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Barriers for Successful ICT Deployment in Czech Hospitals

Abstract
Information and communication technologies (ICT) play an essential role in supporting daily life in today’s digital society. They are used everywhere and play an important role also in delivery of better and efficient healthcare services. The healthcare is currently not only in 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. The goal of this article is to find the main barriers of successful ICT deployment in hospitals in Czech Republic. The qualitative research of information systems management and technologies was realized in three hospitals. This research was realized during one year (2013) by the structure questionnaire and interviews with IT managers, human resource officers, research and design (R&D) managers and other management staff. The results confirm increasing use of information and communication technology in health care sector especially in infrastructure, security and in education of staff. This is related to increasing requirement of financial resources and it is the biggest problem in all Czech hospitals. These increasing financial needs are in the conflict with political opinion and with the effort to keep healthcare free of charge especially in election years. Article also brings results of the secondary research which was oriented towards use of process management systems in Czech hospitals. These software tools can help to solve the biggest problems with lack of financial funds and to manage the effective and efficient hospital processes and ICT services.

Key Words
Information and communication technology, information systems, health care, process management

JEL Classification: I10, C89

Introduction
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 of 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. But still the management has the following key questions:

- How to improve the internal and external 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 or unexpected situation?

In Czech Republic health care expenditure were increasing continuously every year till 2009 (see figure 1). Since 2010 the expenditures have descended. Therefore the hospital mangers started to put emphasis on efficiency and savings.

![Fig. 1 Total expenditure on health % GDP in Czech Republic](image)

Many studies have been carried out in various aspects of ICT health. When looking at types of barriers for hospital ICT adoption, most of the studies aimed to identify all relevant barriers as:

- Organizational management barriers [8, 9],
- ICT skills [13].
• Team work and cooperation [14, 3].
• Face-to-face interaction versus new ways of working [7, 8],
• People policies [3, 9],
• Changes in work processes and routines [2].

1. Background of the research and methodology

This article brings results of the survey which is part of big international project: "An Evaluation of the Management of the Information Systems (IS) and Information Technologies (IT) in Hospitals" This project (http://www.cti.gov.br/projeto-gesiti.html, GESITI/Hospitals) was established in the Center for Information Technology Renato Archer in Brazil by the Coordinator of the research José Antonio Balloni [5] who is the author of the questionnaire. In this large project team we can find the members from the whole world including the Czech Republic.

The questionnaire [5] is copyrighted of the Center for Information Technology Renato Archer (CTI), located at Campinas/SP/Br, a unit of the Ministry of Science, Technology and Innovation (MCTI) and, the 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. The methodology is fully described in reference [1, 5]. During the year 2012 the questionnaire has been distributed in three hospitals in Czech Republic, where the high managers from human recourse, ICT, R&D, strategic planning and other departments (as procurement, waste management) fulfilled the questions. Detailed results of the questionnaire are described in report An Evaluation of the Information Systems Management and Technologies in Hospitals: The Region of the Technical University of Liberec, Czech Republic, [1]. This report brings the complex overview of ICT in these three hospitals. One of the main questions of this research is: "are there some big differences in ICT barriers among the hospitals in capital and bigger city and the hospital in smaller town in ICT use"? The second question is: What are the barriers of ICT deployment in all hospitals? The first hospital is located in smaller town (17 thousands of inhabitants), has 281 beds, 582 employees, the second hospital is from bigger town
(100 thousands of inhabitants), has 957 beds, 1100 employees, the third one is from the Czech capital (1 million of inhabitants), has 970 beds and 2351 employees. All three hospitals are state contributory organisations. None of three hospitals operates in foreign countries.

2. Barriers of ICT Deployment

All main areas of answers in questionnaire (each area had approximately 10 – 20 detailed questions) in analyzed hospitals have been summarized in the next table. Some of the answers were identical, some of them very similar and some were totally different. For example – question: “Level of client importance within a process of strategy creation” could be: Low, Middle, High. When the answer was Low and High – that was considered as different answers, when the answer was Middle and High – that was considered as similar. We can see that a lot of areas of answers were very often similar or identical.

<table>
<thead>
<tr>
<th>Areas of questions</th>
<th>Identical answers</th>
<th>Similar answers</th>
<th>Total different answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Human resources</td>
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<tr>
<td>2 Strategic management of a medical institution</td>
<td>+</td>
<td></td>
<td></td>
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<tr>
<td>3 Research and development</td>
<td></td>
<td>+</td>
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<td>4 Technological innovation investments</td>
<td></td>
<td>+</td>
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<tr>
<td>5 Cooperation for innovation</td>
<td></td>
<td></td>
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<tr>
<td>6 Competitiveness of hospital &amp; Cooperation for strategic advantage</td>
<td>+</td>
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<tr>
<td>7 Information technology availability in medical institution</td>
<td></td>
<td></td>
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<tr>
<td>8 Acquisition of equipment and facilities</td>
<td>+</td>
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<td>9 Application programs</td>
<td>+</td>
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<td>10 Databases</td>
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<tr>
<td>11 Outsourcing</td>
<td></td>
<td>+</td>
<td></td>
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<tr>
<td>12 Network, security and telecommunications</td>
<td></td>
<td>+</td>
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<tr>
<td>13 IT management</td>
<td></td>
<td>+</td>
<td></td>
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<tr>
<td>14 E-commerce (buying products and services)</td>
<td>+</td>
<td></td>
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<tr>
<td>15 General information about ICT</td>
<td></td>
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<tr>
<td>16 Use of the Internet</td>
<td>+</td>
<td></td>
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<td>17 ICT Management</td>
<td></td>
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<tr>
<td>18 E-commerce (selling services)</td>
<td>+</td>
<td></td>
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<tr>
<td>19 Costs/Expenditures of implemented system</td>
<td>+</td>
<td></td>
<td></td>
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<tr>
<td>20 Barriers in use of the Internet and E-commerce</td>
<td></td>
<td>+</td>
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<tr>
<td>21 Telemedicine</td>
<td></td>
<td></td>
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<tr>
<td>22 Approach to clients e-Health</td>
<td></td>
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<tr>
<td>23 Quick prototyping of health</td>
<td></td>
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<td>+</td>
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<tr>
<td>24 Waste management in a health-care</td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>13</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

*Source: Own*

Similarity of the answers was compared with the statistic test \( \chi^2 \) chi-square (see tab. 2).
Null hypothesis \((H_0)\) has been formulated: The answers of the questions are different in analyzed hospitals. \(H_1\) negating hypothesis \(H_0\) was also determined (The answers are not different in analyzed hospitals).

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

(1)

If the tested criterion value is greater than \(100(1-\alpha)\) % – division quintile \(\chi^2\) with \((r-1)(s-1)\) degrees of freedom, with \(\alpha\) = the level of significance (most frequently used 5 %), with \(r=\text{number of rows}\) and \(s=\text{number of columns}\).

\[
G = \sum_{i=1}^{r} \sum_{j=1}^{s} \left( \frac{n_{i,j} - n_{i,j}^*}{n_{i,j}^*} \right)^2
\]

(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 \(G > \chi^2_{0.05}\), zero hypothesis \(H_0\) can be rejected.

### Tab. 3 Results of \(\chi^2\) test

| \(G\) | 48 |
| \(\chi^2\) | 5.91 |
| Contingency coefficient (CP) | 0.64 |
| Cramer coefficient (CCR) | 0.84 |

Source: Own

Table 3 specifies the results of calculation according to statistic application Statgraphics. CP and CC must be from interval \((0.1)\). Considering the fact that value \(G > \chi^2_{0.05} (48>5.99)\), 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 is almost the same (answers of the questions are not different).

The biggest barrier of ICT deployment is lack of finance and it does not depend on the size of hospital. How to manage this barrier? How and where to find the financial reserves? One of the ways is to use ICT-based management tools. These tools can help to promote more efficient processes also in ICT departments. Business process
management tools can also allow not just more effective monitoring of the performance but also the simulation of processes. Therefore the second following research was oriented towards using of process management tools.

3. Successful ICT deployment

During the last decades the process management has been applied in many business or production enterprises but still Garner Group [21] expects that business process management (BPM) will grow. Gartner research identifies business process analysis as an important aspect and not just in manufacturing industry but also in services and health care services. Structural changes and the ability to be able to react on in routine work and also on the emergency or different unexpected situations in the health care sector intensify the need of simulation and process optimization [4]. The hospitals and health care centers are the new emerging areas. They are very important elements also in the crisis situations and therefore we have focused our research on the health care services and ICT use [6].

Business Product Management (the BPM) tools are appropriate solution in this kind of situations, because they allow high-quality analysis elaboration and – as a side effect – give valuable information to management of the organization. Additionally these tools can help to simulate the different changes during emergency and disasters. Some of these software tools are free:

- Adonid Modeler,
- BizAgi Process Modeler,
- Questetra BPM Suite,
- Tibco Business Studio,
- Aris Express,
- Process Maker,
- Open ModelSphere,
- Visual Paradigm – Smart Development Environment (Community Edition),

Information about processes is in information systems [11]. These records monitor different types of events that occur during process execution, including about start and completion time of each activity, its input and output data, the resource that executed it. Also any failure that occurred during activity or process execution is recorded. Data in warehouses are cleaned, aggregating and analyzing by with Business Intelligence technologies. It is very important that with these tools and methods it is possible to explain why for instance low-quality executions occurred in the past and to predict potential problems in running processes or to predict some exceptional situations.
3.1 Data collection and results of process management survey

The next step of the research was focused on a narrow group of ICT tools, which are designed for the managing and modeling process in hospital facilities. These tools can be used by the management and medical staff as a sophisticated auxiliary tool. The research aims to identify the satisfaction with the currently used ICT tools, in various medical facilities throughout the Czech Republic.

Data of the survey were collected through a structured questionnaire in 40 hospitals. The questionnaire was distributed in spring 2012 to determine the use of information systems in hospitals and using them as a tool for process management. Questionnaire had 20 questions as: how the organization strategy is creating, orientation to process management, which ICT tools are used for process management, using of new ICT technology, research and development etc. One of the most important questions in questionnaire, which caused further research in this area, was: using of process modeling tools. This question emerged from previous research realized in year 2011 and the issue is mainly associated with the individual management methods of hospitals [2, 3]. Especially in the health care there is a problem with the need of implementation the specific modeling supported by ICT [3].

Results of this second survey confirm very low use of ICT tools in process management (just 26 % hospitals use ICT tools in process management), 79 % of hospitals have financial problems with ICT costs (it confirms the results from the first survey), only 20 % measure the process effectiveness, 40 % hospitals think about some innovation in ICT and realize some radical changes in ICT process.

4. Conclusion

Health care industry should be one of the most information intensive and technologically advanced in our society. In Czech Republic the expanses were 290 billions 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.

From the first questionnaire we can see that there are not big differences between the analyzed hospitals in relation with the size of hospital and the town where the hospital is situated. All analyzed 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 analyze, Balanced Scorecard Method [10] and benchmarking for creating of the organization strategy. The strategic plans are designed for 2 years. An important element of organization strategy creation is a client. The client (patient) is in the centre of attention if hospital intends to improve its competitiveness.

Second survey also confirmed that the hospitals do not manage their processes effectively and are not using ICT tools for process management. The main advantages of these tools 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.

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.

Research and development activities in hospitals, especially those linked to the ICT, are related to many changes in their processes and organisation. Dynamic development of external environment of hospitals leads to a higher saturation of ICT applications and often to a generation exchange. At present, 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. Therefore the European Union supports projects oriented towards new technologies in agenda A2020 vision [20].

Acknowledgements

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References


