INFORMATION SYSTEMS MANAGEMENT AND TECHNOLOGIES IN CZECH HOSPITALS

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This article brings results of qualitative research of information systems management and technologies in three Czech hospitals. Research was realized during one year (2012) by the structure questionnaire and interviews with information technology (IT) managers, human resource officers, research and design (R&D) managers and other management staff. The results confirm increasing using of information and communication technology in health care sector especially in infrastructure, security, education of staff. This is related to increasing requirement of financial resources what is the biggest problem in all Czech hospitals. The increasing financial needs are in the conflict with political opinion and with the effort to keep health care free of charge especially in election years.

Key words: information and communication technology, information systems, health care, e-commerce, process management.

Introduction

Information and communication technologies (ICT) play an essential role in supporting daily life in today's digital society. They are used everywhere now and play and important role in the delivery of better and more efficient healthcare services. The health care is currently not only in the Czech Republic one of the biggest "challenges" for advanced information and communication technology. Some of the main problems (ineffective use of some kinds of technological equipment, useless frequency of diagnostic tests, prescription of drugs often without knowledge of other drugs used by the same patient, several times visits of some patients to verify diagnosis) can be solved by sharing data and integrated information.

Management of medical services is currently associated with a challenge to lead an institution with a relatively large number of employees, complying with the statutory requirements of the Health Ministry and insurance companies. Management also has to deal with significant quantities of various medical equipment, is influenced by the ethical requirements and very limited financial resources. Furthermore there are a number of other requirements and restrictions that must be observed. Therefore the hospital management depends on good information systems and information technology.

The basic modules of information systems (IS) needed for health care industry are almost the same as in other business areas. They include all economic modules necessary for the operation of hospitals and therefore enable consistent economic data entry without a need to duplicate the inputs. More sophisticated information systems have advanced modules for the needs of healthcare facilities that are required for system integration and operation of medical departments. Such modules have options for editing and reading data (medical card), maintenance of medical devices, and fault reporting requirements, registration of medical devices, property records and reading bar code on drugs. Using of more sophisticated information systems enables to implement systemic approach to management in healthcare facilities. It also helps to response to the following key questions:

- How to improve the processes?
- How to assess the processes?
- How the processes could be more flexible?
- How to simulate the processes?
- How to be prepared for a crisis situation?

In Czech Republic health care expenditure were increasing continuously every year till 2009 (see figure 1). Since 2010 the expenditure has descended (Antlova, 2011). Therefore the hospital mangers started to put emphasis on efficiency and cost savings. One of the areas where the managers look for saving is ICT.
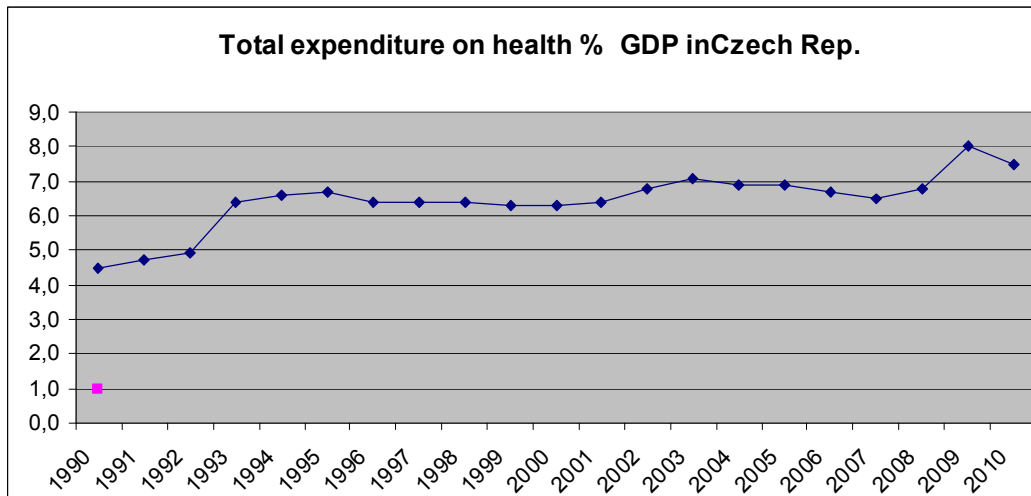
Figure 1 Total expenditure on health % GDP in Czech Republic

The use of ICT in hospitals is becoming more important as the demands upon hospital-based healthcare change. Identifying directions for development of future ICT for healthcare depends on understanding the context in which solutions are to be deployed. Analysing and mapping of the situation in ICT health sector helps to find answers of the above mentioned questions. Therefore the prospective questionnaire was realised in Czech hospitals. The questionnaires contains more than 200 inter related questions aiming to identify the need and opportunities of ICT management, financial situation, the continual learning of staff and innovation. There are many accounts of failed healthcare ICT systems, the failure often caused by mismatch between technology capabilities and the needs and constraints of healthcare workers. When looking at types of barriers for ICT adoption in hospitals, most of the studies (Mayer-Schonberger, 2003, Dorr, 2007) aimed to identify all relevant barriers as: organizational management barriers, ICT skills, team work and cooperation, face-to-face interaction versus new ways of working, people policies, changes in work processes and routines.

Existing in-house technologies from different application domains were investigated for their relevance to the healthcare sector. Different scenarios were developed for future ICT use in healthcare based on existing literature on ICT application deployment in healthcare. Also a lot of interviews and workshops were carried out with healthcare professionals to obtain their insights into ICT application in hospitals. These methods gave insights into how to carry out future development of ICT solutions for health-care.

1 Data and methodology

This research report brings results of survey which is part of big project: "An Evaluation of the Management of the Information Systems (IS) and Technologies (IT) in Hospitals" This project (http://www.cti.gov.br/projeto-gesiti.html) GESITI/Hospitals was established in the Centre for Information Technology Renato Archer in Brazil by the Coordinator of the research José Antonio Balloni who is author of the questionnaire. In this large project we can find the members from the whole world including the Czech Republic.

The Questionnaire (Balloni, 2013) is copyrighted of the Centre for Information Technology Renato Archer (CTI), located at Campinas/SP/Br, a unit of the Ministry of Science, Technology and Innovation (MCTI) and, a Cooperation Agreement has been signed between Faculty of Economics, Technical University of Liberec.

More than 200 open and closed questions are divided into several strategic areas:

- Human resources,
- Strategic management,
- Research and Development and Technological innovation,
- Competitiveness of Hospitals and their cooperation for a strategic advantage,
- Information technology availability,
- E-Business,
- Telemedicine,
- Approach to clients,
- Quick prototyping of health and
- Waste management in a Health-care.

This questionnaire has been updated since 2004 by the GESITI Project and the methodology is fully described in reference (Balloni, 2013). During the year 2012 the questionnaire has been distributed in Czech hospitals, where the managers from human recourse, ICT, R&D, strategic planning and other departments were interviewed and ask to fulfil the questionnaire.

The questionnaire was distributed to five hospitals in Czech Republic. Just three hospitals were helpfulness to cooperate in this project and to fulfil the questionnaire. The first hospital (marked A) is located in smaller town which has 17 thousands of inhabitants, this hospital has 281 beds and 582 employees. The second hospital (marked B) is from bigger town, which has 100 thousands of inhabitants, hospital has 957 beds and 1100 employees. The third hospital (marked C) is one from the Czech capital hospitals. The capital has 1 million of inhabitants. The hospital has 970 beds and 2351 employees.

All three hospitals are state contributory organisations. None of three hospitals operates in foreign countries. The main hypothesis' question is: "are there any big differences between the hospital in capital town or smaller towns in ICT using" and which are the biggest common problems in these hospitals?

2. Results

This chapter contains the evaluation of collected data applying the methodology presented in Chapter 1. The subsections copy the structure of the questionnaire. Some of the answers are reduced and shortly explained.

2.1 Human resources

In the field of human resources, several aspects were investigated through the questionnaire. Firstly, the level of education of the employees, secondly, the possibility of training and educational courses provided by the hospital, thirdly, the other possibilities to increase the

qualification of employees (see table 1). And finally, it was considered important to find out if employees´ performance is evaluated.

	A	B	C
Primary education	20%	20%	6%
Secondary education	60%	50%	63%
Tertiary Education	20%	30%	31%

Table 1 Education of employees

New methods, procedures and tools are in health care regular in these days. Therefore it is necessary to keep good quality of the employee's knowledge and train them. Number of trained employees altogether in all hospitals explains next table.

	None	>20%	>50%
Top management	2	3	6
Control processes	1	2	10
Supervision	2	4	7
Administration	2	6	2
Main processes	1	5	1

Table 2 Number of trained employees in the past two years

2.2 Strategic management of a medical institution

Strategic management can be defined as "the identification of the purpose of the organisation and the plans and actions to achieve the purpose. It is set of managerial decisions and actions that determine the long term performance of a business enterprise. It involves formulating and implementing strategies that will help in aligning the organization and its environment to achieve organisational goals" (Lamb, 1984). The only way how to achieve strategic plans is that all employees should know about the strategic goals. Table 3 explains who knows a strategic plan of the hospital. We can see that on the operation level nobody knows the strategic plan.

Strategic plan is known to:	Hospitals
Director	A, B,C
Management	A,C
Operational level	0

Table 3 Who knows a strategic plan?

It is obvious, that the strategic plan is mostly known among the top and middle managers.

Participation on strategic planning	Hospitals
Only executive management	A
All employees	0
Executive management and process owners	B,C
Planning group	0

Table 4 Participation on strategic planning

It is obvious that the patient (client) is in the middle of interest during the main strategy creation (see figure 2 and 3).
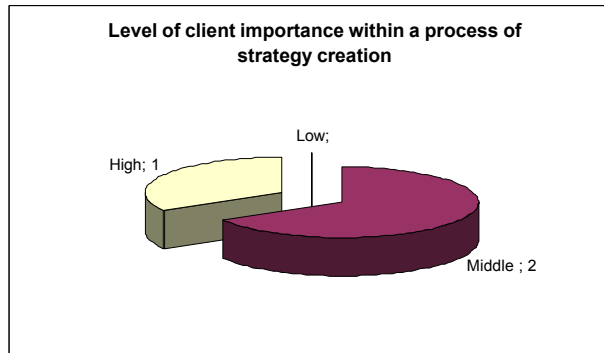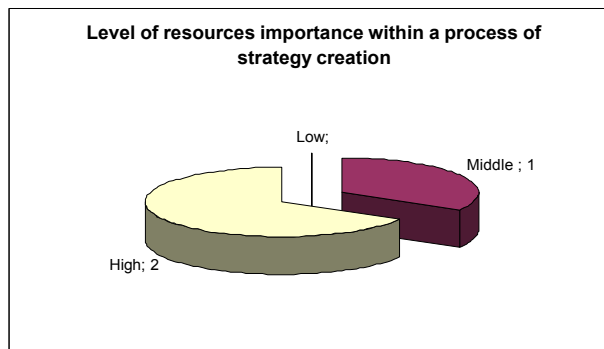

Figure 2 Level of client importance

Figure 3 Important elements of a strategy creation

The method - Balanced Scorecard (BSC) is quite well - known management and performance measurement tool (Kaplan, 2000). This tool provides executives with comprehensive frameworks that translate a company's vision and strategy into set of performance measures. These measures are organized into four perspectives: financial, customers, internal process and learning and growth. These measures could be used also in different way - to help align individual, organizational and cross – departmental initiatives to achieve common goals. Therefore the elements of creating a basis for a strategy were analysed. Within this issue, three lines can be distinguished:

- Importance of a mission within a strategy creation,
- Importance of clients´ satisfaction assessment,
  - Satisfaction as a main attribute of a process of a strategy creation,
  - Satisfaction as a decisive indicator in a process of creation of competitive prices,
  - Satisfaction as an indicator of performance measurement and management of a hospitals,
  - Satisfaction as a determinant of current and potential development.
- Importance of strategic analysis methods (SWOT analysis, scenario analysis, benchmarking).

All three hospitals create strategic plans for time from 12 till 24 months; all of them use SWOT analysis, benchmarking and use information about client's satisfaction. Just one hospital - the marked B uses Balanced Scorecard as tool for creating strategy.

2.3 Research and development

When we look at the responses about respondents´ evaluation of research and development, the research and development activities have mostly been identified as "occasional" and the importance of these activities is medium important in hospitals B and C. On the other hand the R&D activities have been realized continuously in hospital marked A but the importance of these activities is low. In Czech Republic R&D are concentrated in different types of hospitals - in university hospitals.

2.3.1 Technological innovation investments

All managers of analysed hospitals share the same opinion about technological innovation investments. They are aware of the fact that intensive use of the information technologies increase added value of the hospitals´ services and their output and contribute to their competitiveness. But all hospitals declare lack of financial resources for technological innovation. They also do not see any problems connecting with implementation of any technology (a new IT solution, modernization or reconstruction) which requires an intervention into organizational units and increase in knowledge of personnel. Within the questionnaire, focus was put on the investments of hospitals into the sphere of ICT during the past three years as well as in the future. First of all, each of analysed hospitals had included the intention to invest in innovation technologies into their strategic and business plan. Within the past three years, only one hospital (A) has invested more than 2 % of revenues, two remaining hospitals invested less than 1% of revenues.

Priorities of two hospitals A and B in the sphere of technological innovations are directed mainly towards clients´ databases utilization, in hospital marked C they think about the cloud computing.

Considering the suppliers of technological innovations all three analysed hospitals have used small and middle-sized domestic companies. A part of questionnaire was also focused on quality standards of hospitals. International norm EN ISO 9001 refers to a quality management and it is applicable for any organization in sphere of production and services, including hospitals. All three analysed hospitals use quality management system.

2.3.2 Cooperation for innovation

An important part of the questionnaire has been devoted to a cooperation of hospitals with other hospitals or other public or private institutions. Next table brings the results of this cooperation.

Hospitals	High importance	Medium importance	Middle importance	Irrelevant
Clients	B	A		C
Suppliers	A,C	B		
Other hospital		B	A	C
Advisory companies		B	A	C
Universities and research institutions	A,C		B	
Institutes of professional capacities		A	B	C

Table 5 Importance of cooperation of analysed hospitals

Furthermore, table 6 presents the goals of the above mentioned cooperation.

	R&D	Technical assistance	Training	Product testing	Other
Clients	B		A		C
Suppliers			A		C
Other hospitals	C				
Advisory companies				A	C
Universities and research institutions				A	C
Institutes of professional capacities	C				

Table 6 Goals of cooperation

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2.4 Competitiveness of hospital & Cooperation for strategic advantage

According to the questionnaire the most important factor for efficient management in hospitals A is competitiveness and cooperation, in hospital B is minimization cost and in hospital C it is profit creation. With respect to the expectations of hospitals for the future, they were asked what the main challenge of hospitals is in the 21st century. In hospital A it is rising efficiency of processes. In hospital B and C it is efficient of strategic management and innovation. Although considering the main challenge of the 21st century, analysed Czech hospitals do not declare the accordance of project activities with the strategy. Next question was focused on the increasing of competitiveness and on the main influencing factors. The managers from all hospitals consider the reduction of server, application, IT contracts costs. As important tool they consider benchmarking, increasing of financial resources for core business, centralisation of IT services, increasing of security and reduction of capital costs. In hospital C the using of new application is also very important.

2.5 Information technology availability in medical institution

2.5.1 Acquisition of equipment and facilities

Considering the results of research performed in the Czech Republic, the number of computers used in the hospitals depends on their size and structure of hospitals. Computers with Internet connection cover of all computers in hospitals (see table 7). Also all computers have access to the LAN. Various devices are designed for communication of user with information systems. Their construction and structure is dependable on a particular architecture of each hospital, on its mission and preferred IT applications.

	Hospital A	Hospital B	Hospital C	Average
Number of PC	250	1100	1200	850
Number of PC with access to Internet	250	1100	1200	850
Number of PC with access to LAN	250	1100	1200	850
Number of laser printers	120	452	300	290
Number of inkjet printers	10	78	0	29
Number of dot matrix printers	50	79	20	49
Number of PC with multimedia	0	0	800	266

Table 7 Basic equipment of PCs and printers

2.5.2 Application programs

The medical informatics is the integration of data, information, knowledge, and tools necessary to apply that data and knowledge in the decision-making process associated with patient care. The focus on the structures and algorithms is necessary to manipulate the information separated medical informatics from other medical disciplines. To be more precise, the entire hospital system that is being practiced with the manual system has to be completely transformed into electronic by using the latest information technology for example: IS which contains the domain functionality, flowcharts, screens, database that are developed, tested and produced as application software for implementation in order to convert a hospital into a computerized format. This is the most important part of domain functionality IS which can be used in whole Health centres and hospitals:

• The application layer to include: Patient management, Medical care, Nursing, Technical support and Medical support, Administrative, Ancillary services, Controlling.
• The middleware layer should include: Authorization component, Patient component, Activity component, Resource component, and Healthcare record and Knowledge component.
• The persistent layer related to Images, Bio-signals, alphanumeric data, Web pages.

While developing the electronic hospital information system, in order to achieve inter-operability, portability and data exchange health care information system must apply standards. Analysed hospitals use the usual office applications (see table 8). All hospitals use the package of Microsoft Office. Considering the applications used within particular activities, the following table displays a review of various types of software.

	Hospitals	Name of software
Hospital management	A	CGM Care-Centre
Integrated management		-
Accounting	B,C	Navision, Amis ECO
Human resources	A,B,C	VEMA PaM, Target, AVENSIO
Purchases/Sales	B,C	Navision, AMIS ECO
Inventories	A,B,C	Navision, AMIS ECO, PANAKEA
Asset management	A,B,C	Navision, Profit, AMIS ECO
Cost management		-
Other	A,B,C	Marie Pacs

Table 8 Application software used within particular activities

2.5.3 Databases

For IS of hospitals and web application, a necessity to work with large data files is typical. In order to save and use them efficiently, it is useful to create logically interconnected structures - databases. Table 9 brings details of areas where databases are used.

	Hospitals
Administration	A,B,C
Financial dept.	A,B,C
Tax dept.	B,C
Human resources	A,B,C
Beds/Reception	A,B,C
Emergency	B,C
Surgery	A,B,C
Clinical lab	A,B,C
Marketing	B,C
Sales dept.	A,B,C
Inventories	A,B,C
Medical report	A,B,C
Outpatient dept.	A,B,C
Addtional support	A,B,C
Diagnostic	A,B,C
Other	B,C

Table 9 Databases in hospitals

2.5.4 Outsourcing

Based on the outputs of research the hospital B is using the outsourcing for security services and the hospital C is using telecommunication services and Help Desk services.

2.5.5 Network, security and telecommunications

If we focus on results of analysed hospitals, 100 % of hospitals use antivirus programs and almost all use firewalls. As all analysed hospitals have been using intranet, the secured communication between intranet and Internet is essential. Next figure explains tools of security management.
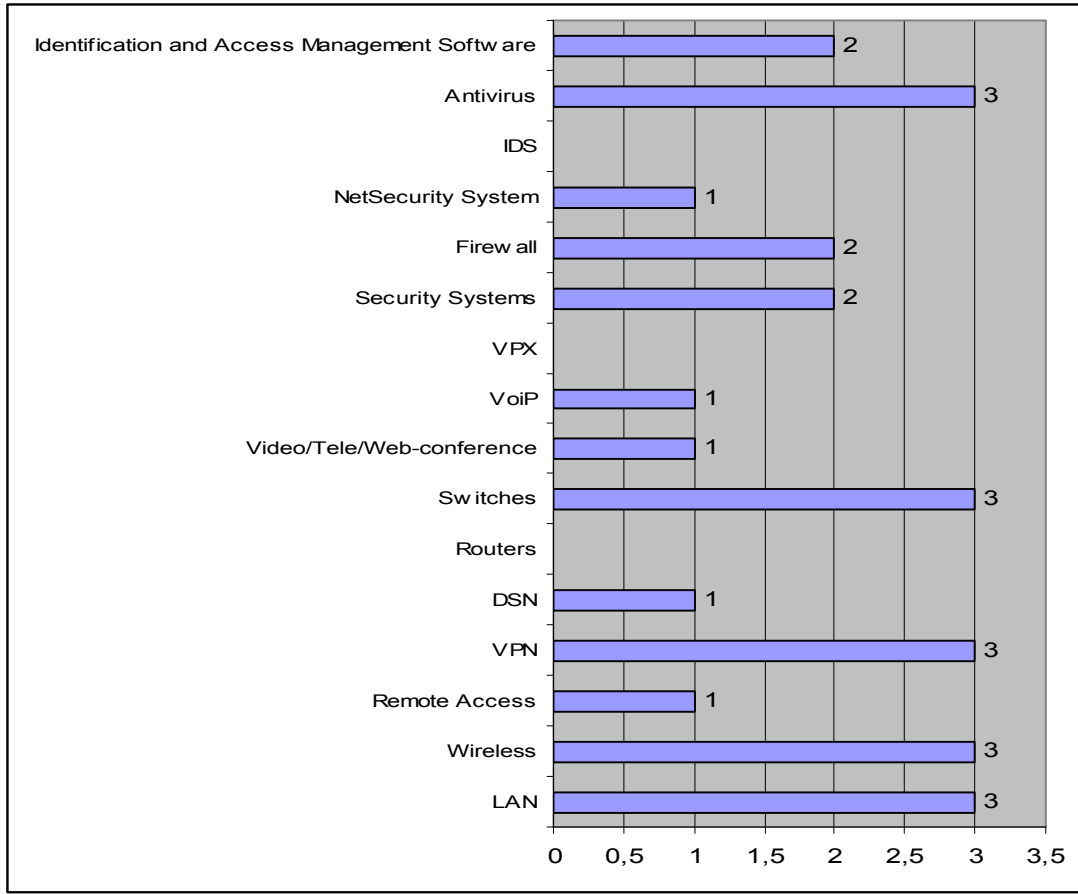
Figure 4 Network, Telecommunication and Security

2.5.6 ICT management

One of the ways how to increase the flexibility of the processes is to use modern tools which allow the simulation of the processes. Nowadays there is a trend to look at organizations from their processes and to improve the flexibility of organizations through them. A review of the literature (Šmída, 2007, Ministr, 2010, Karagiannis, 2002) suggests that although the term "process management" is increasingly being used in everyday business language, the practical experience especially in hospitals is very limited. The emergency response requires information sharing, including the time-critical nature of emergency services and the need for timely information in a form that can be trusted and used by emergency responders (Arens & Rosenbloom, 2002; Dawes, Cressell, & Cahan, 2004; Sawyer, Tapia, Pesheck, & Davenport, 2004; Turoff, Chumer, Van de Walle, & Yao, 2004). Effective and timely service depends upon all participating organizations working cooperatively and utilizing information technology effectively (Mayer-Schonberger, 2003).The main part of hospital process management has to be focused on process maps. These maps are very important for easy viewing of the processes which are conducted in hospitals. Table 10 brings used IT management solutions in hospitals.

Number of hospitals	
PC application	A,B,C
Asset management software	C
Human Resources Software	
Information Bank Management	
Logistic Software	B,C
Management Software	
Financial Software	B,C
Business Intelligence/Data Mining	B,C
Decision Support management	
SCM	
BPM/BPO	C
CRM	C
Groupware	C
ERP	A,B,C

Table 10 IT management solutions used in hospitals

2.6 E-commerce

Electronic business (e-business) involves all business activities executed through computer networks. Electronic commerce (e-commerce) represents a transaction carried out through computer network which results in change of ownership or rights connected to use of products or services.

2.6.1 General information about comunication and information technologies

Next table (Table 11) explains that the hospitals are using the internet long time ago.

Since 2001 or earlier		Since 2008	Since 2012	In upcoming 5 years	Does not plan to use
Intranet	B,C	A			
Extranet	B	A			C
WAP					A,B,C

Table 11 Selected ICT in hospitals

2.6.2 Use of the Internet

The Internet has become a substantial and increasing body of information available to patients and to the general public at large. The Internet is a tool to improve health and health care delivery. An increasing proportion of the public is using the Internet for health information. The advantages of the Internet as a source of health information include convenient access to a massive volume of information, ease of updating information, and the potential for interactive formats that promote understanding and retention of information. Health

information on the Internet may make patients better informed, leading to better health outcomes, more appropriate use of health service resources, and a stronger physician patient relationship. More-informed patients often have a more favourable prognosis, and doctors can help make patients better informed by supplying reliable Internet sites. In conclusion, the Internet and Web have had important impact in the practice of medicine. Physicians need to know the importance of this media and how to use it in a pragmatic and efficient way. They can have easy access to clinical guidelines, journal contents, and reference textbooks and even provide patients with educational materials. Physicians will be able to obtain information on state-of-the-art conferences and have direct communication with other physicians and specialists or practice telemedicine, thereby expanding the depth and extent of medical knowledge and providing better diagnosis and patient care. Next figure explains for which activities the employees are using of internet.
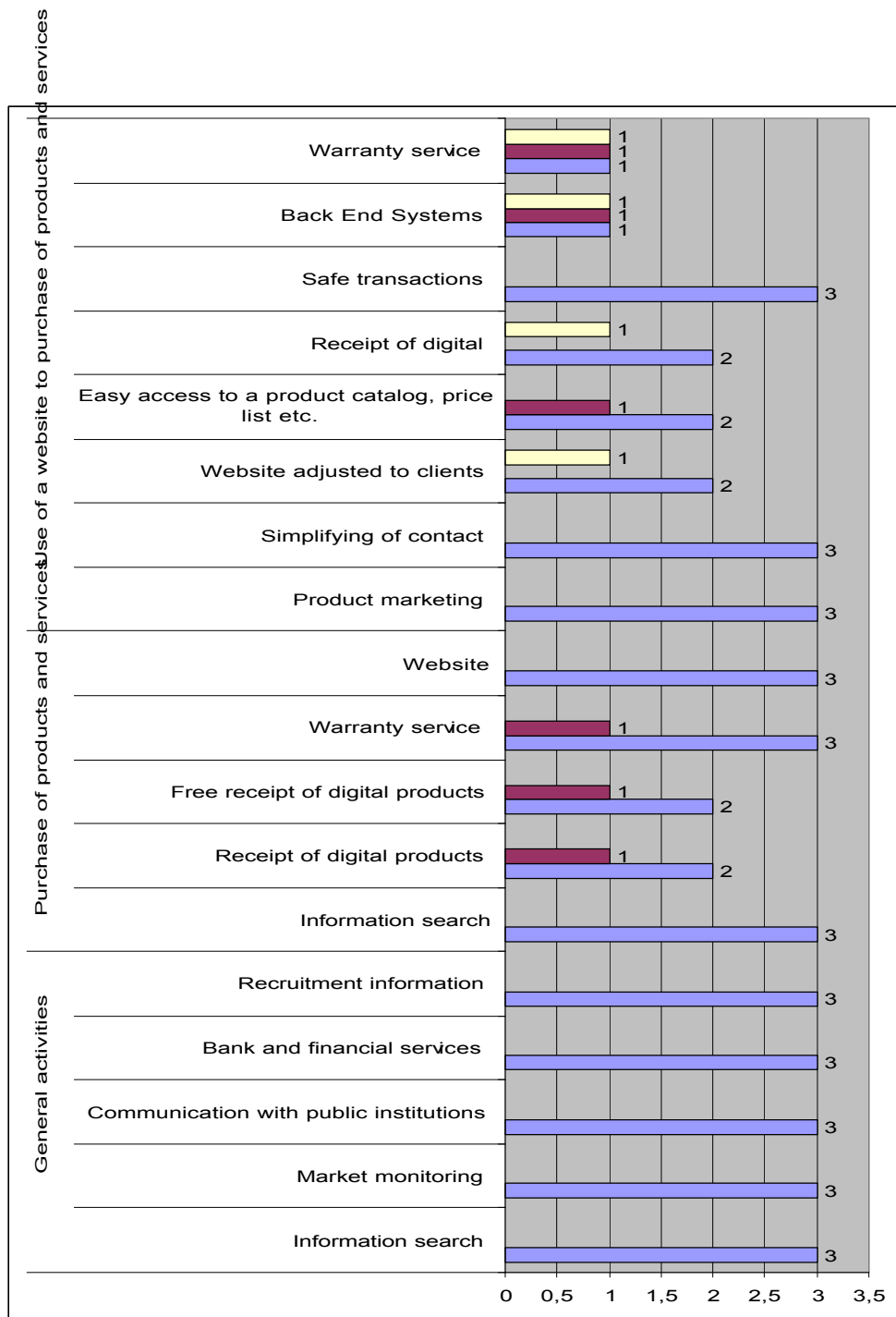
Figure 5 Use of Internet

Internet purchases are conducted by all three hospitals, but none of them pay on-line. Two hospitals (B and C) have a catalogue of their products and services online. None hospital sells anything on Internet.

2.6.3 E-commerce via the Internet (E-business)

Next tables (table 12 and 13) show which advantages are important in cost minimizing, better access to information and in improving of business processes. It also shows in which area the hospitals have good or weak results.

Hospitals	Cost minimizing		Better access to information of suppliers		Business processes velocity increase	
	Importance	Results	Importance	Results	Importance	Results
A	The most important	Good results	The most important	Good results	The most important	Good results
B	Important	Good results	The most important	Good results	Important	No results
C	The most important	Weak results	The most important	Weak results	The most important	Weak results

Table 12 Advantages and results of Internet purchases

Hospitals		A	B	C
Image	Important	LI	LI	LI
	Results	LI	LI	LI
Cost minimizing	Important	LI	LI	LI
	Results	LI	LI	LI
Business processes velocity increase	Importance	LI	LI	LI
	Results	LI	LI	LI
Service improvement	Important	LI	LI	LI
	Results	LI	LI	LI
Acquisition of new customers	Important	LI	LI	LI
	Results	LI	LI	LI
Expansion on a market	Important	LI	LI	LI
	Results	LI	LI	LI
Introduction of new products	Important	LI	LI	LI
	Results	LI	LI	LI
Keeping up with competitors	Important	LI	LI	LI
	Results	LI	LI	LI

LI - Little important, I – Important, VI - Very important, MI - The most important
NR – No results, WR – Weak results, GR – Good results, FE – Fulfilled expectations

Table 13 Advantages and results of e-sales

2.6.4 Costs/Expenditures of implemented system

Despite significant time and administration savings of the e-commerce, its utilization is connected with some costs. Costs are structured according to the phase of e-commerce in which they arise (implementation maintenance). We can see that the costs of e-commerce are quite low. The hospitals invest just less than 20 % in next areas:

- Website creation
- Domain purchase
- Telephone
- Hardware

In next areas they do not invest in:

- Software
- Database
- Maintenance of website
- Telephone
- Provider of hosting
- Direct costs
- Emailing
- Marketing
- Database
- Other costs

2.6.5 Barriers in use of the Internet and IT in general

All three hospitals see the biggest barriers in use of the Internet are:
- hospital products are not suitable for Internet sale,
- security problems with payments and in high costs of e-commerce system creation and maintenance.

Other barriers see all hospitals less important in:
- Complexity of technology
- High costs of creation and maintenance of website
- Loss of working time
- High costs of data communication
- Slow or instable data communication
- No visible advantages

As very important consider the managers:
- Low level of employees´ qualification

- Difficulties of employing qualified ICT personnel
- Unwillingness of current employees
- Nonexistence of actualized ICT strategy
- No visible advantages
- Very high costs

Not important consider the managers of analysed hospital:
- Frequent new software versions
- ICT solutions are insufficient for hospital purposes

2.7 Telemedicine

Telemedicine represents use of telecommunication and information technologies in order to provide medical services at a distance. A location of providers, patients, medical records or facilities is not important. Just one hospital - A is using radiology. This hospital is also using videoconferences for radiology consultations and diagnosis with Marie-Pacs.

2.8 Approach to clients e-Health

E-Health is closely related to European policies on health, employment, regional development, research, innovation, industry and internal market. E-Health is also breaking down barriers, enabling health service providers (public authorities, hospitals) from different Member States to work more closely together. If a particular treatment can be provided to a patient more effectively in another country, e-Health systems make it simpler to organise and carry out treatment abroad. Suppliers of e-Health tools – such as databases for patient records, mobile monitors which transmit data automatically, or handling systems for patient call centres – also benefit from the development of a European market in the sector, which has enabled them to build a strong base from which they can tackle the global market. Broader Figure of this issue can be provided by answers of hospitals on questions concerning directly applied structures of customer's care and practical approach to clients.

2.9 Quick prototyping of health

The specialized devices to gain measured data have been used more and more often in a health care sphere. These data can be represented by individual number, one-dimensional signals or images, static 2D, 3D or 4D outputs. None of the analysed hospitals is using these devices. If all three hospitals have chance to have devices for free, they would be interesting in it.

2.10 Waste management in a health-care

Considering research results, hospitals were asked to comment if they have developed a management plan of waste in healthcare. All three analysed hospitals have Plan of waste management. Each hospital conducts also staff trainings. Their frequency is one a year. A

closer look at the stages of waste management in analysed hospitals has shown a dominance of stages: sorting, packing, identification, temporary storage, internal and external transport.

3. Similarity of analysed hospitals in ICT use

All answers of analysed hospitals have been summarized in next table. We can see that a lot of answers were very often similar or identical.

	Areas of questions	Identical answers	Similar answers	Total different answers
1	Human resources		+	
2	Strategic management of a medical institution	+		
3	Research and development		+	
4	Technological innovation investments		+	
5	Cooperation for innovation		+	
6	Competitiveness of hospital & Cooperation for strategic advantage		+	
7	Information technology availability in medical institution		+	
8	Acquisition of equipment and facilities		+	
9	Application programs		+	
10	Databases	+		
11	Outsourcing		+	
12	Network, security and telecommunications		+	
13	IT management		+	
14	E-commerce	+		
15	General information about ICT	+		
16	Use of the Internet	+		

17	ICT Management		+	
18	E-commerce	+		
19	Costs/Expenditures of implemented system	+		
20	E: Barriers in use of the Internet	+		
21	Telemedicine		+	
22	Approach to clients e-Health	+		
23	Quick prototyping of health	+		
24	Waste management in a health-care	+		
	Total	11	13	0

Table 14 Similarity of the answers

Similarity of the answers was compared with the statistic test χ^2 chi-quadrant (see table 15).

Questions	Yes	No
Identical	11	0
Similar	13	0
Different	0	24
Total	24	24

Table 15 Contingency table

Null hypothesis (H_0) has been formulated: There are different answers in analysed hospitals H_1 negating hypothesis H_0 was also determined (There are not different answers in analysed hospitals).

$$G > \chi^2_{1-\alpha} [(r-1)(s-1)] \tag{1}$$

i.e. if the tested criterion value is greater than $100(1-\alpha)$% - division quintile χ^2 with (r-1)(s-1) degrees of freedom, with α = the level of significance (most frequently used 5%), with r = number of rows and s = number of columns.

$$G = \sum_{i=1}^{r} \sum_{j=1}^{s} \frac{(n_{i,j} - n'_{i,j})^2}{n'_{i,j}} \tag{2}$$

The dependences of variables are measured according to the above-specified formula. If the dependence of the monitored and hypothetical variables are small, the differences are minor.

If G > $\chi^2_{0,95}$, zero hypothesis H_0 can be rejected.

Table 16 specifies the results of calculation according to statistic application Stat-graphic.

G	48
χ^2	5,91
Contingency coefficient (CP)	0,64
Cramer coefficient(CCR)	0,84

Table 16 Results of χ^2 test

CP and CC must be from interval (0.1). Considering the fact that value G > $\chi^2_{0,95}$ (48> 5.99), and both coefficients (Cramer and Contingency) show a strong dependency, hypothesis H_0 can be rejected, thus proving hypothesis H_1. The ICT use do not depends on the size of the hospital and the level of ICT use in analysed hospitals is almost the same.

4. Summary

Health care industry should be one of the most information intensive and technologically advanced in our society. In Czech Republic the expanses were 290 billion Czech Crowns in 2011. It is less than in last years because of economic crisis. The research confirms that the biggest problems in all three hospitals are financial resources. The health's care is free of charge in the Czech Republic so the hospitals are financed by health insurance companies. The only way how to increase the hospital's incomes are patient's payments for above-standards rooms.

From the questionnaire we can see that there are not big differences between the analysed hospitals in relation with the size of hospital and the town where the hospital is situated. All analysed hospitals use ICT for the communication, storage the patients´ data and financial applications. All hospitals educate their employees; have the main strategic plans which are known to management but not to the low operational levels. They use SWOT analyse and benchmarking for creating of the strategy. The strategic plans are for 2 years. An important element of strategy creation is the client. A client (patient) is in a centre of attention if hospital intends to improve its competitiveness.

Research and development activities in hospitals, especially those linked to the ICT, in hospitals are related to many changes in hospitals processes. Dynamic development of external environment of hospitals leads to a higher saturation of ICT applications and often to a generation exchange. At presence, the attention is focused on more efficient resource

utilization and hospitals´ growth and expansion than on ICT capacity expansion. Current competitive environment requires high quality management systems and, consequently, from the point of view of data reception, elaborating and storage, high quality information systems. Waste management is an important element of hospitals´ management. It is necessary to put emphasis on a reduction of the amount and harmfulness of waste produced, reusing and recycling. All analysed hospitals have waste plans.

In future research the author will concentrate to process management in the Czech hospitals. During the last decades the process management has been applied in many business or production enterprises but still Gartner expects that business process management (BPM) will grow. Also Gartner research identifies business process analysis as an important aspect and not just in manufacturing industry but also in services. The main advantages are in better services to patients, better resource planning, increasing of service quality and better cooperation in research and sharing of knowledge.

Structural changes and the ability to be able to react especially to the emergency and different disasters in the health care sector intensify the need of simulation and process optimization. The hospitals and health care facilities are the new emerging areas; they are very important elements in the crisis situations.

Still many other questions remain and it will be necessary to identify truly effective applications for the health care sector and the user base. How will future ICT solutions be deployed? What forms of user interface will be most effective? How will future ICT systems link to existing systems and existing healthcare practices? These are some of the questions that need to be addressed further in order to ensure a productive collaboration between industry and the healthcare sector in developing future ICT solutions in hospitals.

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