a equivalent of a low-level construct called "Semaphore" (synchronization tool of the operating system). Monitor is a powerful tool with which is possible to synchronize basically any activity of threads (Albahari et al., 2012). Monitor consists of methods Enter, Exit, Wait, Pulse.

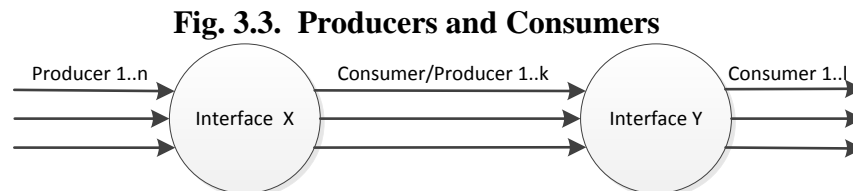
The first two methods deal with the locking (the enter method prefix entry into the critical section and the exit method prefix the end of critical section). The rest of the methods will be discussed in the following section dedicated to signalisation.

3.2.5. Signalisation

Signalisation is used for the communication between threads. This is the situation where one thread creates output that is entering the next thread. In this way, can be defined the whole process activities of the program. The problem occurs when there is a delay between the threads in terms of continuity. For this reason some threads must wait for their input data (actively), which unnecessarily consume machine time of the computer. For this reason is used the signalisation that allows to block the waiting thread until the required input is available.

Threads, whose outputs are used as inputs for other threads are referred to as "The Producers". Conversely, threads which are using these outputs as their inputs are referred to as "Consumers". Figure 3 illustrates an example of connection of threads. Producers here are the threads that generate outputs for "Interface X". Through this interface, these outputs incorporate the threads identified as "producer/consumer" as its inputs and transform them

into outputs for "Interface Y". From the "Interface Y" the data are taken to the final consumers.



Source: (Ibl, 2011)

The operating system includes a basic set of low-level signalisation tools such as Semaphores, Mutexes, etc. In the following will be explain the principle of methods Pulse and Wait (Monitor). Methods Pulse and Wait allow with the thread signalisation coordinate locking and unlocking, depending on the fulfilment of interlocking. If, for instance, thread waits for input (output of its producer), it may call the method wait and thereby block itself. The thread is unlocked again; if another thread (the producer) calls the method Pulse.

This principle is at the consumer usually implemented using an infinite loop whose termination is quoting a condition that determines whether inputs are ready or not. In the body of the cycle is called the Wait method, whereby the thread is blocked (without endless cycle). Since the blocking condition represents the operation on a shared resource (input), the whole operation is located in a critical section. If the producer prepares its output, it calls the Pulse method, which unblocks one thread (the consumer).

3.2.6. Synchronisation models

The synchronisation methods can be modelled as a simultaneous activity of several independent threads. For the modelling purposes each thread will contain three parameters, namely the name of the thread, the index (state of the thread) and name of another thread. The individual threads are named in capital letters of the English alphabet, i.e. A – Z. The next parameter is the index that specifies detail information about thread status. The last

parameter is the name of the thread on which blocked thread waiting to be terminated. List and description of each thread index contains the table 7. The Join method works with the first three indexes, i.e. 0-2, and the last index (index 5). Other indices will be used in the following sections of this chapter.

Tab. 3.1. List of indexes

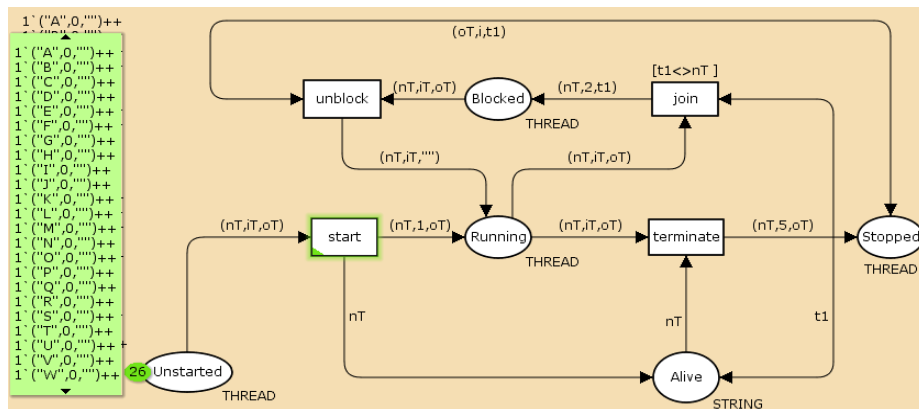
Index	Description
0	Thread is newly created
1	Thread is running
2	Thread is blocked (waiting for completion of another thread - Join)
3	Thread is blocked (Sleep)
4	Thread is blocked (waiting for a signal - wait)
5	Thread is stopped

Source: (Ibl, 2011)

3.2.7. Model of the method Join

The model of the method Join represents the states of each thread (A-Z) and their changes (see Figure 4).

Fig.12.4. Producers and Consumers

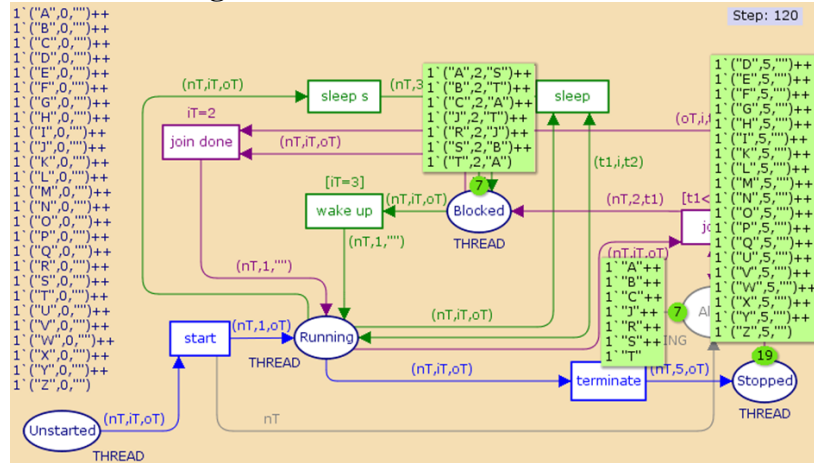


Source: (Ibl, 2011)

3.2.8. Model of the method Sleep

Modelling of the method Sleep is similar to the Join method and is incorporated into the model of the method Join (see Figure 5).

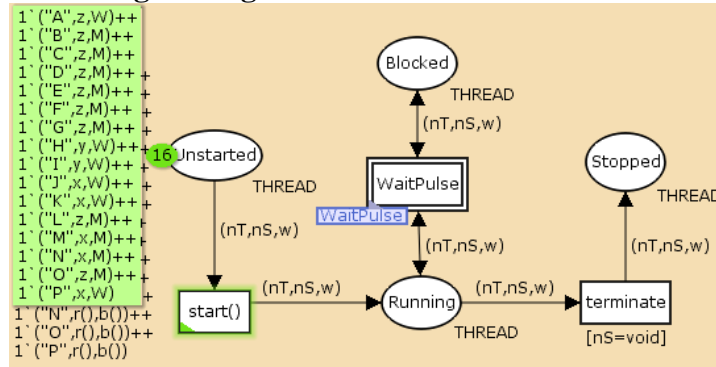
Fig.3.5. Producers and Consumers



Source: (Ibl, 2011)

3.2.9. Model of the signalisation logic

Fig.3.6. Signalisation – Pulse and Wait



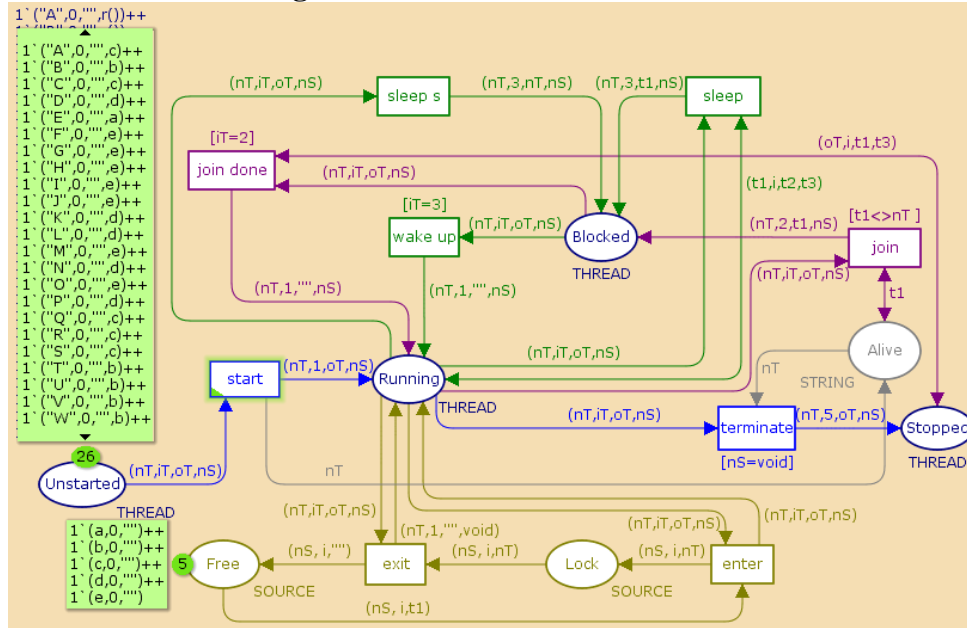
Source: (Ibl, 2011)

To illustrate the activities of the Pulse and Wait methods, is used (for better clarification) the hierarchical abstraction in CPN, or HCPN. Figure 7 presents the basic network, which is made up of the standard thread states. The default marking contains 16 threads ("A"-"P").

3.2.10. Model of the locking logic

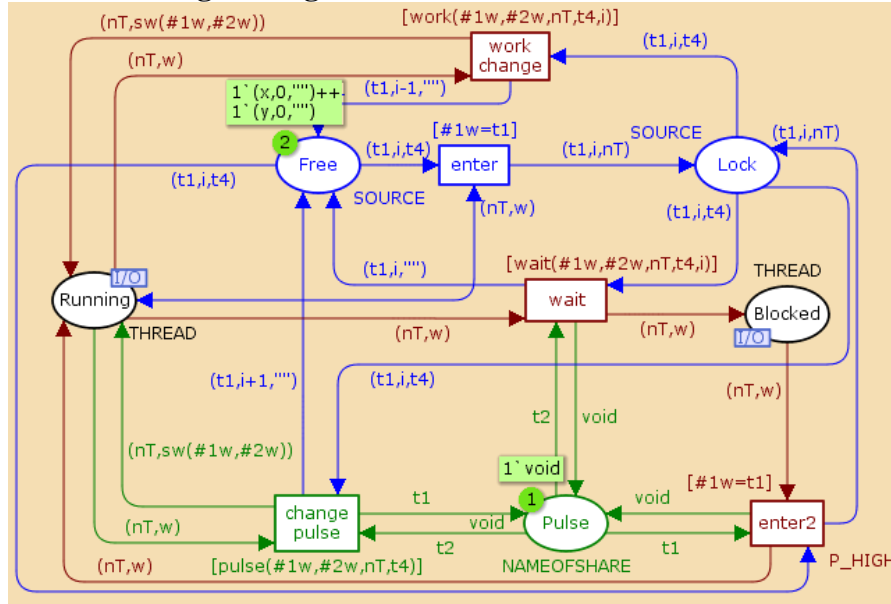
The principle of the Enter and Exit methods is illustrated in Figure 6. It is essentially the extension of the previous model.

Fig.3.7. Producers and Consumers



Source: (Ibl, 2011)

The transition „WaitPulse“ represents a separate module (sub-model), whose structure is illustrated in figure 8.

Fig.3.8. Signalisation – Pulse and Wait

Source: (Ibl, 2011)

A detailed description of the model (and other models of synchronization primitives) and his behaviour is not part of this chapter and can be found in (Ibl, 2011).

3.3. Verification of models

The model can be verified in terms of the assumptions, which were laid on it. Verification of models in coloured Petri nets is done by using state space generation and its subsequent (automatic) analysis. The result of the analysis of the state space is conclusions about the characteristics of a deadlock or boundedness. Tab. 2 illustrates the results of the analysis of deadlock in the previously defined synchronization primitives.

The model of signalisation does not include an exit condition, and it is therefore not possible to verify this model (contains infinite state space). The only model that includes deadlock (unwanted) is the method Join where improper use can create a loop (for example, thread A waits for the thread B to be terminated, thread B is waiting for thread C to be terminated and thread C waiting for thread A to be terminated).

Tab.3.2. The results of the verification analysis

Method Join	More than one dead markings (possible situation when a chain of waiting threads create a cycle – deadlock)
Method Sleep	One dead marking corresponding to the target state
Locking (methods Enter and Exit)	One dead marking corresponding to the target state
Signalisation (methods Pulse and Wait)	Infinite state space, cannot be specified

Source: (Ibl, 2011)

3.4. Discussion

As has been shown, Petri seems to be a powerful tool for modelling and verification of thread synchronization. The use of coloured Petri nets for verification of more complicated synchronization primitives (e.g. the Wait and Pulse methods) is very useful, because it allows modelling a variety of cases for which there is not a template. This means that the developer has, in principle, greater flexibility in the use of, for instance, methods such as Pulse and Wait. One of the best approaches of how to avoid problems during implementation is appropriately verify the design model architecture of the future software.

3.5. Conclusion

One of the views on the thread activities is associated with their behaviour (behavioural perspective), or mutual interactions. In this context, the basic principle of synchronization tools has been modelled that solve the problems associated with the concurrent activities of the threads (critical section problem, signalisation, sleep, etc.). Individual synchronization tools are design to ensure the safety of (the transparency and consistency) threads

communication. This chapter presents four basic synchronization primitives, which are used when working with threads communication.

The outlined options of verification analyses show that the proposed CPN models are an appropriate tool to ensure the consistency of the modelled system (in the design or in the implementation stage). Models can also be used for educational purposes.

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4. Agent-based Model of Spatial Dispersion of Celtic Settlements

Jan Procházka, Kamila Olševičová

Abstract: *Our objective is to create social simulation of the growth and collapse of the Celtic society in Central Europe in the Late Iron Age. To achieve this, we work on CeltSIM modelling framework. This set of models represent a multiple-scenario approach: the scenarios describe different aspects of the oppida occupation: population increase or decrease, food-production strategies, landscape changes or economic interactions between oppida and their hinterlands. Within a modelling process different methods are integrated: cellular automata for the representing landscape and its changes, system dynamics for expressing population dynamics, economic strategies and ecological and societal rules, and the agent-based component for modelling interactions of autonomous entities such as settlements. In this chapter we present one of our models, the Region Model of spatial dispersion of the network of settlements in the location of the oppidum Staré Hradisko.*

Keywords: *agent-based model, archaeology, NetLogo, settlement hierarchy, social simulation, spatial dispersion*

JEL Classification: *C63.*

4.1. Introduction

On a transition from middle to late Iron Age period we encounter a transformation of the central European Celtic society which was represented especially by the new settlement forms – the oppida. They appeared as a part of an economically advanced environment, together with a distinctive intensification of settlement patterns. The population density increased from

the beginning of the occupation (half of the 2nd century BC), peaked around the end of the 2nd century, and then it decreased again within two generations.

This probably massive change was not restricted to the oppida only, but reflected also on the settlements in the countryside. Causes for gradual trend of depopulation of complex Celtic society are object of our interest.

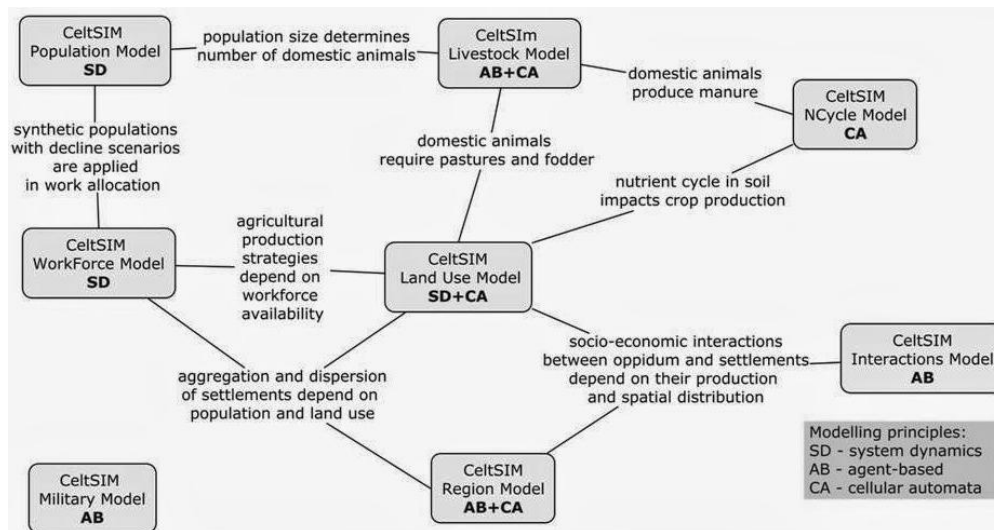
The analysis of related political, economic and organizational factors is obstructed by the overall lack of detailed archaeological data. In this situation building of explanatory models is the only valid way of exploring the structure and hierarchies of Celtic settlements.

Our objective is to develop CeltSIM framework, the set of models based on domain knowledge and archaeological evidence. Our set of models represent a multiple-scenario approach: the scenarios describe different aspects of the oppida occupation, especially population dynamics in terms of its increase or decrease, food-production and agricultural strategies, landscape changes or economic interactions between oppida and their surroundings.

For overview of the framework, see Fig. 1, for our previous results see e.g. (Danielisová et al. 2013), (Olševičová and Danielisová 2014a) or (Olševičová and Danielisová 2014b), for similar research project see e.g. (Christiansen and Altaweel 2006) or (Kohler and Varien 2012).

In following sections we present the Region Model, the agent-based model of spatial dispersion of the network of settlements in the location of the oppidum Staré Hradisko.

The aim of the model is to provide the picture of the region during the period of the existence of the oppidum and to enable exploration of hypotheses about the maximum population and carrying capacity of the region, and about probable agricultural practices and economic interactions.

Fig.4.1. CeltSIM modelling framework

Source: authors

4.2. Conceptual Model

The following concepts were essential for the dispersion of Celtic settlements and thus are included in our model:

- *Environmental population potential* – The environment is defined as the grid of square patches. One patch represents the area of 100 x 100 square meters with certain resources potential and soil type and quality. Environmental potential and friction radius are used to estimate the population potential which quantifies the maximum population of each settlement.
- *Resources and requirements* – The population of the settlement is limited by two types of renewable resources:
 - Cereals crop is produced by working part of the settlement population and covers significant part of caloric needs of the whole population of the settlement.
 - Fuel and construction wood is available in forests around the settlement. Exhausting of wood reserves in walking

distance around the settlement might be the incentive for the movement of the settlement to a new location.

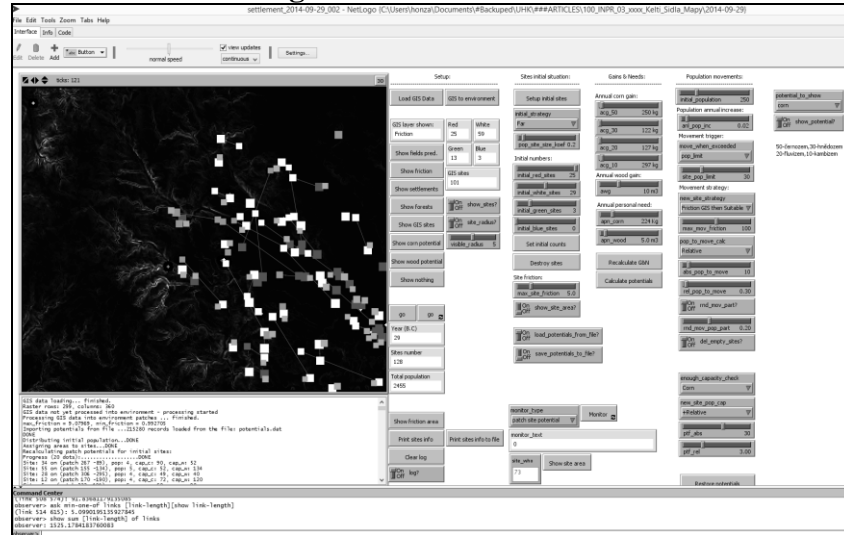
- *Settlement area* – The model works with a simple specification of the settlement neighbourhood area. This specification is based on maximum operational distance given by the friction distance radius in meters.
- *Population dynamics* – The annual population growth of the whole region is about 2%, with uniform distribution of new individuals to the set of settlements.
- *Population migration* – Numerous triggers can make a part of population to move and either to found new settlements (dispersion process), or to join to existing ones (aggregation process). Typically, triggers are based on:
 - *Population limit* – when the settlement population exceeds a given number of inhabitants, part of the population moves to a new location.
 - *Cereals crop capacity* and *wood capacity* – when the cereals crop does not cover the consumption requirements of inhabitants, or wood reserves are not sufficient, part of the population moves.
- *Places for new settlements* – The suitability of particular locations is evaluated using GIS landscape data (soil quality, slope or distance from water) that indirectly define maximum cereals crop capacity and wood capacity. Moreover, partial archaeological evidence informs us about probable locations of settlements. Identification of relevant combinations of criteria for selection of the best location for a new settlement and subsequent formation of settlement network are main objectives of simulation experiments.

4.2.1. Implementation in NetLogo

Our model was designed in NetLogo 5.1.0 (Wilensky 2014). The settlements are represented by agents. Attributes of agents specify size of population, link to the parent settlement (i.e. site from which originators came) and environmental characteristics of the surroundings related to the

maximum carrying capacity of the settlement and available resources. See Fig. 2 for interface of the model.

Fig. 4.2. Model Interface



Source: authors

The initiation consists of loading GIS data and setting the initial state of the environment. Four GIS data files are used:

- *field_pred* defining soil quality,
- *gis_sites* defining places with archaeological findings,
- *gis_settlements* defining the settlement suitability of the patch,
- *gis_friction* defining the friction.

GIS data are converted to attributes of NetLogo patches in four layers:

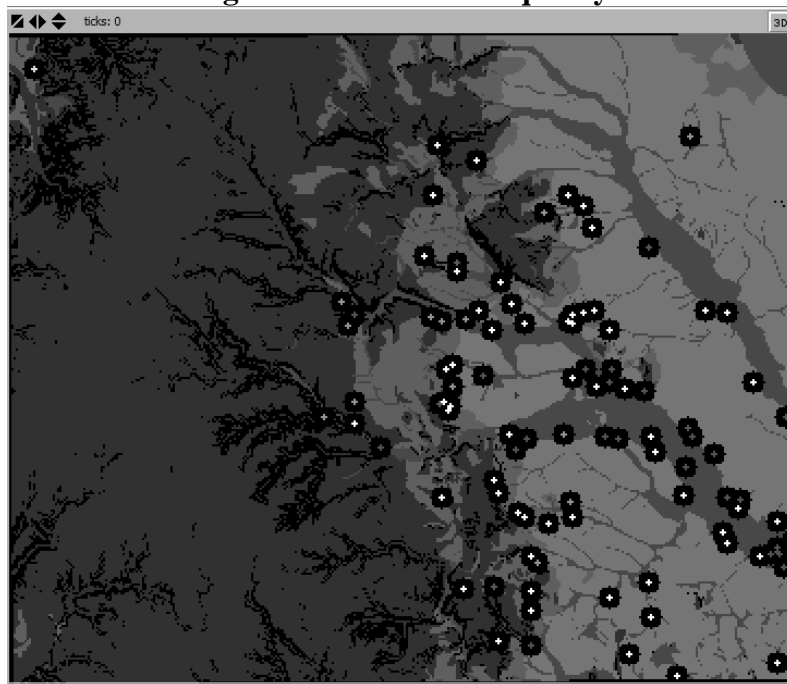
- *field_pred* – lighter shades correspond to higher quality of soil (Fig. 3),
- *gis_friction* – dark areas are those with low friction (Fig. 4),

- *gis_settlements* – map of suitability for founding new settlements (Fig. 5),
- *forests* – derived from *field_pred* map (Fig. 6).

Environment raster consists of 299 rows and 360 columns (107.640 patches), number of patches in maximum site friction radius (15) is 193. To speed up the model initialization of $2 \times 193 \times 107.640$ patches (41.549.040), cereal crop capacity values and wood capacity values are saved in files and loaded repeatedly for each run of simulation.

The initialization involves creation of the initial set of settlements, their population and land units. See Fig. 7 for the example of the initial configuration of the model.

Fig.4.3. GIS data – soil quality



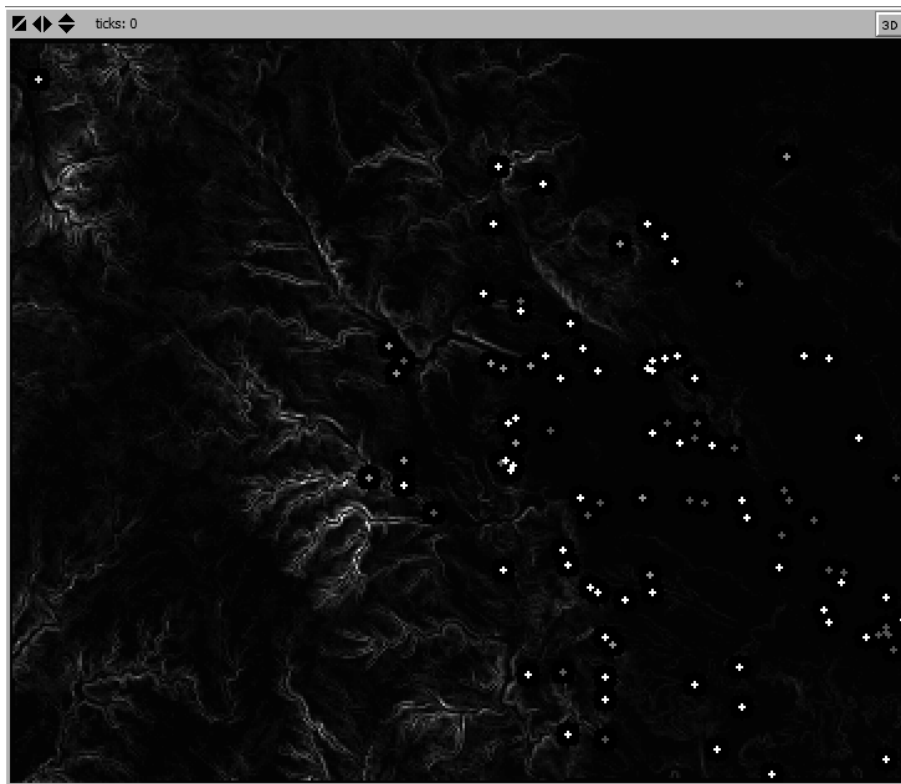
Source: authors

The simulation takes 120 yearly steps. The aim of each step is to recalculate cereals crop and wood requirements of the growing populations of

settlements and to compare them with the estimation of the production for the upcoming year. The annual cereal crops depend on land areas and soil quality. Wood production is limited by the forest area.

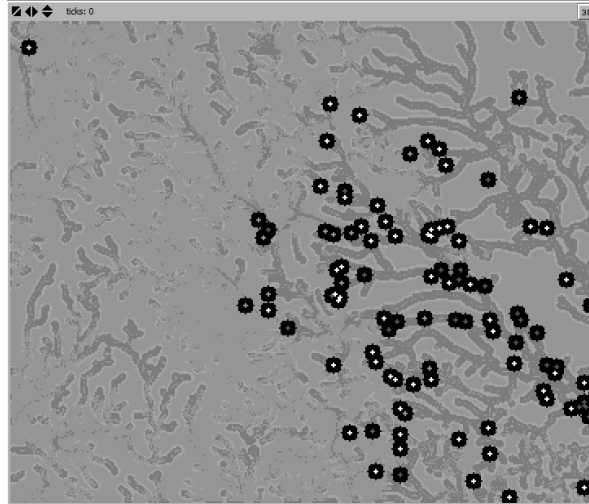
After achieving the carrying capacity of the site, part of inhabitants of the settlement leaves and seeks a new place for living: either new settlement is founded, or inhabitants join one or more existing settlements. Overall emerging pattern is understood as either dispersion or aggregation.

Fig.4.4. GIS data – friction



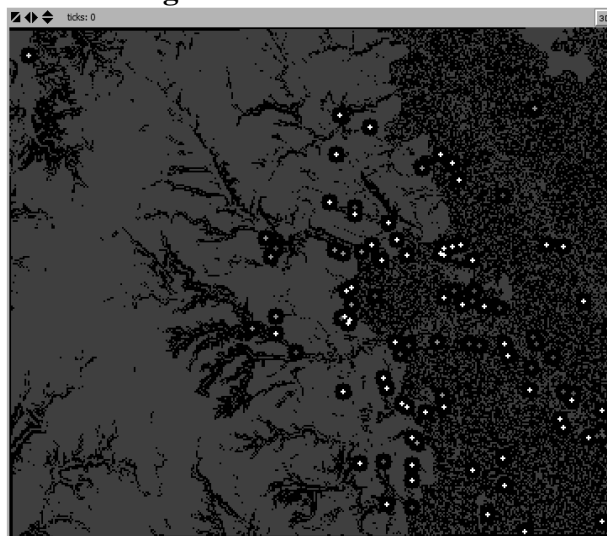
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Fig.4.5. GIS data – prediction map for settlements



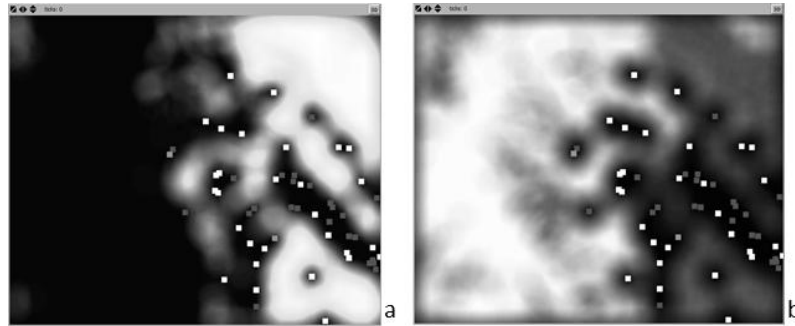
Source: authors

Fig.4.6. GIS data – forests



Source: authors

Fig.4.7. Cereals (a) and wood (b) potentials of environment with initial set of settlements



Source: authors

4.3. Experiments

The objective of experiments is to explore the population migration triggers and to observe the spatial dispersion of settlements.

The first experiment was focused on examination of the influence of the population limit as a migration trigger in relation to particular migration strategies. For experiment settings see Table 1, for visualization see Fig. 8.

Tab.4.1. Settings of experiment 1

<i>Initial settlement placement strategy</i>	<i>Random</i>
<i>Maximal settlement friction radius</i>	<i>5 minutes</i>
<i>Total population in the region</i>	<i>250 inhabitants</i>
<i>Population migration trigger</i>	<i>30 inhabitants</i>
<i>Movement strategy</i>	<i>a) The nearest available place b) The most suitable place</i>
<i>Population to move</i>	<i>Relative: 30%</i>

<i>Destination suitability check strategy</i>	<i>Places with the carrying capacity for 30 individuals are considered as potentially suitable</i>
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Source: authors

Fig.4.8. Experiment 1 – initial (a) and final (b) state



After 90 yearly steps, there were 125 settlements (101 of them were created on GIS-defined places, 24 on another suitable locations), final population was 2455 individuals.

Minimum distance to ascendant settlement was approx. 0.5 km, maximum distance to ascendant settlement was approx. to real 8.2 km. Total movement distance was approx. 147 km.

Minimum carrying capacity of the settlement was 14 inhabitants, while maximum was 94 inhabitants.

The second experiment was focused on examination of the influence of the crop capacity as a migration trigger in relation to particular migration strategies. For experiment settings see Table 2, for visualization see Fig. 9.

After 90 yearly steps, there were 128 settlements (88 of them were created on GIS-based places, 48 on another suitable locations), final population was 2373 individuals.

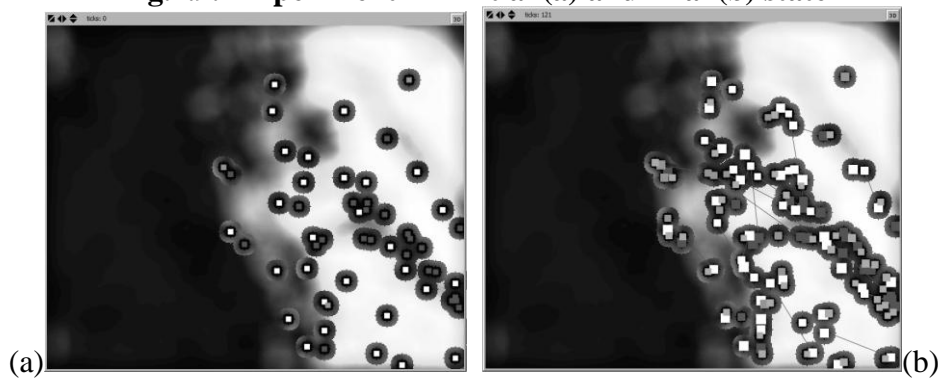
Minimum distance to ascendant settlement was approx. 0.5 km, maximum distance to ascendant settlement was approx. 8.2 km). Total movement distance was approx. 153 km. Minimum carrying capacity of the settlement was 14 inhabitants, while maximum was 94 inhabitants.

Tab.4.2. Settings of experiment 2

<i>Initial settlement placement strategy</i>	<i>Far</i>
<i>Maximal settlement friction radius</i>	<i>5 minutes</i>
<i>Total population in the region</i>	<i>250 inhabitants</i>
<i>Population migration trigger</i>	<i>30 inhabitants</i>
<i>Movement strategy</i>	a) <i>The nearest available place</i> b) <i>The most suitable place</i>
<i>Population to move</i>	<i>Relative: 30% of population leaving the original settlement when migration trigger is fired</i>
<i>Destination suitability check strategy</i>	<i>Places with the carrying capacity for 3 times more inhabitants then is number of moving inhabitants</i>

Source: authors

Fig.4.9. Experiment 2 – initial (a) and final (b) state



Source: authors

4.4. Conclusions

The advantage of our approach is in providing dynamic picture of the dispersion of settlements and enabling experimenting with parameters that are related to the carrying capacity. Advanced methods of social network analysis (Knappett 2013) are seen to be a perspective research direction.

The recent version of the model works with maximum possible production related to the potential of the hinterland of each settlement. In the further version of the model, the available manpower and its allocation will be taken into account; therefore estimations of the production will be more realistic.

More sophisticated definition of operational radius of settlements would be based on real friction values (in minutes).

Sudden or gradual depopulation scenarios could be introduced, if the depopulation of the region was objective of experimenting.

Acknowledgement

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5. Models of Artificial Life Based on Fuzzy Cognitive Maps

Tomáš Nacházel

Abstract: *This article is a summary of thesis aimed at designing functional model of artificial life. The model is based on fuzzy cognitive maps (FCM). The ecosystem simulation provides limited resources to thousands of individuals interacting with the environment. The intelligence of individuals is driven by enhanced FCM. Evolutionary principles are also involved in the simulation. It provides individuals with a possibility of development and adaptation to actual conditions. Evolutionary principles are used to modify decision-making models, and therefore give individuals ability to adapt behaviour.*

Key words: *fuzzy cognitive maps, artificial life, multi-agent system, Netlogo*

JEL Classification: *C69.*

5.1. Introduction

Simulations of artificial life allow us to explore real one. It is easier to look into emergent processes of real world nature by observation of evolving artificial intelligent agents while they are trying to deal with changes in dynamic environment. After dozens generations of agents in the simulation there appear main directions of evolution and specialization of various species.

5.2. Fuzzy cognitive maps

Fuzzy cognitive maps (FCM) in basic form are represented by set of nodes, their values and rated relations between nodes. Every discrete time step (*tick*) new values of nodes are computed from previous values by

transformation matrix of relation values. Different degrees of causality between nodes and their values are expressed by fuzzy value. It is expressed as a truth value that ranges between 0 (completely false) and 1 (completely true). Values of causal relations may be negative, therefore range between -1 (strong negative causality) and 1 (strong positive causality) (Kosko, 1986).

FCM proved its qualities for both simulations of dynamic systems and decision-making models. Even without specialized hardware it is easy to implement and adjust performance / accuracy ratio. That is why this approach is commonly used in robotics (Böhlen, 2000), system modelling (Stylios et al.), military (Hanovich, 2010), and as a learning tool (Bandler et al., 1996). FCMs are often used in artificial life models, expert systems and automatic process control. In research they help to clarify reactions in cells, predict effects of various substances on organism and simulate complex organic processes (Wurtele, 2003). In this simulation it controls behaviour of individuals in environment and also simulates dynamic changes of their inner states and needs.

Classic FCM model processes all nodes in same way. Used extended model distinguishes 3 different types of nodes: *needs*, *activities* and *states*, which are each treated in a different way. This extension provides FCM with few useful features, which allows better simulation of organisms, (more in Mateou et al., 2005, Nacházel, 2012).

The first type of nodes represents *needs*. Value of node usually depends only on the matrix of relation values and previous values of other nodes. Generally it does not depend on own previous value. However, e.g. current level of biological needs depends a lot on its previous level. When an exhausted organism is going to sleep, it will not be brisk at next tick, instead of that its fatigue level will gradually drop. Values of *needs* stay at the same level (even nonzero), while they are not influenced by any node.

Second type of nodes represents *activities*. In order to control and influence something through FCM, FCM requires means for launching external actions. Effect of these actions influences system or its surroundings in a desired manner. In real world most of actions may be either performed or not. It is represented by values 0 and 1. It is also possible to implement

activities limited to one in each tick. It prevents inadmissible combinations, such as individual which is both sleeping and searching for food.

Finally last type of nodes represents *states*, which do not need any special treatment. These nodes are computed in classic way as all nodes in fuzzy cognitive maps without this extension. This simplicity can be used to import values from external world to internal calculations of FCM. Mostly FCM-driven systems have to use values from sensors or other external sources. In order to process these values, system requires node in FCM for each external input.

Among nodes of states there is included *primary state*, which describes state of whole system or fitness of individual at a given tick. This state is decreased by needs and after each tick represents success of individual in satisfying its needs. When it (or other state node) is rounded to 1 before computing FCM, it may serve to constant growth of other nodes.

5.3. Implementation of artificial life model

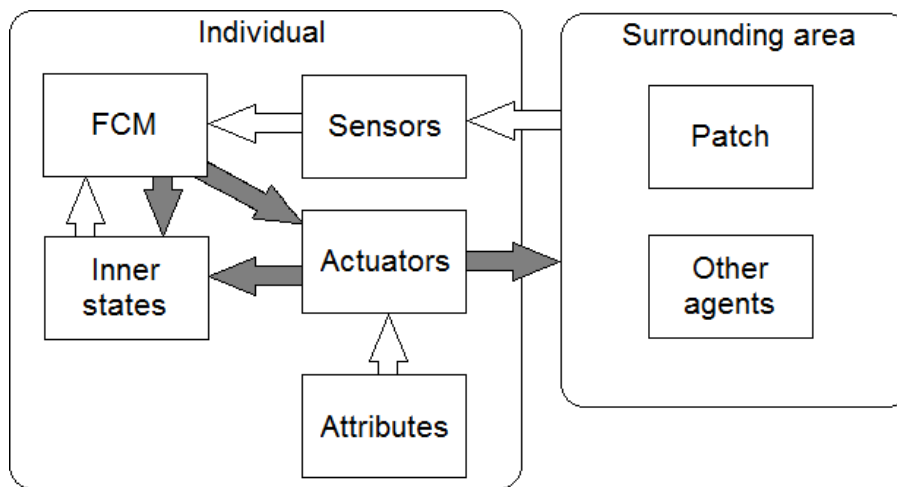
The simulation was implemented in NetLogo 5.0. It is running at discrete time steps (in NetLogo they are called *ticks*). At each tick the simulation computes FCM of every individual. Every tick each individual has an option to do exactly one activity which is chosen by FCM.

Individuals are moving in two-dimensional grid of patches. Each patch has its own values of resources and surface, which determines regeneration of vegetation in simulated landscape. In the environment there are obstacles – body of water. It makes movement across environment difficult but also provides important resource to all individuals.

Each individual has its own attributes describing his abilities and efficiency at various activities (speed, range, carnivory, herbivory ...). Individuals are assigned to species according their characteristics. This allows users to explore evolution in the simulation (more in Nacházel, 2014). Predators are able to hunt only individuals of other species. On the other hand only individuals of same or related species can reproduce, which leads to specialization and better branching of phylogenetic trees. In addition, each

individual has its own pattern of behaviour – setting of decision-making part of FCM. This provides individuals with continuous adaptation of their behaviour to environment. As it is based on evolutionary algorithms, behaviour is not adapting within life-cycle of individuals but through generations.

Fig.5.1. Diagram of FCM-driven individual



Source: author

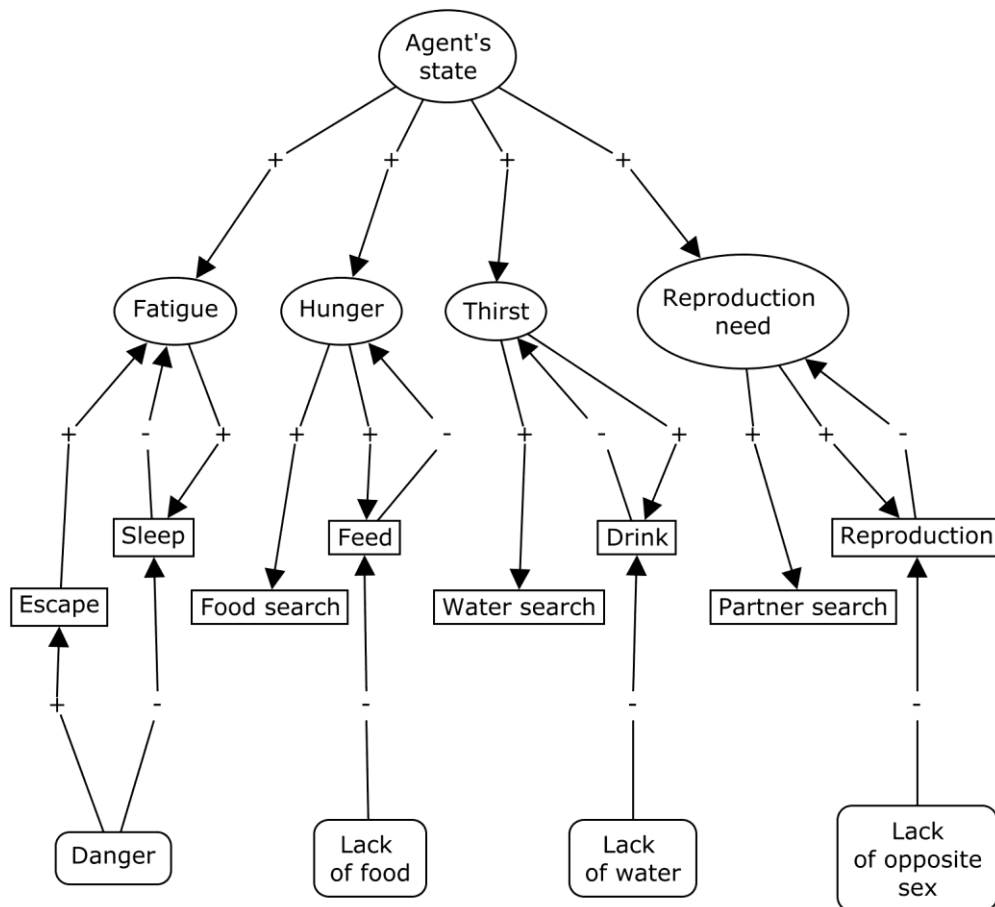
Figure 1 shows diagram of individual in the simulation. Light arrows represent direction of reading or information transfer. Dark ones represent influence or commands. Firstly, sensors get data from environment and translate them to fuzzy values.

Then information is directed to corresponding state nodes of FCM. FCM is computed according to previous values of nodes and received information from sensors.

FCM of individual decides which activity is most desired for given tick. Its motivation is to survive and lower its need nodes as much as possible. The decision is commanded to actuators, which realize chosen activity in

environment. Behaviour of individual influences environment and its own inner states and needs (e.g. drinking lowers thirst). Individuals interact with environment in two main ways – they consume resources or interact with other agents. Individuals can mate and run away from stronger predators, which hunt prey.

Fig.5.2. Simplified graph of basic relations between nodes



Source: author

In the model of artificial life FCM is not used exclusively to decision-making, but it also simulates needs of individuals, which motivates individuals to do activities. Figure 2 shows basic design of FCM with elementary relations with information about direction and positive or negative effect. FCM allows creating even complete graphs.

There can be extra relation from node to itself or two-way relations. For clarity there are shown only most important relations, which FCM is based on.

Direction of arrows in figure 2 represents direction of influence; signs represent positive or negative effect. E.g. node *Fatigue* raises value of node *Sleep*, therefore tired individual tends to fall asleep.

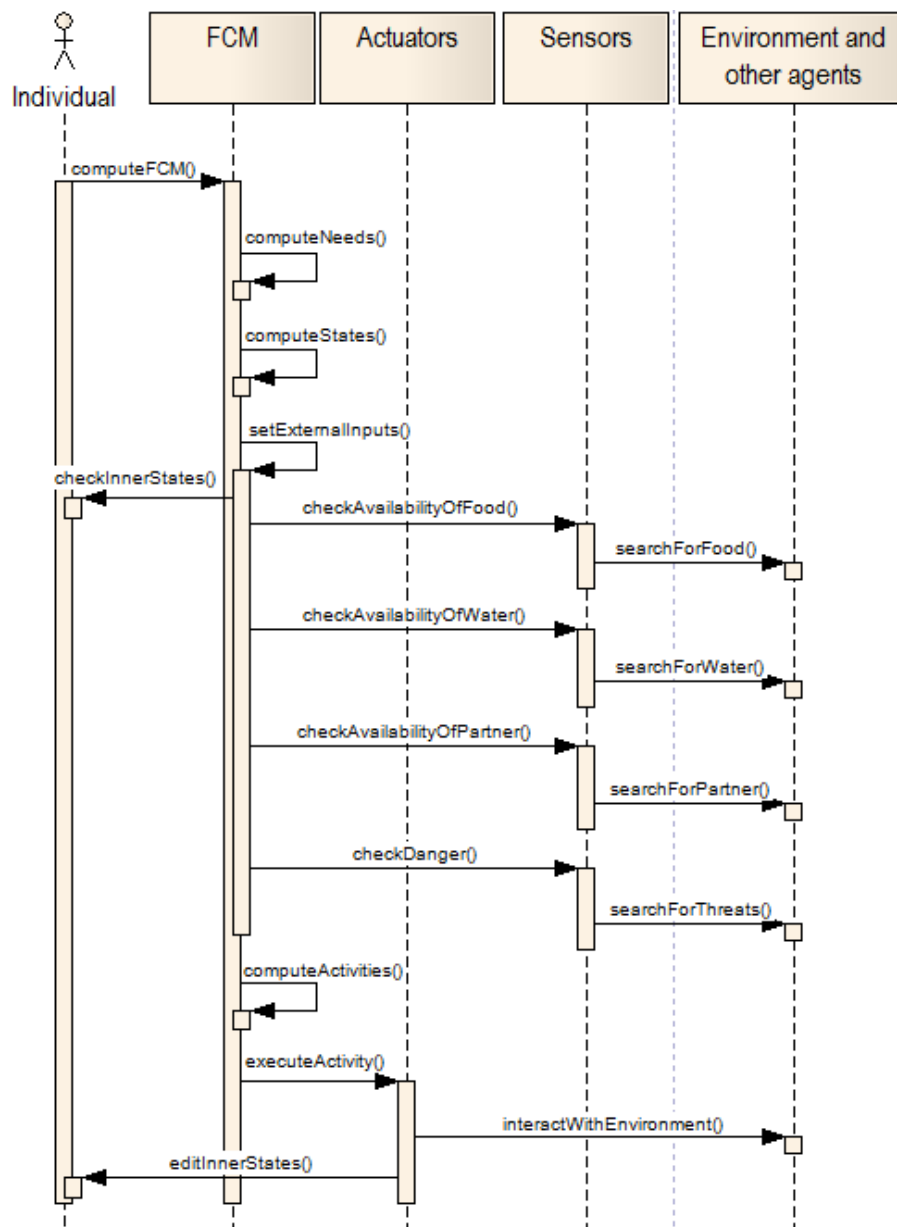
Values of nodes in lower part of diagram are received from sensors, which process acquired data about surroundings and fuzzificate results. Value of primary state Agent's state in the simulation serves as indicator of fitness of an individual. An individual dies when it drops too low.

The distribution of nodes into 3 categories allows changing order of computation of different parts of FCM. Also it is possible to insert reading of external inputs between computations of nodes.

Decision-making (computation of activity nodes) is delayed to the end of process, because then new values of other nodes are available, so individuals can immediately respond to stimuli (see fig. 3). Need nodes usually have the slightest change per tick, so they are computed at the beginning with values from previous tick only.

High number of individuals in environment is essential for observation of emergent phenomena and efficient evolution of species. Therefore, it is important to ensure smooth running of simulation with several thousands of individuals. Computation of FCM with 17 nodes is quite performance-demanding. Better performance was achieved for example by optimization of algorithms for extended FCM and by combination of FCM with decision-making model AHP (more in Nacházel, 2014).

Fig.5.3. Sequence diagram of FCM processing



Source: author

Danger	0	0	0	0	-0	-0	-1	-1
Lack of opposite sex	0	0	0	0	0	0	0	-1
Lack of water	0	0	0	0	0	-1	0	0
Lack of food	0	0	0	0	-1	0	0	0
Agent's state	0.01	0.01	0.01	0.002	0	0	0	0
Escape	0	0	0.1	0	0	0	0	0
Partner search	0	0	0.01	0	0	0	0	0
Water search	0	0	0.01	0	0	0	0	0
Food search	0	0	0.01	0	0	0	0	0
Reproduction	0.3	0.3	0.3	-1	0	0	0	0
Sleep	-0.01	-0.01	-0.2	0	0	0	0.2	0
Drink	0	-1	0	0	0	0	0	0
Feed	-1	0.05	0	0	0	0	0	0
Reproduction need	0	0	0	0	0	0	0	1
Fatigue	0	0	0	0	0	0	0.8	-0
Thirst	0	0	0	0	0	1	0	-0
Hunger	0	0	0	0	1	0	0	-0
	Hunger	Thirst	Fatigue	Reprod. need	Feed	Drink	Sleep	Reprod.

Source: author

In table 1 there are initial values of relations used in the simulation. In this table each value represents influence of column node to row node. For example value -1 in first row and fifth column expresses strong negative influence of feeding to hunger. It means that hunger of individual decreases while it is feeding.


It is important to understand different sections of the table. Only causalities influencing activities can be changed by evolution. These are represented by middle rows (from row Feed to Escape). This section defines behaviour of individual because it contains all values which participate in decision-making.

Upper section rows are constant throughout the simulation run. Unlike previous section these values are rather rules of simulation and environment than properties of individual. For example value in third row (Fatigue) and seventh column (Sleep) expresses how fast is fatigue decreasing while individual is sleeping; therefore it determines efficiency of sleep. Values influencing *needs* in column *Agent's state* represent constant growth of *needs* in time. Higher values are more difficult to survive, because individual has to more often satisfy its needs.

Lower section rows are mostly filled with zeros. State nodes in this simulation are mostly external inputs from sensors. Values of these nodes are always taken from sensor before computing other section, so there is no point to setting them up. Primary state node *Agent's state* is an exception, its value express life of an individual and is rounded to 1 or 0. Only need nodes are influencing this node by decreasing. When *needs* are too high, *Agent's state* lowers and individual eventually dies.

Fig. 5.4. Evolution of decision-making section of FCM

	Hunger	Thirst	Fatigue	Rep. need	Feed	Drink	Sleep	Reprod.	Food s.	Water s.	Partner s.	Escape	Agent's s.	L. of food	L. of water	L. of o. sex	Danger
Hunger	0	0	0.001	0	0	1	0	0	-0.2	0.7	0	-0.2	0	-0.5	0	0	0
Thirst	0	0	0.001	0	0	1	0	0	-0.2	0	0.7	-0.2	0	-0.55	0	0	0
Fatigue	0	0	0	0	0	0	0.8	0	0	0	0	-0.2	0	-0.35	0	0	0
Rep. need	0	0	0	0	0	0	0	1	0	0	0.7	0	-0.1	0	0	0	0
Feed	-1	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drink	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sleep	-0.005	-0.005	-0.2	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0
Reprod.	0.3	0.3	0.3	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
Food s.	0	0	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water s.	0	0	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Partner s.	0	0	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Escape	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agent's s.	0.01	0.01	0.005	0.002	0	0	0	0	0	0	0	0	1	0	0	0	0
L. of food	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0	0
L. of water	0	0	0	0	0	-0.5	0	0	0	0	0	0	0	0	0	0	0
L. of o. sex	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0
Danger	0	0	0	0	-0.2	-0.2	-0.8	-0.8	0	0	0	1	0	0	0	0	0



	Hunger	Thirst	Fatigue	Rep. need	Feed	Drink	Sleep	Reprod.	Food s.	Water s.	Partner s.	Escape	Agent's s.	L. of food	L. of water	L. of o. sex	Danger
Hunger	0	0	0.001	0	0.86	-0.05	0.16	-0.2	0.74	0.09	-0.2	0.07	-0.5	0	0	0	0
Thirst	0	0	0.001	0	0.22	0.88	0.25	-0.1	0.24	0.59	0.02	-0.15	-0.55	0	0	0	0
Fatigue	0	0	0	0	-0.08	0.15	0.74	-0.03	-0.12	0.02	-0.27	0.08	-0.35	0	0	0	0
Rep. need	0	0	0	0	0	-0.05	-0.1	0.98	-0.07	0.15	0.53	-0.07	-0.1	0	0	0	0
Feed	-1	0.05	0	0	0.06	0.1	-0.13	-0.04	0.09	0.39	-0.07	-0.02	0	0	0	0	0
Drink	0	-1	0	0	-0.07	0.18	-0.18	0.22	0.09	0	0.09	0.07	0	0	0	0	0
Sleep	-0.005	-0.005	-0.2	0	0.1	0	0.22	0.04	0.13	-0.03	0.19	-0.05	0	0	0	0	0
Reprod.	0.3	0.3	0.3	-1	-0.07	-0.13	0.17	-0.08	0.07	0.02	0.19	0.12	0	0	0	0	0
Food s.	0	0	0.005	0	0.17	0.05	0.1	-0.03	-0.2	-0.26	-0.1	-0.23	0	0	0	0	0
Water s.	0	0	0.005	0	-0.06	0.11	-0.07	0	-0.05	0.04	0.07	-0.13	0	0	0	0	0
Partner s.	0	0	0.005	0	-0.07	0.02	0.24	0.03	-0.02	0.3	0.13	-0.15	0	0	0	0	0
Escape	0	0	0.1	0	0.24	0.14	-0.14	-0.12	0.06	0.13	-0.11	0.09	0	0	0	0	0
Agent's s.	0.01	0.01	0.005	0.002	0.01	0.06	0	-0.07	0.02	-0.04	0.15	-0.05	1	0	0	0	0
L. of food	0	0	0	0	-0.44	-0.02	0.05	0.02	-0.16	-0.01	-0.24	-0.08	0	0	0	0	0
L. of water	0	0	0	0	0.12	-0.5	0.12	-0.1	0.26	0.08	-0.13	-0.21	0	0	0	0	0
L. of o. sex	0	0	0	0	-0.05	0.06	0.09	-0.85	0.15	0.12	-0.04	-0.07	0	0	0	0	0
Danger	0	0	0	0	-0.19	-0.15	-0.56	-0.87	-0.07	-0.22	-0.25	0.88	0	0	0	0	0

Source: author

Figure 4 shows evolution of decision-making section of FCM (middle section of columns). Initial values (top table) are adapted to environment and possibilities of individual through evolution (lower table). More saturated cells represent stronger relation between nodes. Noise in the table is caused by mutation. Few relations was erased, created or strengthened, because behaviour of individual is more effective that way.

5.5. Discussion

Main obstacle in FCM-driven multi-agent systems is a balance of performance and complexity. Huge FCMs with many nodes are very performance-demanding; therefore allow lower number of agents in environment. Low number has negative effect on the research of emergent phenomena in the simulation.

It is possible to replace one large FCM with several smaller ones. This division provides better performance while maintaining the same complexity. It expects there is no relation between every possible pair of nodes. Generally the division makes FCM less complex, but when it is well designed, complexity loss is insignificant.

There are two ways how to connect these smaller FCMs. The first possibility is horizontal connection of FCMs at the same level (Stylios et al., 2000). The second approach designs hierarchical structure of multi-layered FCMs (Mateou et al., 2005). Both approaches should be compatible; and therefore it should be possible to combine them.

5.6. Conclusion

The paper explained implementation and usage of fuzzy cognitive map in agent based simulation. FCM model handles dynamic changes of inner needs and behaviour of individuals in environment. Whole thesis (Nacházek, 2014) also depicts connection of FCM with evolutionary algorithms, which enables FCM learning, and replacing decision-making section of FCM with AHP model in order to lower computational demands and increase number of individuals in environment. One of useful features of the simulation is an algorithm for assigning individuals to species. It allows rising of new species and embranchment of phylogenetic trees, which visualize evolution in a graph.

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6. Analysis and Testing of Antivirus Software

Josef Horálek, Jan Matyska, Vladimír Soběslav

Abstract: *The paper presents the basic issues and distribution of malicious software and the basic principles of protection. The paper presents the results of measurement of selected criteria of the eight selected best known antivirus programs, their requirements on system resources and the speed of scanning system and data disk.*

Key words: *Virus, worms, antivirus software, protection, testing*

JEL Classification: *X00, X00.*

6.1. Introduction

The users of data networks no matter if in academic or corporate environment or home networks are exposed to permanent threat by malicious software. For effective protection from this malicious software is necessary to know the basic principles and distribution of malicious software and select the right antivirus program. Nowadays there are several tens of antivirus programs that are different not only in their acquisition costs but also in methods of protection, in scope and frequency of virus database update and in the system requirements, etc. This article does not aim to select the best antivirus program, but the introduction of several tests, whose results can help users to optimize their choice of protective software, and also serve as motivation for meaningful and interesting testing for our students.

6.2. Malicious software and its division

The term malicious software refers to all programs that are performing undesirable activity in computer. An example of undesirable activity can be deleting files on the hard disk, theft of sensitive information such as a data,

usernames and passwords to accounts, computer abuse for another attacks or displaying unwanted advertisement. The term malicious software comes from English collocation malicious software and very often is using its short version malware. Malicious software is primarily divided according to the systems that attack (MS-DOS, MS Windows, Linux, BSD, Mac OS, Symbian, Android etc.) Dividing of malicious software is different in various sources. The main reason is that the individual technologies blending with each other. One of the divisions of malicious software can be following (Szor 2006, Hák 2005, Jalůvka 2000):

- Viruses – malicious software that can be self-replicated by using the host.
- Worms – programs that are spreading primarily in computer networks that unlike viruses usually do not need a host for spreading.
- Trojan horses – they seems like useful programs that brings undesirable behaviour to the system

Other categories:

- Macro viruses – viruses that attacks executable macros in documents
- Rootkits – tools that allows hiding viruses from antivirus programs
- Exploits – codes that are using vulnerability of web servers, browsers, etc.
- Retroviruses – aggressive viruses that are trying to decommission the antivirus software
- Spyware – spying programs that are collecting information about user
- Adware – applications, that are displaying unwanted advertisement to user
- Spam – unsolicited messages sent through e-mail or instant messaging programmes (ICQ, MSN, IRC etc.)
- Hoax – alarming message most of time with the theme of threatening computer infection, that requires the user for forwarding message to another users

- Phishing – getting sensitive data from user through electronic communication, that faces seriously (for example as a message from the bank with a request for update your login and password)
- Dialer – program, that changes the way of internet connection at a dial-up connection through modem, most of time changes dialled number for number with a higher rate

6.3. Antivirus software

Antivirus software indicates the software that identifies, blocks, cures and removes malicious programs. It protects computer from viruses, worms, trojan horses, spyware, adware, rootkits, exploit and other malicious software. According to information from Czech statistical office from year 2010 two-thirds of users in Czech Republic are using antivirus program. (Sionová, 2010) Nevertheless at the time of exploits and more malicious infiltrations it's enough visit infected web page and malicious software will get into computer through web browser. Many users don't realise risks connected with malicious software. Nowadays definitely the antivirus software belongs to the basic safety equipment of the computer.

6.3.1. Division of antivirus programs

According to complicity and purpose can be antivirus software divided into single-purpose antivirus, online scanners and antivirus systems.

The single-purpose antivirus programs are the programs focused on detection and disinfection of concrete viruses. They are used when the virus is specific and for its remove is necessary to use a different method than that the antivirus program is using.

Online scanners offer full scanning of system through the web browser. Online scanners offer complete verification of the system or control of the concrete file. It can detect a large number of malicious software from viruses to spyware and some of them can even detect errors in registry or detect the vulnerability of the operating system (Kratochvíl, 2010). However, online scanners do not supply the antivirus system because the antivirus system contains more security elements.

Antivirus systems are complex system consisting of several parts of antivirus security. It follows inputs and outputs in computer that could be attacked from malicious software. According to requirements of user it can test files and folders in computer (On-demand scanner). In real time it is watching over work with files (On-access scanner), controls incoming and outgoing electronic mail and site activities.

For the reliable function of antivirus software is important the actualization of virus database that contains definitions of viruses and information important for its detection as a sequence of characters or checksums of the parts of virus (Szor 2006, Hák 2005). It is used for controlling files by the antivirus scanner for known viruses.

6.3.2. Antivirus scanners

Antivirus scanners or search engine are able to perform the process of scanning in which are using information about the malicious software from the virus database. Because of it scanner can't recognize the threat that is not placed in the database yet. Scanners can be divided according if they automatically searching infiltrates in system process (On-access) or up on a request from user (On-demand) (Hák, 2005). On-access alias residual shield is performing permanent supervision of operations in computer in real time. It automatically searches malicious codes by controlling used files, attachments of electronic mail or systems areas. In case that it encounters infected file during testing, it blocks access to it and waits if user will decides to delete the file or move it to the isolated area or treating file. Launching on-demand scanner depends on user who specifies the area of scanning and who can plan its automatic launching too.

6.4. *Methods of detection*

For detection of malicious software are using all sorts of methods that are constantly being developed and innovated because virus writers are inventing even more sophisticated techniques of hiding malicious software from antivirus program.

6.4.1. Scanning

The method of scanning is representing the simplest way how can be viruses detected. It searches for viruses in files by comparing group of instructions (signatures) that are typical for virus. These instructions are saved in the virus database and the scanner is systematically working with them during scanning. During scanning can be detected new viruses that are based on already known viruses (they have same signature) that are registered in database yet (Szor, 2006).

Scanning is greatly accelerated because scanners started finding signatures in file locations where can be expected (at the beginning and at the end). When the scanner finds out the same group of instructions it marks the file as infected. Searching by more identical signatures is using for more reliable detection of malicious code. More sophisticated detection method was the implementation of counting checksums of areas in the body of the virus and comparing with data in the database. However the polymorphic viruses are resistant against this method. They change both the body of code and decoding routine. Antivirus companies response that by developing code emulator.

6.4.2. Code emulation

With using the virtual machine scanner the conditions are simulated for safe start of malicious software inside antivirus program. The system is waiting when the malicious code starts working in this testing area. When the virus decodes it's body the method of scanning with comparing signatures can be used on it. This way can be detected even the most complicated polymorphic viruses. The heuristic analysis is closely connected with using code emulators. (Szor 2006, Hák 2005).

Heuristic analysis

By using heuristic analysis is performing the code analysis where are searched the typical processes and the virus activity. The suspicious activity could be attempt at opening and customizing another file. Using of heuristic analysis enable detect the viruses that are not saved in the database yet. The first heuristic analysis is called passive. During searching it focused on the typical attributes of viruses and when it found enough of this symptoms it

marked the file as infected. Nowadays is using active heuristic analysis. It is based on code emulator that can run the file in the virtual area and encrypt the body of the virus. Then is using scanning that finds the typical signatures in the code. The emulation of the file is slower than the real launch and because of it the emulator has the timeout configured. After the timeout the process of emulation on tested file will stop.

6.4.3. Generic detection

The scanning of source code enables detection of the generic viruses that have similar structure as already known virus. For example the structure of the replication mechanism can be similar. The generic detection then allows detect new viruses that are using the typical replication mechanisms. There viruses are most often created by using virus generators or slight modification of the old code (Jalůvka, 2000).

6.4.4. Data integrity control

During the data integrity test is compared the actual status with the status that were noticed in the antivirus program earlier. Among to stored information about the files belongs length, date, attributes, control checksum of the file (CRC), control checksum of the system area. It is an on-demand control, for determination the virus is not necessary the virus database, that makes detecting new viruses possible. Antivirus systems are using data integrity test in together with on-demand or on-access scanners. They control files by integrity test and when they detect changed file they scan it by scanner. This application considerably truncates the time of testing. (Hák 2005, Jalůvka 2000)

6.4.5. Suspicious behaviour monitors

Its so-called behavioural monitors, that are watching system behaviour in real time and blocking suspicious activity of running applications which could be for example opening another executable files for recording, attempt for format of the disk etc. In this cases behavioural monitor blocks this activity, displays warning about the suspicious activity to user and for continue requires confirmation from the user. The problem is that for the monitor could be suspicious even completely legitimate software and it often burden the user.

6.5. Methods of disinfection

At the beginning when the virus propagation process went very slowly had the antivirus companies enough time to explore the virus and make the tool that will clear the virus from the computer. Nowadays this process cannot be used. (Hák, 2005). The most reliable method of disinfection is deleting file. Of course user could lose even valuable data. Methods of curing can be divided into two groups, algorithmic disinfection and generic disinfection.

Algorithmic disinfection

Based on information about founded virus from the virus database is the malicious code removed from the file and after that the file is fixed into to its original state. This way can be possible to cure only those files that are attacked by non-destructive viruses (Szor, 2006).

Graphic disinfection

Infected file is emulated until the virus restores infected file to the original state and it's ready to launch it. During this process is using combination of heuristic scanner and heuristic disinfection. Well written virus saves the beginning of file, and everything that is necessary to do with the code is copy the clear program back to the file. Using this technique is possibly to erase most of basic viruses (Szor, 2006).

Sandbox

Sandbox is for testing in the virtual environment. It allows simulating complete environment of operating system where safely launches and tests files in closed area isolated from the rest of operating system. After the launch the antivirus program recognises behaviour of the file. At the suspicious behaviour, when the tested program is trying to download files from internet, hiding its processes or intervenes to the system, antivirus program will evaluate it as suspect and block it. It will inform the user and the user can decide if the suspicious software can perform another activity in the system or not.

Quarantine

The quarantine is using as a special storage for files that cannot be cured or are marked by antivirus program as malicious. Files are saved in the special format and for the computer do not represent danger. In the quarantine there are several options what can user do with the file. Usually the user can remove the file from the computer, test again, restores to its original state or send suspicious file to the virus laboratory. Using quarantine prevents unnecessary deleting potential important data. (Jalůvka 2000, Sionová 2010)

6.6. Methodology of testing

During testing were used selected representatives of the best-known antivirus programs. The best part of the products has been tested as a 30-day trial of the full version. The one exception was Microsoft Security Essentials 2.1 which is completely free.

Products selected for testing were:

- avast! Pro Antivirus 7.0
- AVG Anti-Virus 2012
- Avira Antivirus Premium 2012
- Microsoft Security Essentials 2.1
- ESET NOD32 Antivirus 5
- Norton AntiVirus 2012
- McAfee Antivirus Plus 2012
- Kaspersky Anti-Virus 2012

The test has been done on the ordinary desktop computer with following configuration of the processor: Core2Duo 2.4 Ghz, RAM: 2 GB DDR2 800MHz, graphics card: Ati Radeon EAH5450 DDR2 512MB, HDD: WD 160 GB SATAII with operating system 7 Professional 64-bit.

As the testing criteria were chosen measurable values that can be objectively evaluated. Concrete, the size of installer and of the installation, the time of start-up of the computer with comparison in launching without antivirus software, speed control of the disk fixed capacity and the same content structure and usage of CPU and RAM. All criteria were measured on a physical machine. Testing were carried on MS Windows 7 Professional 64-

bit including updates. To measure the time required for complete booting of system has been used the WinBootInfo application. For measuring the CPU and RAM usage were used the application Performance monitor (included in Windows 7) in which were be activated counter of processor - % of time of processor, total, average and memory – working set – private, total, average.

The bit copy of prepared system was created for further use. The next was the time of computer start-up and use of CPU and RAM after the installation. The start-up time was measured 10 times and the final value was calculated as an average of these measurements. CPU and RAM usage was performed in the resting state of computer for the 5 minutes, measurement was made 10 times and the final value was again the average of the values. After each testing of antivirus program the system has been restored to its original conditions using bite copy.

Tab.6.1. The size of installer and installation

Product	Installer [MB]	Installation [MB]
avast! Pro Antivirus 7	91,0	350,0
AVG Anti-Virus 2012	164,0	154,0
Avira Antivirus Premium 2012	80,9	175,0
Microsoft Security Essentials 2.1	9,9	22,5
ESET NOD32 Antivirus 5	54,7	69,5
Norton AntiVirus 2012	106,0	87,2
McAfee Antivirus Plus 2012	143,2	244,0
Kaspersky Anti-Virus 2012	143,0	133,0

Source: Author's own processing

The next test was measuring the time that the computer needs to complete start-up of the system. Ten measurements have been done and calculated the average from the obtained data. From this value was subtracted the value before the installation of the product and it was the time of prolongation of start-up system (the difference).

Tab. 6.2. Start-up time

Product	Before installation (s)	After installation (s)	Difference(s)
avast! Pro Antivirus 7	29,0	33,6	4,6
AVG Anti-Virus 2012	29,0	42,1	13,1
Avira Antivirus Premium 2012	29,0	35,0	6,0
Microsoft Security Essentials 2.1	29,0	31,5	2,5
ESET NOD32 Antivirus 5	29,0	30,6	1,6
Norton AntiVirus 2012	29,0	30,9	1,9
McAfee Antivirus Plus 2012	29,0	29,9	0,9
Kaspersky Anti-Virus 2012	29,0	33,3	4,3

Source: Author's own processing

To measure the speed of the disk was connected to the computer 80 gigabytes SATAII hard disk, divided into two sections, that each of them contains 15 GB of data. The first section was system and contained installed operating system Windows 7 Professional 64-bit with other programs. It was being consisted of 84703 files in 15842 folders in total. The second section was data section and it included: video, mp3, images, MS Office documents, PDF, application installer and archives. Altogether, it consisted was of 7961 files in 820 folders.

Each section was scanned by an antivirus program 3times and the testing time was recorded. Times for these controls have shown that anti-virus programs are recording the data that has been tested yet and that they are skipped during the test. It aims to reduce the time of testing of the already known data. For this reason, the disk were connected to the computer just before testing, to antivirus product did not have enough time to make a record of data located on disk, which could skew the testing time. The measurement is recorded in the form of minutes: seconds.

Tab. 6.3. The time of control of the system section

Product	Measurement 1	Measurement 2	Measurement 3
avast! Pro Antivirus 7	12:43	12:52	12:13
AVG Anti-Virus 2012	5:20	00:34	00:19
Avira Antivirus Premium 2012	13:08	12:47	12:31
Microsoft Security Essentials 2.1	20:35	20:02	19:59
ESET NOD32 Antivirus 5	8:01	00:38	00:35
Norton AntiVirus 2012	13:38	2:16	2:17
McAfee Antivirus Plus 2012	52:56	6:07	5:44
Kaspersky Anti-Virus 2012	8:31	00:30	00:29

*Source: Author's own processing***Tab.6.4. The time of control of the data section**

Product	Measurement 1	Measurement 2	Measurement 3
avast! Pro Antivirus 7	1:49	1:37	1:35
AVG Anti-Virus 2012	6:18	00:07	00:04
Avira Antivirus Premium 2012	19:02	18:35	18:34
Microsoft Security Essentials 2.1	26:10	26:35	26:08
ESET NOD32 Antivirus 5	13:35	2:09	00:56
Norton AntiVirus 2012	18:00	00:11	00:10
McAfee Antivirus Plus 2012	22:55	5:12	5:02
Kaspersky Anti-Virus 2012	25:16	00:29	00:23

Source: Author's own processing

In another test was measured CPU charge and RAM usage, both in the run in the background, and during scanning. Testing was conducted by using the Performance Monitor. In testing in burden was running on-demand scanning of section from the connected hard disk. The values measured in the burden during scanning are very approximate, because it was not possible in a single installation establish the same conditions for multiple measurements. The reason that is already mentioned is reduction of the number of scanned files with repeated scanning. The other use is when the antivirus program scans files, and others when skips already known.

Tab. 6.5. Usage of RAM, MB units

Product	Before the installation	After the installation Bacround running	After the installation - scanning
avast! Pro Antivirus 7	120	133	185
AVG Anti-Virus 2012	120	133	212
Avira Antivirus Premium 2012	120	154	422
Microsoft Security Essentials 2.1	120	137	237
ESET NOD32 Antivirus 5	120	137	207
Norton AntiVirus 2012	120	132	174
McAfee Antivirus Plus 2012	120	183	368
Kaspersky Anti-Virus 2012	120	137	297

Source: Author's own processing

Tab. 6.6. Usage of CPU, in %

Product	Before installation	After the installation bacround running	After the installation - scanning
avast! Pro Antivirus 7	0,066	0,090	28,822
AVG Anti-Virus 2012	0,066	0,105	68,241
Avira Antivirus Premium 2012	0,066	0,125	42,570
Microsoft Security	0,066	0,075	46,954

Essentials 2.1			
ESET NOD32 Antivirus 5	0,066	0,078	49,884
Norton AntiVirus 2012	0,066	0,211	40,095
McAfee Antivirus Plus 2012	0,066	0,200	86,985
Kaspersky Anti-Virus 2012	0,066	0,121	56,971

Source: Author's own processing

6.7. Conclusion

The comparison of the size of the installer and the installation comes out that the most economical product, about the size of installator and the time of installation, were from Microsoft. In contrast, the largest installer had AVG product and Avast occupied most of the space in the Program Files folder!

From testing the start-up time comes that most of the products increased the time to complete start-up about 1.5 to 6 seconds. An exception is the AVG Anti-Virus 2012, which extended system start by 13 seconds. Conversely McAfee antivirus program increased start-up time on less than 1 second.

In testing the speed of the disk check is important to take into account the different behaviour of each antivirus software during the repeated checks. For an objective comparison, it is possible to consider only the data from the first measurement. The system sections were checked fastest from the AVG Anti-Virus 2012 it lasted for 5 minutes and 20 seconds. Conversely longest lasting control by McAfee's program and it was lasted for 52 minutes and 56 seconds. Time of all three measurements were similar for products avast !, Avira and Microsoft. The control of the data section performed avast! Antivirus 7 as fastest and it lasted for 1 minute and 49 seconds. The longest scan of data section was performed by Microsoft and it lasted for 26 minutes and 10 seconds.

The last measurement, which focused on the use of CPU and RAM shows that the increase in CPU usage at run time on a background is negligible and that these products do not burden the computer in the sleep mode. Conversely the usage of the processor during testing by McAfee product

sometimes reached 100%. In most cases, the CPU load ranged between 20 to 70%, depending on the current control.

Increasing private working set memory after the installation about from 12 to 63 megabytes also shows almost negligible use. Especially nowadays, when the average memory size is around 2 048MB. During scanning the size of the used working set in some products raised twice up to threefold.

The presented results show that the choice of a suitable and optimal antivirus software is not simple and straightforward. From the obtained data, it can be concluded that running of the antivirus software during active scanning can significantly slow down the work with other software products and in some cases even for long periods of time. Everything is of course influenced by the size of the antivirus database, whose testing the authors are completing and the results obtained of effectiveness of finding selected types of viruses will be published in the next post.

An important conclusion now is that the choice of a suitable anti-virus software for our operating system should focus not only on individual product materials makers, but it is important to consider the system demands that the programs have.

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7. Analysis of Features Required from Software Applications for Visualisation in Automation

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Abstract: *Automation might be defined as the performance of activities by machines rather than human beings. Automation is associated with several pros and cons regardless the methods, techniques, or approaches, which are applied. Visualisation might be considered as a tool helping industrial managers to cope with issues related to automation better, because it is based on graphic representation of enormous volumes of data. This chapter is focused on two particular software applications, WinCC and Intouch. Both applications are mutually compared with the help of several criteria such as available tools, security issues, or graphical representation. Analysis of both systems consequently leads to the outline of general requirements for software application enabling visualisation in automation.*

Keywords: *Software application, Automation, Visualisation, Intouch, WinCC, Comparison.*

JEL Classification: *O14, L86.*

7.1. Introduction

Automation, which might be defined as the performance of tasks by machines rather than humans (Parasuraman and Riley, 1997), continues to be deployed in various settings in the current society in order to increase efficiency and reduce variability (Balfe et al., 2015). Automation improves the quality of the production processes and consequently decreases the presence of humans within these processes (Casar et al., 2013). Other benefits are associated with the reduction of operator workload and errors resulting in reduction of labour costs (Dekker, 2004; Hollnagel, 2001). On the other hand, there are also disadvantages connected with automation of processes and activities. The most important one is the level of reliability

(Balfe et al., 2015). With a level below 70 % it is believed that the situation is worse than if no automation is employed (Wickens and Dixon, 2007). Other weak points such as the threat of programming errors (Wickens, 1992) should be considered as well. Furthermore, automation can lack the flexibility of human users, when a novel situation occurs. Thus, several issues can appear when the designers try to replace human problem solving abilities with automation.

Automation represents the use of automation means to manage the industrial equipment and processes. It is the next step after the mechanisation from the point of view of the industrialisation (Bock, 2009). The mechanisation is represented by the equipment for the simplification of human work. Furthermore, the automation improves the quality of the production processes whereas decreasing the necessity of human presence in various activities (Mendes et al., 2009). It lies in utilisation of technical means, economic-mathematic methods and management systems in retrieval, processing, transfer and use of energies, materials and information. In case of so called complex automation the humans might be eliminated in the production process (Abitova et al., 2011).

The automation process is included nearly in all areas of business operation - for example in material production, planning and management processes, scientific research, medicine or military (Bureš et al., 2012). In comparison with mechanisation, it improves the economy of operations and subsequently also the decrease of costs in production. The price reduction is reached due to better organisation of the production process, material savings, reduction of energies and their optimal regulation together with the elimination of expensive human work (Caracas, 2012). The product is mostly produced in shorter time with higher quality and higher workplace safety. The production in automated process is linked with wider possibilities of reaction to customer needs and demands (Čech and Bureš, 2009).

Automation bears a lot of advantages. Nevertheless, it should not be overused. The so called paradox of automation might occur and lead to the increase of mistakes and faults. The cause is the separation of humans within the managed process, the information overload and the loss of concentration (Bureš and Čech, 2007). The main task of humans should lie in the ability to supervise and decide about the emerging problems during

the production process. The automation of production should be used for routine actions and for the elimination of dangerous situations.

Automation is currently employed in all areas of business and improves their economics (Islam, 2013). Various tools such as visualisation are used. Visualisation represents a graphic version of a process enabling quick understanding and control. Moreover, it provides the data transfer with automation means and other systems (Vyatkin, 2013). Visualisation represents the illustration of large amount of data and their representation in graphic form enabling the visual perception and quick comprehension of their content and meaning to humans. Visualisation and superior systems encompass the set of software tools used for the visualisation of automated technological process (Vrba et al., 2011).

The systems are usually labelled as „Supervisory Control and Data Acquisition“ and „Human-Machine Interface“ (SCADA/HMI). Based on the previous work published in Bureš and Otčenášková (2014), the main aim of the paper is to introduce the visualisation systems and to compare the possibilities of their development and reachable results when using the analysis and description of the developing platforms. The structure of the paper includes the following sections. Firstly, a brief introduction of the basic starting points of visualisation in automation is provided. The next section deals with the methodology and afterwards the results are mentioned. In the last section, the selected aspects and problems related to the reached outcomes are discussed.

7.2. Methodology

The visualisation systems compared within this paper comprise WinCC version 7.0 SP1 developed by Siemens company and Intouch version 10.0 SP2 produced by Wonderware company. Both these products remain to the SCADA/HMI category tools for visualisation and management of production technologies and processes. These represent efficient systems usable for a wide spectrum of visualisation tasks. They can visualize specific machines as well as observe, monitor, manage, archive and analyse vast technological units. These are deployed either as separate units where visualisation tasks are solved using one computer, or as a configuration

based on client/service principle. During demanding processes with the emphasis on the reliability, the redundancy can be used. This enables to work with relational databases MS SQL Server which can be accessed with help of Open Data-Base Connectivity (ODBC) or Structured Query Language (SQL) method.

Visualisations are developed and operated in Microsoft Windows operating system. The programmers can use the scripting language for the access to the object libraries which include these visualisation systems and also objects of type ActiveX or .NET. These objects are to be imported to the visualisation projects. The created scripts can be linked with the characteristics of objects. Moreover, these can be launched on the basis of a particular event such as the action realised by an operator, the fulfilment of previously given condition, the value amendment or the expiration of particular time interval.

The complex comparison of the systems is based on the following criteria: Measured Values of Installations; Tags; Graphic Development; System of the Screens; Trends; Alarms; Scripts; Cross Reference; and Security.

7.3. Results

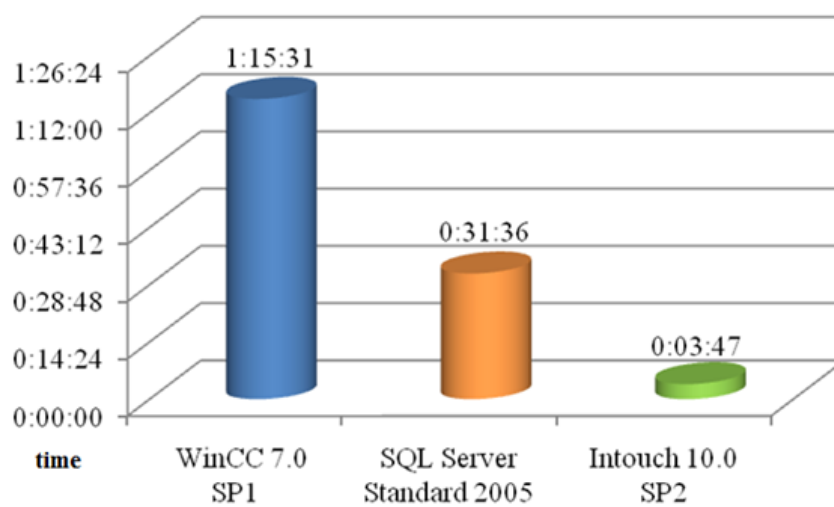
This section comprises the results of the discussed issues. Particular criteria are described and the outcomes are mentioned.

7.3.1. Measured Values of Installations

The measurement of the installation is intentionally realised on a laptop, because the visualisation programmers often travel and debug the product at the customer's place. Individual installations are done using the following laptops: Dell Latitude D830 (screen diagonal size 15,4"), processor Core 2 T7300, operating system Windows XP SP3, memory 2GB DDR2, hard disc 80 GB 7200 rpm, graphic card NVIDIA Quadro NVS 135M, optical mechanism DVDRW reading DVD8x and CD24x immediately after new installation and configuration of new hardware. The testing set does not comprise any software except from the visualisation system itself. For better comparison, SQL Server 2005 Standard is installed as well. It ensures the run of the application Intouch (it saves all the configuration and archive data

of the whole system) and serves as a benchmark for the comparison. The installation shows the following values in case of WinCC, Intouch and SQL Server: time need for the installation is 1:15:31, 0:31:36, and 0:03:47 respectively (see Fig. 1); and hard drive space is 2056, 1660, and 135 kB.

Fig.7.1. Time needed for the installation (in the hours : minutes : seconds format)



Source: authors

7.3.2. Tags

Tags represent external and internal variables providing the communication within the automation system. Both visualisation systems use different terminology for various types of tags. WinCC offers tag values from byte to double word type in form of negative or positive values; or in double count of the positive values only. Intouch replaces the mentioned types only by one tag with strictly given range of values. There are only 131 characters for a string tag in ASCII character set. WinCC provides 255 characters when offering also the choice of the character set ASCII or Unicode. Furthermore, Raw Data tag is available. It signifies a “field” of values and can be used for simultaneous value transfer for trend representation. Various characteristics and limitations can be set in relation to tags. Both systems enable to adjust

for example the quantity of external tags, persistence, initial values, conversion of values, extent of values, logging of the value amendment, structured tags, system tags or the functions for import and export. Intouch extends the setting options by the rejection of the requirement of used tag removal, reading function, reading function with writing, notes, reverse bit value, dynamic change of addressing, etc. WinCC offers only one more setting option represented by the value of the connection loss. The summary is provided in Tab. 1 and 2.

Tab. 7.1. Tags in WinCC

WinCC		
Type	Name	Range of values
Bit	Binary Tag	0,1
Byte	Signed 8-bit value	from -128 to +127
	Unsigned 8-bit value	from 0 to 255
Word	Signed 16-bit value	from -32768 to +32767
	Unsigned 16-bit value	from 0 to 65535
Double Word	Signed 32-bit value	from -2147483647 to +2147483647
	Unsigned 32-bit value	from 0 to 4294967295
Float	Floating-point number 32-bit IEEE 754	+/-3.402823E+38
	Floating-point number 64-bit IEEE 754	+/-1.79769313486231e+308
String	Text tag, 8-bit	1 byte - 255 characters, ASCII
	Text tag 16-bit character set	2 bytes - 255 characters, Unicode
Raw Data	Raw data tag	up to 65535 bytes

Source: authors

7.3.3. Graphic Development

WinCC uses program Graphics Designer for the graphic development (see Fig. 2). This program is triggered in a new window. Intouch performs the development in WindowMaker (see Fig. 3). Both programs have similar layout of desktop where most space is occupied by the developed

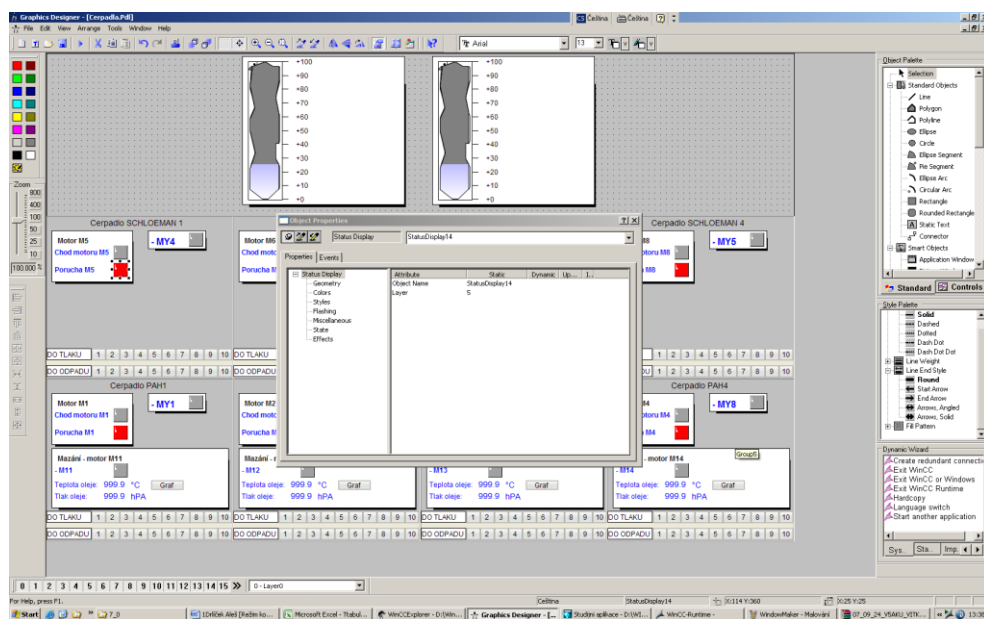
application. The rest of the screen is surrounded by developing tools which a programmer can freely distribute on the whole desktop.

Tab.7.2.Tags in Intouch

Type	Intouch	
	Name	Range of values
Bit	Discrete	0,1
Byte	Integer	from -2147483647 to +2147483647
Word		
Double Word		
Float	Real	+/-3.402823E+38
String	Message	131 characters, ASCII

Source: authors

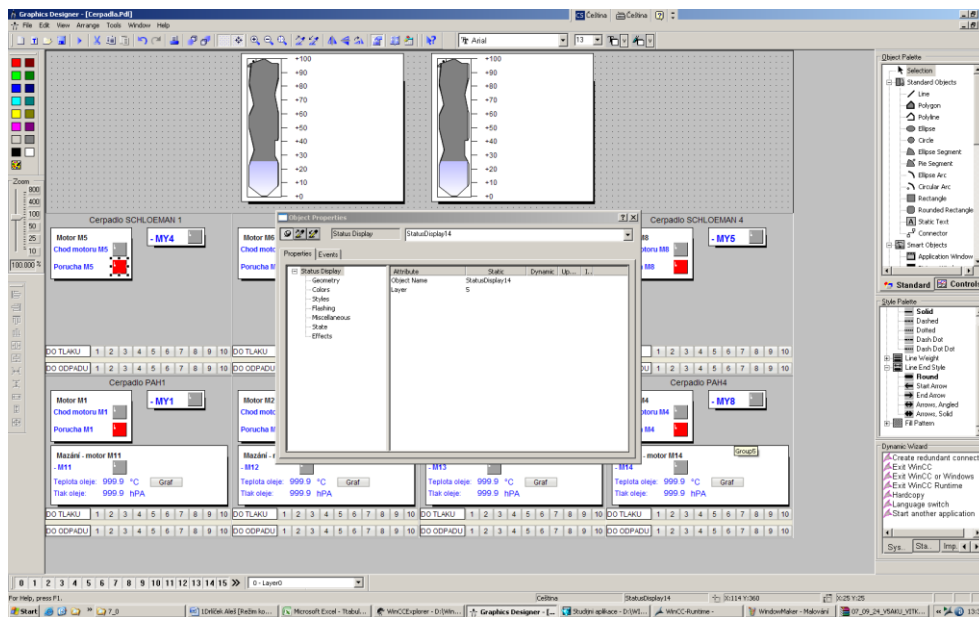
Fig.7.2. The desktop of the program Graphics Designer



Source: authors

Moreover, Intouch offers the so called full screen mode where just one click hides all the tools and only the screen with the developed application is shown. This is appropriate especially within situations of the application development with higher resolution than it can be displayed on the workstation where the development is realised. Both systems support the basic graphic objects except from the circular segment and pipeline objects in case of Intouch. For the settings of the object features, Intouch uses the tool Animation Links.

Fig. 7.3. The desktop of the program WindowMaker



Source: authors

Dynamic changes are not available for all the features. Relating to text, only the colour might be amended, all the other parameters can be set only statically in this case. Features can be also set in relation to the value of a particular tag where there are no other tools in comparison with WinCC.

7.3.4. System of the Screens

Project of visualisation system is created by screens. These screens are switched among themselves during the application runtime. The system of screen switching in both systems is set during the application development

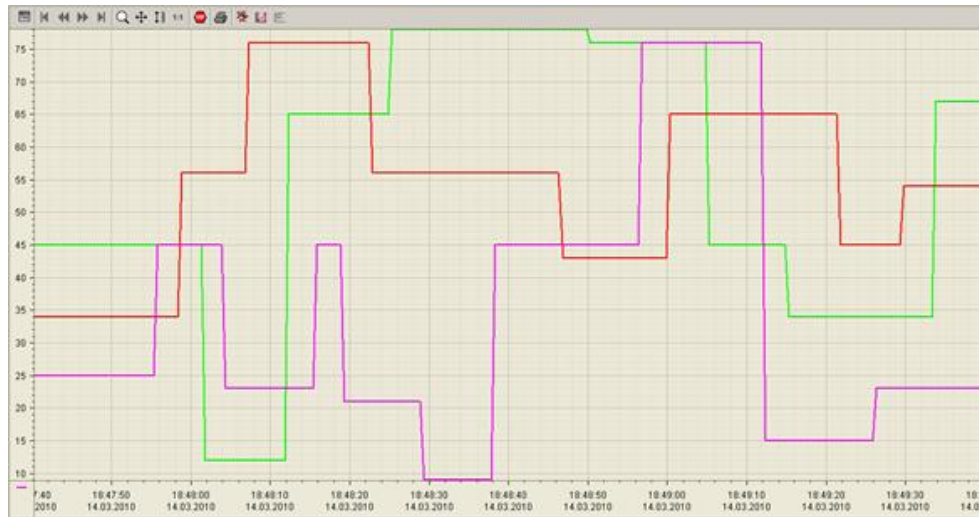
using various tools. WinCC requires the choice of the screen called Start Picture before the first launch. This determines the first screen displayed after the initialisation of the runtime. The display of further screens can be performed either by the screen switch from another one where its display replaces the previous one, or by the utilisation of Picture Window objects in any screen. Intouch uses the tool called Windows which enables the screen display setting during the runtime which is similar to WinCC. However, before the first initialisation it is necessary to set one or more screens which will be displayed during the runtime.

During the screen creation it is needed to set particular types of screen display and its features. The created screens are to be moved among various projects in Intouch. For these purposes, the tool for screen Import/Export is provided. WinCC does not offer this tool. Nevertheless, the screens can be transferred by simple copy of their files.

7.3.5.Trends

Both visualisation systems support graphic display of values during time which is represented by trends. The value amendments are monitored and further plotted in charts during the runtime. The programs, tools and objects are used for these purposes. These have to be set appropriately before the application is initialised. WinCC uses the program Tag Logging providing the setting of the monitored values. This enables to choose tags, respectively the values which will be traced (see Fig. 4). Intouch does not require the settings of the monitored values in a specific program as it is needed in WinCC.

There, the tags of these values are assigned directly into the objects used for the chart plotting. It is necessary to set the logging of the changes of tag values only for tags which will be used for historical displays. The values are displayed with help of two objects - Real-time Trend which shows the current values and Historical Trend which displays the historical values. Historical and current values cannot be displayed in one object as in WinCC. These can be shown only separately. Objects and tools are represented in obsolete appearance in comparison to WinCC. Nevertheless, their functionality is the same.

Fig.7.4. Example of trends visualisation in WinCC*Source: authors*

7.3.6. Alarms

Alarms represent an unusual error state of the visualized process (Habibi, 2013). Both systems support this function. WinCC manages these in program Alarm Logging. Their creation is generated using the choice of particular tag and the assignment of its description. Within this program it is possible to create only the alarm which originates in change of a particular bit in a chosen tag. For the alarm definition which should be based on the change of a particular number in tag, it is needed to create a function in script. This function watches the changes and sets a bit in the next tag on the basis of this change.

Afterwards, the tag is defined in program Alarm Logging. For the alarm displays in the runtime, it is essential to set the object ActiveX called WinCC Alarm Control which includes the table of alarms (see Fig. 5). Intouch uses different way of the alarm definition. During the tag creation it is assigned that the created item is an alarm. Afterwards, its description is provided and the group of alarms is specified. The features are similar to the program Alarm Logging in WinCC. Nevertheless, the differences are mostly in groups which are limited neither in their quantity nor in the levels to which these can be assigned. Intouch distinguishes only two states of alarms

which comprise the confirmed one with the same meaning as in WinCC and the unconfirmed one with the opposite meaning.

Fig.7.5. Example of alarm monitoring in WinCC

ID	Datum	Cas	Trida	Typ	TextAlarmu	User
1	22.03.2010	17:21:09	CLASS	TYPE	TEXT	Trvani
2	22.03.2010	17:21:10	CLASS	TYPE	TEXT	drice
3	22.03.2010	17:21:11	CLASS	TYPE	TEXT	drice
4	22.03.2010	17:21:12	CLASS	TYPE	TEXT	drice
5	22.03.2010	17:21:13	CLASS	TYPE	TEXT	drice
6	22.03.2010	17:21:14	CLASS	TYPE	TEXT	drice
7	22.03.2010	17:21:15	CLASS	TYPE	TEXT	drice
8	22.03.2010	17:21:16	CLASS	TYPE	TEXT	drice
9	22.03.2010	17:21:17	CLASS	TYPE	TEXT	drice
10	22.03.2010	17:21:18	CLASS	TYPE	TEXT	drice
11	22.03.2010	17:21:19	CLASS	TYPE	TEXT	drice
12	22.03.2010	17:21:20	CLASS	TYPE	TEXT	drice
13	22.03.2010	17:21:21	CLASS	TYPE	TEXT	drice
14	22.03.2010	17:21:22	CLASS	TYPE	TEXT	drice
15	22.03.2010	17:21:23	CLASS	TYPE	TEXT	drice
16	22.03.2010	17:21:24	CLASS	TYPE	TEXT	drice
17	22.03.2010	17:21:25	CLASS	TYPE	TEXT	drice
18	22.03.2010	17:21:26	CLASS	TYPE	TEXT	drice
19	22.03.2010	17:21:27	CLASS	TYPE	TEXT	drice
20	22.03.2010	17:21:28	CLASS	TYPE	TEXT	drice
21	22.03.2010	17:21:29	CLASS	TYPE	TEXT	drice
22	22.03.2010	17:21:30	CLASS	TYPE	TEXT	drice
23	22.03.2010	17:21:31	CLASS	TYPE	TEXT	drice
24	22.03.2010	17:21:32	CLASS	TYPE	TEXT	drice
25	22.03.2010	17:21:33	CLASS	TYPE	TEXT	drice
26	22.03.2010	17:21:34	CLASS	TYPE	TEXT	drice
27	22.03.2010	17:21:35	CLASS	TYPE	TEXT	drice
28	22.03.2010	17:21:36	CLASS	TYPE	TEXT	drice
29	22.03.2010	17:21:37	CLASS	TYPE	TEXT	drice
30	22.03.2010	17:21:38	CLASS	TYPE	TEXT	drice
31	22.03.2010	17:21:39	CLASS	TYPE	TEXT	drice
32	22.03.2010	17:21:40	CLASS	TYPE	TEXT	drice
33	22.03.2010	17:21:41	CLASS	TYPE	TEXT	drice
34	22.03.2010	17:21:42	CLASS	TYPE	TEXT	drice
35	22.03.2010	17:21:43	CLASS	TYPE	TEXT	drice
36	22.03.2010	17:21:44	CLASS	TYPE	TEXT	drice
37	22.03.2010	17:21:45	CLASS	TYPE	TEXT	drice
38	22.03.2010	17:21:46	CLASS	TYPE	TEXT	drice
39	22.03.2010	17:21:47	CLASS	TYPE	TEXT	drice
40	22.03.2010	17:21:48	CLASS	TYPE	TEXT	drice
41	22.03.2010	17:21:49	CLASS	TYPE	TEXT	drice
42	22.03.2010	17:21:50	CLASS	TYPE	TEXT	drice
43	22.03.2010	17:21:51	CLASS	TYPE	TEXT	drice
44	22.03.2010	17:21:52	CLASS	TYPE	TEXT	drice

Source: authors

7.3.7. Scripts

Both visualisation systems provide the option to create the scripts using the programming languages. These enable the commands and logical operations based on the fulfilment of the given criteria which can be exemplified as the pressing of a particular key, opening the screen or changing the value. Within these, it is possible to set the functions and actions, define the variables, use the conditions and cycles in syntax related to a specific language.

The functions can be either with the return value or without it. WinCC offers a tool Global Script within which the scripts are developed using the language C or Visual Basic. Using these languages, the events are created for the purposes of feature amendments or of launching the events in objects within Graphics Designer tool. Each language has also its own editor,

namely C-Editor and VBC-Editor. The editors contain the supportive tools for the inserting of tag and screen names and for the syntax control. Intouch uses the script editor QuickScript deployed for all types of functions. The used programming language is not specified. Nevertheless, it looks alike Visual Basic.

QuickScript comprises supportive tools for the inserting of tag and screen names as well as for the syntax control similarly to WinCC. Moreover, the buttons for easy insertion of the conditions, operators and signs are available. In both systems it is possible to debug the final scripts and to reveal the errors which appear during their development. These errors contain the faults which have not been detected during the syntax control, logical errors, incorrectly addressed or called tags, etc. WinCC uses the object Application Window in which the errors are shown during the runtime. Optionally, the reports from Global Script are displayed as well.

7.3.8. Cross Reference

Cross Reference is a tool for searching of places where the investigated project elements are used. The elements are called, read, input, or processed in these places. Both systems include this tool. WinCC supports searching for the placement of tags, screens, functions, ActiveX and .NET elements. It can be set whether the searching will be realised within screens, functions, alarms or trends. After the initial setting of the search area, the table appears. It contains the overview where the element is used together with the description of its location.

Based on the information provided in the overview, it is possible to move to the chosen location with an easy command. The Cross Reference in the system Intouch works on similar principles. Nevertheless, it is possible to search only for tags and functions. On the contrary, the searching criteria can be set in more detail.

As an example, the search based on the specific developing tools is available. After the search initialisation, the results are shown with their location. Unfortunately, Intouch does not provide with the option to use the redirecting command to this location as in WinCC.

7.3.9. Security

Both systems use the same ways of the security of the developed projects. The security is based on the user login to the project application. It is essential to create these users in the project and to assign specific access levels appropriately. Furthermore, a period of time after which a user is automatically logged off can be set. Security is performed either by the users within the project or by the users of the operating system. The user creation in WinCC is realised in program User Administrator. There user groups with their individual users within them are defined. Afterwards, the access levels and the passwords needed for users' login during the runtime are assigned.

The element security is given in Graphics Designer using the authorisation features setting or in the function editor. The users are created in Intouch in the aforementioned program WindowMaker. There are two main types of users - the default login as Administrator or login as another user with a particular administrator level access. Therefore, it is impossible to create groups of users. The element security is defined only using the functions of QuickScript. The abovementioned ways are applied for the security based on the users within the project.

The security linked with the users of the operating system is realised in the same way. However, it is needed to create the user groups in operating systems which have the same names as users of the visualisation system. These groups are then assigned to specific users of the operating system. These users enable to login in the runtime of a visualisation system.

7.4. Discussion and Conclusions

In general, automation brings many benefits that justify its usage. On the other hand, there are also weak points, which have to be carefully considered. For instance, some lab-based studies have been undertaken to explore the impacts of automation and some of them have often found that the benefits are not as evident as it might be expected (Parasuraman and Riley, 1997). Reduction of situation awareness in case of high levels of automation (Kaber and Endsley, 2004) or workload increase under abnormal circumstances (Kantowitz, 1994) can serve as examples. Therefore,

automation is mostly successfully implemented in closed loop systems, such as manufacturing systems, whereas humans are likely to remain vital to system performance in open loop systems, commonly found in control environments for many years (Parasuraman and Wickens, 2008).

In particular case of visualisation, the aforementioned disadvantages might be reduced by deployment of a software application. This paper analysed and discussed two applications. Both visualisation systems use variables called tags for communication. Whereas WinCC offers wider extent of tags, Intouch enables wider options of their settings. Some of these settings are in WinCC substituted by functions and graphic objects. Nevertheless, this is more time and skills demanding in contrast with Intouch. Both visualisation systems handle with communication with the automation means of various producers (Siemens, Allen-Bradley, Mitshubishi, etc.).

They use several standards for these purposes. Profibus, Profinet or Ethernet serve as examples. The tag management of the visualisation system Intouch is realised in a tool Tagname Dictionary which is triggered in WindowMaker. The latter represents the situation when only the tool for tag management is used. For the initialisation of another tool it is necessary to close the tag management tool firstly. WinCC realises the tag management in Tag Management which classifies tags into three groups. These are internal, external and system one. Each group comprises only the tags which are assigned to it. This approach is more comfortable for users. Nevertheless, more sophisticated search for tags is not available in comparison with Intouch.

Additionally, WinCC offers the application WinCC Tag Simulator which dynamically sets the values of internal tags. This also enables to assign the extent of values which are changed after certain period of time. The application is especially appropriate for debugging of the visualisation project.

The layout of the graphic development desktop is basically similar in both systems. It includes the desktop of the developed screen surrounded by available tools. The development is realised by the composition of the graphic objects which can be assigned with various features statically or these can be dynamically changed during the runtime. The objects enable to

trigger the events in case of feature amendment or the choice of the user during the runtime.

Both visualisation systems enable to create trends monitoring the value changes. They represent them in charts during the runtime. WinCC realises the connection with these values in program Tag Logging followed by the ActiveX object and the object OnlineTrendControl. This object displays both the current and historical charts. It provides wide options of settings and the user can use a wide variety of tools for required information retrieval during the runtime. Intouch connects the monitored values directly with the objects with no need of other specific program as in case of WinCC.

The object used there is Real-time Trend enabling the display of current values, or Historical Trend providing the display of historical values. Nevertheless, the objects are limited in number of displayed charts. Only four current and eight historical ones can be presented. The frequency of value loading and other features can be set there in a similar way as in OnlineTrendControl in WinCC. The objects do not include any other tools which might be deployed by the user during the runtime. These are available only in an extra graphic set.

The scripts are created by programming languages within the visualisation systems. These enable commands and logical operations based on the accomplishment of particular criteria. The scripts are created in editors comprising supportive tools for tag and screen name insertion as well as syntax control. WinCC supports two programming languages - language C and Visual Basic. These can trigger the events for changes of features and events in objects of the tool Graphic Designer. Languages are supported in full extent which means that common syntax, commands and functions are usable.

Furthermore, these are extended by predefined functions for the access to graphic objects, tags, alarms, screens and other parts of the visualisation system. Intouch supports one unspecified syntax language which is very similar to Visual Basic and functionally it can be compared to languages in WinCC. Moreover, it enables to work with databases using its own SQL functions. In addition, the editor adds the buttons for simple saving of the conditions, operators and signs. The debugging of the final scripts is

available in both systems and therefore the errors emerged during the development are revealed.

Both systems use the same way of security related to the developed projects. The security is based on the user login to the project application. It is ensured by two basic options presented by the users within the project or by the users of the operating system. Various access levels are assigned to the users and on this basis, the access to defined project elements is permitted. The security of elements in WinCC is assigned by settings of the authorisation features or by the scripts. In Intouch, this is realisable by the function of QuickScript.

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8. Usability of E-commerce

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Abstract: *The article describes current trends in the development of online shops (e-shops) primarily in terms of usability. The main aim of the article is a brief overview build effective use of e-shop with emphasis on the major marketing and technical methods. High user-friendly of web applications is in today's extensive online world is one of the most important and should be incorporated into the initial phase has therefore to draft such applications.*

Key words: *user-friendly application, development of web application, e-shop*

JEL Classification: *X00, X00.*

8.1. Introduction

Online shopping is a form of electronic commerce that allows you to purchase goods or services through a web browser or nowadays and using mobile applications. The most common form of shopping is B2C, which means that the company sells to the end customer. In the last 15 years have seen a great boom in e-shops, online stores and e-commerce.

These concepts are hidden in important idea, you can buy over the internet. In the Czech Republic by research agency TNS Infratest 94% of Internet users have purchased any goods in the e-shop.

The current competition e-shops is considerable, and it is therefore necessary to adopt a customer such services, functionality and layout e-shop, which he hopes to complete your purchase and did not switch to another e-shop and of course, that in such e-shop visited again.

For these reasons, this article will be dedicated to online stores and their usability. To verify the assumptions were made questionnaire.

8.2. Usability

Usability (web usability) is a set of many rules improve visitor interaction with a website. Increases clarity and lucidity site. Usability also ensures that the visitor easily orients him that he can quickly get to the information required to perform a site and its other goals.

Usability is also trying to prevent problems during this process that usually arise. And finally, web usability also emphasizes a positive user experience. Considerable importance for the applicability of the intuitive control.

Every Internet user has already encoded intuitively that the underlined words in the text mean therefore hyperlink link to another website, whether within their own site, or it is an external link.

The problem arises in a situation where you cannot click on the text and the user gets the feeling that the page failed. In the case of e-commerce, this means, among other things, the onset of the psychological effect that is associated with sinking confidence to that used for e-shop.

8.2.1 Basic prerequisites of correct application

If the online store can be a useful assumptions are correct:

- The customer does not need to tediously search shopping cart.
- Customer is not diverted by unnecessary descriptions of predetermined goals visit the online store.
- Shopping basket is logically composed only of important items.
- Shopping Cart is the best single step.
- The customer can order goods of your way.
- Product is the first short description and detail to the opening followed by a long description.
- Clearly Prices of goods including whether the offset value added tax.
- Easily accessible information on transportation and payment options with a concise description of their cost or purchase options without these costs when buying such. Larger quantity of goods and vice versa in the case of goods larger dimensions clearly defined conditions of transport.

8.2.2. Functionality

It is always important to remember what the shop and serve it to draw the necessary system functions, below is a list of basic features that should meet the shop:

- Ability to import data from a supplier.
- Inserting multiple images.
- Interconnection with economic systems (well-being, Money S3,...).
- Templates e-shop.
- Options for goods (eg. Garment size).
- XML output for zbozi.cz, heureka.cz, etc.
- Electronic payments for goods (credit cards, PayU, Paypal, etc..).
- User friendliness (wysiwyg editor, drag and drop, ...).
- Limit the number of items, slowing the rise of items.
- Updating the status of orders.
- SMS messages, e-mails.

8.2.3. Components of a user-friendly e-shop

The use of components to the maximum extent possible not only ensures faster entry into the subconscious of users, but the user has multiple channels for evaluating e-shop associated with greater awareness of the potential customer.

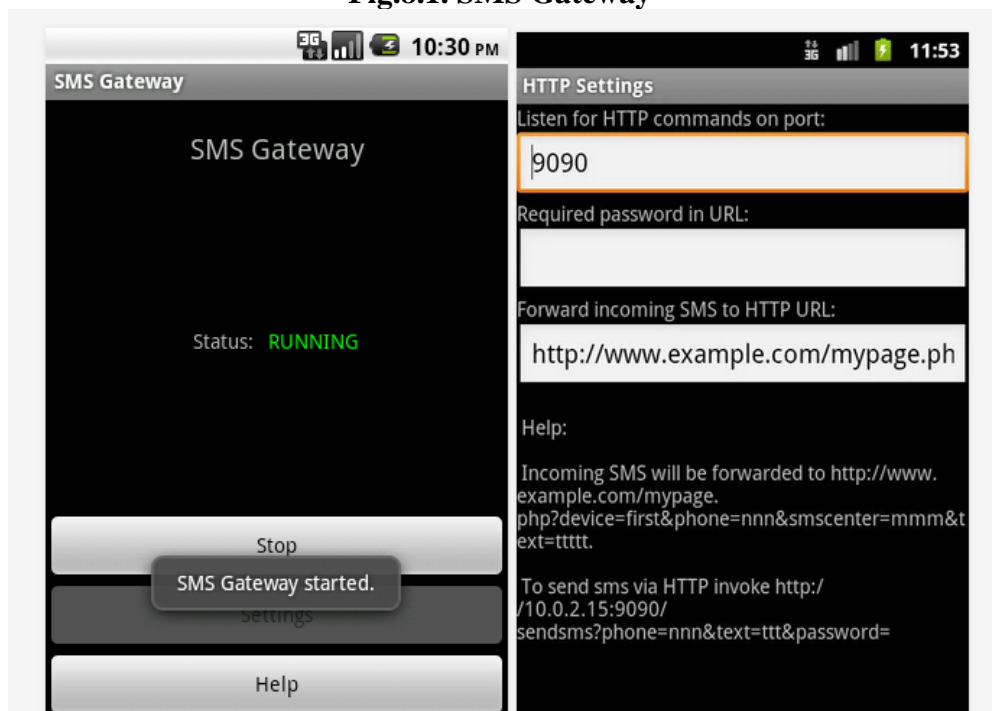
1. Connecting with the accounting program - it is now common practice to link e-shop is in stock when a customer finds the number of pieces levied on goods in stock, its price is without VAT. In terms of the operation of e-shop is the use of this method is very effective, since it is sufficient to export or import data into or from e-shop, is the perfect connection with automatic data synchronization, which ensures the provision of current data to the client.
2. Communication channels - client should able to connect to the operator e-shop through multiple communication channels. The base

is of course the mobile contact. Due to the current generally used services is more commonplace skype, icq chat and activation directly on the site, the user (potential customer) directly to see whether the counterparty is online or not. In terms of the applicability of these contacts should be visible when any user activity on the e-shop.

3. Responsive design - such design should be adaptable to any display device which is nowadays used.
4. Mobile client business - today's smart-phones widespread calls for a separate simple application for a client that you can install on your mobile phone. Risk browsing the product catalogue off-line should be displayed warning the user that the database is not current. In the case of the transition from off-line viewing and transition to on-line mode when ordering goods should be automatically recalculated for example. Available products, so that the client has been clearly informed that it has chosen item in stock.
5. SEO optimization - as a customer searches for a particular product often via a search engine, it is necessary to have the best quality made by search engine optimization.
6. Payment methods - should be chosen such component that meets the three basic forms of payment - cash on delivery, bank transfer and credit card payment.
7. Postal services - client should have a large selection of choice of method of delivery of the goods ordered. Some services are available mostly in larger cities, it is also necessary to remember the clients who come from small towns and delivery options just in their small town or village.
8. Possibility use the services of third parties - most often it is a supplementary insurance or hire purchase.
9. SMS gateway - most customers are in favour of such an e-shops, which send SMS directly and inform the customer about the status of your order.

10. Interconnection with other systems - eg. AukroKonektor, which allows integration with Aukro, another major advantage is the connection with any comparator prices.
11. Multi-lingual solutions - In the case of overlapping e-shop outside domicilaci can recommend a multi-lingual solution that includes not only the presentation part, but also the proper form necessary documents, thus linking.
12. Social Network - shop should use the current most commonly used social networks, but considerable significance has its own social network, since it can lead to a community association clients and thus ensure greater awareness again to its customers.

Fig.8.1. SMS Gateway



Source: author

Fig.8.2. Snippet of source code

```

1 <?php
2
3 if (!defined('_VALID_MOS') && !defined('_JEXEC'))
4     die('Direct Access to ' . basename(__FILE__) . ' is not allowed.');
```

5

```

6 /**
7  *
8  *
9  * specialni typ 'cash on delivey':
10 * @author Vojtech Andres
11 * @package VirtueMart
12 * @subpackage payment
13 * @copyright Copyright (C) 2004-2008 soeren - All rights reserved.
14 * @license http://www.gnu.org/copyleft/gpl.html GNU/GPL, see LICENSE.php
15 * VirtueMart is free software. This version may have been modified pursuant
16 * to the GNU General Public License, and as distributed it includes or
17 * is derivative of works licensed under the GNU General Public License or
18 * other free or open source software licenses.
19 * See /administrator/components/com_virtuemart/COPYRIGHT.php for copyright notices and details.
20 *
21 * http://virtuemart.net
22 */
23 if (!class_exists('vmPSPlugin'))
24     require(JPATH_VM_PLUGINS . DS . 'vmpsplugin.php');
```

25

```

26 class plgVmPaymentEasyvmsms extends vmPSPlugin {
27
28     public static $_this = false;
29
30     function __construct(&$subject, $config) {
31         parent::__construct($subject, $config);
32         $varsToPush = $this->getVarsToPush();
33         $this->setConfigParameterable($this->configTableFieldName, $varsToPush);
34         if(!isset($this->params)){
35             $q = 'SELECT ORDER_status_name FROM #__virtuemart_orderstates WHERE order_status_code ='. $orders->order_status.'';
36             $db->setQuery($q);
37             $jmenostavu = $db->loadResult();
38
39             // Nastaveni podminky a textu
40             if (is_numeric($order['details']['BT']->{$userfieldmobile}))
41             {
42
43                 $smsTEXT = urlencode ($zacateksms."".$jmenostavu."".$konecsms);
44                 $ch = curl_init();
45                 // Android sms nastaveni
46                 if ($this->params->get('smsluzba') == 0) {
47                     $smsURL = "http://91.237.238.6:9090/sendsms?phone=".$order['details']['BT']->{$userfieldmobile}. "&text=".$smsTEXT."&password=".$apikey;
48                 }
49
50                 curl_setopt($ch, CURLOPT_URL, $smsURL);
51                 curl_setopt($ch, CURLOPT_RETURNTRANSFER, true);
52                 $output = curl_exec($ch);
53                 curl_close($ch);
54             }
55         }
56     }
57 }
58
59 /*
```

Source: author

Fig.8.3. Installation xml processing

```

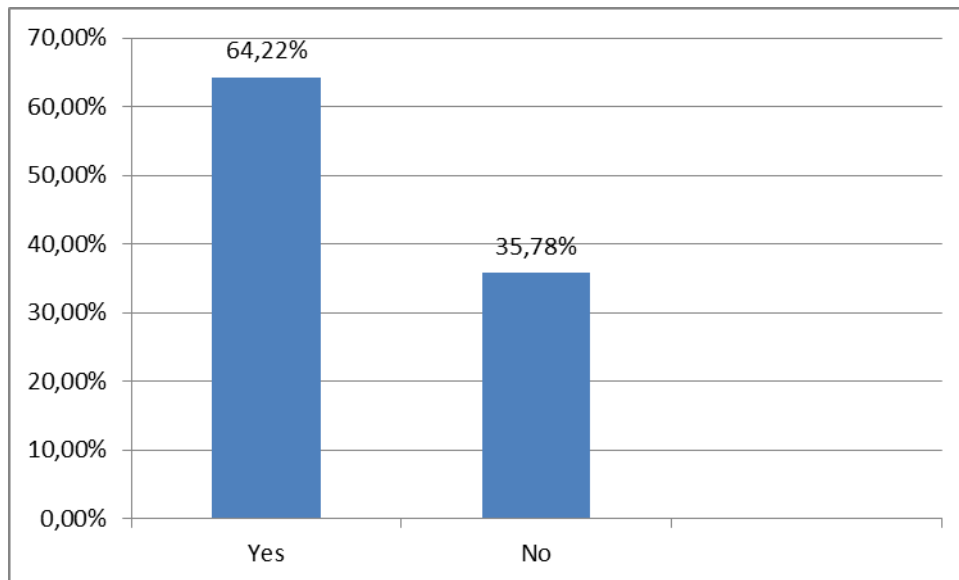
1 <?xml version="1.0" encoding="UTF-8" ?>
2 <extension version="2.5" type="plugin" group="vmpayment" >
3   <name>VoodySMS</name>
4   <creationDate>March 2014</creationDate>
5   <author>Voody.cz</author>
6   <authorUrl>http://www.voody.cz</authorUrl>
7   <copyright>Copyright (C) 2014 Voody.cz. All rights reserved.</copyright>
8   <license>http://www.gnu.org/licenses/gpl-3.0.html GNU/GPL</license>
9   <version>1.0.0</version>
10  <description><![CDATA[
11    Sms upozorneni pro zakazniky.
12  ]]>
13  </description>
14
15  <files>
16    <filename plugin="voodysms">voodysms.php</filename>
17  </files>
18  <config>
19    <fields name="params">
20      <field name="params" addfieldpath="/administrator/components/com_virtuemar
21      <field type="vmjpluginwarning" />
22      <fieldset name="VMPAYMENT_EASYVMSMS_GENERAL_CONFIGURATION">
23        <field name="smssluzba" type="list" default="" label="SMS sluzba" descri
24        <option value="0">Android</option>
25      </field>
26      <field name="zacateksms" type="text" label="Zacatek zpravy" description=
27      <field name="konecsms" type="text" label="Konec sms" description="Zde na
28      <field name="userfieldmobile" type="sql" default="" label="Uzivatelske p
29    </fieldset>
30    <fieldset name="android_nastaveni" label="Android nastaveni">
31      <field name="android" type="text" label="Android heslo" description="Vlo
32    </fieldset>

```

Source: author

8.3. Questionnaire survey – Highlights

The aim of the survey was to determine what features customers appreciate the e-shop. The survey consisted of 23 simple, clearly defined questions. In this paper the most important findings. Overall, 109 respondents out of 243 respondents surveyed, 65% of women and 35% men. At the age of 20 answered 32% of respondents under the age of 30 years 36% under the age of 40 years 28% under the age of 50 years and 3% under the age of 60 years is 1% higher in the age group nobody answered.

Fig.8.4. Do you prefer on-step shopping cart?

Source: author

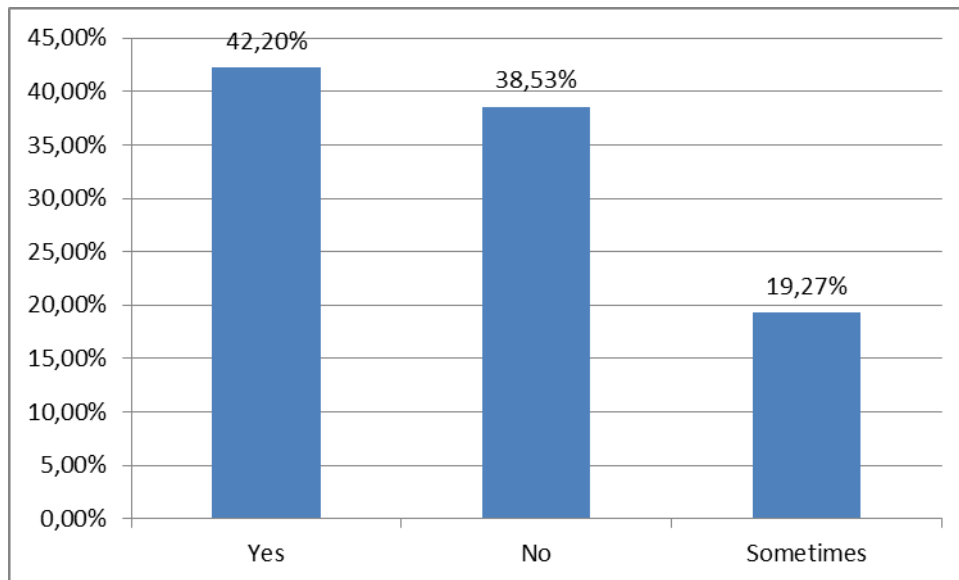
In the first part of the question was to determine how often customers buy on the Internet. The survey showed that the majority of customers (80%) purchased more than 10 times. The vast majority of customers buy because of lower prices, this said, it is important for them to compare products and prices. Half of the customers prefer certified businesses. In the questions 4-8 was examined Delivery and payment, which customers use.

The second section focused on the payment methods, shipping, etc.. Surprising finding was that most of its customers still prefer to pay cash on delivery - choice of transport 60.55%. It is probably mainly for the reason that many users have concerns about buying on unproven or untested e-commerce. In case of advance payment of 40% of customer purchases using credit cards and the primacy of the advance payment of 50.88%.

In terms of the selection of transport services is still based on the best Czech post office, largely because of widespread branch network (80%). In second place was PPL, in the wake of the DPD. For pick-up of goods at the place of residence of the client gives clients prefer collection due to cost savings in

postage. The cost of postage for the majority of 96% of clients make a decision as the actual purchase. Clients include the cost of shipping into the price of goods and if postage is cheaper in another online store and the actual goods more expensive, but the total price is lower, then just buy in this e-shop, where the total cost of goods lower. It cannot therefore rely on the setting of the lowest prices in e-shops, but it is also necessary to provide competitive pricing policy in transport. In the case of white goods then most clients are turning to credit companies, even though overall it can be said that clients hire companies usually offer a minimum benefit.

Fig.8.5. Are you discouraged from buying due confusing of shopping cart

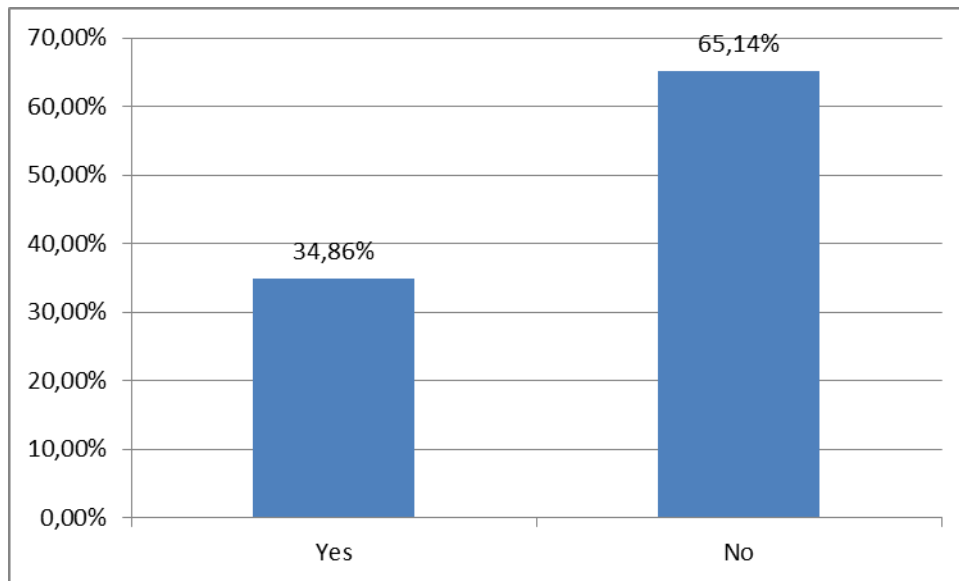


Source: author

Most users and customers e-shop is not decided by whether the shop stone shop. Customers consider graphical e-shop solution for one of the factors for determining whether a given transaction to purchase or not. Of course, for them to view on mobile devices. In case of lack of clarity in the shopping cart most users of the Internet business goes. 64% of respondents prefer shopping basket.

Menu is pleasant for the user in the left Layout. Over 35% of respondents answered that the e-shop to get over social networks.

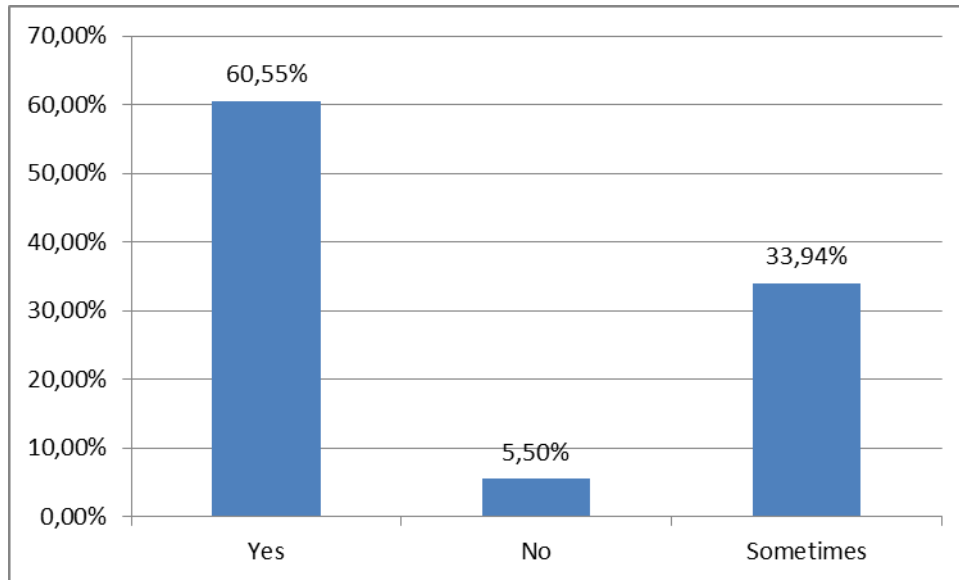
Fig.8.6. Have you ever become a fan on social networks of any e-shop?



Source: author

When the trade is designated authentication certificate customers have to trust him customers default.

SEO seems to be an integral part of the e-shop, since most customers go straight to find specific products through search engines. 80,73% of customers hear about e-shop from search engines. 68,31% in the comparison of prices, 33,94% from 23,85% and friends of advertising (in this issue was possible to tick more than one correct answer).

Fig.8.7. Are you looking for product review before buying

Source: author

Only 12% of customers keep sending newsletters consistently i.e. news about the e-shop. 47.71% of respondents said they have tried it in the past and now no longer interested. Over 32% of customers buy through smart-phones in e-commerce. The alarming result is that 80.33% of customers prefer e-shops to inform customers about order status via SMS.

8.4. Conclusion

In the context of this article were determined on the assumption that the analysis of trends in existing e-shop, they were more widely validated questionnaire survey. In the questionnaire survey were identified individual requirements that customers appreciate. It was mainly about payment options and transport functions, graphical layout, components, services, etc.. Outline presented in this article should help in the creation of competition able to e-commerce.

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9. Research in Web Design

Aneta Bartuskova;

Abstract: *This paper deals with research in the area of web design. Several basic concepts are introduced: user preference, classical and expressive design and evaluating criteria for website design. The article offers various views on categorization of these attributes. Selected research directions are discussed in more detail, in two basic categories - usability and aesthetics. Paper contains thoughts about content organization and navigation of the website, including real examples. The research in various areas is introduced, especially in colour perception, contrast, other visual elements and visual appeal in general. Apart from theoretical introduction and current state of the research in this area, several new interesting research directions are mentioned in this paper.*

Keywords: *web design, preferences, usability, aesthetics.*

JEL Classification: *L86, M39.*

9.1. Introduction

There is an ongoing effort in determining key factors of website presentation's success, since the beginning of the internet. The website presentations are one of the key communication tool for companies in these days, so the need of understanding the user (customer) is even more pressing. Studies in this area work usually with the term "user preference" and more recently also "user experience", usability and aesthetics (van Schaik & Ling 2009, Lee & Koubek 2010a, Lee & Koubek 2010b, Hartmann et al. 2008, Tuch et al. 2012).

We need to know the user preference in order to understand the user behaviour (Lee & Koubek 2010a), which reflects user's feelings and opinion on the website and creates his next intentions with the website (Lee & Koubek 2010b). User preference is very important in a competitive

environment of various products, interaction systems and websites. There was defined several main factors, which influence this preference, these are usually usability and aesthetics (Lee & Koubek 2010a, Lee & Koubek 2010b, Hartmann et al. 2008, Tuch et al. 2012). There are therefore many studies researching user preference and relations between usability and aesthetics.

9.2. User preferences

9.2.1. Influence on user preferences

User preference is a user's (customer's) choice from several websites and consequently a user's decision of his behaviour on the chosen website (Lee & Koubek 2010a). User preference also signifies, how user evaluates a relative importance of interactive system's properties (Ben-Bassat et al., 2006). Many earlier studies conclude, that this influence is dependent more on usability of the website (Keinonen 1997, Nielsen 1993), yet many later studies put a greater value on website's aesthetics (van Schaik & Ling 2009, Tuch et al. 2012, Lavie & Tractinsky 2006, Schenkman & Jönsson 2000, Robins & Holmes 2008). Aesthetics is also revealed much faster than usability and remain relatively stable and adequate to the first impression (Lindgaard et al. 2006).

There are many studies, which investigate a connection between usability and aesthetics on website presentations or generally in human-computer interactions (Lee & Koubek 2010b, Hartmann et al. 2008, Tuch et al. 2012, Ben-Bassat et al. 2006, Hassenzahl 2004). Previous studies have shown that subjective evaluations of aesthetics and usability are strongly correlated (van Schaik & Ling 2009, Lavie & Tractinsky 2006, Hassenzahl 2004). McCracken and Wolfe defined web design attributes as followed: content organization, visual organization, navigation system, colour, typography (McCracken & Wolfe 2004).

Content (information quality) is also one of the key aspects in a website's success (Lynch & Horton 2001), but it is not researched to an extent such usability and aesthetics. Content's characteristics can be further defined as quality and quantity of information part of the website (de Angeli et al. 2006).

Usability and aesthetics can be researched in various ways. Aesthetics however can use only subjective measurements, because evaluation of aesthetics cannot be generalized and most of all measured precisely. It is dependent on every individual user, his experience, feelings, needs and preferences. Still, subjective evaluation of aesthetics helps us understand general guidelines and general user opinions about visual appearance of the website.

Usability on the other hand can be measured as both subjective and also objective factor. Subjective as user evaluation of system's usability - how easy was working with the system, if they would use it again, if they feel that the system was easy to use etc. Objective measurements are for example the task time, number of errors or severity of the errors during fulfilling tasks on the website.

Lee and Koubek (Lee & Koubek 2010b) are comparing an influence of the mode and context on perceived usability and aesthetics and consequently on user preference in their research. Their results show, that before use of the website, user preference was mainly influenced by aesthetics (or visual appeal), after use was the preference influenced by usability as well as aesthetics. Recent research of Tuch et. al. (Tuch et al. 2012) showed that aesthetics has no influence on perceived usability of the website, but on the contrary, the usability has an influence on perceived aesthetics after use of the website.

Van Schaik and Ling (van Schaik & Ling 2009) emphasise so called first impression effect and further more thorough impression and opinion about the website. Lindgaard et al. (Lindgaard et al. 2006) defined the time needed for making of the first impression as 50ms, and this opinion is created exclusively by aesthetics (visual appeal of the website) and not usability.

9.2.2. Classical and expressive design

We can organize design into two groups based on aesthetics - classical and expressive design. Classical design means orderly traditional design, which is directed by rules and standards in web design. Expressive design is on the other hand created creatively, often with a goal to break these rules and

standards. Van Schaik and Ling (van Schaik & Ling 2009) were also inspired by research about influence of the context on aesthetic (Ben-Bassat 2006) and their research proves that the existence of the particular goal has an impact on more stable evaluation of aesthetics, which is caused by user's focus on usage of the website, this usability, more than on aesthetics evaluation. Classical design was rated as more attractive than expressive, according to the authors because of the informative character of the website used in the experiment.

9.2.3. Usability and aesthetics

It is evident from the previous part of the text, that the website design is important for their success and user preference creation. As evaluation attributes can be defined already mentioned McCracken and Wolfe web design attributes (content organization, visual organization, navigation system, colour and typography). Content organization and navigation system are usually classified as usability aspects, colour and typography as aesthetics aspects (Lee & Koubek 2010b), and finally visual organization as a combination of both.

It was already mentioned, that usability can be considered as objective or subjective measure. Hornbæk divided usability measures into three groups: the measures of effectiveness, the measures of efficiency and the measures of satisfaction (Hornbæk 2006). Lee and Koubek considered usability in two types: pre-use usability, which is perceived usability of the website before use, and user performance as a result of user's actions on the website (Lee & Koubek 2010b).

Most widely used method for measuring usability is probably user testing, but also an inspection or an inquiry (Fernandez et al. 2011). Impact of usability is being researched e.g. by manipulating information architecture (Tuch et al. 2012) or disorganizing items and use of confusing labels (Lee & Koubek 2010b).

Aesthetics of websites was originally quite neglected it is however widely researched in various contexts today. An extensive study of Lavie and Tractinsky concluded, that users' perceptions of a webpage consist of two main dimensions, classical and expressive aesthetics (Lavie & Tractinsky

2006). A research of Robins and Holmes showed an influence of aesthetics on credibility and trust, dependent mainly on first aesthetics impression of the website (Robins & Holmes 2008). That supports an experiment of Lindgaard et al., which defines time needed for assessing a visual appeal of a website (Lindgaard et al 2006).

Van Schaik and Ling's studies examined an influence of a context on perception of the aesthetics (van Schaik & Ling 2009) and relation of similar constructs, namely beauty and goodness (van Schaik & Ling 2008). Schenkman and Jönsson stated that beauty is the best predictor for a user judgement (Schenkman & Jönsson 2000). Research of van der Heijden introduced a new construct named "perceived visual attractiveness of website", which influences usefulness and ease-of-use (usability) (van der Heijden 2003).

Aesthetics of the website is usually manipulated through design features such as background, quality of pictures or decorative graphics. Manipulating aesthetics is difficult without affecting usability. As a result, an aesthetics manipulation can be limited, so only minimal decorative changes or change of background is usually seen in these type of studies (Tuch et al. 2012, Ben-Bassat et al. 2008). Perceived aesthetics can be then divided to several categories of subjective evaluation: complexity, readability, organization, beauty, understandability and overall impression (Schenkman & Jönsson 2000).

Hassenzahl used other measurement scale with attributes: pragmatic quality (in other words perceived usability), hedonic quality (stimulation) and beauty. Éthier et al. (Éthier et al. 2008) divided design perception to the following factors: structure of information presentation, navigation, text and visual aspects. They also included to the evaluation of visual aspects these criteria: colours, pictures, background and layout.

9.2.4. Shortcomings of the current research

This section contains some thoughts about the shortcomings of the current research in web design, user preferences, usability and aesthetics. If we want to examine an influence of usability and aesthetics independently, manipulation of one aspect cannot influence the other aspect. In many

studies, used manipulation of usability and aesthetics does not conform to these requirements. In a study of Tuch et al. (Tuch et al. 2012), authors claim to manipulate aesthetics without an influence on the usability by changing only background. Nevertheless, change of background from plain light colour to a colourful texture is definitely changing perceived usability and also actual usability.

Contrast is a key element for legibility, which is a part of usability. In this case, contrast of a navigation area and individual items was changed significantly, so the usability was changed as well. Free space between navigation and content elements was also influenced by this manipulation.

In Schaik and Ling's research (van Schaik & Ling 2009), aesthetics was manipulated by changing content organization and navigation, which are almost solely usability aspects.

Another issue for consideration is a frequent use of between-subject design regarding aesthetics and usability as independent variables. Since aesthetics can be measured only as perceived aesthetics, i.e. a subjective measure, and usability measures also contain subjective scales, there is a great risk of creating an unwished variability.

This is caused by a different perception and evaluation of participants, specifically different abilities in scaling within an equal volume. Variability within a group is therefore mixed with variability between groups and this creates an additional variability which affects results of the studies.

Despite of these issues, many studies use between-subject variables usability and aesthetics (de Angeli et al. 2006, Tractinsky et al. 2000) often in a mixed design, where time is the only one within-subject variable (Lee & Koubek 2010b, Tuch et al. 2012). Although within-subject designs should be preferred, there is sometimes a good reason for usage of the between-subject design.

That is for example when a participant should not have a previous knowledge of the experimental website, if this particular website is used in more alternate versions during the experiment.

9.3. Usability of the website

9.3.1. Content organization

Organization of the content, specific elements (logo, search bar,...) and navigation on the webpage is integral part of web design; it has an influence on the usability and also user preferences. People got used to certain positions for certain elements on the webpage (Roth et al. 2010). Effect of violation of these standards was researched by Santa-Maria and Dyson (Santa-Maria & Dyson, 2008) on the experimental online discussion forum in two versions - one with conventional design and the other violating these conventions. Users of the other version were disoriented and confused, however after short adaptation, the performance of both groups were almost equal, as well as the number of subsequent visits of the website.

9.3.2. Navigation

Hartmann et. al. (Hartmann et al. 2008) conducted research on websites evaluation, both experimental websites have the same information content, one was with the classical navigation, the other metaphorical - creatively designed. Classical aesthetics was rated equally in both versions, expressive aesthetics and user involvement was rated better in version with creative menu, and usability and information quality was on the contrary rated better in the classical version. Overall preference was surprisingly towards the creative version of the website, but is of course possible, that this direction of preference was caused by settings of the experiment. In real situation, when looking for information, the situation could be completely different.

9.3.3. Research directions

It would be useful to test the influence of an untraditional content organization on various types of websites and applications. From the short-time point of view, we would test e.g. adaptation time, from the long-time point of view e.g. visits of the website. We can test in this way usability of stereotypes in web design and improve them. Also the modern techniques, which became technologically available and thus they are quickly spreading, e.g. CSS3 animations, parallax or lightbox.

It would be also very useful to continue in research on relation between aesthetics and access to information, and also overall preferences. We need however representative participants and not students, which are very frequent, case in this type of research experiments.

We could also explore Pareto principle. Fee (Fee 2009) applied this rule on e-learning applications in the meaning of actively used functionality. If we would research this principle in the context of website / application, we could reveal the most effective navigation links and redesign the website / application as more usable. The frequency of links usage could be technically analysed e.g. by heat maps or click maps (Choros 2011).

9.4. Aesthetics of the website

9.4.1. Classical and expressive aesthetics

We perceive aesthetics in two dimensions - classical and expressive, as was already mentioned (Lavie & Tractinsky 2004). Traditional (classical) can be characterized as: pleasant, clear, clean, and symmetrical. Expressive design on the other hand as: creative, exciting, original and elaborate. Design standards have changed radically since this division was introduced in 2004 and they are still changing. Perception of aesthetics is also a subject to individual characteristics, feelings and experience of the particular user (Hartmann et al. 2008, Lavie & Tractinsky 2004, Hall & Hanna 2004).

9.4.2. Colours and contrast

One of the design elements, which we include in aesthetics, is colour scheme of the website. In association with colours were researched cultural differences (Cyr et al. 2010), but only several colours were used (blue, grey, yellow). Study of Hall and Hanna confirms, that preferred colour scheme leads to higher user rating of website's aesthetics (Hall & Hanna 2004). We can research influence (on the user preference) of the primary colour but also of the colour combinations or the difference between foreground and background of the website. The study (Hall & Hanna 2004) has also confirmed that higher contrast leads to better text readability, as was also stated by Horton in his study (Horton 2006).

Bonnardel et al. researched which colours are perceived as attractive on websites (Bonnardel et al. 2011), where attractiveness is defined by feelings, if the colours are perceived as appropriate, pleasant or interesting (Cyr et al. 2010). The authors used in the experiment 23 specially constructed websites, which were exactly the same except for colour, which was used in various shades on every element on the experimental website.

9.4.3. Other visual elements

Finally there are many other visual aspects, which have an influence on user preferences. Conflicting highlighting effects is quite common issue on modern websites, with big pictures and complex visuals competing for user's attention. Horton stated, that we cannot emphasise more than 15 percent of the webpage (Horton, 2006).

We can also research combined effect of individual visual elements, which is created by cooperation and organization of these elements. If this combined effect is more than just sum of individual visual elements, then the website has good consistency, unity, harmony etc. and is more visually attractive.

9.4.4. Research directions

Research on colours in web design is also very interesting, however many studies do not work with real looking websites, e.g. in Bonnardel et al. research (Bonnardel et al., 2011). Also readability was violated, because of very poor tonal contrast. There are also conflicting results - authors of one study claim that yellow colour is perceived negatively on websites and blue colour positively (Cyr et al., 2010), while other research claims that orange colour was more successful than blue colour (Bonnardel et al., 2011). We should aspire for usable results, e.g. with relation to particular industry or type of website.

We could also research the hypothesis, that users perceive visual complexity as noise, which complicates access to information on the website. We should validate common solutions such as white space usage and gradual information disclosure. The influence of gradients, textures and poor contrast in general should be researched in association with the inexperienced or disabled users.

9.5. Conclusion

This paper presented the research in web design. The emphasis of this article was on user preferences and key evaluation criteria of the website design - usability and aesthetics. These areas were presented from the theoretical point of view, the current state of research and also possible future directions of research on this topic.

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Information and Knowledge management

10. The Use of Lean Methods in Information and Knowledge Management

Jiří Ansorge

Abstract: *The concept of corporate leaning has primarily been a very heavily discussed topic since the onset of the economic crisis. Many companies began to seek opportunities for savings in their processes, especially in manufacturing processes. This paper deals with the possible use of lean enterprise methods in the design and changes of internal information and knowledge systems. Acquainting the reader with the most basic lean enterprise methods which can be used in the design of the user interface of the information system as well as knowledge management.*

Keywords: *knowledge, information, lean*

JEL Classification: *M10.*

10.1. Introduction

This paper focuses on the possibilities of the use of lean enterprise methods in the design and editing of information flows. Although the lean enterprise methods are mainly applied in the manufacturing sector, their application can even be found in purely non-manufacturing processes. The aim of the work should be familiarisation with the most basic lean enterprise methods in relation to their application in knowledge management, especially in the design of the user interface of information system and in mapping and optimising the flows of knowledge within an enterprise.

10.2. Lean enterprise methods

The following chapters deal with the possibility of the use of lean enterprise methods in knowledge management in enterprises. Possibility of the

application of these methods is possible only if the emergence of information and knowledge will be viewed as production of the product. In this perspective it is possible to also apply most of the tools of lean production for data, information and knowledge across the enterprise. With each method the application in the context of knowledge management is always described.

10.2.1. Seven types of waste

These types of waste (Hicks, 2007) were originally primarily defined for manufacturing operations, but the same types of waste can also be used in the transformation of data into information and then into knowledge.

- **Over-production** – over-production of information and unnecessary gathering of unnecessary data which is not expected to be worked with further, or their duplicate processing leads to a large amount of searching time, and especially the size of the shared storages.
- **Waiting** – waiting for the information which is required to meet the recipient of the information package. An example is information that is gradually adjusted by multiple processors, where each processor has either a limited or unlimited period of time for processing. Refer to the chapter of the "PULL and PUSH principle in the information flow." Wrong setting of these deadlines may result in a delay in obtaining the final information, see Figure. By reducing the time (deadline) for ongoing information processing, we can obtain information much earlier, but we must reckon with the whole process of the formation of information, which may not always be horizontal, but may also branch out vertically. It is always necessary to foresee with time indisposition of the processor of the modified information, therefore, everyone should have their representative. All this information on processing should be brought to the knowledge audit.
- **Transport** – sending redundant information increases the demands on the internal network bandwidth and storage size. For example, by simply sharing a link to the location in the storage, you can significantly reduce the burden on the internal network and accelerate the work of the email client (reducing the volume of the mailbox)

- **Extra work** – duplicate processing of identical information (two or more employees perform identical work on the data, which then develops two versions of documents) and information processing, which will never be used, etc.
- **Storages** – see sections 3 and 4 - a large number of unnecessary and duplicated information result in inefficient use of storage space and increases confusion in data and information.
- **Movements** – transmission of information across the enterprise network, instead of central storage and sharing only the paths to the data, or information.
- **Scrap** – information without value added, distorted data, the draft documents, etc., pose a risk of confusion with the final version, taking up storage space and can spread inaccurate information.

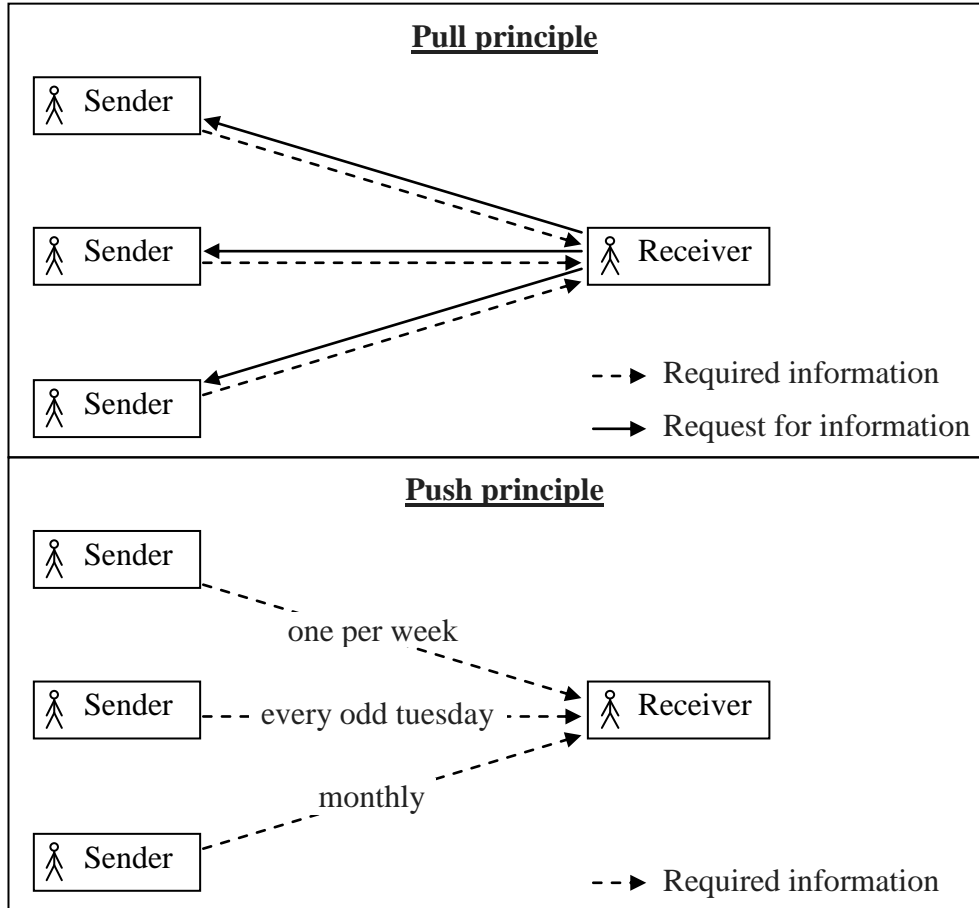
By eliminating this waste, it is possible to eliminate the time (human as well as machine) which is unnecessarily spent on obtaining the necessary information, and optimise space in corporate storages.

10.2.2. PULL and PUSH principle in the information flow

The difference between the Pull (Liker, 2007) and Push principle in the information flow is especially in the development of requirements.

For information that is demanded intermittently by a recipient, it is not possible to apply different principle than the Pull principle. In the case of periodic sharing of current information, it is possible to apply the Pull principle, through setting a schedule for sending information from the owner to the recipient without the recipient's request. The schedule can then be set according to time, change, special events, etc.

By applying the Pull principle in the information flow, we can eliminate the waiting time between a request and sending the required information.

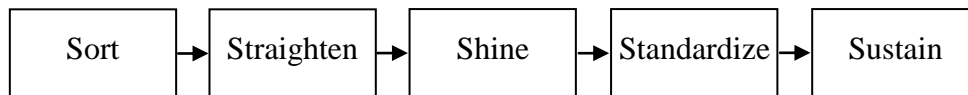
Figure 10.1. Pull & Push principle**10.2.3. 5S**

5S method (Košturiak and Frolík, 2006) is a method that should bring an order to an otherwise chaotic environment. A chaotic environment in the information world can be seen as a place where data and information is gathered without any rules or multi-user system, where users need to work with the data of others, but do not know their exact location and content.

The method consists of five steps, which are designed to standardise operations and to maintain order. In the case of a well-designed information system, the database should perform all these steps automatically. When the information system is poorly designed, or not used at all, that's the right time to apply the 5S method, for example during audit of corporate knowledge, the transition to an information system, migration or data synchronisation.

The 5S method consists of the following five steps:

Figure 10.2. 5S



1. **Remove the unnecessary** – removal (deleting or archiving) of unnecessary or duplicate data making space in the storage, clarify searching and increase the overall performance of the system.
2. **Sort** – sorting of the data, speed up searching and create a clear structure, this structure is appropriate to also be established with regard to the frequency of use with the data.
3. **Clean** – regular removal, data archiving, simplification of documents and forms help reduce hardware requirements for ICT infrastructure and keep the system transparent.
4. **Standardise** – standardisation establishes the rules for working with knowledge and defines exactly how to proceed in the first to the third step, so that activities can be repeated according to predefined rules, at the same time the metrics for monitoring and maintaining these rules are established.
5. **Storing** – the last and most important step is storing. If the established standard is not kept, it is very likely that you will return to the starting position, i.e. the system without applying 5S methodology.

When storing data and information in the central data storages, this method is suitable for the implementation of knowledge audit, and a subsequent arrangement of knowledge into a meaningful structure.

10.2.4. Ergonomics of the work

Ergonomics of the work (Liker, 2007) deals with the elimination of redundant activities related to performing the necessary action. In the area of working with information, ergonomics can be divided into a users work with the information system, searching for information in storage or for example machine work with information (database engines, data mining, etc.).

When working with the information system, we can examine the following:

- easy access to the most frequently used functionalities,
- friendly and simple user interface,
- sequence of form elements or a clear structure of offers.

Ergonomics in conventional storages, such as documents, is mainly due to the user environment of the operating system or the application to data and files management.

Ergonomics can be affected by various user settings, such as font or icons size. Furthermore, it is creating folders and files names, their attributes (data of creation, change, the file type, etc.).

Sorting files by the name of the file can also help, if we enter the file name an attribute according to which we will distinguish the files and therefore we affect also the position in the folder.

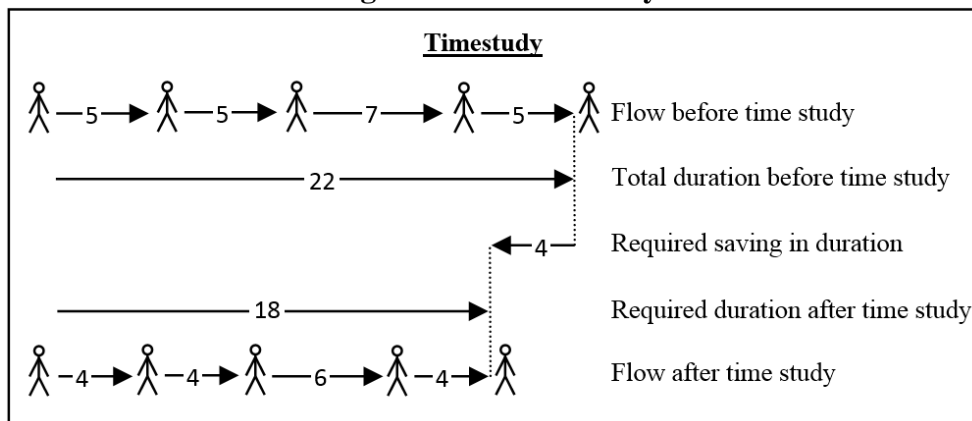
In machine (automatic) working with files you can use ergonomics, especially by editing the indexing rules etc. The following chapter entitled time analysis will be more devoted to measuring ergonomics.

10.2.5. Time analysis

Time analysis (Liker, 2007) is especially useful in the design of a user interface in the newly developed information system, or in assessing the impact of changes to the organisational structure of information and knowledge in the directory structure. For this type of time analyses, the methods existing under the name of MOST or MTM are suitable; these types of analyses are suitable for regularly recurring tasks. For example, calculation of the time needed to establish a new invoice with accounting software or any more demanding form.

Another method is common chronometry which is used to create a time frame of working day of the user of information and knowledge in the enterprise. On its basis it is possible to perform tasks related to speeding up their work, which consist of easier access to the information sought. Same as the MOST or MTM methods, this method is also suitable for regular operations, but the results of this analysis can provide a comprehensive overview of the workload of the staff or user.

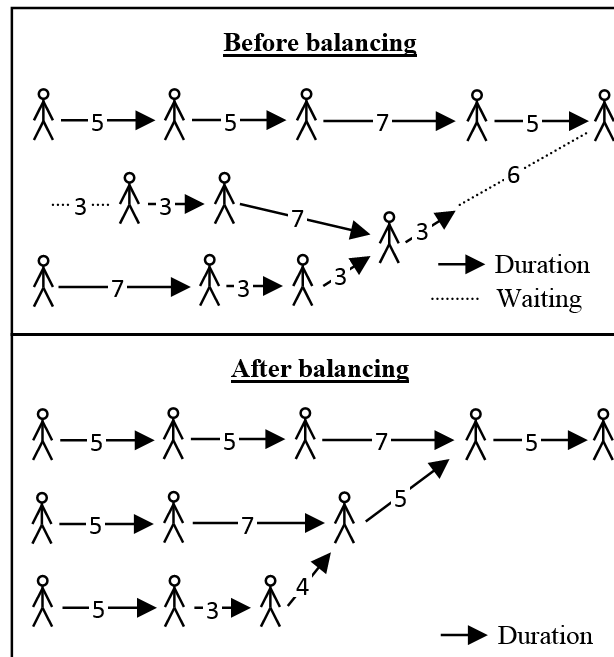
Figure 10.3. Time-study



Time analyses can be used for machine search. The output of such an analysis can include checking the appropriate indexing, which affects the

speed of searching in a database, and therefore the demands on the whole system performance.

Figure 10.4. Time balancing



Using these methods before the introduction of the information system is possible by a re-analysis after its implementation to determine the real return on investments in the information system or changes in knowledge management, which consists mainly in saving human capital that, can be used effectively in activities that cannot be fully automated.

10.2.6. Value flow mapping

Value flow mapping method (Mašin, 2013) is used in the sphere of production to eliminate excess inventory in the process and to achieve the perfect Pull principle of one piece across all manufacturing operations. Achieving this goal is nearly impossible in terms of the real production plant.

Application of this method could be compared with mapping the flow of knowledge within the company through the creation of ontological knowledge map, including owners, authors and recipients of the knowledge. After the classification of the created ontological model, the elimination of duplicate data and links that reduce the system performance and increase storage size requirements should be possible.

As noted in the examples under each method, all the above mentioned methods can be used in enterprise knowledge management and its optimisation.

10.3. Use of the lean enterprise methods in the design of a user interface

In designing user interfaces, software companies often neglect the ergonomic requirements of the customer. The design of user interface often ends by clarity of the interface and the opinion of the application tester. In designing the interface, companies should focus more on communication with customers, especially end-users of the application, who often are not involved at all in the development and the demand of the information system.

Watching operating habits of users or testing by end users can help reveal flaws that would have to be removed under the additional system modifications.

In the design we can use the time analyses and ergonomics methods of the work. To find out what form filling procedure is the most appropriate and fastest for users. It can also significantly speed up the adaptation of a customer to new solutions.

In the design of the user interface it would be appropriate to link the existing databases (such as gradual auto-completion of address according to the postal code), to make entry forms as easy as possible. Appropriate segmentation of the form elements and their logical sequence is also important.

10.4. Options of the application in a real environment

Investing in the implementation of lean enterprise methods is mainly due to time-consuming. A lot of businesses don't want to invest time for two reasons. The first reason are the necessary costs in wages associated with "man-hours" that employees spend by working on the project; and the second reason is the difficulty to prove the cost savings resulting from the application of the above mentioned methods.

We can still find a model among large enterprises, where corporate knowledge is not controlled in any way, bearers of information and knowledge are common electronic documents stored in folders on shared storages without controlled access.

Structure of the data in storage is in the best case clear and central. In the worst case, the knowledge is held in the storage by its creator in the hierarchy, which makes sense only to the owner, so it's easy to lose knowledge simply by the loss of a worker.

Although it would be ideal to have a comprehensive information system that would cover most of the knowledge flows in an enterprise, there will always be areas that often change, in which it would be necessary to have frequent changes in the information system. It is therefore not possible to implement an information system in larger companies that would cover all company documents. For this reason, there are document management systems, which partially solve the issue of chaos in documents, in exchange for spending more time by saving documents.

In these enterprises it is appropriate to apply the lean enterprise methods that can help us to see the waste in internal knowledge flows.

10.5. Conclusion

Applying lean enterprise methods can achieve optimal implementation and mainly maintenance of knowledge management in an enterprise. At present, in the design of information and knowledge systems there isn't enough attention paid to the optimisation of the user interface. It can result in

challenging and expensive modifications or the need to learn how to operate the system that will never fully satisfy its users. Poor interface can lead to errors and a need for higher mental concentration, leading to the user suffering premature fatigue. With suitable design and optimisation of an information system or knowledge management, these shortcomings can be avoided. It is appropriate to use the lean enterprise methods for optimisation, which were described in this paper to avoid potential complications by end users not adopting the solutions.

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11. The Social Media Use within the Customer Knowledge Management

Lukáš Kučera

Abstract: Nowadays, in the very turbulent times, it is essential for organisations to gain a competitive advantage and also a better market position. One way how to achieve these aims is to implement elements of the Customer Knowledge Management. The aim of this article is to introduce the Customer Knowledge Management and also on the practical example from the area of retail business to analyse the social media services use. The Social Medias are very important and effective tool of the Customer Knowledge Management. The four main components of social media are micro-blogs, social networks, mobile applications and discussion forums. The results of the analysis show the observed retail chains do not use social medias too much but there is a certainly scope for their better and more effective use. If the retail chains use the social media more and better they would have possibility to ensure effective and efficient interaction with their current or potential customers and they could improve their market position.

Key Words: Customer Relationship Management (CRM), Knowledge Management, Customer Knowledge Management, Social Media.

JEL Classification: M15.

11.1. Introduction

Nowadays in highly competitive times it is necessary for organizations to look for various ways how to take the advantage against their competitors. One way how to achieve this aim is to implement the elements of customer knowledge management to all processes in the organization. As the name indicates, the customer knowledge management is an interconnection

between customer relationship management and knowledge management. Various surveys have shown that nowadays there is absolutely inappropriate to look on these areas separately, but there is useful to connect and unify those areas. The aim of this article is to introduce the customer knowledge management and also on the practical example to present the importance of social media as a one of the main tool of the customer knowledge management.

11.2. Problem formulation

Zhang (2011) states that only organization, which can effectively and continuously create new knowledge, are able to have the competitive advantage. These organizations have to manage their knowledge in an effective way. For decades, organizations have learnt about the knowledge value and today the knowledge are considered as very important tool in business practice. According to many researchers we can see the transfer from knowledge management to the customer knowledge management and social software. It is obvious customer knowledge management to be a interconnection of two previously separate disciplines:

- Customer Relationship Management,
- Customer Knowledge Management.

11.3. Customer Relationship management

According to Wessling (2002) is the customer relationship management an active creation and maintenance of long-termed beneficial relationship between organizations and their customers. It is also necessary to ensure an effective communication. Four basic elements of customer knowledge management are as follows:

1. People (human capital, customers).
2. Business processes.
3. Technology.
4. Contents.

In general, according to Wessling (2002), it is important to say that the main aim of the Customer Relationship Management (CRM) is to be a

comprehensive methodology of creating economically advantageous and beneficial relationships with customers. The emphasis is given to the qualified personnel – using the methods of social psychology, to the integration and further expansion of current technologies and also to the correct orientation of business processes and the exchange of values between organizations and their customers. Kotler and Keller (2007) add the CRM is the process of managing detailed customers information and also of the effective coordination of all contact points in which the contact with customers is realized.

According to Madhoushi et al. (2011) the CRM is considered as the tool of contact between organizations and customers through loyalty programs, various kinds of electronic messages etc. CRM omits the largest source of value – customer's knowledge. Madhoushi et al. (2011) sees the need of interconnecting the CRM with knowledge management because this interconnection is the only way how to achieve the risks reduction in the strategic decisions making relating to the loyal customers maintaining. Abadi (2007 In Madhoushi et al. 2011) adds that only the organizations that manage customer's knowledge can have success on the market.

11.4. Knowledge Management

Kozubek (2012) defines knowledge management as a purposeful managing of creation, acquisition, sharing and using of knowledge. Knowledge can be defined as an individual person's ability to process information, search data sources and use them in a creative way. According to Sedighi et al. (2012) knowledge play a significant role in current turbulent environment. Many organizations are seeking through the knowledge management implementation to take a competitive advantage. Knowledge management is a systematic method for managing knowledge through the process of collection, organization and communication of skills.

Knowledge management is focused on optimizing the knowledge to improve the organizational performance through various processes, methods, tools and techniques. Sedighi et al. (2012) assert that only organizations which focus on their customers' needs and wishes can have success. Guozheng and Yun (2005 In Sedighi et al. 2012) states that an

indispensable resource for knowledge management is just customer relationship management. Customer's knowledge forms the basis for building a long-termed beneficial relationships with customers. Hualin and Zhongdong (2010) consider the customers knowledge to be a summary of experience, values and situation information –these are required, processed and used by experts.

11.4.1. Customer Knowledge Management

Customer knowledge management can be described (Zhang, 2011) as the process of collecting, sharing, transferring and using data, information and knowledge related to the customers in order to improve the market position of the organization. These processes can take place:

- between customers,
- within the organization,
- between the organization and customers.

Customer knowledge management is the combination of customer relationship management and knowledge management and is characterized by five fundamental characteristics (Zhang, 2011):

- prosumerism,
- team-based learning,
- joint innovation,
- joint creativity,
- intellectual property sharing.

In years 2001 – 2009 there was a high failure rate of CRM systems implementation and therefore organization began to look for alternative ways of creating, maintaining and developing relationships with customers. This creates new web and social applications that have opened new horizons for the organizations. As the social software we can consider software which supports, expands or acquires added value of human behaviour, shared governance, musical tastes, photo sharing etc. Boyd (2006) states the basic types of social software:

- Web services,
- Wiki applications,

- Social networks.

In order to implement successful customer knowledge management and also to ensure maximum return of customer relationships it is necessary to consider the customer knowledge management as the “swing system” (Sedighi et al., 2012).

According to Sedighi et al. (2012) the customers knowledge can arise either its creation or otherwise by its acquiring – acquired information have to be organized in accordance with their content. Next, it is important to integrate new knowledge with the older ones and the last step is a distribution of the knowledge throughout the organization. Customer knowledge management process can be divided into four basic phases:

1. Knowledge creation.
2. Knowledge preservation.
3. Knowledge transfer.
4. Knowledge application.

Peng et al. (2009) assert that the customer knowledge management deals with the management and use of these knowledge:

- Knowledge about customers.
- Knowledge from customers.

Gebert et al. (2003) focuses on this structure of knowledge:

- Knowledge about customers.
- Knowledge for customers.
- Knowledge from customers.

11.5. Social media

According to Chua and Banerjee (2013) social services are on-line services that encourage social interaction between users, enabling them to jointly create, search, share and evaluate different information. Kaplan and Haenlein (In Chua and Banerjee, 2013) and that social media represent a group of web-based applications that build on the ideological and

technological base of Web 2.0 and enable the creation and exchange of content generated by users. Social media has changed the users from the passive readers to co-editors of content – their role is increasingly important. The four most used social services include:

- Microblogs,
- Social networking services,
- Mobile local services,
- Discussion forums.

Social software presents in commerce sphere the social and networking programs used by companies to organize the internal and external communication. If the organization implements social software, it can create virtual communities for current and potential customers for having possibility to communicate with each other, share information and knowledge about products and services.

11.6. Methods

In the following part of the article the level of use of the above-mentioned social services will be analyzed. The analysis is performed by the international retail chain Schwarz Gruppe, which operates on the Czech market with two kinds of retail units – Kaufland hypermarket and Lidl discount store.

11.6.1. Problem analysis

Schwarz Gruppe is German retail chain that operates in the Czech Republic with two formats of retail stores – Kaufland hypermarket and Lidl discount store. In total 112 Kaufland retail stores and 230 Lidl retail stores operate in the Czech retail market. According to the official report of Incoma GfK this retail chain had the revenues of 68.6 billion Czech crowns. The following table summarizes the use of social services by Kaufland and Lidl retail stores in the Czech Republic and Germany.

Tab. 11.1. Social networks use by Kaufland and Lidl retail chain in the Czech Republic and Germany

	KAUFLAND		LIDL	
	CZECH REP.	GERMANY	CZECH REP.	GERMANY
Microblogs / Blogs				
official	NO	NO	YES	YES
unofficial	YES	YES	YES	YES
Social networks use				
YouTube	NO	YES	YES	YES
Facebook	YES	YES	YES	YES
Google+	NO	YES	NO	YES
Twitter	NO	YES	NO	YES
LinkedIn	NO	YES	YES	YES
Mobile applications				
OS Android	NO	NO	YES	YES
OS Win. Phone	NO	NO	NO	NO
iOS	NO	NO	YES	YES
Symbian	NO	NO	NO	NO
BlackBerry OS	NO	NO	NO	NO

Discuss forums				
official	NO	NO	NO	NO
unofficial	YES	YES	YES	YES

Source: author

From the table mentioned above it is clear the retail chain Lidl uses more services of social media. It is obvious this state is related to the orientation of both retailers to different customer segments, whether in the Czech Republic or Germany. The retail chain Kaufland uses only the Facebook social network while in Germany uses all available social networks.

Other forms of social media are not used by Kaufland retail chain in the Czech Republic either in Germany. Lidl retail chain uses more services of social media – in the Czech Republic Facebook, YouTube, LinkedIn and mobile app Lidl. In Germany this retail chain uses all most spread social networks and also mobile app.

11.6.2. Official microblogs and blogs

Retail chain Lidl uses official blog, retail chain Kaufland does not (see Tab. 1). A typical example of blog used by retail chain Lidl, is the “Lidl’s kitchen”. Blog is available on the website:

<http://kuchynelidlu.cz/blogy/kulinarska-abeceda>

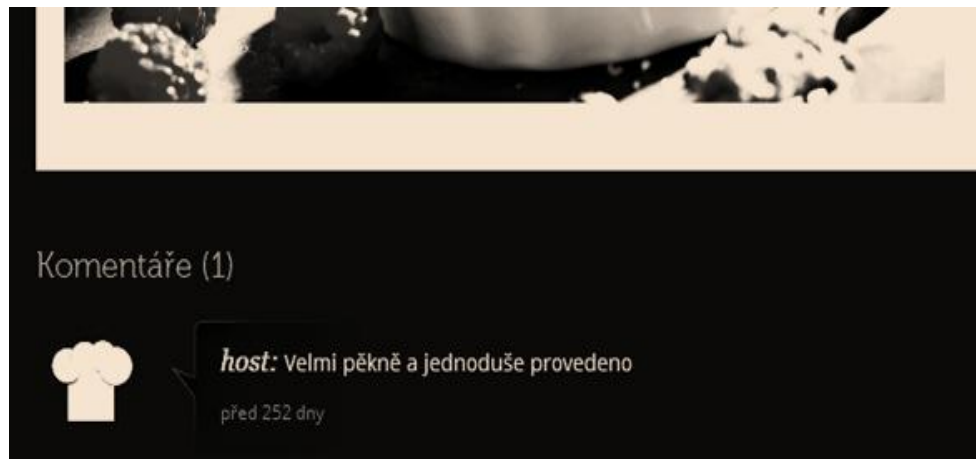
Within this blog various recipes, culinary advices, incl. help videos are presented there. On the webpage there is a space for customers to comment the contributions, sharing information etc.

11.6.3. Social media use

Kaufland retail chain uses from the social media only the Facebook social network (see Pic. 2). This page presents basic information about the Kaufland and various others information (special offers, receipts, loyalty programs etc.). All posts may be commented or shared. The site also

provides a space for customers to leave there their comments, questions or opinions. The employees of information centre reply on these comments.

Figure 11.1. The blog of the retail chain Lidl



Source: (Lidl ČR, 2014)

Figure 11.2. The official Facebook Site of Kaufland retail chain



Source: (FACEBOOK. Official websites of Kaufland retail chain, 2014)

11.6.4. Mobile apps

Mobile app for smart-phones with Android or iOS is run only by the Lidl retail chain. The mobile application provides the following services:

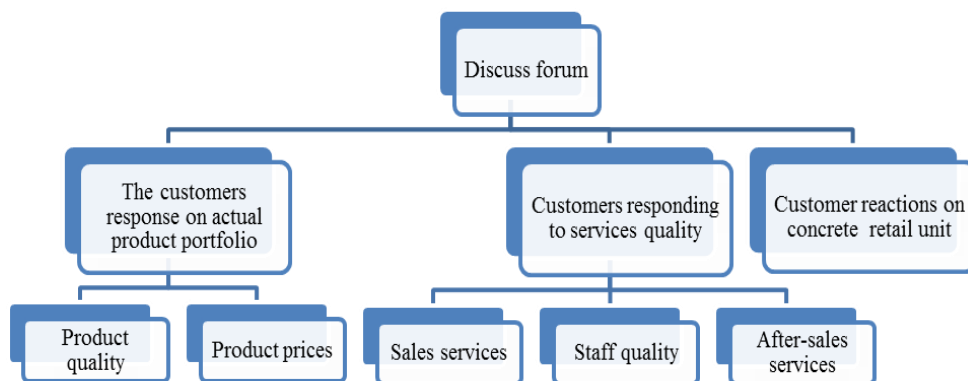
- current information about special offers or other actions,
- nearest shops finding,
- listing all actual flyers,
- setting a reminder for the selected action products,
- detailed information about retail stores etc.

11.6.5. Discuss forums

None of the analysed retail stores provide official discuss forum. For a certain type of discussion is possible to regard social networks where users can be registered and they can share their opinions, product experiences etc. This discussion may also involve retail store employees who are responsible for social networking sites to manage.

11.7. Discussion

Figure 11.3. Factors which may be followed by retail chains



Source: author

Summing up the situation it is necessary to say that social media play significant role in all kinds of knowledge, i.e. within the knowledge about customers, knowledge for customers and also within the knowledge from customers.

Tab. 11.2. Social media impact on knowledge types

	Knowledge for customers	Knowledge from customers	Knowledge about customers
Social Networks	Help organizations to provide customers with knowledge about changes in the product portfolio etc.	Enable organizations to gain knowledge about how the customer reacts to changes	They facilitate the accumulation of shared knowledge about customers – facilitate customer loyalty program
Mobile apps	Help organizations to provide customers knowledge about events, discounts, appropriate stores etc.	Enable organizations to monitor comments and tips from customers which can be a useful source of information from	Enable the connection of geographically distant customers and help organizations gain knowledge

		customers.	about customer preferences in various place
Discuss forums	Enable organizations to provide expertise to customers by publishing content that relates to their existing products and services, as well as ideas that are currently in the experimental phase	Encourage clients to express their needs, doubts, shopping plans and new ideas, which in turn are an important source of knowledge.	Encourage the exchange of customer know-how. This exchange is monitored and reveals knowledge about customers in the form of opinions, preferences etc.

Source: (Chua, 2013)

11.8. Conclusion

It is clear that social media services could be an important tool of customer knowledge management a thanks to their use it is possible to ensure effective and efficient interaction with current but also with future customers. Social media use analysis by the most important retail chain in the Czech Republic, Kaufland retail chain, indicated certain deficiencies in their use (e.g. in comparison with Germany). For the retail chain it is nowadays important to realize the importance of social media which could help to improve the market position of the organization. In the Czech Republic social networks are used – not only the Facebook network, but also other ones like LinkedIn, YouTube etc.

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12. Dissemination of Warning Messages Using Encryption

Tomáš Žižka

Abstract: *The article addresses the problem of disseminating critical information during emergencies. The whole concept of this work is based on two model scenarios. The first situation describes possible problems of information flow in case of mass traffic accident. The second situation is based on a model scenario where, in a certain area is spotted a wanted criminal and the authorities need to ensure security within the area and prevent access to civilians who are approaching to this area or already are in its vicinity. Whether, from the perspective of the recipient, the warning message is going to be encrypted or decrypted depends on the receiver's position (e.g. Mobile phone equipped with GPS system). The article offers a possible view on how to improve the efficiency of transmission of information in the case that such emergency situations occur.*

Key words: broadcasting, cryptography, decryption, emergency, encryption, GPS.

JEL Classification: L86.

12.1. Introduction

Various types of disasters, accidents and emergencies represent an integral part of our daily lives. These emergency situations influence us, either indirectly or directly, when we become active participants in these even life-threatening events.

It often happens that in state of emergency, accurate information is available only to people that are not affected by the disaster directly, meaning the people who learn about the current situation through different media channels. While on the other hand, people directly affected by the threat, do not receive the information at all or with a significant delay which may be considered as a crucial problem in the area of disaster communication.

Disaster-related information can be divided into two types: information prior to an emergency / crisis situation (e.g. information that a flood wave is about to hit a village) and information that needs to be shared during the critical event after it took place (e.g. mass accident on the highway).

At first, it is necessary to define what can be considered as an emergency. Emergency can be defined as an event or a situation that appears in a border specific environment and that may be a result of many causes such as natural disasters, accidents, criminal activity, disease, threats to critical infrastructure, internal security and economy (Coombs, 2010). The most common examples of emergencies are floods, storms, fire outbreaks, traffic accidents, plane crashes and threats to public safety as a result of criminal or terrorist activity.

The transmission of relevant information to affected stakeholders during natural and human-made extreme events and other type of critical situation has always been considered as a significant challenge. However, in today's "modern world", where the development of information technology is rapid, multiple advanced technical resources that can assist in the early and timely distribution of critical and important information to desired locations are available. But, as it turned out in the recent past, we often encounter with situations

(e.g. mass traffic accidents, floods, fires), when transmission of necessary and sometimes vital information has not been effective or failed completely for various reasons.

As a consequence, the question is how could we effectively use available technology to ensure that in case of an emergency or crisis situation, important information will be delivered to affected individuals on time, in an understandable form and moreover only to locations where the warning or informational message will be useful. For example: Is it possible to have timely information that we are approaching to the traffic accident that happened a few moments ago? Or is it possible to be informed that we are approaching a building, which is threatened by a dangerous person?

The aim of this paper is to outline possible methods of information dissemination in emergency situations where public safety is at risk. The proposed models represent an innovative approach how to make the informational flows more effective during crisis situation. A common

denominator of both model situations mentioned in this article is the Radio-Help system which is described in the following sections.

The first model describes situation in traffic that occurred after mass car accident. This model is based on the previous paper titled “Distributing emergency traffic information” (Kubát et al, 2012). The second proposed model outlines possible methods of distributing information in emergency situations that, additionally, require data encryption, so that they are readable only in a certain location/position. Ensuring safety during criminal activity or terrorist attacks is one of the areas where the coding of information based on the position of the receiver could be extremely useful.

12.2. System requirements and model situations

Citizens in today’s modern world are increasingly confronted with situations that require obtaining relevant information in real time and thus enable them react on emergency or unusual situation by adequate way. This information is usually needed only in certain bordered areas. In neighbouring or more distant locations such information has no meaning, and vice versa citizens, it is important for people in these places that they have to receive different information (e.g. reassuring information, that they are not threat by extraordinary events in the neighbouring area). (Skrbek, 2009)

12.2.1. System requirements

The idea of transmitting information which can be additionally encrypted with algorithm based on the receiver’s location, does not necessitate the development of a completely new system, however the existing technological components and solutions will be integrated into new functional units.

The basic requirements are the following:

- Information must be available to everyone (citizens, visitors, etc.) who is inside the targeted area,

- The ability to encrypt information, based on geographic definition of the target area,
- Independence of the functionality of mobile networks and the Internet,
- The information provider must be a reputable source,
- Security and robustness of the system against abuse,
- The possibility of ongoing and continuous testing and verification of the defined functionality.

The basis of the proposed system for encrypted positional broadcasting is the use of system called Radio-Help (Skrbek, 2011). The aim of the present research team is to create a modern and innovative early warning system that will inform citizens during emergencies and crisis situations.

12.2.2. Introducing Radio-Help system

Radio-Help is based on simultaneous application of analogue receiver technology with digital content (HD RADIO and DRM) or all-digital broadcasts with the possibility of defining the positional coordinates via GPS. HD Radio technology company iBiquity Digital Corporation has been selected in 2002 in the U.S. as a key technology for the digitization of radio broadcasting. Currently, this technology carries a large percentage of U.S. radio stations. HD Radio technology uses the principle of superposition of the digital signal to analogue signal. The technology of Radio-Help is in detail described in Skrbek 2011.

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

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

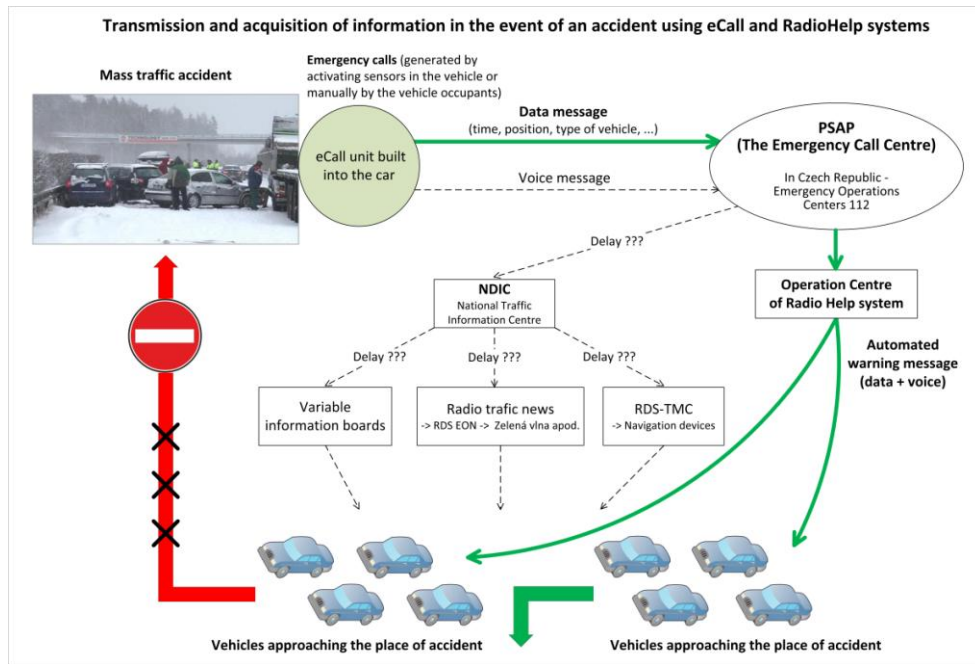
This solution also has a distinct advantage when total power failure, a risk which we are often confronted with. Using this technology offers the possibility of permanent informing the population about the current situation. The system also provides direction to a particular broadcast receiver, which could also be a specific distribution of information to specific groups of people such as representatives of municipalities or other groups of civil servants.

12.2.3. Model situations

The first model is based on the situation where a mass traffic accident becomes on a highway. Currently, there is no technology tool in the Czech Republic, which would ensure that the information about accident gets to drivers approaching to this place during few seconds. The proposed model shows that the cooperation of Radio-Help with eCall technology can ensure that drivers receive important information in a timely manner. The message will be displayed on a mobile phone of a driver (or on other type mobile device) and in addition it is assumed that the driver will be alerted to the upcoming danger also by a forced voice message. Drivers would be able to adequately respond in a timely manner and also if drivers are close to any highway exit, they could leave planned route and bypass the place where the accident happened.

Transfer of information in the case of using these technologies is shown in Fig. 1, where solid lines (green colour) show the flow of information which will the driver receive with minimal delay. The dashed lines represent information flows that correspond with technologies which are used today, including RDS, RDS-TMC or variable information boards. Dissemination of these information is provided and coordinated by the National Traffic Information Centre (NDIC). Unfortunately, the time required to deliver a message to the recipients is in the order of minutes, not seconds. The result of this is that drivers cannot bypass the accident and get stuck in a traffic jam, or worse, become participants of the mass accident.

Fig.12.1. Transmission and acquisition of information in the event of an accident with the use of eCall and Radio-Help

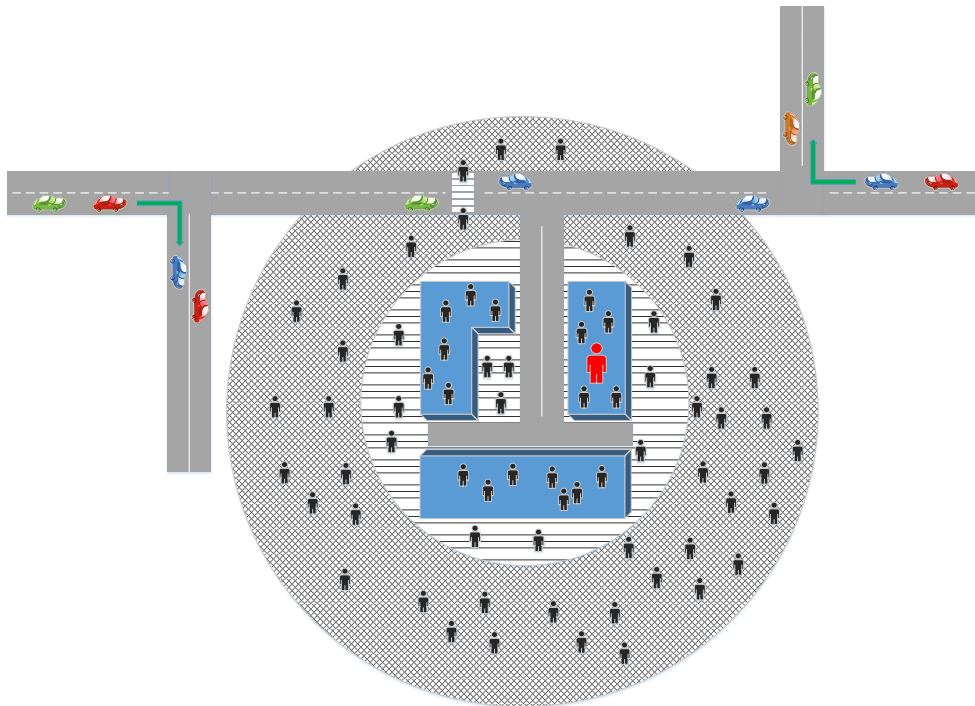


Source: author

The second proposed model is based on the following model situation. A nationwide wanted criminal is spotted inside the building, which belongs to a certain industrial company. The Czech Police coordinates the measures needed to be taken in order to secure safety within the area that is part of the company. Moreover, besides the internal safety ensuring process, another critical police task is to warn the citizens, who are approaching to, or who already are near the given industrial company, and advise them to avoid or leave the dangerous area. Therefore, it is necessary to define the message target area with regard to the industrial company (or in case of other type of emergency with regard to the epicentre) so that only people located in the nearby area around the company, and therefore aspiring to find themselves in imminent danger, would obtain the broadcasted police warning.

As the flow of information within the company is coordinated by the police, the possibility of confusing the company visitors inside the industrial resort with a transmitted message originally intended for another group must be eliminated since it could lead to panic and unwanted behaviour. It is also important that messages distributed through chosen information channels will be kept unreadable and indecipherable (encrypted) for the criminals.

Fig.12.2. Graphical representation of the second model situation



Source: author

A graphical representation of such a model situation is shown in Fig. 2. The area where the decrypted message (a clear warning) should be received is marked with cross pattern. The area of the industrial company and the circle with line pattern represent areas for which the message is encrypted. The location of the described, armed criminal is marked as icon figure that is

larger than the other. Detailed information about solution of this situation is described in the next chapter.

12.3. Technical attributes of positional based broadcasting

In both cases, is above described system Radio-Help intended as basic technological platform for solution early warning before impending danger. In the first described situation is expected utilizing the technology which is known under name eCall. In the second case it is assumed the use of technology, which was published under name of Geo-encryption. The eCall system will be based on the basis of a single European emergency number 112 and consists of three basic components: the on-board vehicle unit, a mobile telecommunications network and public safety answering point (PSAP). The eCall technology is in detail described in Kubát 2012.

The second tool that will be utilized as an additive feature to the above mentioned technology, with the ambition to create a design of a modern and innovative application, is the position based encryption/decryption algorithm. The location based encryption algorithmic procedure is also delineated and utilized by multiple researchers who have already developed and tested its functionality on mobile users.

Scott and Denning et al. (2003) proposed a data encryption algorithm called Geo-Encryption using the GPS. Its functionality was based on the traditional encryption system and communication protocol. For the sender, the message was encrypted according to the PVT (Position, Velocity, Time) of the receiver.

Furthermore, Liao et al. (2008) designed and implemented the Location – Dependent Data Encryption Algorithm (LDEA). The position based encryption concept was also inspired by a similar approach called Location Based Services (LBS) the importance of which was thoroughly analysed and underlined by Mohopatra and Suma (2005).

Location Based Services can be classified into four categories (Mohaparta & Suma, 2005):

- Emergency services
- Information services
- Tracking services

- Entertainment services

Taking into consideration the emergency and information services categories and also the target operation of the functionality defined by the present paper, we can realize that a prospective encryption algorithm, dependent on the position of the mobile user can be derived from existing similar algorithmic approaches and used with the purpose of extending the RADIO-HELP functionality and so helping to prevent the undesired actions and behaviour within a target area.

Location-based encryption or geo-encryption is an encryption method, in which encrypted text (ciphertext) can be decrypted only at a certain specific location. If someone tries to decrypt the message at another place the decryption process fails and reveals no details about the original information.

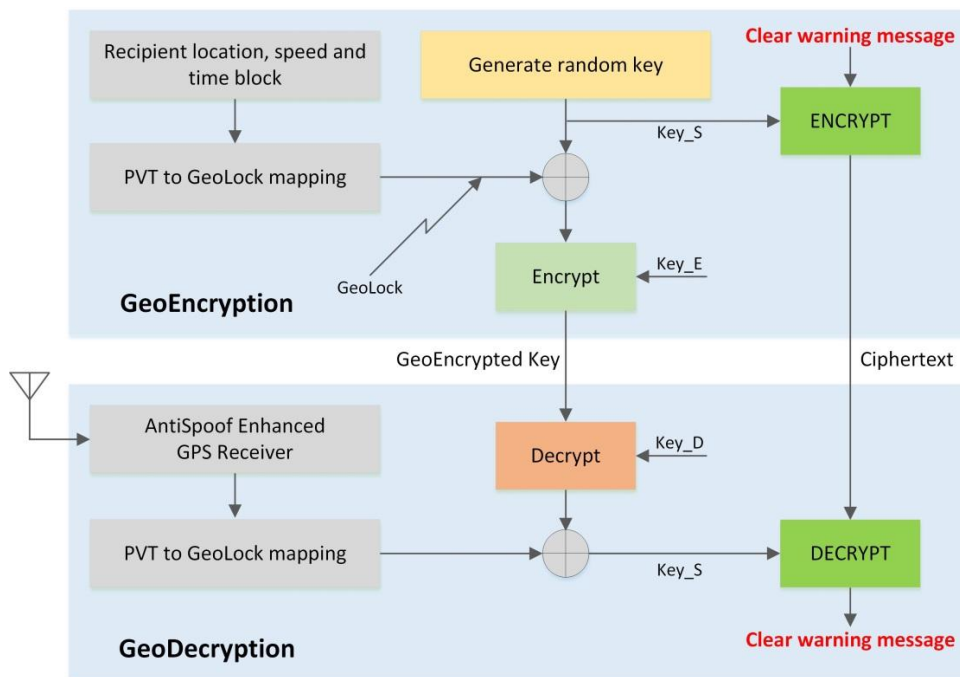
The proposed system, solving the model situation introduced in this paper, relies on the principle of early warning messages broadcasted to citizens within and outside a defined area, where for example, as it was stated above, the criminals and suspects are spotted by the police, and police actions against the latter is about to take place. The core characteristic of the transmitted messages is that they must be based on a position. As a consequence, the data sent inside the defined area where criminals are found in a certain moment, or where is the epicentre of other crisis situation, will differ from the data content which will receive the individuals who are at that time only nearby this area. In other words, the broadcasted warning message has to be sent as encrypted (i.e., ciphertext) when it is addressed to the citizens inside the target area and as a plain text or decrypted when it is addressed to the people outside the defined area.

It follows that the algorithmic approach which is related to the encryption/decryption procedure of the early warning messages should take the following steps: a) encryption of the broadcasted message and b) decryption of the message when i.e. the mobile user is found outside the region.

Multiple message encryption/decryption algorithmic approaches exist, such as the symmetric, asymmetric, hybrid and Geo-encryption (Scott & Denning, 2003). Fig. 3 presents the geo-encryption algorithm, since it is an

approach that takes into consideration the location of receiver, which is, as it was already mentioned, a core characteristic of the desired system. However, the final algorithmic encryption strategy that should be added to RADIO-HELP system in order to create a complete and universal solution to the problem will be decided in further stages of the research.

Fig.12.3. Geo-encryption Algorithm



Source: (Scott, 2003)

The system could be successfully implemented also in other emergency situations, not just in case terrorist or criminal attack. The aforementioned area can represent a shopping centre, a bank, an industrial area, a park, a hospital or a public organization. When responsible authority receives information about the upcoming dangerous situation in the area the immediate action that should be taken according to our proposed model, in order to protect the lives of citizens and succeed in eliminating the danger to

which they could be exposed. The exact transmitting procedure is described in more details below.

12.4. Model of the message transmitting procedure

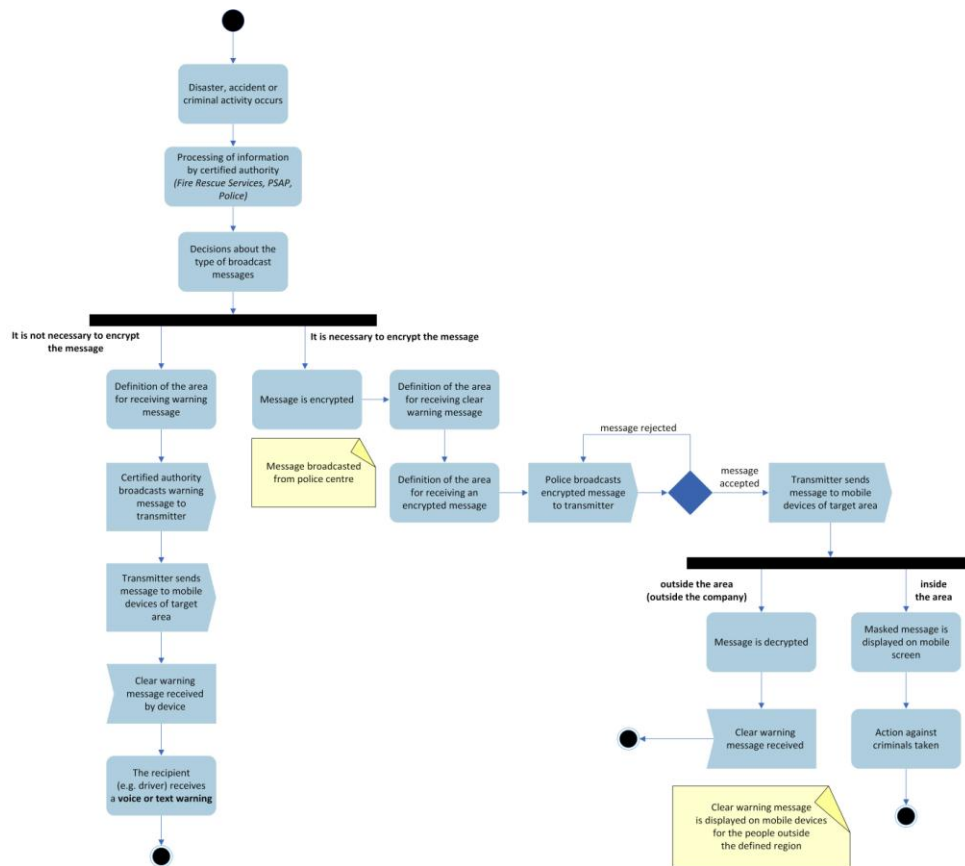
The final critical step of the system's conceptual construction was specification of the flow of the early warning messages broadcasting process.

If we use our model situation with criminal activity - as soon as the Police realizes the criminal's presence (i.e., one of the buildings of the company) there should be an immediate broadcast of a warning message to the citizens who are at that moment inside the area (centre) and at the same time an independent broadcast for those citizens who are outside the area so that they do not attempt to visit the defined territory. In the second case, the message is identified as an early warning protection message. The model of the activity and information flow with regard to the early warning message transmission is depicted in Fig. 4. The transmission procedure is initiated by Message encryption. Consequently, the text of the warning message is formulated and then encrypted.

The encryption is based on the definition of the target area of the warning message as well as on the special algorithm based on GPS coordinates related to this area.

The next step of the process is the transition of the encrypted message from the Police Operation Centre (or other responsible authority, depends on the type of the emergency) to a special transmitter. If the transmitter receives the incoming message correctly, the same message will be sent at once to civilians' mobiles, radios, car radios and other possible devices in a form of a text. For the group of users located inside the target area the broadcasted message, thanks to encryption, will be displayed as an advertising text and it will not be understood by individuals for whom the message is irrelevant or not intended to (it is desirable that for example criminals do not understand the messages transmitted by the Police). Moreover, this form of text will help the authorities to take action without causing panic among citizens.

Fig.12.4. Activity Diagram of the Early Warning Message Transmission Model



Source: author

However, the message will be also addressed to a second group of people outside the defined area. In this case it will be decrypted and displayed in its original form as a clear warning text. As a result, the second group will be successfully and timely informed of the forthcoming danger and will avoid the specific area.

12.5. Conclusion

The paper pointed out the possible methods of critical information distribution in case of mass traffic accident and in the case, when citizen's safety is at risk in relation to possible criminal activity inside certain building or complex of buildings. Both models should be future additional elements to the existing concept of RADIO-HELP system, which will ameliorate its functionality.

In the recent past has happened several times that in emergency situations (e.g. floods) often fail mobile network either due to congestion or due to damage to the infrastructure of mobile operators. One of the main advantages of the concept of Radio-Help is just independence on these existing distribution channels (e.g. mobile networks, Internet).

Unfortunately, the practical application of Radio-Help is not only about final completion of the entire design on campus, but also related to the political and legislative situation in the Czech Republic. Another problem is proposed long wave broadcasting.

In the Czech Republic is currently the only one such transmitter named Topolná, which will be in operation by the end of February 2017. However, the principle of HD radio can also be applied to short-wave radio broadcasting.

In the case of the second model described in this paper, in which it intends to use encryption based on the position of the receiver, some core issues occurs. These problems were discussed as possible obstacles of the execution of the process in practice and during real crisis situation, were the following: a) the limit or border between the region inside and outside the target area and its definition, b) the type of the message sent to people inside the area (encrypted) and outside the area (decrypted), since the message will be received by criminals as well and will try to escape, c) algorithmic encryption/decryption methodologies and finally, d) the technology utilized regarding the data transmission (medium of transition – transmitter, receiving devices, etc.), e) process of developing mobile application that will be able to operate on the basis of the principles set out in this paper.

Despite these problems, the models described in this article demonstrate, that on conceptual level, there are suggestions on how to improve the distribution of vital information in case of emergencies and crisis situations. These models will be further developed in order to apply them in practical application.

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13. Concept of an Early Warning in Traffic and Its Implications

David Kubát

Abstract: *This paper aims to assess the current situation and to identify weaknesses and influence of planned or proposed solutions in traffic.. The previously proposed solution was extended and the implementation of community navigation suggested. This should ensure faster response of the entire early warning system. Although financial savings associated with the implementation of the proposed solution are expected, this paper does not cover this dimension. In the second part there are results of a research presented. The research was focused on fears and worries related to obligatory using eCall system in new cars since 2015. It also discusses some related topic, especially privacy concerns in case of using mobile devices for navigation and dependency of those worries on users' characteristics. It also monitors people's willingness to have eCall installed in older cars.*

Keywords: *eCall, crashes, warning, information, Radio-Help, WAZE, data security, position tracking*

13. 1. Introduction

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

The second part of the paper aims at results of research related to peoples' worries about misusing their personal data and position tracking. The need of the research emerged from many doubts and remarks I encountered during presenting our proposed concept.

13.2. Currently used telematic methods

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

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

13.3. Short range planned method (eCall)

Project co-funded by the European Union aims to the creation of a system that enables automated reporting on accidents to the European-wide emergency line 112, including accurate information about its location. When the eCall device installed in a car detects an accident by means of sensors, it automatically sends a message to the nearest emergency centre, indicating the exact geographical location of the accident as well as other data. This system can be activated either manually by pressing a button on the dashboard by the vehicle passengers or automatically by the vehicle sensors triggered during an accident.

After the system is activated, a connection with the nearest emergency call centre (PSAP) is established transmitting both sound and data flows. The

sound connection enables vehicle passengers to communicate with professionally trained call operators while at the same time data channels are used to transmit data messages (MSD) to these operators.

Each message contains 43 details about the accident, such as time, exact location, car identification, eCall system status (whether the eCall was activated manually or automatically) and information about possible service providers. Based on this information, the operator will liaise with the integrated emergency services to direct them to the exact accident location as well as provide them with an exact description of the accident's severity and the number of injured. (Vávra, J., 2010)

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

Although this system brings a clear improvement of the current situation in terms of saving lives and providing quick health care during accidents, it does not provide a solution for distributing information about the accident to the drivers approaching the place of accident, i.e. who are potentially at danger. When using existing information channels, the acquired accident data could be made available in about 5-10 minutes via motorway information boards, RDS-TMC messaging and radio travel news.

However, each of these distribution channels has specific limitations and based on current traffic density the above-mentioned reporting times are clearly insufficient. The next disadvantage is a fact, that according to the system specification, it cannot locate the car before the emergency message is activated. It means that after activating the message, the system starts searching for satellites therefore a delay is inevitable.

There is also another point of view. This perspective takes in account the fact that although official places claim that there is no way how eCall could "spy" its users, there exists an official document named "Summary for citizens" that advises official places how to introduce eCall to citizens. In this document there is clearly stated that other advantages of the system are following:

- Less traffic jams caused by traffic accidents
- More effective control of traffic after traffic accidents
- The system could be used for other purposes – electronic road-toll, monitoring of dangerous wares, more modern models of insurance etc.
- Via this system automotive industry and telecommunication companies could provide new services.

This view tries to prove that implementing eCall will have next stages and their assertion will result in the real possibility of online tracking our vehicles. Unfortunately the document was withdrawn during working on this paper so the link is not valid. The original document is at disposal on an email of the authors of the paper.

13.4. System for Automated Forewarning of Vehicle Crashes

For better and particularly early distribution of warning information, a system called System for Automated Forewarning of Vehicle Crashes (the System) (Kubát, 2012) can provide remarkable help. This system has a data connection to the receiver systems-vehicle emergency call (e.g. eCall). The principle consists of full automation of generation and transmission of all relevant information about the accident to vehicles moving in its vicinity. The process of warning is initiated by the crashed vehicle, which will send information about the accident using eCall immediately after the collision happens together with the exact location of the accident. Information is received by the central office of the System which immediately generates data and / or voice information about the incident, including the positional code of the accident. Data will be sent via radio session and to car receivers as well. (Brunclík, 2010)

13.5. WAZE method

WAZE is a free social GPS application featuring turn-by-turn navigation. It means that the driver is led through every crossroad. WAZE is supported by Android, iPhone, Symbian, Windows Mobile. WAZE differs from

traditional GPS navigation software as it is a community-driven application and learns from users' driving times to provide routing and real-time traffic updates. It gathers map data and other information from users who use the service. Additionally, people can report accidents, traffic jams, speed traps, police patrols. It can also update roads, landmarks, house numbers, etc.

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

In addition to turn-by-turn voice navigation, real-time traffic, and other location-specific alerts, WAZE simultaneously sends anonymous information, including users' speed and location, back to its database to improve the service as a whole. This crowd sourcing allows the WAZE community to report navigation and mapping errors and traffic accidents simply by running the app while driving. According to WAZE, there were 20 million users in June 2012, who were doubled within a 6 month period. Over 3.2 billion miles had been driven by WAZE users.

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

WAZE does not get information only from its users but from NTIC as well. The reverse flow of information is not possible at the moment. Reports from drivers are verified by other drivers but WAZE is still not reliable information source for NTIC. Of course, even a WAZE user has a duty to report the accident on line 112. In this case the other WAZE users are informed two times. The idea is to allow information from WAZE report flow into NTIC which would then deal with it like with information from any other source. The data format of the information would have to be

standardized. After the standardization the information could be processed flawlessly. It would ensure better awareness on the input. If the information is properly verified it could be processed by the Radio HELP system immediately without causing delay in NTIC. WAZE implementation would take effect in case of traffic problems that are not life-threatening. In those cases eCall is not activated and drivers are not obliged to inform NTIC about the problem.

Security issues of the application are equal to security issues of any other application that can send positional data. And using the application is a person's choice opposed to obligatory eCall.

13.6. Comparing separate segments of each method

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

The situations on input can be following:

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

crashes, second driver reports the accident and third driver get a notice).

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

Data processing:

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

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

Output – message for drivers:

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

13.7. Research

The research was conducted to find out if and why people are worried of new technologies like smart phone GPS applications or eCall and if there are any dependencies on person's personal profile.

Questionnaire

The questionnaire was created with emphasis on the fact that each respondent is different. Therefore the questionnaire was branched so we could get useful information even from a respondent who does not own a car or mobile device. For example if he or she does not use a mobile device for navigation, there was a question: "Why do you think other people find using mobile devices for navigation useful?"

For the best variety of respondents the questionnaire was disseminated many different ways. Via e-mail (friends and family members), Facebook, idnes blog, car section on news server (garaz.autorevue.cz) and 1.9 % of questionnaires was filled directly on the server where the questionnaire was created. I avoided asking students because it would influence a diversity of results.

Composition of respondents

Total number of returned valid questionnaires was 210 from 250. 62,9 % were men and 37,1 women. Other respondents' characteristics are specified in tables 1, 2 and 3. Response rate cannot be figured out since this questionnaire was online. Therefore when a potential respondent decided not to attend the research, authors would not know it. All respondents were from the Czech Republic.

Tab.13.1. Age of respondents

	number	percent
under 18 years	6	2,9%
18 - 25 years	53	25,2%
26 - 30 years	42	20,0%
31 - 35 years	40	19,0%
36 - 40 years	29	13,8%
41 - 45 years	14	6,7%
46 - 50 years	8	3,8%

51 - 60 years	12	5,7%
over 60 years	6	2,9%
total	210	100,0%

Source: Authors

Tab. 13.2. Education

	number	percent
primary school	9	4,3%
skilled	11	5,2%
high school	92	43,8%
university	98	46,7%
total	210	100,0%

Source: Authors

Tab.13.3. Month family income

	number	percent
under 560 €	26	12,4%
570 – 930 €	51	24,3%
940 – 1300 €	50	23,8%
1310 – 1860 €	40	19,0%
over 1870 €	43	20,5%
total	210	100,0%

Source: Authors

13.8. Evaluation

Groups of users

In the first step basic groups of users were discovered. 74,3 % respondents own a car. 73,1 % car owners use smart phone and 68,4 %, e.g. 73 respondents' smart phone owners use it for navigation. People who do not use it for navigation have following reasons: 58,3 % users have dedicated navigation, 13,9 % use paper maps, 25 % do not need a navigation and 2,8% have other reasons.

The question „Would you like to have eCall installed in your older car?“ had also interesting responses. 40,6% respondents would install it if it cost less than 150 €. 10,1 % would install it if it cost less than 300 € and 52,2 % respondents would not install it at all.

Worries about eCall data misusing

In the next step the fear of data misuse when using eCall was evaluated. From total of 210 valid respondents 25,7 % was afraid of data misusing. One of aims of this paper was to find out what affects this privacy concerns. If it is gender, income of the family, age or education. Respondents were not told about possible misusing possibilities in advance and this was an open question (no possibilities were suggested).

Hypothesis claimed that there is no dependency of worries on observed property (age, income etc.). For finding out the dependency a Pearson contingency coefficient was used. The coefficient can reach values $0 \leq P < 1$, whereas value 1 cannot be reached. Calculations showed that the dependency in all investigated characteristics is very low. The strongest dependency is on age and the weakest on gender. Hypothesis has been rejected.

$P_{\text{age}} (0,254) > P_{\text{education}} (0,19) > P_{\text{income}} (0,125) > P_{\text{gender}} (0,039)$

Privacy concerns of social network users

After comparing answers to questions: “Are you afraid of misusing your personal data while using smart phone for navigation?” and “Do you use social networks?” was found out that from 35 respondents who are afraid of misusing their personal data 26 use social networks. So the question is: How righteous are those worries? People may think that Facebook or Google+ are safe because these social networks are widespread. In the contrary, eCall and social navigation software are relatively new systems and people tend to believe that new things could be suspicious.

Categorising worries

For more detailed overview of respondents' worries there were implemented some open questions in the questionnaire. Among them was the question: “How could be data misused?” This question was answered by smart phone users and their replies are in the table 4.

Tab.13.4. Categorising worries – smart phone users

worry	% of users
Position tracking	26.5 %
Marketing issues	23.5 %
Stealing money, property	17.6 %
Various ways	14.7 %
Voice monitoring	5.9 %
Identity theft	5.9 %
I don't know	2.9 %
Speeding tickets	2.9 %

Source: Authors

From users' replies is easily readable that the position tracking is not the only issue. Misusing for marketing purposes or stealing money is a privacy concern of many users as well. Unfortunately there were not more respondents so the results are not very significant.

Next important question was: "Why are you afraid of implementing eCall since 2015?" There are two main groups of respondent that have similar replies. Replies are summarized in table 5. Some replies correspond with facts discussed above, e.g. electronic road-toll is not only pointless fear but taking into account the official document it has some real outlines.

There is no doubt that implementing new technologies can improve reaction time in case of emergency situation. But in the contrary, there are facts that are not officially communicated to public. And after evaluating the questionnaire it can be claimed that citizens are not unconcerned about their privacy. There are some ideas how to improve the safety. For example to make eCall firmware open-source code. But the question is if this would be acceptable.

Interesting fact is that some people use social networks and their data are quite easily available but they are afraid of misusing data about their position. Certainly there is a different character of data but it still means that new technologies should be communicated honestly and carefully.

Tab.13.5. Categorising worries about implementing eCall

worry	% of users
Misusing with no detailed description (Big Brother, Czech law environment, distrust in state apparatus etc.)	34.6 %
Permanent position tracking	32.1 %
Various ways	4.9 %
Electronic road-toll, speeding tickets, travel orders etc.	4.9 %
Other answer	4.9 %
Voice monitoring	3.7 %
What is obligatory, can be misused	3.7 %
Marketing issues	2.5 %
I don't know	2.5 %
Distrust of official information	2.5 %
Hacking a server with users data	1.2 %
Distrust of employees of the system	1.2 %
Minimal law protection	1.2 %

Source: Authors

13.9. Conclusion

As a conclusion it can be seen that it would be useful to incorporate WAZE into NTIC. The verification could be done via three times confirmed report from WAZE users. It would still be faster than sending there police or fire department unit to check it out. Although there are some obstacles, it should be quite simple to incorporate information from WAZE server into NTIC. The question is whether NTIC will be willing to adopt this solution. The broader spreading of smart-phones and lower expenses for data plans could make things even easier.

There is no doubt that implementing new technologies can improve reaction time in case of emergency situation. But in the contrary, there are facts that are not officially communicated to public. And after evaluating the

questionnaire it can be claimed that citizens are not unconcerned about their privacy. There are some ideas how to improve the safety. For example, to make eCall firmware open-source code. But the question is if this would be acceptable.

Interesting fact is that some people use social networks and their data are quite easily available but they are afraid of misusing data about their position. Certainly there is a different character of data but it still means that new technologies should be communicated honestly and carefully.

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14. Resource Constrained Multi-Project Scheduling Problem: New Constraints for Project Activities and Production Resources and Alternative Fitness Functions

Martin Lamr, Tomáš Lamr, Pavel Petr

Abstract: *Extended approach thinking novel real world constraints and behaviour for resource-constrained multi-project scheduling problem in this paper is presented. A new approach for scheduling using genetic algorithm was designed and new constraints of manufacturing resources and projects were implemented. Four fitness functions were designed - minimization of project delays, project costs, project penalties and finally minimization of switching resources within projects.*

Key words: *Scheduling, RCPSP, Genetic Algorithm, Optimization, RCMSP.*

JEL Classification: *M15.*

14.1. Introduction

The area of resource-constrained project scheduling problem (RCPSP) has been a very popular topic in literature during the last decades. The number of articles dealing with this problem has grown even more in the last years. The overview of published works can be found in (Hartmann and Briskorn, 2010), (Kolisch and Hartmann, 1999), (Kolisch and Hartmann, 2006), (Lamr, 2010), (Lamr, 2011), (Lamr, Lamr and Petr, 2014).

Within the environment of a manufacturing company a large number of variables producing a vast number of possible solutions occur in the process of planning and scheduling of sources for project activities. Because of a very difficult resolvability, scheduling is termed as a np complete problem. It means that there are no known algorithms for finding an optimal solution in polynomial time (Blazewicz, Lenstra, and Rinnooy, 1983), (Özdamar and

Ulusoy, 1995). In literature there are simulated annealing (Kirkpatrick, 1983), tabu search (Glover, 1989), or genetic algorithms (Holland, 1992) and others most frequently used methods of solutions in RCPSP. The genetic algorithms (GA), which are one of the most suitable tools for RCPSP (Kolisch, 2006), were chosen as a suitable method for this work, too.

14.2. Formulation of the problem

In the following text initial conditions, limits, procedures and a tool used for solving the RCPSP under conditions of managing the project portfolio of a company will be described. An initial assumption is a limited set of resources, which is shared across by several parallel middle-large (the range of weeks) projects (Lamr, Lamr and Petr, 2014).

14.2.1. Projects

Let a set of all scheduled projects $Z=\{P_1, P_2, \dots, P_z\}$ be considered. Let there be a project P_p , where $P_p \in Z$ and $p \in \{1, 2, \dots, z\}$. Then for every project P_p there exist the following characteristics: $name_p$ is a name of a p -th project, $projPriority_p$ is a priority of the project, where $projPriority_p \in \langle 1; 100 \rangle$, the highest priority is $projectPriority=100$, $startDate_p$ is the earliest possible start of the project, where $startDate_p \in N_0$ is an order number of a day, $planEndDate_p$ is the latest possible end of the project, where $endDate_p \in N_0$ is an order number of a day, $bonus_p$ is a bonus price for every unit of time, when the project is finished earlier than its latest possible end ($planEndDate_p$), $malus_p$ is a penalty for every unit of time, when the project is finished later than its latest possible end ($planEndDate_p$), J_p is a project plan presented by a vector of the activities of the p -th project.

For the needs of a created approach for solving RCMSP let every project P_p be represented by a vector:

$$P_p = (name, projectPriority, startDate, planEndDate, bonus, malus, J), \quad (1)$$

14.2.2. Project activities

Let there be a project plan of the p -th project P

$$J_p = \{Task_0, Task_1, \dots, Task_n\}, \quad (2)$$

where $Task_j \in J$ and $j \in \{0, 1, \dots, n\}$. For every project activity $Task_j$ characteristics are assumed, where $name_j$ is a name and identification of the j -th activity; $effort_j$ is a time estimation of laboriousness in units of time (usually hours); $effort_j \in N$, $skill_j$ is a skill required to fulfil the j -th activity, where $skill_j \in O$ and O is a set of skills; skills, their levels and set values are described in the following text, exp_j is a required degree of the skill needed to fulfil the j -th activity, where $exp_j \in S'$ and $S' = \{Junior, Normal, Senior, Expert\}$ is a set of skill degrees; $priority_j$ is a priority of the activity – it is not worked with it any further and it is only informative, $priority_j = \{Trivial, Minor, Major, Critical, Blocker\}$; $maxRes_j$ is the maximal number of resources, which can work on the activity at the same time, $maxRes_j \in N$; $minRes_j$ is the minimal number of resources, which can work on the activity at the same time, $minRes_j \in N$; $minLoad_j$ is the minimal number of the units of time required to assign the j -th activity to the l -th resource to solving, $minLoad_j \in N$, U_j is a vector of activities, which must be completed before an initiation of working on the j -th activity; $U_j = (task_l, \dots, task_i)$, where $i < j$.

Let every activity $Task_j$ of the p -th project be represented by a vector $Task_{pj}$ in the following form:

$$Task_{pj} = (name, effort, skill, exp, priority, maxRes, minRes, minLoad, U). \quad (3)$$

14.2.3. Resources

Let there be a limited set of production resources $L = \{Resource_1, Resource_2, \dots, Resource_q\}$, where $Resource_l \in L$ a $l \in \{1, 2, \dots, q\}$. Production resources are considered renewable – they are typically represented by machines or workers who have in every time period a constant number of units of time. For every resource $Resource_l$ these parameters are followed: $name_l$ is a textual name or an identification of the l -th resource, $wage_l$ is a reward which belongs to the l -th resource for a worked unit of time (usually man-hour); $wage \in N$, $maxParallelTasks_l$ is the maximal possible number of tasks on which the l -th resource can parallelly work at the time; $maxParallelTask \in N$.

Other characteristics for the resource $Resource_l$ are its skills and the degree of achieved knowledge in the expertise. Let there be a set of skills $O = \{skill_1, skill_2, \dots, skill_o\}$ and the skill $skill_e \in O$ and $e \in \{1, 2, \dots, o\}$. Then let there be

a set of levels of expertises $S=\{exp_1, exp_2, ..., exp_s\}$ and a level of expertise exp_{le} for the l -th resource and e -th expertise, where $exp_{le} \in S$.

The last considered characteristic of the production resource is a resource calendar. For the l -th resource a schedule of working hours is considered for every calendar day $i=\{1,2,...,7\}$ in the extent of time of initiating the work (from) $\alpha_{li}=\{0,1,...,23\}$ and time of finishing the work (to) $\beta_{li}=\{0,1,...,23\}$, $\forall i: \alpha_i \leq \beta_i$. It is therefore possible to define the calendar of the l -th resource as:

$$availability_l=(\alpha_{l1}, \beta_{l1}, \alpha_{l2}, \beta_{l2}, ..., ..., \alpha_{l7}, \beta_{l7}). \quad (4)$$

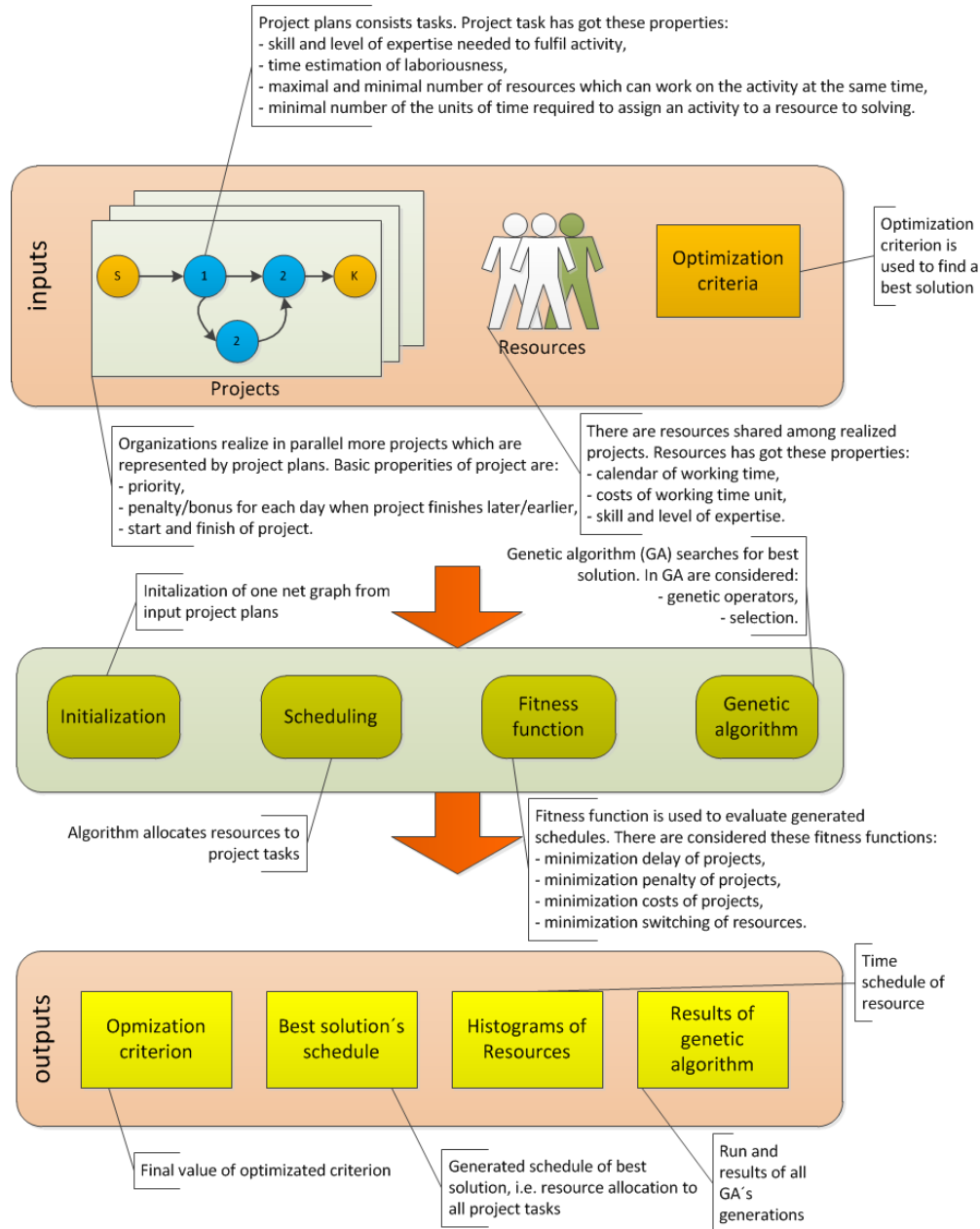
For solving RCMSP let every l -th be represented by a vector:

$$Resource_l=(management, consultation, analysis, design, programming, testing, documenting, deployment, wage, maxParallelTasks, availability). \quad (5)$$

14.3. Methods

Conceptual system model was created (figure 1). In the diagram there are inputs considered within the solved task. Initial parameters are projects described by project plans where each of them is represented by a directed acyclic graph with one beginning and one end. Each project includes an arbitrary number of project activities, which are described by their characteristics (estimation of time, level of expertise, etc.).

A necessary input of the RCPSP task is an optimization criterion used for seeking of the best solution. In the middle part of the diagram a system using the inputs and proposed mechanism for resource scheduling is shown and it seeks the best solution to the set optimization criterion. The output from the system is the value of the sought criterion and a schedule of the best individual. Other view on schedules are histograms of production resources. From the genetic algorithm outputs it is possible to observe the course and results of individual generations.

Fig. 14.1. Conceptual system model of solved RCMSP

Source: authors

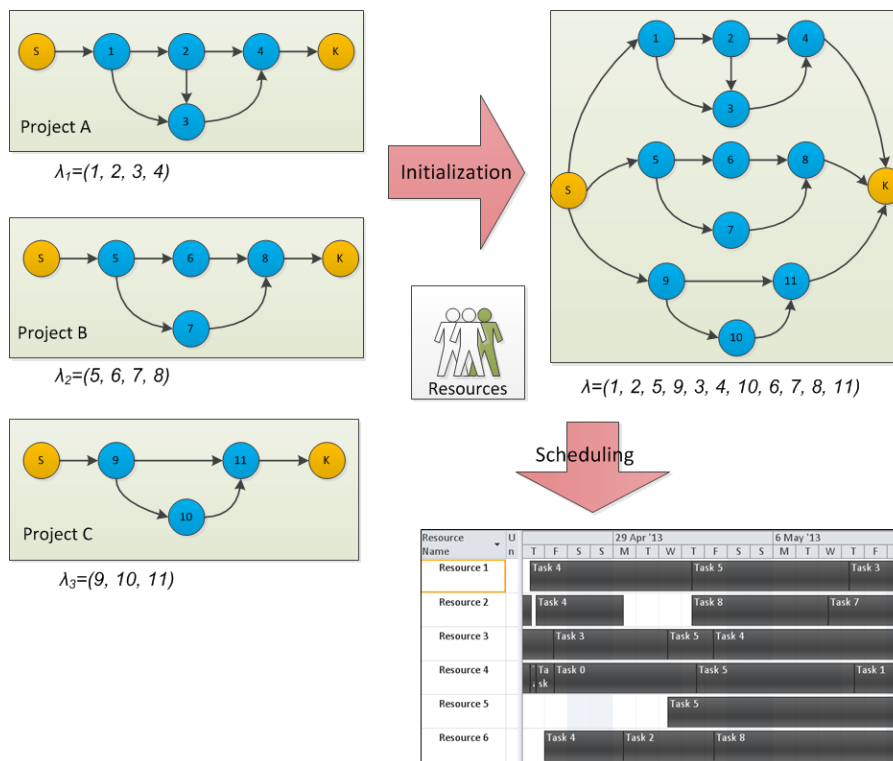
14.4. Description of the proposed solution

14.4.1. Representation

To solve the RCPSP successfully it is necessary to understand the solved task correctly and also set the representation of the individuals correctly. An individual within RCMSP is considered as a complex of all planned and scheduled projects and their activities and is presented by:

- schedule generation schemes (SGS) which is a linear sequence of all project activities in the same order, in which they will be scheduled and done,
- represented schedule, which represents the allocation of resources to project activities in a period of time.

Fig. 14.2. Conceptual model of creating SGS and its using for scheduling



Source: authors

Using the scheme of schedule generation to generate a schedule can be seen in the figure 2. There are more projects within an organization, which are realized in parallel and between which production resources are shared. All the project plans represented by network graphs are connected into one network graph with one beginning and one end. From the created network graph a sequence is created determining the order of scheduling individual project activities. The result of scheduling is a created schedule, where resources are assigned to activities – based on all limits and characteristics, until all the activities are done.

14.4.2. Fitness functions

Forming a suitable fitness function belongs with the choice of the right representation to the crucial points of a successful construction of the optimization task with usage of evolution algorithms. The fitness function is used to evaluate individuals within a population. There were created 4 fitness functions, which are used for evaluation of individuals:

- minimization of project delays (minDelayFitness),
- minimization of project costs (minCostsFitness),
- minimization of project penalties (minBonusMalusFitness),
- minimization of switching resources within projects (minSwitchFitness).

Project delays

In the traditional RCPSP only the fitness function which tries to find the minimum of the duration of all schedules projects using a current set of resources is typically considered. This optimization criterion is in literature called *makespan*. A different, though similar optimization criterion is also considered in this paper. It is a minimization of delay of all projects, which can be described as a difference between ends of projects gained from schedules and originally planned deadlines. The minimization of the project delay can be described as:

$$\text{minDelayFitness} = \sum_{i=1}^n \max(0, \text{end}_i - \text{deadline}_i) \quad (6)$$

where $P \in \{1 \dots z\}$ and z is a number of scheduled projects, $genEndDate_p$ is a generated end of the project from a project schedule, $planEndDate_p$ is the latest possible term of finishing the project contractually dealt.

Based on the relation for ascertaining project delays the fitness function for evaluating individuals in a population was defined:

$$minDelayFitness = 1 / (maxPlanEndDate * z + delay + \gamma), \quad (7)$$

where $maxPlanEndDate$ is the maximal from all of the later possible ends of projects, z is a number of projects in the solution, $delay$ is delay or acceleration of the project, γ is a small number preventing division by zero, usually $\gamma = 1$.

Project penalties

The optimization function also uses *delay* described in the chapter above. The solution is in the fact, for every project a bonus or penalty is calculated depending on its delay or acceleration. If the project is finished earlier than its latest deadline, than for every such a day a bonus of the project is considered, which is set within project parameters. Analogically the total penalty of the project is ascertained as a product of total delay of the project against the original deadline and set penalty per a unit of time. The total value of bonuses or penalties for every individual, and therefore all his projects, is ascertained as a sum of all bonuses and penalties of projects:

$$bonus = \sum_{p=1}^z delay_p * bonus_p, \quad (8)$$

where:

$$projBonus_p = delay_p * bonus_p, \quad (9)$$

$$projMalus_p = delay_p * malus_p. \quad (10)$$

For the penalty criterion it is possible to define the fitness function with the usage of the formula:

$$\min \text{BonusMalusFitness} = 1 / (\max \text{PlanEndDate} * z * \sum_{p \in A} \text{bonus}_p + \text{bonusMalus} + \gamma), \quad (11)$$

where $\max \text{PlanEndDate}$ is the maximal from all of the later possible ends of projects, z is a number of projects in the solution, $\sum_{p \in A} \text{bonus}_p$ is a sum of the bonuses of all projects, bonusMalus is found by the formula (8), γ is a small number preventing division by zero, usually $\gamma = 1$.

Project costs

Another new fitness function is minimizing the costs spent on realization of projects. Despite the fact, that projects have the same plans leading to their finish all the time, using various resources leads to various costs. This is caused by a various price of a reward which is ascribed to resources for their work. On one hand, using cheaper resources can enable to realize planned projects with smaller costs, on the other hand, this can cause delay in prolongation of the deadline. It is necessary to realize which fitness function is used and adjust adequately the analysis of achieved results. The function for ascertaining project costs can be defined as a sum of product of all worked hours of resources from the schedule of an individual and a wage of the resource per a unit of time, i.e. an hour:

$$\sum_{l=1}^q \sum_{i=1}^n \sum_{t=1}^c \text{wage}_l \cdot \omega_{lit} \quad (12)$$

where wage_l is a reward of the resource l per a unit of time (hour), q is a number of resources, n is a number of activities in an individual, c is a number of days in a generated schedule, ω_{lit} is a sum of values from the vector B , which represents an element $a_{lit} \in A$ and can be described by a formula:

$$\omega_{lit} = \sum_{o=0}^{23} b_o, \quad (13)$$

where $b_o \in B$ and $o \in \{0, 1, \dots, 23\}$.

The calculated costs of a schedule of an individual are then used in the fitness function:

$$\text{minCostsFitness} = 1/(\text{sumCosts} + \mathcal{V}), \quad (14)$$

where \mathcal{V} is a small number preventing division by zero, usually $\mathcal{V} = 1$.

Switching resources within project activities

The newly presented fitness function in this paper is minimization of switching resources between project activities. In some cases it is undesirable if the resource starts to work on another activity until it finishes the first one. A formula for ascertaining the number of switching resources is calculated for each resource, which switched from an unfinished activity to a different one within the done project:

$$\text{switchCounter} = \sum_{l=1}^q \text{switch}_l, \quad (15)$$

where switch_l is a counter of switching the resource l from an unfinished activity to another activity within a schedule, q is a number of resources.

The counter of the total switching switchCounter within the schedule is then used in a fitness function, which is set by the formula:

$$\text{minSwitchFitness} = 1/(\text{switchCounter} + \mathcal{V}), \quad (16)$$

where \mathcal{V} is a small number preventing division by zero, usually $\mathcal{V} = 1$.

Genetic Algorithm

The basic description of functioning of the genetic algorithm can be found in (Holland, 1992), (Hynek, 2008), (Mitchell, 1996). The basic scheme of genetic algorithm is used in this paper and it is extended in certain places within the solved task. For the purpose of this paper the genetic algorithm can be described as:

Fig.14.3. Implemented genetic algorithm**Genetic algorithm****Set the counter of generations $t=0$** **Generate the initial solution – Initialization()****Create schedule – Scheduling()****Evaluate the initial solution****Unless a finishing stag condition is not fulfilled****Increase the counter of generations $t:=t+1$** **Apply genetic operators****Crossover()****Mutation()****For every chromosome λ_i , $i \in \{1, 2, \dots, pop\}$ and $pop > 0$ is a number of individuals****Create a schedule – Scheduling()****Evaluate created schedule according to the used fitness function****Selection****Elitism()****For $v=1$ to w ; where $w=pop-eli$** **Do a roulette selection****Finish genetic algorithm***Source: authors*

Let there be mentioned that genetic algorithm will work with one population, within which a defined number of individuals pop exist. The individuals represent a sequence of scheduled activities represented by SGS λ_i and the result of allocation of resources to activities of all projects (schedule), which is represented by a three-dimensional matrix A_i , $i \in \{1, 2, \dots, pop\}$. Genetic operators with the set probability are used for a reproduction of individuals into other generations. The best individual selected by the fitness function represents the sought optimal or suboptimal solution.

14.5. Conclusion

The paper aimed at proposing a solution for scheduling of shared limited resources under conditions of project portfolio management, implementation of genetic algorithms, using current knowledge and extending the task by new characteristics, parameters and fitness functions.

New characteristics of project activities, which are a level of expertises, the maximal/minimal number of resources, which can work on the activity, or the minimal number of units of time, which is a condition for assigning the resource to the activity, were considered. On the side of production resources there was realized a parameter of the maximal number of activities, on which the resource can work.

Within the genetic algorithm there were realized 4 fitness functions for minimizing the project delay, penalties, costs and switching of resources within project activities.

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Administration

15. Further Education of Employees in the Textile and Glass Industry in the Liberec Region

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Abstract: *The following paper discusses the current situation in the area of further education of employees in the textile and glass industry in the Liberec region. The problematic is treated from the perspective of information management thus the main emphasis is put on the possibility of access to further education and its distribution among the employees of selected companies. The final section of this paper presents the results of the survey analyzing the dependence of used managerial and educational techniques with regard to various factors such as company size or its annual turnover.*

Key words: *further education of employees, textile and glass industry, Liberec region*

JEL Classification: *M53, M54*

15.1. Introduction

The general economic goal of all companies is the generation of profit. In order to achieve this objective it is very important to monitor the trends in the business sector and the evolvement concerning competition. To survive and stay competition-capable, the economical subjects must keep up or even become pioneers in their field. In today's market environment as well as in other non-profit and non-economical activities, the selection of relevant sources plays a major role in information sharing capability. The development of modern communication technologies and devices created new opportunities for achieving the assigned goals. However, this new setting puts a great pressure on the study of these technologies and increases the requirements on staff training and literacy. According to Chandler and

McEvoy (2000), firms that invest in employee training, implement systems of performance evaluation together with motivational rewards are likely to have a lower employee turnover, higher productivity and financial performance.

Last year, the American Management Association (AMA) (2014) conducted a survey, to which participated 352 managers of human resources. This survey confirmed that investing in the future of employees is more important than immediate compensation. Programs that improve job skills and future career development are considered to be particularly effective. AMA survey identified the following techniques to improve employee skills: externally organized conferences and seminars (78.1% of respondents), tuition reimbursement (67.3%), management training (66.8%), support of the study of consequent degree programs (62, 2%), training soft-skills (56.8%) and technical training (54.5%).

The following article examines the issue of staff development in the Czech Republic, while the local focus is targeted on the situation in textile and glass industry in Liberec region. Both of these industries have a long tradition in this area, but in recent years, companies operating in this sector recorded a significant decrease in profits.

Over the last twenty years, the textile industry lost its privileged position. This phenomenon was caused by the influx of cheap goods from the countries of Southeast Asia and by the recent economic crisis. The metaphorical nail in the coffin was the bankruptcy of textile company Textilana in the early 21st century. The glass industry was not affected as hardly as the textile production. Although in 2009, 1000 employees of the Crystlaex company were laid off Crystalex, the international fame helped the Czech glass industry to partially regain its pre-crisis position again. Since this time, the companies are trying through a variety of restrictive measures return to their former profitability.

As it was already mentioned, the training of employees may represent for the company a very effective tool to increase productivity. The aim of the research presented in this paper was to determine what is the current situation of staff development in the selected companies, depending on the type and size of the business entity and also what kind of education prevails.

15.2. Theoretical research background

According to the Society for Human Resource Management, one of the most common steps taken by companies in response to the increasingly difficult conditions in the competitive environment is the investment in systems of further education and development of their employees with the aim of improving their skill level (Aguinis et al., 2009). The available research on the training of employees mentions two types of variables that can affect the efficiency of investment in the area of human resources. Firstly, there are organizational and situational variables (Maurer et al., 2008), which can directly influence the processes managed by the company. Organizational and situational influences can be seen as a set of elements in an organization having an impact on the staff development.

As an example we may introduce the training in the form of learning right in the workplace from the senior workers or managers, co-workers and even customers (Major et al., 2006). The main objective of effectively set strategies concerning educational activities in an organization is to make individuals actively and willingly seek to develop their skills. For this reason, the encouragement for continuing education and proactive approach from the part of the organization should be supported by clear and motivational tools. The second important aspect is the predispositions, individual characteristics and socio-demographic background of employees that can be influenced only indirectly (Dysvik et al., 2008).

Gary Becker (1994) already in the 60's examined the importance of staff development and its impact on business efficiency. Becker distinguishes two types of educational activities: general training and specific training. According to his research, employers should provide general education rather to employees who are employed for a limited or part-time job since this type of education is less financially demanding. If the company offered specific training, which is more expensive, to these employees it could be considered as poorly made investment in human capital that most likely will not stay in the company as a long term asset.

Learning is usually defined as a permanent change in behaviour or in knowledge gained through the process of studying. Creating a learning supportive culture is judged as essential in today's economy. Regarding the working environment, this culture is already created by the educational

institutions which the employees have gone through, including high schools, vocational schools or college. Also, a significant part of educational programs is subsequently subsidized from national funds. The programs most frequently educate the employees in topics such as security, economic growth and scientific development. In developed countries, it is quite frequent to hire various specialized agencies for the purpose of analyzing the current state of business processes, optimizing their parameters and implementing follow-up systems consisting in retraining employees in case of changes and new processes (Noe, 2010).

Development and implementation of training and management development programs should be based on the needs of the particular company and based on available resources such as time and money that the company is willing to invest in education of employees. At various stages of their careers, all employees need different kinds of training and different kinds of skills. Although education can prepare students for their first job, they will still have to acquire new knowledge through experience during their next career.

Patterson (2004) distinguishes four levels of education of employees with different learning outcomes: **1.** functional competence, knowledge in finance, accounting, marketing, information technology, economics, operation management and human resources; **2.** understanding of the context and strategies and how organizational processes interrelate. Understanding the effect of changes in society, organizational politics, social values and technological procedures. **3.** The ability of interpersonal communication, human resources management based on the application of principles of motivation. **4.** Reflective skills consisting in the determination of the priorities and operative allocation of work effort. Therefore, in order to maximize the effectiveness of training and development of employee skills, organizations must continually assess the current stage of education of each of their employees and identify anticipated following procedure.

15.2.1. Methods of employees training

As it was already mentioned above, before selecting the suitable methods of employee training the company must specify the training parameters which are based on the need to improve the economical competitiveness and company image. Since high performers and quality professionals are not easy to find, the only possible step in this situation is therefore planning a

profound and continuous education of employees. Important factor is undoubtedly the choice of appropriate methods of education that are wide in number. In the following paragraphs we list only the most efficient and frequently applicable ones (Counseil des, Canadian Textile Industry Labour Market Information and HR Needs Assessment, 2011).

15.2.1.1. On the job education

Method of workplace learning is also called method "on the job" takes place in the workplace environment during working hours. Thanks to these characteristics this method is not very demanding on time and investments. This method is considered to be more suitable for training workers that perform manually (Gravene, 2010). Methods of on the job learning include:

- **Mentoring** at work is the most commonly used method especially for the novice trainees, or when employees are being transferred from other parts of the organization and when they are changing their major occupation and responsibilities.
- **Coaching** unlike mentoring belongs among mentally demanding methods of instruction. It consists in a systematic incitement of the employee by workers educated in coaching methods with the aim of motivating the employee to the desired performance. Mentoring is similar to coaching just with the difference that to the employee is not assigned a specific coach but the worker chooses himself based on the experience, sympathy or respect.
- **Counselling** is a relatively new method of learning and transferring information or knowledge that is realized through consultations. This method helps to overcome the one-way relationship between educator and educated, or between superiors and subordinates.
- **Assisting** is the traditional method of employee formation when to the educated worker is assigned assistant with more experience.
- **Job rotation** or **cross training** is a method of education, where a worker is in charge of different tasks in different sections of the organization. This method is widely used in managerial training where the

potential leaders need to get familiar with all types of work assignments in the organization.

- **Work meetings** are also considered to be an educating process since they are organized for the purpose of consulting and to sorting out any problems that appears on the workplace.

15.2.1.2. Off the job education

The method of training outside the workplace called "off the job" is used for the training of specialists, and executives. It can be used also for other groups of employees in numerous positions however, there are various modifications with regard to the scope of the job they do (Gravene, 2010).

- **Lecture** focuses on the acquisition of theoretical knowledge. Lecture combined with discussion provides greater interactivity and the opportunity to clear up the topic even more. Discussion can be beneficial in many ways because it may offer a solution to many problems since "more heads are better than one."
- **Demonstration** can be defined as transferring knowledge and skills using audio-visual equipment, computers and the like.
- **Case studies** are one of the favourite training methods for management assessment centres. They bring up a problem that needs to be analysed, diagnosed and resolved. **Workshop** is a variation of a case study. However, the problems are addressed comprehensively in terms of assembled group.
- **Brainstorming** may be also understood as a form of a case study, although, in this case, each member of the group is asked to come up with his own solutions to the problem. The solutions of all members are then put together and combined into one optimal solution.
- **Simulation** of a situation is more focused on the practical aspects, for example, two employees are asked to play a scene that may occur in the organization environment and must resolve it. On the other hand, **role playing** is a management game method that is aiming for creative

development of managerial personnel requiring playfulness, independence and focus and for developing practical skills of the participants.

15.2.2. Education and training of employees in textile industry in leading countries (EU, USA, ASIA)

The engineers of textile technology participate in defining the concepts of managing these innovative tools that are of a paramount importance for the growth and development of the textile enterprises. There is a big demand for expert personnel on the employee market that nevertheless offers the potential employees a constant advanced training. Besides implementing the “traditional” skills and knowledge of various textile technologies, contemporary expert personnel should also possess knowledge of organizational science, business management, strategic and operative planning, marketing and quality management (Urošević, 2002, 2008).

One of the essential problems in textile industry is - together with unbalanced competition, the increased level of “grey economy”. It is very difficult to estimate its share level, but it ranges approximately from 50 % to 60 % of a total production in this branch of industry. Uncontrolled import of textiles and unfair competition existing at the textile market (illegal import from Turkey and China) – great quantities of goods imported under low custom tariffs or duty free. While the income increases in other branches, at the same time it constantly decreases in textile industry. Due to the low income problems among textile industry workers their motivation keeps *falling (Counseil des, Canadian Textile Industry Labour Market Information and HR Needs Assessment, 201)*.

Employment in the textile and apparel industries has been on a downward trend for decades. However, U.S. textile and apparel companies are striving hard to compete, focusing on developing innovative fibres, fabrics, creative designs, and blends. Cutting edge production technology is being adopted both to cut costs and to permit the production of high technology, differentiated products. In addition to these proposals, in 2002, the Employment and Training Administration launched a High-Growth Job Training Initiative (HGJTI) that focuses on establishing partnerships with businesses and working with high-growth industries. Textile and apparel workers may benefit from this initiative, which seeks to train workers for careers in high-growth industries through partnerships between businesses,

educators and the workforce investment system (U.S. Department of Labor., 2004).

Firm-specific training is a commonly used approach that includes the transfer of knowledge from existing employees (and particularly from retiring employees) as well as cross-training and in-house training. Firm-specific training is also used as a method to provide back-up staff with the skills required to operate machinery. However, firms do not necessarily know the most effective ways of delivering in-house training and skills transfer. Some mentioned they had sought advice on how to do this. For all firms, and in particular small firms, increasing access to train-the-trainer type programs may be an effective strategy. Much of the workforce is low skilled – many firms are trying to cross-train their workers but, because of their low level of education, this is a challenge. Some workers lack the educational foundation for technical training.

15.3. Methodology and data collection

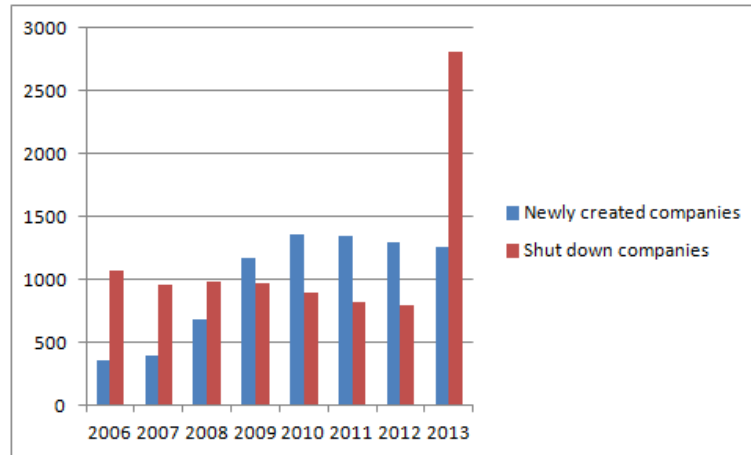
For the purposes of exploring the management of staff development we put together a questionnaire, which was then electronically distributed to small and medium-sized enterprises in the Liberec region having core business activities in the textile and glass industries. Initial set of questions examined the size, the main area of activity, year of creation, business form and an annual turnover of surveyed companies. The main section of the questionnaire was focused on the collection of the data related to the current situation in the area of further education of employees. Via this survey, we tried to identify from which sources are these systems founded, what employees are involved in them and also what type of education they receive.

15.3.1. Current state of the industry and selection of the sample

At the end of 2013, in the Czech Republic, there was registered almost 35 000 businesses involved in the production of textiles or clothing and nearly 12 000 subjects in the glass sector. In the Liberec Region, there are 1,540 and 2,300 subjects that operate in textile and glass industry (respectively). After Prague, Liberec region is the second smallest in geographical size, it occupies only about 4% of the territory of the Czech Republic. Despite this fact, there is a fifth of all registered entities in glass industry. The following

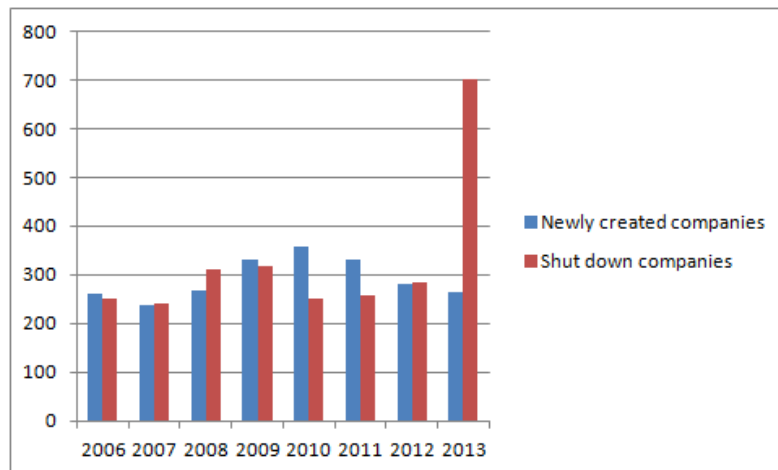
graphs show the number of newly created and shut down textile and glass companies in the years 2006-2013 in the Czech Republic and in the Liberec region.

Figure 15.1. Newly created and shut down textile companies in the Czech Republic in 2006-2013



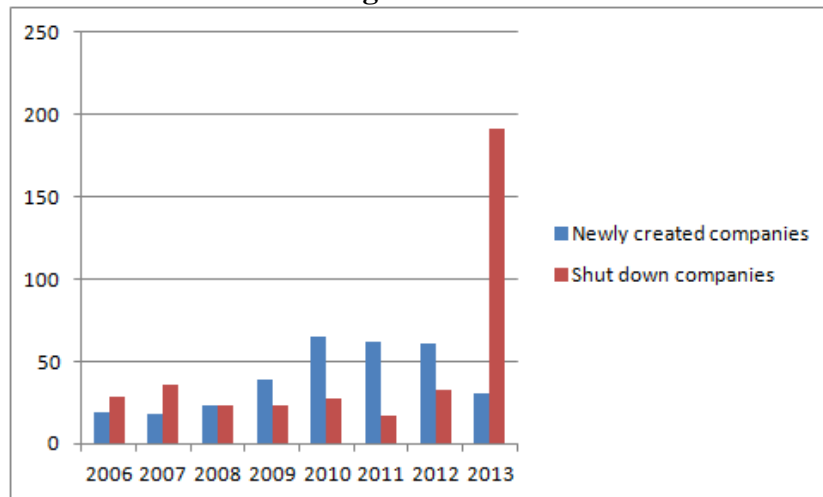
Source: public database of Czech statistical office

Figure 15.2. Newly created and shut down glass companies in the Czech Republic in 2006 - 2013



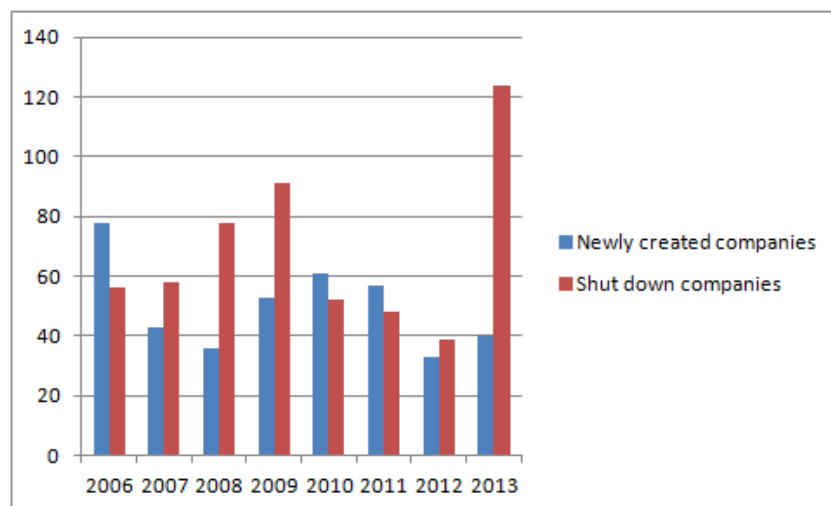
Source: public database of Czech statistical office

Figure 15.3. Newly created and shut down textile companies in the Liberec region in 2006 – 2013



Source: public database of Czech statistical office

Figure 15.4. Newly created and shut down glass companies in Liberec region in 2006 – 2013



Source: public database of Czech statistical office

The graphs show a different development of the two studied sectors in recent years. For textile industry, we can see an increase in the number of new businesses in both, the Czech Republic and in the Liberec region. Data for the glass industry diverge. While in the Czech Republic it is rather a stagnation in the number of businesses, in the Liberec region in the period between 2006 and 2008, deepened the gap between the numbers of created and shut down entities. The situation culminated with the advent of the economic crisis in 2008, the following two years after the outbreak of the crisis in the region disappeared twice more glass companies than they were created. As exceptional we may designate 2013, where much more subjects in both sectors were shut down.

For the last 8 years, we may observe the same 18% decline in textile industry in both, the Czech Republic and in the region. The opposite situation is in the glass industry. While for the same period, the decline in the Czech Republic was only 11%, in the Liberec region disappeared more than a third of companies operating in this sector. The results of the analysis show that the economic crisis and other factors negatively affected the number of businesses. The most hardly hit was the glass industry in the Liberec region. As it was already mentioned, many companies were closed and thousands of people laid off.

During the survey, we electronically contacted 148 companies located in the Liberec region and operating in the textile or glass industry. These companies were found using a commercial database gathering data from all official national statistical sources. As the search criteria, we set the seat of the company, type of business and number of employees. Based on the output, were subsequently selected companies which we addressed with our questionnaire.

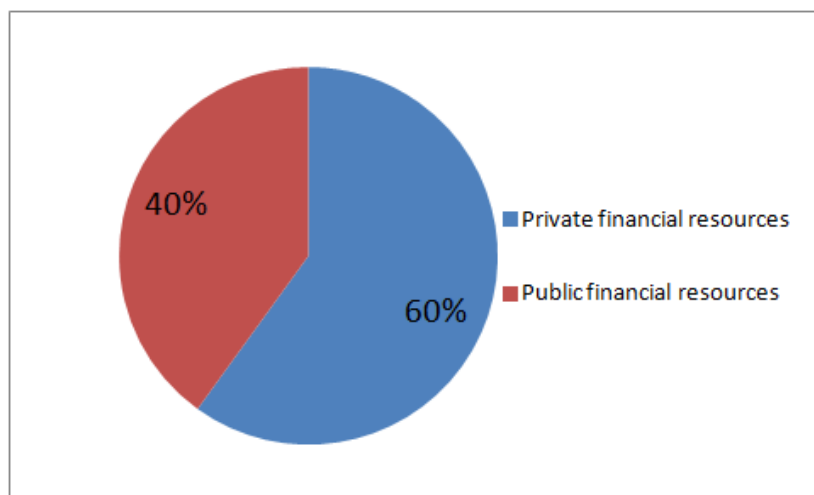
15.4. Results of the survey

During the above described investigation we managed to gather 31 completed questionnaires, which represent 21% of the selected companies that operate in the Liberec Region in the glass and textile industry. The sample consisted of 81% of textile companies, while companies in the glass

industry were represented only by 19 %. In terms of size, companies were evaluated by the number employees, and the composition of the sample was as follows: 39% of micro companies or individuals (1-9 employees), 39% of small enterprises (10-49 employees) and 23% of medium-sized companies (50-249 employees). The respondents can be characterized as rather well-established companies, given that 42% of them was created in 1999 and 55% by the year 2009, only three percent of the respondents consisted of younger firms, which were established between 2010 and 2014. Firms who participated to the survey were in terms of turnover divided in the following categories: 0-999 999 CZK (13%), 1 000 000 - 9 999 999 CZK (52%), 10 million CZK and more (35%).

Answers to the main part of the questionnaire can be considered quite alarming, since only 32% of the respondents implement at least to some extent the system of further education of employees, 68% do not. Companies that introduce a system of further staff development usually finance it from own resources (60%), the remaining ones use ask for investments from public sources such as EU funds and national funds (40%).

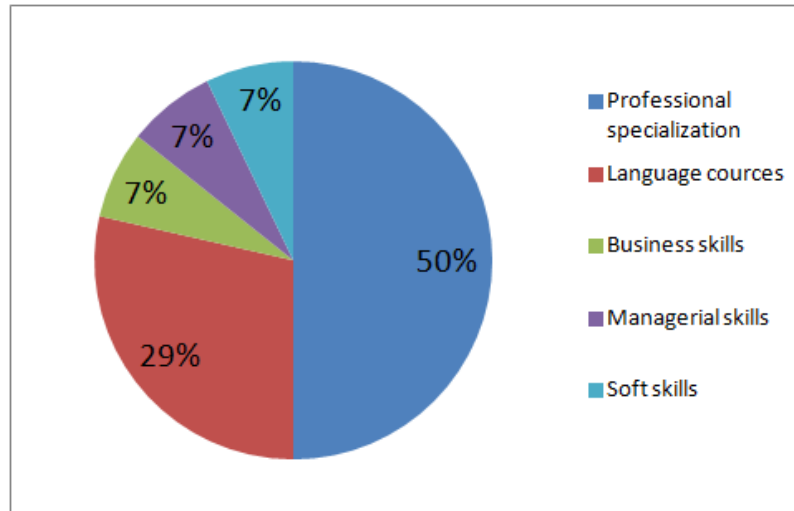
Figure 15.5. System of further education funding



Source: questionnaire survey

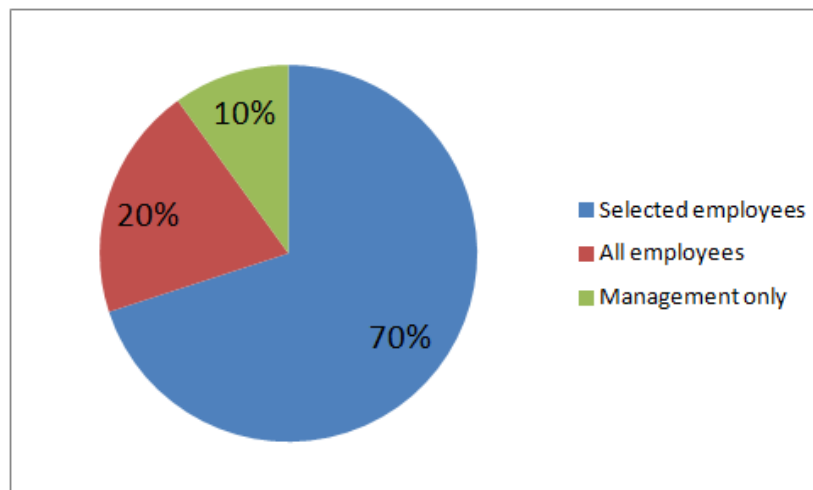
The survey results suggest that the European funds are used primarily by companies that realize a turnover of more than 10 million CZK.

Figure 15.6. What types of education are provided by the organizations



Source: questionnaire survey

Figure 15.7. What employees are included in the system of further education



Source: questionnaire survey

Respondents indicated that within these systems are supported either all employees (20%), only the management (10%) or selected employees throughout the organization (70%). Most funds are invested in staff training in the area of professional specialization (50%) and language development (29%). The minimum amount of resources then subsequently flows in the training promising improvement of business (7%), managerial (7%) or the so-called soft skills (7%).

15.5. Conclusion

The results of the survey demonstrated that companies in the textile and glass industries operating in the Liberec Region are concerned with the problematic of further employee education but only 32% of them consistently implement a system of staff development. The education focuses on the expert areas and the employees are chosen purposefully across the entire organization. It is therefore rather a long-term investment in the development of the company. To support the training of employees the companies may ask for financial means from public funding sources (e.g. Funds of the European Union) that are currently being used mostly by firms with higher turnover. This finding may be developed in a future research since we did not found any explication why the companies with a lower turnover do not use as extensively the public support from EU or national funds and what are the motivational factors for using this type of help in general.

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16. Impact of Information Technology and Temperament on Motivation for Self-education

Václav Zubr

Abstract: *Self-education is an extensive and internally heterogeneous set of educational activities aimed at adults. This is largely influenced by the development of information technology. Education contributes to increasing and improving the skills of workers and the possible development of innovations in organisations. The main objective is to assess personality characteristics, temperament and aspects that influence a positive attitude towards further education. The theoretical part of the thesis deals with the motivation and barriers in education that may affect the implementation of innovative strategies within a company. The research methodology includes both qualitative and quantitative research. In the first phase, 20 interviews with experts working in various educational institutions in the Czech Republic were carried out. In the second phase, a set of questions were created based on qualitative understanding of the issue. The questionnaires were then distributed through <http://docs.google.com> to randomly selected e-mail addresses, which are available on the websites of the educational institutions. The questionnaire was sent to 1,450 respondents with a return of 272 (18.76%) correctly completed questionnaires. The questionnaire survey shows a number of observations: current status and respondents' views regarding continuing education, opinion on the effectiveness of information communication, attitudes towards learning and the influence of personality factors and temperament influencing self-education. The article shows the relationship of information technology and self-education, which is a prerequisite for the implementation of the principles of innovations' development.*

Keywords: *E-learning, information technology, self-education*

JEL Classification: *M15, I21.*

16.1. Introduction

Adult education is a broad and heterogeneous set of activities directed at adults. Adult education is quite often discussed in the context of lifelong learning, whether for reasons of personal interests in education or improving from professional reasons. The interest of each organisation should be permanent an upgrade in the knowledge of their employees, which fulfils the concept of a learning organisation. Lifelong learning should therefore be integrated into the daily activities of the company and initiated by its active employees. (Galbavý, 2007) This system of thinking comes to us from the west; the founder is American Peter Senge with his book *The Fifth Discipline*. (Senge, 2006) For self-education of employees it is especially essential to have internal as well as external motivation, but it's also necessary to remember the barriers preventing its commencement.

IT technologies are now so widespread in everyday life that they are often used not only for education itself, but to inform people about training events and also the motivation for participation in these events. Digital technology supports lifelong desire to learn in all employees aged 18 to 65 years, allowing easier access and narrower focus on lifelong learning. (Passey, 2014). What is interesting is the result of a survey published in 2013, when the effectiveness of a method of combining e-learning with traditional learning "face to face" approach was examined. In the survey, traditional tests in a classroom were combined with others in a virtual environment that encourages participation and learning. The results were very positive as regards the participation of students and improving learning. (Novo-Corti, Varela-Candamio and Ramil-Díaz, 2013)

The survey's value, however, is reduced by narrow application of the method on Micro-economics. The question is, in what cases this method would find the biggest application. I think it would probably include difficult subjects particularly within secondary or university education, for pupils in primary schools the use of the method will likely depends on the benefit consideration of the situation. Within information technology, e-learning may not be the only tool used to improve education.

The aim of this paper is to map the use of IT technology for self-education, information regarding training events and the motivation of people to education.

16.2. *Methodology*

In the first part a pilot study was carried out, in which twenty experts in the education area in the Czech Republic participated in structured interviews regarding basic information concerning what influences respondents in their decision-making on further education:

- What is your qualification and in what type of school do you teach?
- What further education did you previously attend?
- What motivated you to participate in this training?
- How do you gather information with regards to educational activities?
- Is there a system at your school for sharing information about education opportunities?
- What methods of financing educational activities are used at your school?
- What temperament qualities do you consider important for future success?
- What features are on the other hand undesirable for teachers?
- What type of acquisition of additional knowledge is the most effective in your opinion?
- Is in your organisation a possibility for career development or continuing education?

On the basis of the responses, an electronic questionnaire was compiled using the "docs.google.com" web service. This questionnaire was between 14th of April and 4th of May 2013 and was sent to 1,450 respondents via e-mails available from the websites of educational institutions. Educational organisations were selected randomly using the service of "maps.google.com". The total return of completed questionnaires was 18.76% (272 questionnaires).

Approximately 5-10% of sent e-mails promptly returned with an error message containing information that the given address is no longer active or is unavailable. Due to the fact that in most cases these are organisations established by the state, this information is very striking. The electronic form of communication can be used in both internal communication as well as in communication between teachers and the external environment, i.e. mostly children and their parents. An e-mail address that isn't working

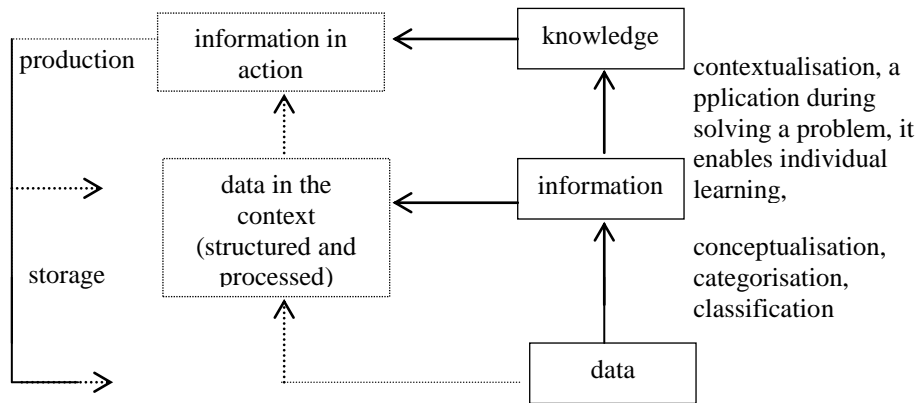
prevents this communication. Another possible cause of a malfunctioning e-mail address is a website presentation which hasn't been updated, which include former employees and conversely miss out the current employees, who have joined the organisation, and the web list has not been updated since then.

One of the most important concepts in a learning organisation is the concept of knowledge and its relationship to information and data. These connections are explained using the definition according to Beckman (1977):

- data = facts, pictures and sounds,
- information = formatted, filtered and summarised data,
- knowledge = instincts, ideas, rules and procedures that govern actions and decisions.

For easier understanding, the relationship between data, information and knowledge can also be expressed using the diagram below.

Figure 16.1. Relationship between data, information and knowledge



Source: own processing according to Bureš (2007) and De Vasconcelos (2001)

As stated in the book of Mikšík (2007), Eysenk's temperament two-dimensional typology takes extroversion and introversion from Jung and follows Pavlov. This typology is based on three mutually independent temperament characteristics:

1) bipolarity of extroversion X introversion

- Introvert, for whom introspection, introversion, close circle of friends, temperance, peace, plans, control of feelings, serious, aggressive, usually pessimist, etc., are typical.
- Extrovert, who can be characterised by light-heartedness, openness, sociability, activity, communication, quick-wittedness, impulsiveness, less reliability, etc.

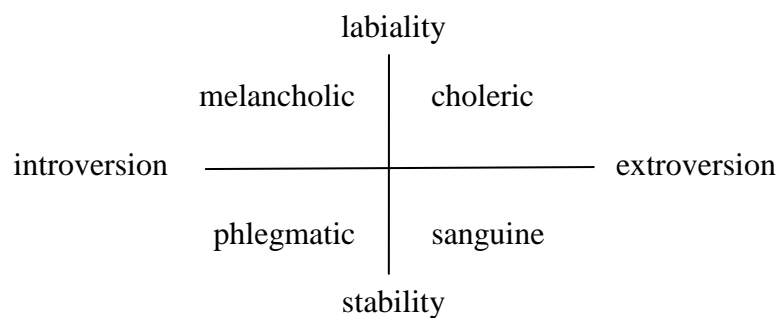
2) neuroticism (continuous scale in terms of stability - instability)

- emotional stability (good integration, strength, endurance)
- neuroticism (poor integration, emotional instability, low self-esteem, anxiety, concernment)

3) psychoticism is based on Kretschmer and Jung's concept of the norm to pathology. Certain types of temperament are predetermining any failure (on a scale it is possible to measure the degree of normality disturbance).

- in connection with introversion → unstable introvert (personality problems, increasing psychotic tendencies from psychasthenia to schizophrenia)
- in connection with extraversion → stable extrovert (relationship problems, hysteria to sociopathy and affective psychosis)

Figure 16.2. Eysenk's temperament two-dimensional typology



Source: own processing according to Mikšík (2007)

16.3. Results

The age distribution and composition of employees by gender confirms the fact that there is approximately twice the number of women than men working in educational institutions. Also the length of the data acquisition, speed of the responses and the number of respondents confirm extensive use of IT technologies in practice.

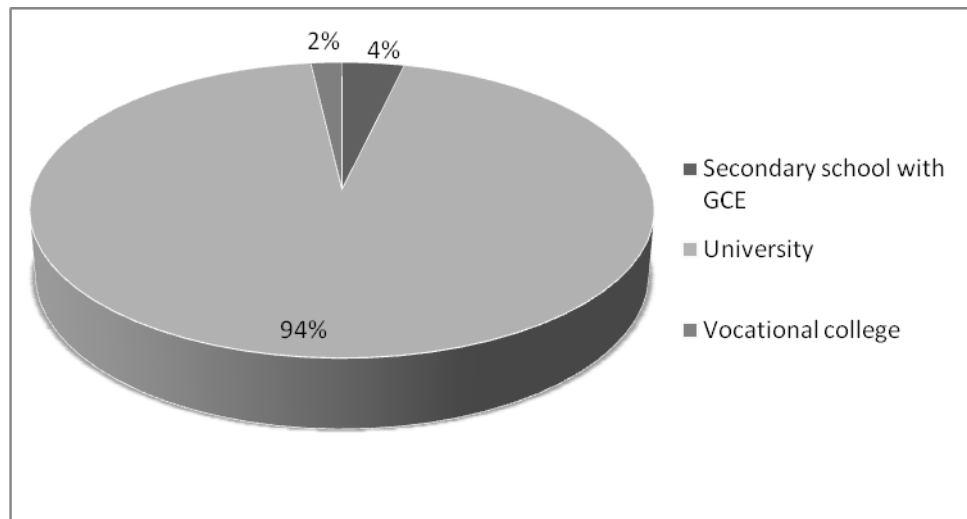
Tab.16.1. Evaluation of the respondents' gender by age groups

Age	Male	Female	Total Number
21 - 30 years	9	19	28
31 - 40 years	29	37	66
41 - 50 years	22	62	84
51 - 60 years	24	57	81
61 years and over	9	4	13
Total number	93	179	272

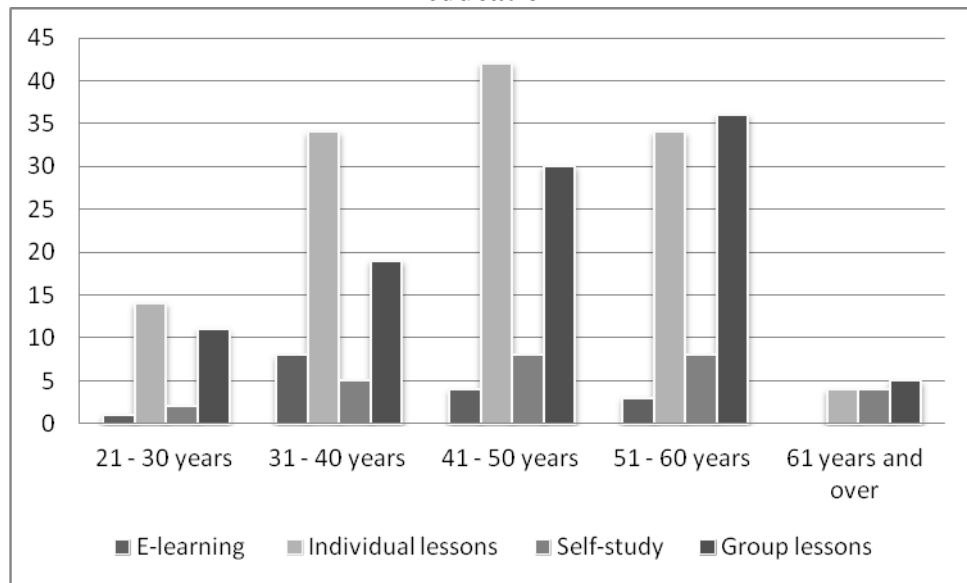
Source: author's own processing

Most respondents (94%) achieved a university education. The research by the INSOMA Company has proved that with increasing educational attainment also the use of various ways of further education increases.

IT technologies are then used more by respondents with secondary and tertiary education than respondents, who attended vocational education or secondary education without a GCE. (Sak and Saková, 2006) For this reason, education and motivation of people through information technologies is more effective for people with higher education than for workers with lower education.

Figure 16.3. Highest level of education achieved

Source: author's own processing

Figure 16.4. The most effective type of education

Source: author's own processing

The chart above (Fig. 4) shows that the respondents aged 21 to 50 years consider individual (one to one) tuition followed by group lessons as the most effective type of education. In the group of respondents aged 51– 60 years, this order is reversed. Respondents older than 61 years prefer self-study and individual lessons as well as group lessons. Rejection of the effectiveness of e-learning by respondents over 61 years old likely results from later development of IT technology. E-learning is mostly preferred by age group between 31 to 40 years, i.e. in the most active period in which an employee has not worked for a very long time yet and is mostly motivated to education by extending their qualification and a subsequent increase in salary. (Burson-Marsteller 2009)

Tab.16.2. The most effective type of education

Age	e-learning	Individual lessons	Self-study	Group lessons	Total
21 – 30	1	14	2	11	28
31 – 40	8	34	5	19	66
41 – 50	4	42	8	30	84
51 – 60	3	34	8	36	81
61 and over	0	4	4	5	13
Total	16	128	27	101	272

Source: author's own processing

Table 3 shows respondents' answers evaluated on a 4-level scale (4 – I would welcome it, 3 – I attend it without interest, 2 – I try to avoid it, 1 – I fundamentally do not attend it). Each option was evaluated independently, and averages of these values were calculated. Respondents in all age groups have the best access to the education which they have chosen themselves, while the worst relationships they have towards training are those which they have to pay for from their own funds. As can be seen from the data obtained, the respondents do not distinguish between who pays for the education for them (whether employer or third party). The results also shows that learning undertaken within a school grant is in the third place

compared to training, which the respondents selected themselves and which was recommended to them by the school management. When comparing age groups there is evident a decline of interest in education with increasing age.

Tab.16.3: Evaluation of attitudes to learning influenced by certain factors

Age	I chose it myself	It was recommended to me by the school management	I attend it within a grant for school	I pay it from my own funds	Paid by my employer	It is paid by a third party
21 - 30	4,000	3,643	3,643	3,071	3,893	3,893
31 – 40	4,000	3,561	3,545	3,394	3,727	3,773
41 – 50	3,964	3,619	3,464	2,952	3,774	3,762
51 – 60	3,963	3,605	3,531	2,852	3,778	3,642
61 and over	3,846	3,308	3,231	3,000	3,615	2,923

Source: author's own processing

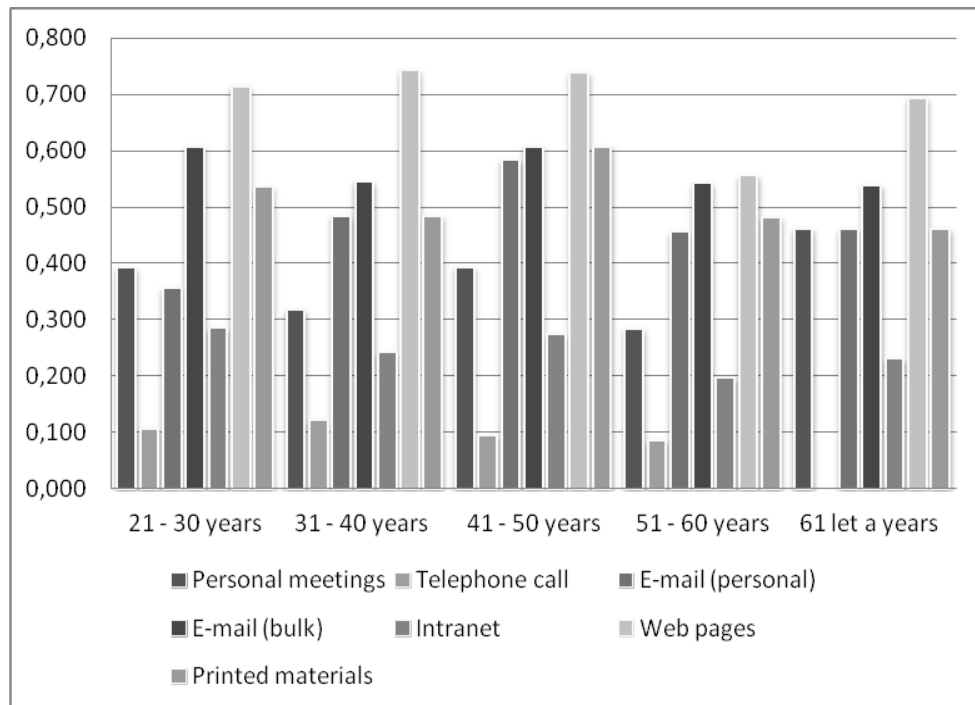
Websites, collective and personal e-mail were proved to be the most frequent source of information regarding education for teachers, printed materials were less common. Teachers learn the least information by telephone regarding education. These results suggest information on obvious widespread and rich use of IT technologies in practice.

The advantage of continuing education organisers, who provide information concerning their courses through ICT, includes motivating future students by acting on one of the busiest motivational factors using photos and videos of the courses offered and examples of applications of the information

obtained in practice. The scope and effectiveness of this motivation method could be the subject of one of the other investigations

The pilot study with experts in the field of education shows two factors that explain the possible low use of the intranet. The first factor is the small number of teaching staff at many schools, making personal communication to be more preferred. The second factor mentioned by teachers, is the financial situation in educational organisations that fail to invest in advanced information technologies.

Fig. 16.5. A method for obtaining information regarding education

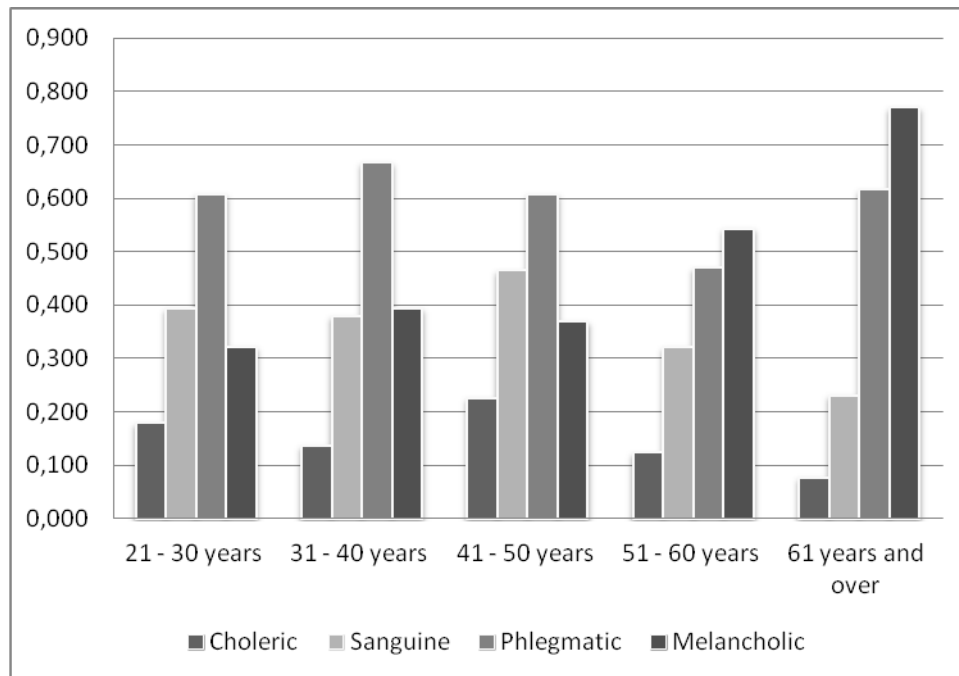


Source: author's own processing

Another issue in question was how the characteristics of a person can capture the personality of the respondent (i.e. teacher). The respondents rated the following characteristics, depending on how it expresses their person: absolutely yes; mostly yes; neither; mostly not; not at all.

The evaluation was conducted by 12 characteristics (for each temperament three representative characteristics were selected): passion, optimism, serenity, seriousness, initiative, eloquence, patience, diligence, thoroughness, non-conflict, independence, loyalty.

Fig. 16.6. Temperament of the respondents



Source: author's own processing

The graph shows that most respondents fitted in the features characterising melancholic and phlegmatic. The least of them were choleric. With increasing age the influence of the respondents' characteristics that can be categorised as phlegmatic, also grew. On the other hand, the least we can observe the influence of choleric nature characteristics in older teachers. Teachers up to 50 years have predominant features of mostly phlegmatic

and then choleric begins to prevail. A possible extension of this paper could be monitoring the factors that influence the change of a stable introvert to introvert with prevailing unstable factors.

The questionnaire set three characteristics characterising a certain type of temperament. In total the respondents had a choice of 12 characteristics, depending on the most completed feature each respondent was then assigned to a particular type of temperament.

16.4. Conclusion

Information technology is currently widely used for both gathering information and for motivating staff towards further education. For motivation for further education, the best group appears to be secondary school and university educated respondents, who are positively inclined to further education. In contrast in the group of people with a vocational school or without GCE, there is a need to work on improving motivation for further education.

In the context of educational organisations it is also a need to improve the functioning of the Intranet as a means of acquiring new information. The questionnaire survey shows that the potential of the intranet network is often not fully exploited.

It is also necessary to increase the motivation of teachers towards their education by e.g. implying on the most common motivators for learning. According to the research by the INSOMA Company, generally the biggest motivation for training of employees is the reason of existence, professional and also the possibility of better job prospects. In the Czech Republic, 33% of respondents are motivated by the desire for self-education. (Sak and Saková, 2006)

As the biggest motivation for further education, according to the survey by the Czech Statistical Office, is the desire to improve career prospects and increase performance. (Czech Statistical Office, 2013)

It is Important to use e-learning, which is preferred by respondents aged 31-40 years. This result corresponds to the survey carried out by Donath – Burson - Marsteller Company (2009), which proved that it's mainly the

young and more ambitious people who have inner motivation for education, and the result of the survey conducted by INSOMA according to which online e-learning is used by 29% of employees, of which a majority consists of women (52%).

PC, CD and DVD for training are used by 31% of the population. (Sak and Saková, 2006) These people can fully appreciate the benefits of e-learning: availability, non-stressful learning environment, consistency of learning content, individualism as well as online consultation, monitoring learning outcomes, supporting educational effects, and more. (Vychová, 2008)

The best attitude towards education belongs to those, who choose educational events themselves. Taking into account the busiest way to get information regarding education through a website, it seems beneficial to recommend several training courses to staff through a specific website, from which they can then choose the most appropriate one for them.

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17. The Efficiency of a Managerial Training Programme in a Franchise Company

Gabriela Mádllová

Abstract: *This article deals with the effectiveness of the educational program applied to the upper management level in an international chain of fast food company. The aim of this exploration was to determine whether this broad international model is effective even for national, or regional class, and whether the employees are subsequently adequately prepared for their work, motivated and satisfied. Questionnaire survey was conducted in the regional units of the chain and evaluated by appropriate statistical methods.*

Key words: *Knowledge, training program, learning organization, competition.*

JEL Classification: *X00, X00.*

17.1. Introduction

This topic concerns on the issue of the introduction and improvement of knowledge management in the region, especially in services. It is the service where knowledge management is not such a commonplace, as is it in larger production companies. Knowledge management is nowadays a hot topic because it is mainly the knowledge and experience what today forms an essential part of business competitiveness. How the company takes care about the development and education of its employees is its future success or failure.

Nowadays more and more organizations beginning to realize and emphasize the personal and educational development of their employees, managers are trained on how to manage the flow of knowledge in the enterprises, how to motivate employees and manage talents. Often, however, a general template

is taking over, that does not respect the diversity, culture specifics or simply demographic constraints and the enterprise applied it only as "to-use-something", without significant results on the operation. Therefore is necessary to put emphasis on the feedback of knowledge management in enterprises and continuous evaluation of its effectiveness.

17.2. Issues formulation

17.2.1. Literature review

In recent years become knowledge management and knowledge-based economy an invoked panacea for all the ills of modern times. It is expected from them to revive the economy, solve unemployment or help with competitiveness. To a certain extent this is so, however, until people fully realize the extent and essentiality of these two powerful tools, they will never be able to use them in their entirety. The essence of knowledge management is that the owner of knowledge has an information advantage over other market participants.

This knowledge provides him a temporary monopoly. Implementation of monopolistic or oligopolistic profits is the main charm of the knowledge economy. In the era of globalization, goods and labour become freely tradable commodities with low margins. Only owners of special knowledge are an exception: they become beneficiaries of intellectual annuity (Kohout, 2005).

Companies with this intellectual advantage (usually protected by licenses or patents) may require a much higher business margin. Companies that offer only labour are witness to the edge, because workforce is today- in comparison with the knowledge, a cheap commodity. Quite the opposite pole is of the opinion has the economist Jan Urban (2011).

In his publications is inclined rather to the fact that the knowledge economy and knowledge management are a myth and cannot work. He argues with the statistics of various developed countries over the last decade: "Statistics of the developed countries shows, that the share of people with secondary and higher education in some sectors grow (this concerns mainly to

services), but productivity growth in real wages, however, does not responding to this growth." The education of workers is increasing, but does not lead to higher productivity or higher wages, as one would logically assume, argue Urban.

17.2.2. Knowledge management models

Classical concept model of knowledge management, gives as its goal especially saving information, so that they are not forgotten in the future. This model is based on the assumption that future needs will be the same, or at least very similar to those which have been addressed in the past. In this way are workers viewed as a passive recipient of information.

The second possible meaning of the term „knowledge management“ is much broader and closer to modern approaches to knowledge management needs. In this case, the knowledge management is seen as a process of creating new knowledge, not only of the transfer. This creation is done through the maximum support teamwork among employees, functional communication and sharing of personal experience between individuals in the team (Fischer, 2001).

From the static concept becomes a smooth and continuous process of creation and sharing of information between employees of the organization, not just in one area, but ideally across disciplines and departments through the whole enterprise. World trade is in recent years focused on the issue of knowledge management, according to the survey reached on the University of Northern California (O'Leary, 1998).

"More than 40 percent of companies have a special department set up by workers and knowledge management, creation of adequate infrastructure and environment for sharing information within organization." In the traditional concept of knowledge management, as we mentioned at the beginning. Management collects and structures the individual parts of the corporate memory and passes it as the final product. This "top-down" approach implies that knowledge is created by managers and workers just passively receive it (Fischer, 2001).

In a more recent concept it is extended of continuous learning to solve problems as unique cases. This approach has two main aspects, one of which is that it is the workers, not the managers who make knowledge and at the same time they use it. A second is that the knowledge is actually a by product of the work itself (Fischer, 2001).

Such knowledge then provides suggestions, worksheets and documents pointing rather to evaluate and improve the possibilities of work on the task (O'Leary, 1998). Repetitive, cyclical process of knowledge management then involves three main activities: creating- involving- expansion. Information "warehouse" of the company collects and stores information which have been formed in the past, and distributes them free to their employees. This leads to innovative possibilities, because different approaches carry a different solution methods, it have been created by other people, thus may offer other mechanisms or strategies (Fischer, 2001).

17.2.3. Learning organization

There are a lot of definition that seeks to characterize the concept of the learning organization, most aptly is it characterized by Wick and Leon (1993) as "an organization skilled at creating, acquiring and transferring knowledge and skills to change their behaviour in sight of new knowledge and skills. It is a place where people continually expand their capabilities in order to create results, after which truly desire and where people are continually learning how to learn ". It is therefore an ideal business model, which takes place continuously in a spiral learning process and smooth response to this knowledge. Workers themselves have an interest to educate and thereby strengthen both their fulfilment, and business performance.

Armstrong (2007) see the features of a learning organization, learning strategies and corporate culture as very closely linked, consciously learning organization based on the opportunities and risks of business, individuals, groups and entire organizations which are not only thought, but also learn how to learn. Learning organization is very much oriented to the creation and transmission of knowledge what is critical to their strategic success. The organization must ensure that the people are ready and willing to learn, understand what they need to know and be able to do to be able to take responsibility for their education that will make full use of existing education resources, including assistance and guidance from their line

managers. People must be motivated to learn and educate. And to be motivated and educated people must find satisfaction in learning.

17.2.1. Problems and promises of knowledge management

With the growing amount of information in the corporate database grows somehow a need to efficiently manage this information. In the past, this information was stored on paper and in the minds of people. The paper has limited access and it is very difficult to update, and when employees leave, they take with them most of their knowledge, so valuable to the business. The first problem was definitely to teach the employees to teamwork. Teach them where to apply teamwork rather than to stay individuals and learn how to communicate during this process. More views allow multiple options to find solutions and more information about the problem (Fischer, 2001).

The knowledge has a longer life than information obtained from handbooks or by an individual lonely process. Discussion with workers teach to understand the problem, understand it better and to obtain information to work with. Another problem may be the reluctance to share information with other employees. "If people do not want to share their knowledge, it is in most cases not because they want to hide any ill intent. It's not because they were not rewarded for it. And it's not because the organization structure urges to do this. Is it because they do not know **why** and **when** and **how** to share it "(Seeman, 2010).

Sometimes this reluctance may also stem from fears that their minds will spin out or even contradict to the company policy and employee will be somehow persecuted (Walshman, 2001). Another huge problem appears in the area of knowledge management is called "information overload". In some cases, efforts to acquire and store knowledge are by the managers overestimated (Fischer, 2001). Knowledge management is therefore trying to focus mainly on qualitative data rather than the quantitative (O'Leary, 1998) Employees are otherwise inundated by manuals, on-line manuals and hundreds of thousands of pages of information.

Lots of information contained herein is not essential and unnecessarily distracting from the important things. In addition- worker is not able to perfectly master the knowledge only due a simply reading, unless there is no possibility to try it in practise and so it can easily happens that is forgotten

over time. Therefore, to avoid such situations, knowledge management must provide the information that the employee really needs and when it needs (Fischer, 2001). And last, here mentioned problem of smooth implementation of knowledge management into enterprise policy can be a problem of sharing information in a multicultural society. Due to the globalization occurs in many enterprises to international connections.

This process entails a problematic of different understanding of the issues, of information, attitudes, traditional values and approach to work. "Intercultural cooperation involves the interaction of people whose tacit knowledge developed in a different way and who were educated in another way. These differences must be taken extremely seriously and do not try to change them by any existing corporate template "(Walshman, 2001). To benefit from the implementation of knowledge management to run the company, it is necessary to overcome some deep-rooted stereotypes and myths.

17.3. Methods

The method of data collection was used in the text, especially the analysis of documents, both printed and electronic form. Furthermore, the method of comparison of the data and partly also the method of deduction. Most major part of the work is presented by own research in the form of a questionnaire. The questionnaire was distributed to the South Bohemian branch of surveyed organizations upper management level. The questionnaire had a 100% return. Data obtained from the questionnaire was then evaluated especially in cluster and factor analysis.

17.3.1. Analysis of the problem

For the purpose of the research was chosen a company operating on the market as one of the world's biggest fast food chains. Parent company secures and controls the level of each restaurant and organizes their joint marketing policy and supply. One of the reasons for this choice was the fact that it has built a strong, recognizable brand uniformity in different parts of the world and maintains this uniformity even in the field of care for their employees, so it should therefore be an efficient and effective system.

The question that is of course hand in hand with this is that if it is even possible for different types of people, different nationalities and different socio-cultural conditions to use the same methodology. Subsequent research should, at least generally assess how effective is that American manual for the Czech environment, particularly for southern Bohemia.

As regards education, in addition to the aforementioned internal alight and training courses for individual positions this corporation has decided to fight against bad-perceptions of their jobs by introducing a university management program. It is accredited by Manchester Metropolitan University. It was preceded by the establishment of an apprenticeship program which received good reviews from British authority to regulate standards in education Ofsted.

17.4. *Statistical methods*

Questionnaires were distributed among all shift leaders and second assistants on all five units in South Bohemia. Return on anonymous questionnaires was perfect. The range of responses between locations or positions did not differ significantly; therefore I worked in the processing of questionnaires with division according to location. For further evaluation were used the following statistical analyzes: Factor analysis and Cluster analysis.

17.4.1. Factor analysis

The role of factor analysis is to find the right unobservable variables and assess their impact on variables directly observable. In this case is it about the determination of latent variables which affecting knowledge management training evaluation, which was carried out through a questionnaire. The first step was to collect from a questionnaire 10 questions, which are in some way in touch with past training evaluation. The actual factor analysis was performed by using the maximum likelihood method and verified with the main factors using statistical software XLSTAT. The results obtained by using both methods were comparable, what is suggesting the stability of the model.

Overall it can be said that despite the small number was obtained fairly satisfactory four factor model, which can be clearly interpreted. When assessing whether that's ten questionnaire may be sufficient to measure the quality of training focused on knowledge management would be required also further analysis regarding its reliability and validity. In terms of internal consistency achieves this questionnaire Cronbach's alpha values of 0.804, which is quite a high number.

17.4.2. Cluster analysis

The task of cluster analysis is typically to classify n objects into k mutually disjoint classes so that in each class were objects that are in some predetermined criteria as similar as possible. In this case it will be the 22 respondents divided into classes based on their answers to 10 questions relating to evaluation of knowledge management training, which were considered already by factor analysis.

It was working with quantitative data and uses the same encoding as in the previous factor analysis. On the basis of the calculations was considered by clustering into three classes. In terms of interpretation is evident that the first class is made up of respondents who rated the training very positively in all matters.

In the second class are individuals, who were, compared with the first class, on some critical issues, but overall significantly outweighed positive outlook on training. Finally, the third class is made up of respondents who were significantly more critical and in some matters rated this training even worse than the 3rd degree on a five-point scale. It should be noted that the different classes are represented by individuals working in various positions and various branches of the company.

It was confirmed that it does not make sense to perform clustering by occupation and location. Overall, the cluster analysis provided some information about how different outlook on training evaluation is between different types of respondents. Practical use of this statistical method, however, when considered relatively low number of respondents and the type of the used questionnaire is rather questionable.

The conducted survey already shows that in higher management positions in regional offices can be employees after a year of the incorporation, which is probably due to the high turnover of staff in lower positions. And what do these branch managers think about the effectiveness of offered training program?

About the preparation before the training process- the majority of respondents agreed that the time to get familiar with the materials and the trained theme was enough, the rest of them adding that it could handle, but would welcome more time to prepare, for inadequate time voted nobody. Both groups also consistently said that preparation for training lasted them a maximum of three months, 54% could make it even earlier. When should employees evaluate the usefulness and clarity of the materials provided on the preparation they showed their satisfaction and final grade in rating scales gave 1.8. Furthermore, they also praised the approach of senior colleagues who came out to meet them willingly and professionally advised. This positive collegiate experience had a full 87% of respondents!

In the next section regarding on the course of the training was detected that the own process of training is perceived and evaluated positively by workers. Again, the overwhelming majority agreed that the prepared materials fully corresponded with subsequent training, and that they were during a training session well prepared for different situations in practice, even if not all of the obtained skills they can utilize. Big benefits were seen by 85% of participants in the selection of knowledgeable teachers who were identified as highly competent and experienced. As another example, participants also appreciated the optimal ratio of information, theory and practice.

When was the staff some time after re-training approached to retrospectively evaluate what would they with current practical experience include into the training program, the most frequently mentioned were- more practical examples and model situations (31%), crisis management (23%) and deeper insight into psychology and sociology (also 23%), 15% of respondents would also like better training in communication skills. Almost identically perceive respondents this training as a support of their career growth within the company, and as the opportunity to gain new knowledge for practice. In

retrospect form 88% of respondents judged the training as entirely satisfactory, the rest by the same ratio of percent either missed self-preparation before training or this self-study takes as his duty and has not a strong opinion on it.

The questionnaires also showed that after training, there is also offered a helping hand of older colleagues and freely available employee manuals. Newly trained employees feel that their work is monitored immediately after the training and their performance is much more carefully analyzed and evaluated. Which was generally positively received, only a tiny percentage of it do not feeling good under this supervision.

The results of the survey show that the education system here is set up correctly and fully in accordance with the needs of the region and operator. Employees are not stressed and overloaded with information that might not be usable in practice. In preparation for learning outcomes have enough time and appropriate study materials. In work process they lack the bigger emphasis in crisis management training and possibly something more from the range of interpersonal communication.

Hierarchy and career progression are set very motivating, corporate culture is geared to support each employee who is interested in its own professional growth. It can be seen that the company realizes its potential "breeding" of workers; therefore it strengthens their loyalty and trying to build a strong corporate identity. Such system of education is a great support of functioning knowledge management in a learning organization. It is seen that even though it is a legacy program from abroad, it is suitable for our conditions and has proven to be effective.

The company, however, should pay more attention to training programs feedbacks and other employee activities feedback, since two-way communication with employees can continue to further strengthen their loyalty and to reduce the current fluctuation. Certain haste, which is significant for the present time is in this case harming the lower positions, where the employee is part of the "crowd" and is not able to realize its value and position for the company, therefore does not tend to identify with the corporate identity and start its career growth within the company.

17.5. Conclusion

As in many other fields, a major role of human value-added as a carrier of information, knowledge is very important. Despite some sceptical estimates, I think the investment into a lifelong education of employees and supporting their development is a huge advantage for enterprises and it leads to a significant strengthening of competitiveness in an increasingly supersaturated market.

We can admit that the researched subject has elements of a learning organization, as was defined in the text above. The education system is indeed global, but as you can see it is also applicable to individual regions and is understood and accepted by workers regardless of geographic classification.

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18. Ecological Innovations Treated from the Perspective of a Medium Sized Enterprise

Miroslava Lovichová

Abstract: *This monograph aims to highlight the importance of the so-called ecological innovation (eco-innovation) in the small and medium enterprises (SMEs) and describe possibilities of its implementation. The article gives an example of production improvement process in relation to the possibility of secondary waste treatment and subsequent benefits for the company. This fact is shown in a given example focused on implementation of eco-innovation, which includes the purchase of innovative technologies in the company Pilana-Knives, Ltd. This company belongs to the group of medium-sized enterprises relating to the number of employees. Pilana-Knives, Ltd. specializes in manufacturing of industrial knives, which means with a number of environmental aspects that have some impact on the environment. One suggestion how to solve this issue is brought and described in this monograph.*

Key words: *Innovation, ecology, environmental management, implementation, small and medium enterprises.*

JEL Classification: *A19, C30.*

18.1 Introduction

Nowadays there could be found, in most cases, so-called “late-pattern” of the environment protection. It means that the company or responsible person resolves compensation and penalties only when the damage is committed. It is talked about the short-term prevention. As it is known, long-term protection of nature is more important and it should be supported with the help of regular information about the environment condition, at least to the extent when the environmental gains and losses obtained on a similar importance as the economic gains and losses. Environmental protection in

developed countries has become a priority and the basic question to be addressed. The public interest is ensuring of sustainable development. Between environment and society there is an interactive relationship, and therefore the socio-economic development should not compromise its function.

According to Freeman (2008), the most effective tools to protect the environment are so-called voluntary instruments. One of the tools is voluntary environmental management system. There are many approaches to this system. This article highlights the significance of potential environmental management tool itself, namely so-called eco-innovation. The need for a demonstration of the practical applications will be discussed in the following sections of this monograph, which aims the main goal to analyse the benefits of establishing eco-innovation and use of the Hempel-Oppenheim model, specifically in the medium company Pilana-Knives, Ltd.

18.2. Problem formulation

It is necessary to keep small and medium enterprises, competitive and mostly "clean". This resolution is a part of all documents and programs relating to the environmental trends in the context of small and medium enterprises. We already know that small and medium enterprises are important engine of economic growth and employment across the EU, but also significantly contribute to the environment pollution. The success of European policy towards small and medium enterprises (SMEs) depends mainly on initiatives in member states.

“The EU policy framework provides support and added value of coordination and facilitation”, as in his speech Růžicka says (2011). Initiatives to help SMEs have already been created at national or regional level. Role of the European Commission, in accordance with the modern SME policy is to help SMEs leans on acceptance of production sustainable patterns and sustainable business models, and in ensuring that the objectives of EU environmental legislation were thwarted by the low level of compliance with the building on successful national or regional experiences, and facilitating and encouraging the development initiatives to assist in achieving compliance with the law throughout the Union.

18.2.1. Environmental programs and support for SMEs

Like the large companies also small businesses may voluntarily integrate social and environmental concerns to their operations and into their interaction with stakeholders, and thus contribute to the long-term sustainability and competitiveness. All this is also related to the so-called “Corporate social responsibility” (CSR).

The main point is to negative impacts on the environment at each stage of the product life cycle. It is very important to deal with crucial decisions, consisting in the use and production process, transport, means of distribution, consumption and disposal. *“During the design of the product and its development should be clear how the product will be disposed of and how we could prevent its possible effects on environmental pollution”*, Moutchnik (2009).

First of all it is necessary to think about these measures in the sectors of small and medium enterprises, which have the greatest impact on the environment. They represent: production of metal goods, some of the electronic industry, food industry, production of beverages, tobacco, printing, textile industry, leather processing, wood processing, paper industry and the production of certain specialty chemicals. According to the European Commission (2013), the small and medium businesses involve 70% of the total industrial pollution in the EU.

At the same time 75% to 90% of SMEs believe that their activity does not impact on the environment. As an activity harmful to the environment often mention storage of chemicals, fuels and oils and waste storage and almost 70% did not apply any practical measures to reduce its negative impact on the environment. In order to minimize this share there are a number of support programs designed to promote "green" operation of small and medium enterprises in their activities.

Currently, the small and medium enterprises can join these long-term programs such as: LIFE +, CIP, JEREMIE initiative, program for research and technological development and cohesion policy. For the common priorities can be considered: improving water management and reduction of flood risks, improving air quality and reducing emissions, improving waste

management and removal of old environmental burdens and reducing industrial pollution and environmental risks. These programs have their beginnings in 2007, a newer and more up to date program measures within environmental efforts can be regarded as the Concept of development of small and medium enterprises from 2014 to 2020, *“which is largely built around energy performance of the business sector, the development of energy production from renewable sources and support increased use of secondary raw materials”*, Adamec (2011).

Another important program is the Action Plan on Sustainable Consumption and Production (Action Plans on Sustainable Consumption and Production and Sustainable Industrial Policy), which represents *“a set of measures and tools to ensure sustainable production and consumption patterns to achieve economic growth while respecting the capacity of our planet, reducing damage to the environment and the sustainable use of natural resources”*, Kocmanová (2004).

This plan is based on the so-called pillars, such as: cleaner production, better products, innovation, better consumption, global view. In order to fill these occurred between pillars and their implementation was based, is required to “collaborate” with the legislative instruments for the realization of a fertile soil. Comply with the requirements of environmental legislation and implement steps to improve ecological efficiency can be challenging for small and medium-sized enterprises (SMEs). Therefore, there is a program for help SMEs comply with the laws and regulations in the environment issues, that is called ECAP (Environmental Compliance Assistance Program), under the auspices of the EU, *“which offers a helping hand, provides resources, information and tools that European entrepreneurs need to have their activities were greener”*, Trnková (2004).

18.2.1.1. Program ECAP

ECAP program designed to help the SMEs comply with the laws and regulations in the environment issues was adopted in October 2007, provides a framework in connection with the SMEs regarding to the implementation of European environmental legislation as minimizing the impact of their activities on the environment.

Planned events will focus on the following areas: EU (2004)

- Better regulation policy development and implementation in order to minimize the administrative burden on SMEs in complying with the legislation. The European Commission is reviewing all Community legislation in order to find out where we can get rid of unnecessary spending or reduce administrative burdens. When creating new policies also cooperates with the authorities responsible for implementing the law and try to involve more SME sector, supports the implementation of the EU Eco-Management and Audit Scheme environment, called EMAS.
- The production of affordable, tailor-made environmental management plans, which will make possible to integrate environmental issues into core business activities of SMEs, through logical and economical manner.
- Concentrated financial assistance to promote and support initiatives by public authorities or business support networks aiming at sustainable production in SMEs.
- Increasing of local expertise in the field of ecology, to help SMEs to overcome the lack of know-how at company level.
- Focuses on innovation in environmental management, namely so-called eco-innovation.

It is obvious that the above given programs support environmental management and implementing "green" practices in small and medium enterprises have virtually the same meaning and common goals. This paper will now focus on one of these common objectives, which is shaping up to be not so strong, and thus innovation, more "eco-innovation".

18.3. Methods

In the frame of the issues given in this paper there is used the type of explanatory method, specifically in the form of deductive inference, in

general, theoretical focus of this method. This form is called the Hempel-Oppenheim model, Ochrana (2009):

C_1, C_2, \dots, C_k	- statements about unique occurrences, definitions of starting conditions,
L_1, L_2, \dots, L_r	- general principles and statements,
$\frac{\quad}{E}$	- a sentence expressing that should be answered.

The following chapters will be devoted to the contribution of this model in relation to the explanation of the issue analysed the process of implementing eco-innovation.

The objective will represent findings in the company Pilana-Knives, Ltd. And formulate the importance and benefits relating to implementation of eco-innovation in this company. The subject of investigation is therefore eco-innovation as the introduction of new technology for secondary treatment of waste resulting from production. All this is done on the basis of objective factors (business analysis) and also subjective factors that are determined on the basis of the criteria of basic information, which will be formulated by the end of the following hypotheses:

- Is the benefit of eco-innovation sufficient?
- Has the implementation of eco-innovation fulfilled environmental and economic objectives of the company Pilana-Knives, Ltd.?

18.4. Analysis of the problem

As the European Commission (2012) defines - eco-innovation is *"any form of innovation, which leads to a significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or on the progress sought by increasing resistance to stress on the environment or achieving a more efficient and responsible use of natural resources "*.

In response to the above definition, the following chapters focus on the analysis of examples of existing eco-innovation in the company Pilana-Knives, Ltd., which is specialized in the manufacture of industrial knives and categorized according to the number of employees (150 employees) to

the group of medium-sized enterprises. Eco-innovation concerns the improvement of waste management in their production, namely the possibility of secondary use of waste for other purposes, thanks to a facility that provides treatment (pressing) of abrasive slurries and steel chips. The aim of this chapter is to analyse the available information in connection with this type of eco-innovation, which is to emphasize the benefits of eco-innovation in relation to changes in some selected environmental aspects which the company Pilana-Knives, Ltd. appears to be the most serious.

18.4.1. Characteristics of waste production and its use of eco-innovation in the enterprise Pilana- Knives, Ltd.

Totally, the company Pilana-Knives, Ltd. processed about 720 tons of waste per year (about 30 tons of abrasive slurries and 30 tons of steel chips per month). Total capacity is about 1,125 tons per year, i.e. 1.5 tons per shift.

The company produces in connection with the manufacture of industrial knives considerable amount of abrasive slurries (it is fine steel filings, which are formed by cutting steel). They were mined from the abrasive fluid mechanical lifts or magnetic separators. The remainder of the cutting fluid that remained in the separator, constituted by subtraction and dripped about 20-30% of the total weight of waste. And just the rest of humidity composed of water and cutting concentrate, were causing the inability to sell scrap to smelters for processing as secondary raw material.

The disposal of this waste was solved through outsourcing, concretely through a company having the needed permissions. These services were paid, but above all the waste was disposed of without effective option for secondary use. Sludges were disposed by solidification or biodegradation methods and thus deprived of abrasive fluids. The resulting fiduciary waste was stored or adding to the tailings after homogenization became necessary part of its capacity utilized for landscaping in the construction of roads, highways, etc. There is also another way to repair the waste produced, which is much more environmentally friendly.

Above all, do not require intensive method of disposal and enables the re-use of waste. Abrasive slurries may be compressed into briquettes. Thanks to it, the moisture can be removed down to the minimum level and the common iron waste represents secondary raw material for reprocessing metallurgical way. The extracted liquid formed during pressing is returned

back into the production process of industrial grinding knives. During pressing, grinding sludge into pellets in a ratio of about 1: 1 steel scraps are added arising from the milling of the basic shape of the blade to ensure sufficient cohesion briquettes and facilitate their metallurgical processing for secondary use.

18.4.2. Analysis of the Hempel-Oppenheim model of eco-innovation in the company Pilana-Knives, Ltd.

The aim of this part is to bring practical analysis of the Hempel-Oppenheim model to the case of implementation of eco-innovation in the company Pilana Knives, Ltd.

C_1, C_2, \dots, C_k	- statements about unique occurrences, definitions of starting conditions,
L_1, L_2, \dots, L_r	- general principles and statements,
<hr/>	
E	- a sentence expressing that should be answered.

Explanatory model in the form of deductive inference (inference) begins allegations of unique occurrences and the definition of initial conditions. Regarding practical example, which deals with this post, for these allegations $C_1, C_2 \dots C_k$ may be considered:

- C_1 - Eco-innovation will support the efficient production of the company Pilana-Knives, Ltd.
- C_2 - Eco-innovation will solve the problem and subsequent disposal of the waste generated,
- C_3 - Eco-innovation is a mean to promote the objectives of environmental efforts in the company.

Based on the above testimony, depends on the general laws and statements, expressed as L_1, L_2 , etc. ∴

- L_1 - Eco-innovation is an important asset for the company Pilana-Knives, Ltd.

- L2 - Eco-innovation is a part of fulfilment of the corporate social responsibility,
- L3 - Eco-innovation will solve the problem of disposing of the waste generated.

Brought statements, definitions, general laws and statements are an outlet for element E, which in this model is referred to as a sentence that expresses what is to be explained. For example solved with respect to eco-innovation sentence:

- E - Eco-innovation has brought improvements to the company and benefits that are expected from it.

These benefits include improvements and various positives are elaborated in the following chapter.

18.5. Discussion

The aim of eco-innovation in the company Pilana-Knives, Ltd. was to increase the environmental friendliness of industrial knives based on:

- Ensuring the secondary use of waste produced, which was previously disposed of without the use of "secondary raw material" and to eliminate the current process of disposal of this waste, which because of grinding sludge disposal also had some negative impact on the environment,
- another goal was to increase the efficiency of the entire production process of industrial knives, the implementation of the project has no costly waste disposal specialist firms, but the waste is sold as raw material to smelters. For this reason, the positive impact of the project on the economy of the applicant throughout the period of the project.

Regarding to the hypotheses as following::

- Is benefit of eco-innovation sufficient?
- Has the implementation of eco-innovation fulfilled environmental and economic objectives in the company Pilana-Knives, Ltd.?

There are clear answers "yes", the benefits of eco-innovation is more than sufficient, and its introduction has fully complied with all environmental and economic goals in the company Pilana-Knives, Ltd. Regarding to the analysis of the environmental aspects related to the production of industrial knives there were improvement for processing metal material.

18.5.1. Recommendations for further development

The above analysis of eco-innovation in the company Pilana-Knives, Ltd. would continue to be expanded by the possibility of further innovative steps in the company. In particular, the importance of linking environmental and economic aspects of the company in connection with the eco-innovation, for example:

- Emphasize the importance of eco-innovation influence on the final prices of products offered
- Emphasize the importance of the impact of eco-innovation in the context of total savings in the company,
- Emphasize the importance of the impact of eco-innovation to increase demand for the products of the company.

These points proposed for development can be processed on the basis of the analysis method:

- Measurement - which would have been assessed quantitative signs researched phenomena, which could then be carried out comparison,
- Comparison of individual findings of the measurement results, which were included in a table or graphical representation.

18.6. Conclusion

Supports for new ideas that take into account the environment and at the same time they can not only increase the competitiveness of small and

medium-sized enterprises, but also the whole European industry, it is the core of contemporary activities of the European Union. It is necessary to point out the importance of all possible innovations, but also environmental and innovation. In the fact, these innovations are not only environmentally friendly, but they also reflected economic aspects, as it was written in the above discussion, the cost of waste disposal is replaced by the possibility of secondary use. This is closely related to the support of the state policy, which should identify a clear trend and adopt cost-effective measures to achieve the environmental objectives of the business sector in order to create space for the transition to more environmentally friendly technologies.

Example of eco-innovation in the company Pilana-Knives, Ltd., is a practical example of success in introducing innovative trends in the business. It goes from the analysed case in connection with the given environmental aspects.

About Pilana-Knives, Ltd. we can say that it has taken responsibility for their environmental behaviour, acceded to the environment and rational use of, inter alia, environmental management systems, which are among the voluntary instruments. Environmental management systems are a method that combines the economic interests of the owners and environmental interests of the whole society, thus express the idea of sustainable development of society, as evidenced by Pilana-Knives, Ltd., mainly to improve attitudes towards the environment in terms of emissions reductions, reduction in the use of chemicals or removal process environmentally intensive disposal of waste resulting from production.

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19. The Level of Implementation and the Effectiveness of Use of Internet Communication Tools in the Marketing Area by Accommodation Facilities in the North Bohemia Region

Jitka Němečková, Jitka Novotová, Tereza Semerádová

Abstract: *Hospitality industry, due to its close relation to tourism, belongs among the leading service sectors that with the arrival of the Internet had to fundamentally change their approach to the customer communication. The priority of the accommodation facilities ceases to be the sale of complex travel products their attention is now being moved towards establishing more personalized relationships with customers which requires quality reservation services and easily reachable information. The main objective of this paper is to present the results of a survey focussing on the level of implementation of online tools by the lodging facilities in the North Bohemia region and on the evaluation of their effectiveness by the owners and managers of these facilities.*

Key words: *Internet marketing, online tools, North Bohemia, accommodation facilities, hospitality industry*

JEL Classification: *M30, M31.*

19.1. Introduction

With the further development of the information society, online tourism has become a new form of distribution of travel products where the providers offer their services to groups of customers exclusively via the medium of Internet and regardless their physical position (Neuhofer et al., 2014). The users globally find online applications and technologies as very helpful tools

in the decision-making process and in evaluating offered services/products. The invention of Internet has allowed the customer to freely express their needs and to search information about the areas they wish to visit, about the pricing, equipment, room availability or weather and communicate directly with the facilities.

Parets (2002) mentions that good internet marketing does no longer represent a powerful tool suitable just for the large hotel chains, on the contrary, it may be considered as a big opportunity to face the threats in this high competition environment even for the smallest accommodation facilities. For example, well visually and organizationally designed website could become a very efficient low cost marketing platform even for the facilities with small capacity and minimal economical power. If these facilities desire to embrace the full potential of the Internet they need to keep all the tools and all the content constantly updated and try to implement new instruments allowing them to deliver more personalized information tailored exactly to answer the needs of the customer.

The primary objective of the survey whose results are presented in this paper was to investigate and describe the current status of implementation of Internet communication tools by lodging facilities in the regions of Liberec, Hradec Králové and Ústí nad Labem. Via this survey we analyzed the level of Internet use by individual facilities with regard to the official classification category in which they belong. Next, we examined the type of individual online tools and the way of administration (whether the tools are administrated internally or externally). The respondents were also asked to rate the effectiveness of the tools that they implement and actively use on daily basis in the facilities they own or work in.

19.2. Theoretical background

Internet marketing communication has recently been experiencing a large boom and slowly begins to prevail over the traditional marketing tools used in the traditional media format. In the Czech Republic in 2013, online advertising with 6.5 billion Czech crowns of investments (an increase of 19.3% since 2012) represented the third most used marketing channel right behind television and press (Kotler et al., 2007), Internet based communicational instruments due to their constantly changing

characteristics belong among the most dynamic sectors of contemporary marketing and they are able to reach the ever-growing number of Internet users which is currently in the Czech environment about 3.7 million per day and approximately 6.3 million per month (Simkanič et al., 2013).

Companies that wish to keep pace with the rapid development of the Internet need to find new methods of sharing the information about their products. The virtual market brings together a wide spectrum of vendors selling similar products and therefore provides the potential customer with quite detailed information that can significantly influence the decision-making process. Customer will quickly and with ease obtain the information about the best-selling products, reviews, expert advice etc. (Hlavenka, 2001). The main advantages this emerging media offers are easy accessibility to the potential clients all around the world at the given languages, relatively financially non-demanding, broadcasting visible 24 hours a day, 365 days a year and the possibility of immediate content updates and adjustments. The percentage of people who search travelling and accommodation information on the Internet is constantly growing as well and the facilities that do not present themselves via this channel are for these customers almost unreachable (Czechtoursim, 2014).

19.2.1. Information and the communicational process

As a consistent tendency that we can observe in the area of information is the increasing level of education among the population and its growing ability to obtain the required data. Thanks to this phenomenon the decision-making power has shifted from the manufacturers to the customers (Kotler, 2005). According to the information theory, the information is more valuable, if the message contains something new, something that was not previously known. The concept of information is very broad and difficult to define. Information is of intangible and abstract nature but is always associated with some physical process, which carries it. In order to enable the information transmission, the transmitted data must be first encoded and converted into recognizable symbols and signals. Signal is a physical quantity that carries information. Message represents a way of expressing information as a sequence of symbols (characters) (Ošmera, 1989).

The marketing perspective focuses on the communicational process that describes the transmission of the information from the source to the recipient. Generally the individual stages of the process are defined as transmission, reception and processing of information and they are present in every communicational process whether it is carried out by an individual or by a group of people. We consider the communication as successful only if the recipient is able to understand the transmitted information, in other words if the message reaches the targeted audience and triggers the intended reaction. The communication takes place either in person or through a variety of media such as television, radio, telephone, or nowadays very often the Internet (Clow et al, 2008).

The Internet offers an enormous amount of information about different markets, consumers, retailers, competitors, products and many others. According to Kotler, these new circumstances can be perceived as the origins of a new type of market setting that he describes as “networking economy”. Economical subjects have nowadays a better access to the communicational online technologies which allow them to carry out a significant percentage of their transaction with their customers via the virtual channel. Organizations and individuals can electronically transmit questions concerning products and services, orders, payments, establish mutual dialogue based on which they can create customizable and personalized offers. Furthermore, these companies and organizations are not limited by the borders of the local market they operate on, thanks to the worldwide networking characteristics they have the opportunity to address employees and customers from all over the world (Kotler et al., 2007).

19.2.2. Current status of Internet implementation in the Czech Republic

1) Data concerning the households

As it was already stated, the Internet is a rapidly growing worldwide phenomenon. In 1987, there was only ten thousand active users, in 1992 over a million and in 1996 already over thirty million. In 2010, the number of Internet users exceeded 1.7 billion and in 2013 the number reached 2.4 billion worldwide (Přikrylová et al., 2010). In the Czech Republic in 2000, according to the Czech Statistical Office, just 1 million of individuals had access to the Internet. In 2013, this indicator got over 6.5 million. Looking more closely on the gathered data and focusing on the age distribution, the group using Internet the most (up to 96.9%) are individuals among 16 and

24 of age. On the other hand, the data show a very low level of Internet penetration among the group 65+ since only 19% of the individuals actively uses the Internet. The oldest generation is therefore still very difficult to reach via this information channel. In the category of education level achieved, university graduates dominate (90.2% active users) while people with lower educational degree have Internet access only in 20.3%. For this group, as well, the application of online marketing strategies would probably be very inappropriate (ČSÚ, 2014).

In the Czech Republic, the individuals connect to the internet quite often, up to 70% of the Czech population gets on-line at least once a week and more than a third of the Czech Internet users stay online around the clock. The Czechs mostly connect to the Internet at home (98%), then at work (48%), but also while watching television (33%). The study comparing on-line habits of users of five Central European countries also proved that men use mobile connection more frequently than women (Empresa Media, 2014).

According to the data from 2008 published by CSO, the Czech citizens use the Internet for purposes such as: communication (88% of the users have e-mail, 37% of them use it for voice communication and 28% for chatting), search for information (78% search for information on goods and services and 44% search for information about travelling and accommodation), 56% of the active users reads online news, newspapers and magazines. A significant part of the users also spend 28% of time by playing or downloading music, 23% by watching online television or listening online radio and 16% by downloading or playing games. Quite a low percentage of users (25%) have an online banking account and only 39% shop via the Internet. Those results are quite outdated, but we can expect a large increase in all of these areas since the number of Internet users is nowadays much higher than it was in 2008 (ČSÚ, 2014).

2) Data concerning businesses and organizations

An Internet access in the business sector has long been a matter of course. Already in 2003, the share of enterprises connected to the Internet represented 90% and ever since it has been growing to the current value of 96% (January 2013). If we observe the level of Internet implementation from the perspective of company size, there are no notable differences. In 2013, own website to communicate with existing and potential customers

had 80.1% of the companies, which represents an increase of 10% since 2006. On the other hand, there are substantial differences in the web presentation of these companies. Small firms (10-49 employees) use their own website only in 76.9%, medium-sized companies (50-249 employees) in 92.8%, and large ones (250 or more employees) in 93.1%. It is therefore a relatively large difference between the small and the large firms. Many small businesses, including a great number of accommodation facilities, still need to integrate Internet communication into their marketing and visibility-improvement strategies (ČSÚ, 2014).

19.2.3. Implementation of online information technologies

Innovations have always been a very important part of business activities, but they never had such an importance as in today's global economy. Innovation is nowadays regarded as a prerequisite for the further development of the whole society. Innovations are considered to be endogenous growth factors that influence the development of the economical unit and change its structure on the socio-occupational, environmental and economic level. Innovation, in case of a successful implementation, can become for the company an important competitive advantage (Svatošová, 2010).

Oronsky and Chathoth investigated the use of information technology by the businesses with the purpose of identifying factors that motivate managers to implement new innovation technologies. The results suggest that businesses are generally aware of the importance to innovate the tools they use, but they have to face many obstacles in terms of cost of adoption or complex administration (Oronsky et al., 2007). The use of Internet tools can increase operational efficiency of the organizations and facilities, but if their implementation is done without precaution they may cause a reverse reaction (Kothari et al., 2007). Small and medium-sized businesses approach new tools and technologies very carefully due to lack of knowledge, skills and doubts about their effectiveness and safety.

Introducing new technologies is a complex process that can be influenced by several internal and external factors. The perception of these factors in the hospitality industry was thoroughly analyzed by Wang et al., who focused primarily on the use of the Internet in the sales processes and in the

marketing strategies of small and medium-sized lodging facilities. Although more and more facilities are online present, the information they provide on their websites are of a poor quality (Wang et al., 2007). Similar results were obtained in the studies focusing on Thai hotels. All the investigated subjects had their own websites and implemented various types of Internet communication with the customer, but the frequency of use of these instruments and the sophistication of the strategies differed significantly for the individual subjects (Buhalis et al. 2008).

19.2.4. Online marketing communication

Marketing communication can be considered as a crucial process for the tourism and hospitality industry, as it is a very specific service sector with a large competitive market. Getting the right information to the right people is one of the most important prerequisites of succeeding in this area (Scott, 2009). The term “marketing Internet communication” does not describe only the websites of companies that were mentioned above. The modern Internet communication tools include e-mail marketing, social networking, PPC advertising, chat, forums, discount portals, Skype, messengers and in the field of tourism also accommodation search engines and online travel agencies (Miletsky, 2010).

All of these tools require lots of internal and external information in order to correctly target the selected strategies establish relationships with customers and implement all the components of the communication mix. Many researchers have examined the effects of marketing information systems on the creation and maintenance of the buyer-seller relationship on the internet. Their research suggests that online marketing activities can significantly contribute in building lasting relationships and creating an effective program of E-CRM (electronic customer relationship management). For example, Kim et al. found out that the quality of information increases the probability that consumers will continue to have a relationship with the provider after the transaction is over. Updated, accurate, complete and relevant information are attractive for the consumer and may become a source of differentiation and competitive advantage. Ensuring the quality of information presented through web channels represents therefore a necessary step for creating a functioning E-CRM program (Kim et al.,

2008). Karliček and Král (2011) refer to quality information as a content attractiveness. Content attractiveness is influenced by the level to which the online tools offer to the targeted group entertainment or interesting, relevant, original or useful information. Another important prerequisite for the effectiveness of online marketing is the ease of navigation. The organizational transparency of the user interface and quick search of the desired information can reduce the efforts of the consumers seeking to fulfil their needs. If the consumers find the Internet presentation of the facility too complicated and time-consuming source of information, they will simply interrupt the visit of the communication channel due to the increasing transaction costs (Stockdale, 2008).

19.2.5. Official classification of lodging facilities in the Czech Republic

The Association of Hotels and Restaurants of the Czech Republic in reaction to the Resolution of the Government dated 17th July 1999 and with the support of the Ministry of Regional Development and the Czech Tourist Authority - Czech Tourism - has published a document called “Official united classification of accommodation facilities in the Czech Republic”. This official classification was taken in consideration during the construction of the questionnaire used in the research whose results are presented further in this paper.

The Czech Association of Hotels and Restaurants is a member of the European association HOTREC that represents hotels and restaurants in the European Union. Classification systems of individual EU countries are currently undergoing harmonization. The members of HOTREC adopted “document 21” containing unifying criteria and principles. Official united classification of accommodation facilities in Czech Republic became part of the European Hotelstars Union system, which standardizes the classification criteria within the Czech Republic, Germany, Austria, Hungary, Switzerland, Sweden, Netherlands, Luxembourg, Lithuania, Latvia, Estonia and Malta. Hotelstars Union guarantees the same quality parameters of accommodation services in the defined region (Ministerstvo pro místní rozvoj, 2013). For the purposes of this research, due to the number of representatives of each type in North Bohemian region we chose the

following categories: hotels, guesthouses, cottage settlements, tourist hostels and campsites.

19.3. Sample case study

A mountain chalet Zuzana is a small family type guest house with 30 beds that in addition to lodging services also offers hot meals. Pension and its surrounding area are suitable rather for more peaceful holiday activities. The guests usually come for activities such as cycling in the summer season and skiing in winter. Since we are talking about a small and independent lodging facility the owner her-self is directly responsible for all leadership processes. This guesthouse is annually visited by an average of 500 visitors.

The administration and management of customer communication, including the Internet, are solely in the hands of the owner of the facility. It is highly probable that the owner has decided to administrate these instruments internally for the reasons of elevated costs of external administration and because of the small profitability of small-scale accommodation, which makes it almost impossible to outsource the management of the Internet communication. We can also assume that the owner believes in her own skills and is confident that she can manage all the tools more than sufficiently. The owner is well aware of the importance of the Internet as a communicational medium and of its benefits. The owner has over time implemented in total 5 online tools that she uses to attract the customers.

The mountain chalet Zuzana uses as a main communicational tool its own website. In order to build this web site the owner had to expend a significant investment which was according to her well spent. External IT expert who designed the website and created it gave the owner the option to self-manage the websites content, especially the textual features. From the professional point of view it is apparent that the owner does not have the sufficient skills in copywriting, thus in creating attractive web texts that would attracted customers and convince them to spend their holiday in the facility. The owner had just simply described the surroundings and the type of cuisine that her guesthouse offers. A potential customer that is considering staying in the lodging facility would doubtlessly have appreciated more information. The texts presented on the website are very

important for the search engine optimization nevertheless for which the owner refuses to pay because of the general lack of confidence. The website is also linked with the facility e-mail that the owner administrates daily. The owner once or twice a year also implements e-mail marketing consisting in sending her former customers updated offers of accommodation services.

As important tool of Internet communication was by the owner labelled the social networking site Facebook. At first sight, it is evident that in this type of communication with customers was never invested. The current number of fans on Facebook is 30. Even though the owner claims that actively encourages customers to rate the offered services on Facebook, the total number of reviews displayed here are two, although these two give a very positive reference. This profile on Facebook is updated only several times a year and some of the information presented there is outdated.

Other tools implemented by the owner and positively evaluated by her are accommodation search engines and online travel agencies. These instruments are administrated by external experts. We can assume that these tools bring the most customers. Her satisfaction with these tools can be attributed to their ease of use. They require nearly no update and no additional activity. The owner does not use at all to communicate with customers discount portals, PPC (Pay-Per-Click) advertising or PR articles. These tools may therefore be considered as opportunity.

Improper management of the online communication tools shows up as well on the fact that the owner does not know the traffic of the facility website, or the traffic of the Facebook profile. The lack of reviews on accommodation services, the lack of information about the traffic and also the insufficient level of feedback are causing that the owner is not able to assess which sources bring her more customers and therefore cannot assess the effectiveness of various tools that are implemented. Over the time, the owner has acquired rather negative attitude to the online communication tools, because she is not satisfied with the returns of investments she made.

Based on the analysis of the Internet communication implemented by the mountain chalet Zuzana, we may assume that the biggest problem of these facilities is financially demanding external administration that the small and medium enterprises in the lodging industry cannot afford. We can only speculate on whether the owner is not interested in the Internet

communication or whether she has the interest but does not have the possibility to consult the right information sources from which she could learn how to communicate effectively with the customers over the Internet.

This paper focuses on the level of implementation of the Internet communication tools by accommodation facilities and analyses what could be the causes of the current situation. Pursuant the previous case study and the results obtained by observation of limited sample of subjects we expect that the level of implementation of these tools is in the case of many small facilities alarming. If this hypothesis is confirmed we will try to propose possible innovative solutions to improve the awareness and related skills of the owners and managers in the lodging and hospitality industry.

19.4. Methodology and data collection

In order to determine the level of implementation of Internet communication tools and to evaluate their effectiveness we organized a survey among the owner and managers of accommodation facilities in the North Bohemia region, specifically in the localities of Liberec, Hradec Králové and Ústí nad Labem. The research was conducted via an online questionnaire. We investigated the level of Internet implementation with respect to the category the facilities belong in. Further, we focused on the type of implemented online tools and their administration, whether it is internal or external. Respondents were also asked to rate the effectiveness of the tools that they actively use in the facilities they manage.

With the purpose to distinguish what tools we used according to the aim of the communication and at what stage of the communicational process we divided the questionnaire into several sections. In the first part of the survey, the respondents were asked to answer to what extent they use the Internet to communicate. The second section was focused on the type of instruments used during the customer acquisition and the third one, on the tools ensuring the order processing and the last set of questions examined how the subject collect feedback from customers in this virtual environment. The questions in the survey were not of quantitative nature, the participants only, based on their personnel experience, subjectively assessed the degree of use of these instruments, the amount of investment in it, etc. The questionnaire also dealt

with other aspects of the Internet communication in the lodging industry that are not the subject of this article.

As decisive criterion for evaluating the choice and the effectiveness of each tool was selected the type of accommodation facility according to the Official united classification of accommodation facilities. The main reason for choosing this variable was the assumption that the type of lodging unit has a major role in the decision process concerning what Internet communication tools to use and how much to invest in them. There were 2,835 accommodation units in total in the three monitored regions. We addressed 60% of these that have at least some Internet presence. The response rate for the number of 356 responses was 20.92%. The categories of the classification were in this sample represented as follows: 17 cottage settlements (4.8%), 47 hotels (13.2%), 12 campsites (3.4%), 138 guesthouses (38.8%), 43 tourist hostels (12%) and 99 other non-specified lodging facilities (27.8%).

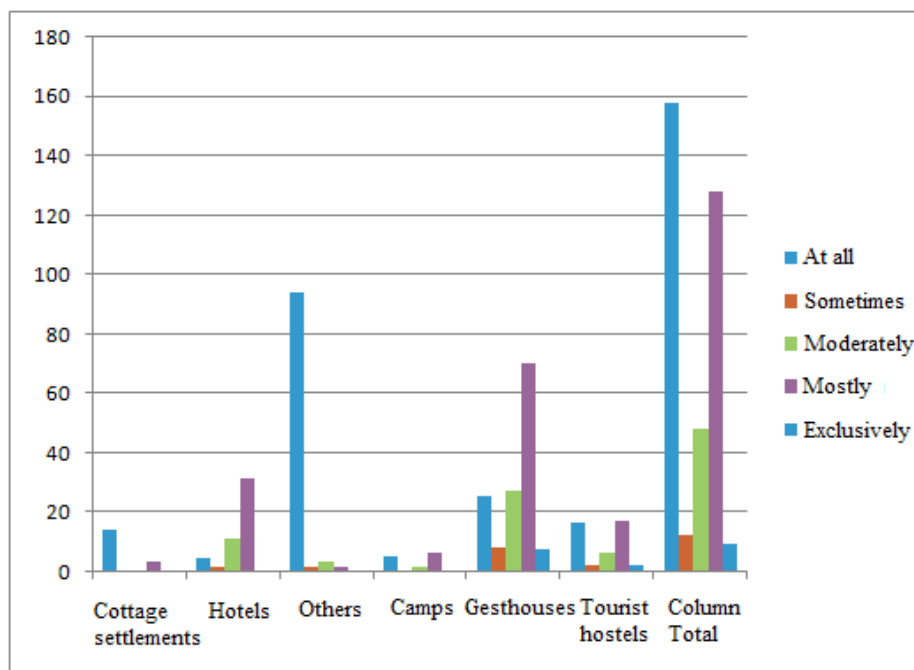
19.5. Results of the survey

The introductory part of the questionnaire contained questions trying to identify the frequency of the Internet use by accommodation facilities either to communicate with customers, either in the process of obtaining and managing orders or for getting feedback from the clients that have experience with their services. In addition to the frequency of the Internet use, the respondents were also questioned about the form of administration of online tools, the amount of the investment in this form of marketing and at the end of this section the respondents had to assess the level of investment into their online communication and its returns.

The first question examined the frequency of use of the Internet to communicate with customers on general basis. The respondents could select the answer from the following scale: at all, rarely, moderately, mostly, and exclusively. Based on the chi-square test of goodness of fit was at the 5% level of significance rejected the hypothesis that the variables, facility type and level of use of the Internet to communicate, are independent. The test therefore suggests that there is a dependency relationship between the category the facility belong and in and the degree of implementation of

online communication tools. We can assume that the larger lodging units such as hotels have better conditions for implementing successful online communication than smaller facilities e.g. guesthouses. Our research indicates that the least use the Internet to communicate cottage settlements (82% not at all), and other unspecified facilities (95% not at all). As expected, the most frequently use the Internet to communicate hotels (23% moderately and 66% mostly) followed by guesthouses (51% mostly and 20% moderately). Regarding the camping and hiking hostels the results were contradictory - part of them does not use the Internet to communicate at all and the others use it mostly. Obviously in this category, there are significant differences in the choice of marketing and communication strategies or again in the level of awareness of the importance of these tools.

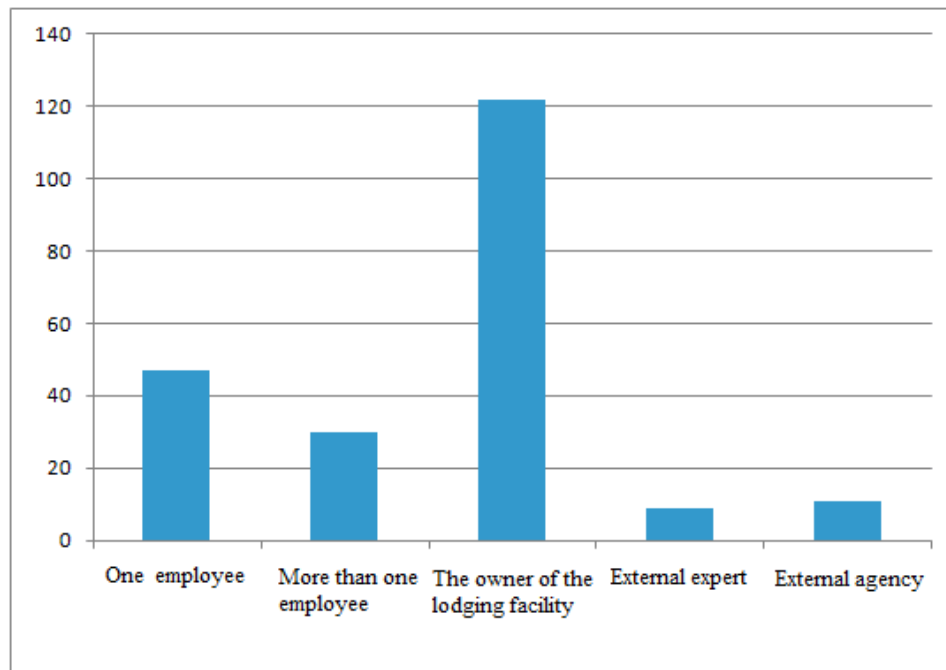
Fig.19.1. Facility type and the frequency of use of implemented online tools



Source: authors

On the question analyzing the responsibility of managing online tools, 56% of respondents stated that the instruments are managed by the owner of the accommodation facility, 21% of them answered that it is one assigned employee, in 14% more than one employee and only 9% of the participants manage these tools externally with help of an external expert or external company. After analyzing these results we can conclude that businesses in the hospitality industry are not too interested in outsourcing the administration of Internet communication tools and instead prefer to manage all the instruments theme-selves. The collected answers as well indicated that quality implementation of Internet communication is still highly underestimated.

Fig.19.2.Type of administration of the online tools.



Source: authors.

Furthermore, it was investigated to what extent the respondents are investing in the Internet communication tools. We discovered that the amount of investment in the category of hotels differs greatly (12% do not invest at all, 32% insignificantly, 40% average and 16% significantly).

Guesthouses invest mostly only insignificantly (32%) or average (50%). Hostels invest rather insignificantly or average. Overall, the most invested guesthouses.

The fact that most invest guesthouses is a little bit surprising, although the data suggest that for these facilities the implementation and the use of the Internet communication tools represents a relatively easy, economical and effective way of communication and can help them to create a competitive advantage.

Regarding the return on investment we found that 22% of respondents are unable to quantify the returns, 11% feel that the investments do not return at all and 67% have an impression that the investments definitely return. The overall results suggest that the lodging facilities, except cottage settlements and unspecified facilities are aware of the importance of having a web presentation. A majority of the active users also agreed that their investments in these instruments pay off.

The purpose of the next set of questions was to identify the specific types of instruments, the facilities implement in the context of their marketing and promotional strategies. Respondents were again asked the question about the administration of these instruments in order to determine whether the individual tools are administration demanding or not.

This section of the survey was answered only by those respondents who use at least some of communication tools. Even those results confirmed the general tendency to manage most of the tools internally, meaning without help of either marketing or IT experts.

The data indicate that companies practically do not use messenger tools such as online chat or Skype. Own website and e-mail appear to be basic instruments implemented by almost all of the respondents. As another tool that places among the most frequently used, are considered to be the accommodation search engines (33% of the facilities administrate them externally and 54% internally). Two thirds of the respondents replied that they also have an order form on their website.

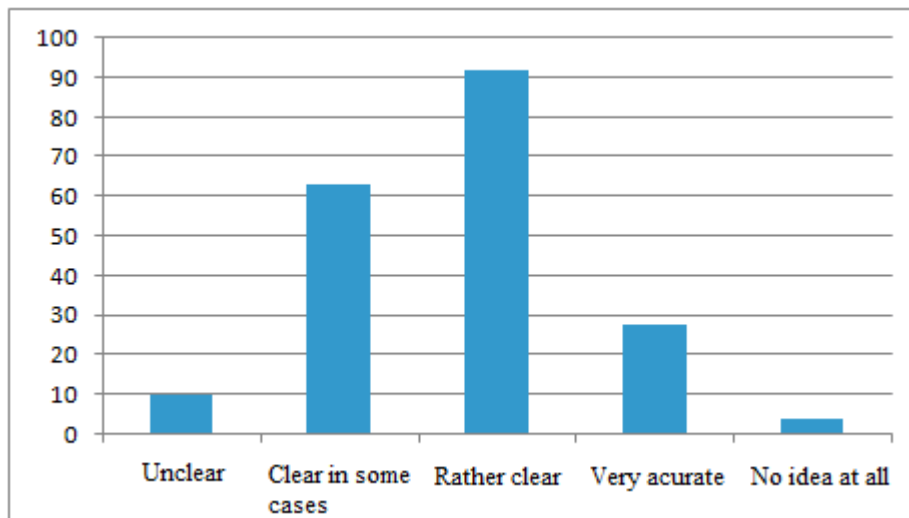
Approximately a half of the lodging units benefits from the promotion on social networks and from the services offered by online travel agencies.

Rather additional and rarely used tools are online PR articles, PPC advertising, discount portals and reviews published through discussions and guest books on the websites.

As it was mentioned above, after the mapping section that examined how lodging facilities implement individual internet communication tools, followed a section assessing the effectiveness of these instruments. However, the prerequisite to assess the effectiveness is the awareness of the owners and managers of these facilities about what sources bring them the most customers.

The general trend is rather positive, since the responses indicate that the owners have a good idea and up to 14% of the respondents even very accurate idea about how many customers found their facility via which tool.

Fig.19.3. The level of awareness about the customer sources



Source: authors

We may therefore assume that the respondents were able to evaluate the effectiveness of each instrument. The following table shows the results of the evaluation by the interviewed accommodation facilities.

Tab.19.1. The level of implemented online tools

The implemented instrument	No efficiency at all	Rather inefficient	Efficient only in some cases	Rather efficient	Very efficient
Own website	2%	1%	11%	26%	46%
E-mail	2%	2%	7%	24%	46%
Social networks	10%	5%	17%	24%	6%
Virtual travel agencies	11%	6%	26%	14%	7%
Accommodation search engines	3%	5%	29%	19%	24%
Online PR articles	9%	3%	21%	14%	3%
Discount portals	17%	5%	7%	7%	5%
PPC advertising	14%	2%	7%	7%	7%

Source: Authors.

The table above does not include the answers of survey participants who do not use the instrument or are not able to assess its effectiveness. The results indicate that the most useful tools are websites and e-mail. Major role in the communicational process with the customer also play accommodation

search engines and online travel agencies. The results the effectiveness evaluation concerning social networking and online PR articles were very inconsistent, some respondents evaluated them as useful, some as useless. The category of less effective tools for accommodation facilities includes PPC advertising and discount portals. We can assume that the inefficiency of these two instruments lies in the significant amount of investments that increases the cost of acquisition and maintenance.

19.6. Discussion

Based on the research presented in the previous sections of this paper, we may conclude that the implementation of the Internet marketing tools represents currently an increasing trend among the accommodation facilities in the Czech Republic. This assumption is confirmed by the fact that 85.6% of the facilities, who participated in the survey, implemented at least to some extent Internet communication. Our results indicate the existence of unevenness in the use of the Internet as a communicational medium. Hotels and guesthouses implement the greatest number of online instruments. On the other hand, accommodation facilities such as cottage settlements and other unspecified facilities are not able to use the Internet effectively. The survey demonstrated the need to improve the current situation concerning the lower categories of lodging facilities.

The main reason why extensively implement Internet communication even for these categories is the high return on investments (67%) that was reported by the respondents of the survey. The Internet may be therefore considered as a profitable investment that does not necessarily generate high initial costs. Despite the fact that up to 85% lodgings facilities use internet to communicate with their customers, only 9% of them outsource the administration of these instruments. In the majority, the communication is managed by the owner-himself. A greater professionalization in this area is recommended. However, given that most of the facilities prefer to administrate the Internet communication tools internally, the marketing consulting agencies and experts should shift more into the role of "advisers" who would help the internal managers to learn how to administrate and develop these tools correctly.

The general objective of this research was to investigate what online tools are relevant for the implementation by Czech lodging facilities and to evaluate their benefits for the operators. As it was already mentioned, the respondents evaluated as the most effective tool own websites which implies that its design and content should be of the best quality and optimized in terms of the easy and time-saving search for desired information. The results suggest that e-mail is still to be quite beneficial, even very beneficial in some cases.

On the other side, the newer forms of marketing communication such as Skype or discount portals, which have been gaining more and more importance in the past years, are implemented only by a very small percentage of respondents. In addition, the respondents agreed that discount portals are not very effective. In terms of social networks, we were surprised that 53% of the participating facilities communicate via this channel, which is more than we expected at the beginning of the research.

19.7. Conclusion

The research has confirmed the vital role of the Internet in the field of contemporary marketing communication. In the case of hotels and guest houses the traditional online tools are implemented on the large scale while the more advanced tools are still neglected. For the other types of lodging facilities, own pages or e-mails belong among the non-implemented instruments as well. Despite the relatively good level of the Internet marketing of hotels and guesthouses in the North Bohemia region, there are persistently remaining very important insufficiencies. The collected data also indicate a very likely lack of IT and marketing literacy of the self-administrators that could be reduced by the cooperation with external experts which is, however, by the facilities rejected for the reasons of elevated costs and overconfidence in their own skills.

As limitation of the presented research may be considered the narrow scope of the tested sample which consisted from only three Czech regions, due to the time constraint of the project. An expansion on all the Czech regions is therefore recommended in order to obtain profounder information.

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