EVALUATION OF TECHNOLOGY ACCEPTANCE AND SUCCESS OF HEALTH IT
Case maternity pathway in Shanghai Weifang CHC and East hospital

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Report 2
China-Finland eHealth Partnership Project
(TEKES 40210/07)
SUMMARY

China-Finland eHealth Partnership-project (TEKES 40210/07) has studied applicability of the methods related to needs analysis and requirements specification, evaluation, service-oriented architectures, standards assessment and interoperability of health information systems in the multicultural cooperation between China and Finland in the health IT systems context.

Work has been focused on the maternity care pathway which presents a good example on information sharing needs in a regional health care context. The implementation and adoption of the Pudong regional health IT system has not, however, progressed as fast and smooth as planned. The system as a whole is not yet in October 2008 in use, and therefore our evaluation study has been focused on the user acceptance issues and on identification of the success and failure factors in the current situation. The study was carried out by interviewing the maternal system users in their normal working environment in Shanghai, October 2008. We could not analyse any of the system specifications or development documentations, because they were not accessible for us.

The users had positive expectations for the new regional system, they had good earlier experiences on the use of health IT systems and they expected to have a lot of benefits when they have these new systems in use. They also had a good picture of the Pudong project, and its progress, though they had little knowledge on the project objectives and the current project situation. Based on the interviews it seemed that the specifications were made without user participation and the project objectives were not clear for pilot organizations or the future users. Also the interviewees had no idea when the system is ready and what will happen to old systems and how things are done in the future. Lack of
user participation and communication might result in problems in user acceptance and also raise resistance towards change when the system is to be taken into use.

The work has shown that there are big cultural differences between the two participating countries, e.g. in language, in cultural behaviour, and most importantly in the ways and means how health care is organised, managed, delivered and used. Maybe these cultural differences are the most important reason why the results of this Finnish-Chinese cooperation are not very visible in this Pudong regional health IT project. Knowledge sharing in a multi-cultural cooperation requires appropriate levels of trust, commitment and collaborative learning strategy, and the partners need to have interorganisational learning practices. Cultural aspects may restrict the flow of information and knowledge if the partners are not able to communicate without misunderstandings. IS research has shown that the cultural aspects are an important part of all IT development and application and it seems that in this project we paid too little attention to the cultural differences.
Acknowledgements

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The 12th Joint Session under the Agreement on Scientific and Technological Cooperation between the People’s Republic of China and the Republic of Finland, in Beijing on 24 May 2006, approved the Cn-Fi eHP project and its sister project Researching on the strategy of construction & evolution in digital hospital (Guidelines for information interoperability), by the Health Information Center of Shanghai Municipal Health Bureau, to the Sino-Finnish Scientific and Technological Cooperation Programme as project no. AM12:08.

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1. INTRODUCTION

China-Finland eHealth Partnership-project studied the applicability of the methods related to needs analysis and requirements specification, evaluation, service-oriented architectures, standards assessment and interoperability of health information systems in the multicultural cooperation and health IT systems development context.

The project is organized along four research themes:
- Needs and requirements,
- Architectures, interoperability and standards,
- Data set definition for electronic health records,
- Evaluation.

All these themes focus on the same case domain: Maternity care pathway. This case has been selected because of the existing background knowledge of research partners in the domain and because this presents a good case on regional information sharing. In China, two healthcare organizations, Weifang Community Health Center (CHC) and East Hospital, are the case organizations in Pudong New area, Shanghai.

Data on the current situation as part of the needs and requirements analysis was gathered in field studies in these organizations in November 2007 and in January 2008 in the case maternity pathway. Evaluation study was carried out in October 2008 in the same organizations in Shanghai with the maternity pathway case. Due to the delayed
implementation of the regional health information system the study as a whole has remained more restricted than what was originally planned.

The current situation of the maternity pathway has been reported in the Project Report 1, June 2008 (Luukkonen et al., 2008). Figure 1 from report 1 presents the case maternity pathway.

![Maternity pathway overview: main organizations, activities and actors](image)

**Figure 1: The case maternity pathway (Luukkonen et al., 2008)**

In the current situation analysis (Luukkonen et al., 2008) major development points were identified and they were as follows:
- Paper-based information sharing and overlapping information: Paper-based information still plays an important role in maternity care.

- Lack of information transfer causes fragmented and isolated information: Maternity data is fragmented in two levels: within maternity care chain in different organizations and inside each hospital in different systems, both paper based and digital information systems. Fragmentation and isolation of information leads to other problems, like duplicate or increased work, and overlapping or inconsistent information.

- Delay in or lack of information transfer results in many phone calls: Phone calling was experienced as time and resource consuming task.

- Duplicate work: Not all applications are integrated, and this means information and data is collected from one system and transferred to another, often manually.

- Information transfer is important for developing healthcare actors’ professional skills: Feedback from higher level hospital would be important in seamless treatment in the care chain, but also for educational reasons.

- Generic needs: Governmental decisions in China national level are needed in healthcare organization (= how to organize healthcare services), citizens’ unambiguous identification and healthcare ISD.

These identified development points, problem situations are the starting point for this evaluation study.
2. EVALUATION

The use of modern ICT offers opportunities to support health care professionals and to increase the efficiency, effectiveness and appropriateness of care. However, there can also be hazards associated with information technology in health care. ICT can be inappropriately specified, have functional errors, be unreliable, user-unfriendly, ill-functioning or the environment may not be properly prepared to accommodate the ICT in the working processes (Heeks et al., 2004). Such breakdowns and failures may negatively affect the working processes and decisions of health care providers and may result in harm for the patients, i.e. ICT can create adverse side-effects in the care process. Therefore, there is a need for evaluation of ICT systems that are (intended to be) in operation in a health care environment to identify potential side effects. Such evaluations should not only be carried out during operation (summative evaluation), but also during system development (constructive, formative evaluation during system analysis, design, and implementation) as to avoid the potential misalignment of the intended system and the system actually being developed as well as to identify harmful consequences as early as possible (Ammenwerth et al., 2004).

**Evaluation is the act of measuring or exploring properties of a health information system (in planning, development, implementation, installation, operation-phase), the result of which informs a decision to be made concerning the measured system in the specific context. Measurements are done and judged or used in a context, there is always a question to be answered (Brender, 2006, p.3).**

Evaluation can be performed from various perspectives, these include at least:
Experimental, economic, constructive and management perspectives (Övretveit, 2003). Constructive evaluation aims at finding problems and failures in the system development life cycle and to make corrective interventions in the development or implementation process. Economic evaluation may be cost-effectiveness or cost-benefit evaluation. Experimental evaluation tries to identify the effects and impacts of an information system implementation or installation. In the management evaluation interesting questions are those related to service production effectiveness or service production management.

Typical evaluation questions are, for example (Ammenwerth et al., 2004):

- Is the technology usable in the intended environment and for the intended user group and task? Do the different user groups (e.g., physicians, nurses, and administrative staff) accept the ICT and use it as intended? What are the patterns in the users’ attitude towards the (future) system, and their pattern of behaviour? Have the users had sufficient training and guidance to be able to use the technology appropriately?

- How does the technology affect structural or process quality (e.g., time saving, data quality, clinical workflow)? What are the effects of an information system on the quality of patient care (outcome quality)? To what extent does the information system not only meet the requirements but also the objectives? What are the reasons for the observed effects?

- What are the investment and operational costs of ICT-based solutions? Are they cost-effective? What is their return on investment?

- What are the problem areas of an information system in daily operation? What are current pitfalls with it, and how can it be improved?

- What are the organizational and social consequences of introducing ICT into health care environments and how can we include these aspects into design, development and installation to achieve the planned changes in the working structures, work content and work environments?
The necessity, but also the complexity, of evaluation studies has been discussed in the literature, and reasons for problems encountered during evaluation studies were identified as follows (Brender, 1997; Ammenwerth et al., 2004; Kaplan and Shaw, 2004):

- Insufficiently available evaluation methods, guidelines and toolkits to cope with the complexity of health care information systems originating from a combination of technical as well as organizational and social issues.

- Insufficient collaboration between evaluation researchers from different academic fields and traditions.

- Little support by methods and guidelines for constructive (formative) evaluation in an implementation or installation project, since many studies focus on summative aspects.

- Often insufficient and costly evaluation studies are carried out, which do not ask or are not able to answer the important questions of information systems evaluation.

- Limited value of evaluation reports to others, because these lack sufficient information enabling others to adopt the approach or to judge the validity of the conclusions given.

Additionally, the organisational resistance to evaluation has been identified as a barrier for doing evaluation studies. Reasons include the diversion of resources from activities that are perceived as more creative, the reluctance to find and publicise “failures” or “mistakes”, and concern about encouraging damage-seeking litigation. To counterbalance this, better publicity of evaluation approaches, but above all of the proven benefits of evaluation and adoption of lessons learned, are needed.

A commonly used approach in evaluation of health information systems is the life-cycle model (Nykänen and Chowdhury, 1991; Nykänen and Nuutila, 1991; Clarke et al, 1994; Talmon et al, 1999). In many models the lifecycle is divided into 4 phases: 1) preliminary
specifications, 2) validity and functionality of the first prototype, 3) functionality and usability of a more advanced prototype in a real environment, 4) effects and impacts of a final system on the user, organization, health care system, its output etc. In this approach development process is seen to be composed of phases and evaluation is carried out at all phases with different focus at each phase. This approach emphasizes that evaluation is an integral and essential part of an IS development process.

Other approach that has been much applied in IT evaluation is the model of IS success (DeLone and McLean, 1992, 2003) which describes the success of an information system. The model depicts that the information system quality, information quality and service quality effect on the system use and on the user satisfaction with the system. If the system is used and the user is satisfied, then net benefits will be achieved. Net benefit is the benefit the organization acquires by use of the system.

The multistakeholder approach (Turunen, 2001) emphasizes the various stakeholders views on the system and pays attention to measure the technical quality, personal performance and effects and impacts of the system on the patients, personnel, organization and society.

Many examples on evaluation studies and applied approaches and frameworks can be found in the literature, see e.g. (Nykänen et al., 1999; Kaplan and Shaw, 2004; Ammenwerth and de Keizer, 2005; Brender, 2006; Friedman and Wyatt, 2006; Talmon, 2006; Yusof et al., 2008). There is no global, single approach that could be applied on any case and therefore many reports are found on pros and cons and on restrictions of used approaches in various situations. In recent years social and organisational aspects of health information systems have been recognised important and in the future evaluation studies attention should be paid on these issues. It is important to evaluate IT systems in
situations where these systems are used and where their effects and impacts on all user groups can be studied. When we in evaluation studies detect failures in IT systems development and adoption, then we should analyse these failures carefully, because from them we can learn and can collect valuable information and improve our future IT development and adoption activities. It is also recommended (Kaplan and Shaw, 2004; Talmon et al., 2008) that evaluation studies should be performed in the future in a broader scope, in a larger number and their results should be published and made available for the health IT community.
3. EVALUATION STUDY PLANNING

3.1 Good evaluation practice guidelines

In this evaluation study planning we have followed the EFMI guidelines on good evaluation practices (Nykänen et al., 2008, available at iig.umit.at/efmi). Because there is no single global approach or methodology that is valid for all evaluation studies in any context, guidelines are useful in giving us advice on how to design and how to carry out evaluation studies, and what issues to consider in various study phases. The guidelines are based on the literature studies and on consensus making in the health IT evaluation community. The guidelines are applied on this study only partially due to the restricted scope of this study.

The phases of the Good Evaluation Practice Guidelines in Health Informatics (GEP_HI) are:
- **Study exploration** focuses on the starting question of the evaluation study,
- **First study design** focuses on the preliminary design of the evaluation study,
- **Operationalisation of methods** focuses on making the design and evaluation methods concrete and compliant with the organizational setting and the information need, while taking into account the known pitfalls and perils
- **Detailed study plan and project plan** focuses on providing plans, prescriptions and procedures detailed to the level necessary for the specific study,
- **Evaluation study implementation** focuses on activities related with the actual accomplishment of the designed evaluation study, and reporting of the study results.
The phases – or the activities within a given phase – do not necessarily follow each other in a linear or sequential fashion, but there may be iterations with one or more tasks of a previous phase in case of problems at the current phase. The phases and their related issues are listed in more detail in table 1.

Table 1: Items recommended to be taken into account in any health informatics evaluation

<table>
<thead>
<tr>
<th>Phase</th>
<th>Item</th>
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<td>Study Exploration</td>
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<td>The Information Need</td>
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<td>Primary audience</td>
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<td>1.3</td>
<td>Identification of the buyer / sponsor / study funding party</td>
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<td>The context of the evaluation study</td>
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<td>A first identification of stakeholders</td>
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<td>1.6</td>
<td>A first identification of consultants</td>
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<td>1.7</td>
<td>A first sketch of the setting</td>
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<td>1.8</td>
<td>Exploring the conditions for evaluation</td>
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<td>1.9</td>
<td>Methods to be used</td>
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<td>1.10</td>
<td>A draft budget</td>
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<tr>
<td>1.11</td>
<td>Result of this phase</td>
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<td>1.12</td>
<td>Political/administrative acceptance to proceed to the next phase</td>
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<td>2</td>
<td>First Study Design</td>
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<td>Establishment of the design team</td>
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<td>Stakeholder analysis/Social Network analysis</td>
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<td>2.4</td>
<td>Key evaluation issues/questions</td>
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<td>Study constraints</td>
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<td>Methods</td>
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<td>Risk analysis</td>
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<td>Section</td>
<td>Details</td>
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<td>2.14</td>
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<td>2.16</td>
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<td>3</td>
<td>Operationalisation of Methods</td>
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<td>Approach</td>
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<td>Timing</td>
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<td>Justification</td>
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<td>Outcome measures</td>
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<td>3.10</td>
<td>Participants</td>
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<td>3.11</td>
<td>Study flow</td>
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<td>3.12</td>
<td>Result of this phase</td>
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<td>4</td>
<td>Detailed Study Plan and Project Plan</td>
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<td>4.1</td>
<td>Project management</td>
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<td>4.2</td>
<td>Evaluation activity mapping</td>
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<td>4.3</td>
<td>Quality management</td>
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<td>4.3.1</td>
<td>Methodological approach</td>
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<td>Methodical aspects</td>
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<td>Risk management</td>
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<td>Communication strategy</td>
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<td>4.5.1</td>
<td>Project controlling and risk management</td>
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<td>4.5.2</td>
<td>Reports and publications</td>
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<td>4.6</td>
<td>Recruitment of necessary additional staff</td>
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<td>5</td>
<td>Evaluation Study Implementation</td>
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<td>Establishment of the frame of reference</td>
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<td>5.2</td>
<td>Observation of changes</td>
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<td>5.3</td>
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<td>5.5</td>
<td>Continuous project management, quality management and risk management</td>
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<td>Regular reports</td>
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<td>5.7</td>
<td>Final result of this phase</td>
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<td>5.8</td>
<td>Reporting guidelines</td>
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3.2 Evaluation study context

The Pudong New Area is the biggest and leading health district in Shanghai and the Pudong Hospital Authority was set up early 2007. Maternity care services are given in community health centers (CHC) and hospitals. Women are advised to visit CHC in the community where they live, but they can choose whatever hospital they would like to visit. Floating people are advised to register their pregnancy at the Birth Control Office. CHC establishes a Maternity Card: a paper-based booklet kept by the mother, and a maternity health record: kept by the CHC. Figure 2 presents an overview of the maternity pathway under study. A detailed description of the workflows and information flows is found in (Luukkonen et al., 2008).
The information systems environment of the Weifang health centre is presented in figure 3, and that of the East Hospital in figure 4.
Figure 3: Information systems in Weifang maternity pathway (Luukkonen et al., 2008)
3.3 Evaluation study implementation

There have been severe problems in information sharing in Pudong District between the primary care and specialised care organisations. These problems were clearly identified in the current situation analysis (Luukkonen et al., 2008). These problems have also
served as a motivation for the new regional health IT system. The aim has been to solve many of these problems by introducing a new regional health information system where primary care components (in this case the Weifang health centre maternal system component) enable information access and sharing with the specialised care organisations (in this case the East hospital system component). The regional health IT system includes also other IT components, but in this research we focus only on the maternity pathway.

The implementation and adoption of the regional health IT system has not, however, progressed as fast and smooth as planned, and therefore the focus in our evaluation study has changed from what was originally planned. The system as a whole is not yet in October 2008 in use, only restricted pilots are in use, and therefore the effects and impacts of the system use cannot be studied and evaluated. In this situation we decided to focus in our evaluation study on the user acceptance issues and on identification of the success and failure factors in the current situation where the system is not yet fully used and is not fully accepted by the users. On the user acceptance issues we could only collect in the interviews users’ expectations because the interviewed users had not been using the pilot system. To the success and failure issues we paid in the evaluation our most attention in order to identify success and failure factors and thus to find useful information for the further implementation process. Success and failure factors identification adds our knowledge on regional IS implementation and adoption.

The study was carried out by interviewing the maternal system users in their normal working environment. The interviews were done in a user group. There was no possibility for any observation study. Either we could not analyse any of the system specifications or development documentations, because they were not accessible for us.
The interviewing situation was very simple, the interviews were performed in Weifang health centre on afternoon October 15th and in East hospital in the morning October 15th. The number of persons interviewed was very limited, 3 health professionals in Weifang health centre and 1 health IT professional in East hospital. Additionally we had a short interview with the project manager.

After the interviews had been carried out, the researchers had a brainstorming session on both aspects, success and user acceptance. The conclusions were drawn and there are presented in this report chapters 6 and 7.
4. SUCCESS AND FAILURE FACTORS IN THE CASE MATERNITY PATHWAY

4.1 Success and failure factors

It is widely accepted that many of the information systems development projects fail somehow (see e.g. Lyytinen and Hirschheim, 1987; Heeks, 2006). These development projects may fail completely, but the failures also may be minor. It is hard to say when a project is a success or a failure, because people usually have different views about what is a successful information system.

Researchers have developed models of how to measure success and one the most famous one is DeLone and McLean (D&M) model of IS success (DeLone and McLean, 1992). In the original D&M IS success model there were six variables which were interrelated together. These variables were system quality, information quality, use, user satisfaction, individual impact and organizational impact. DeLone and McLean (2003) define that system quality measures technical success, information quality measures semantic success and the four other variables measure effectiveness. Because information systems success is a multidimensional concept it is important to measure all these different kinds of success types so that we can reliably find out the success of the information system.

A decade after their first model version DeLone and McLean released an updated version (figure 5). In this updated version they made some changes to the model based on empirical studies and other literature published during this time. In this new version DeLone and McLean have introduced a new quality dimension – service quality. All of these three quality dimensions will affect to use and user satisfaction, so they all should be measured equally. Also in the updated model there is “intention to use” which tries to
measure users' attitudes towards the information system, as use is measuring more behavioral things. Individual impact and organizational impact has been grouped as “net benefits”, which are the results from the use of the system. Net benefits should be positive or the system should be considered as a failure. (DeLone and McLean, 2003)

Figure 5. Updated version of DeLone and McLean IS success model (DeLone and McLean, 2003).

Heeks (2006) has divided possible results of a health information system development project into three categories. These categories are total failure, partial failure and success. Total failure is when the system isn’t implemented or is abandoned after implementation. Partial failure is when the system doesn’t meet its major goals or there are undesirable outcomes. A project might sometimes be hard to define as a partial failure because the goals aren’t always unambiguous. According to Heeks (2006) project is a success, when most of the stakeholders’ goals are fulfilled and there are no undesirable outcomes.
Brender et al. (2006) have defined success in their study as something that evolves and cannot be characterized only in one way. They have also defined some factors that a IT-based solution in health care needs to fulfil to be defined as a success:
- It is widely acknowledged and used in daily practice
- It fulfils the role and tasks it was planned
- It is useful for the stakeholders and benefits the patient.

Lyytinen and Hirschheim (1987) have identified four major types of failure in information systems development:
- Correspondence failure: It means that the objectives of the design couldn’t be fulfilled thus information system is a failure.
- Process failure: When the design process fails, for example budget or time schedule are exceeded. It can also mean that working information system couldn’t be developed.
- Interaction failure: Users don’t interact with the information system.
- Expectation failure: Information system doesn’t meet the expectations of stakeholders.

Information systems development projects can fail for many reasons. Reasons can be anything from technical problems to information quality problems or to conceptual misunderstandings. Researchers have tried to find out common reasons for failure and success in information system projects. Brender et al. (2006) made an extensive Delphi study about critical success and failure factors in health care information system development. In their research they identified 110 critical success factors and 27 critical failure factors. All of these factors were found relevant in information system development.
Brender et al. (2006) divided critical success and failure factors into twelve different categories. These categories were functional, organizational, behavioural, technical, managerial, political, cultural, legal, strategy, economy, education and user acceptance (Brender et al., 2006). Yeo (2002) found out in his questionnaire study ten different issues of influence for information system failure. These ten issues were project planning, corporate culture, project management and control, business process and system design, IT/IS professionals, information technology, users, corporate management, politics and business planning. From these studies we can see that there are many different kinds of factors that should be taken seriously when a new information system is being developed.

Standing et al. (2006) made a questionnaire research among Australian IT personnel about critical factors for information technology projects. They found out that the top five things for failure were lack of user support and involvement, lack of properly defined project scope, lack of executive management support and commitment, imprecise defined objectives and poor project management and leadership. The top five reasons for project success in their study were good user support and involvement, good project management and leadership, effective planning, executive and sponsor commitment, and total organization and project team commitment.

As we can see from these studies there are many different kinds of factors that should be taken into account in information technology projects. We should try to learn from these past experiences so that we could avoid common failure factors and focus on the success factors.
4.2 Success and failure analysis in the maternity pathway case

In this research we chose a few critical success and failure factors to be analyzed in the Pudong project. These critical factors were found from the scientific literature. We tried to evaluate the Pudong project based on these factors. Interview questions in Pudong area were based on these factors. With these interviews and critical factors we tried to analyze the project from four different aspects. These aspects were functional, organizational, managerial and cultural.

We chose four success factors to be analyzed:
1) work from the workflow,
2) continuous user involvement and user participation,
3) understanding the context,
4) organizational commitment.

Also four critical failure factors were analyzed:
1) poor specifications and unclear objectives,
2) overambitious implementation plans,
3) not understanding the organizational context, and
4) underestimating user acceptance.

Work from the workflow means that the actual workflow is the base of the system design and the workflow should be analyzed fully. Continuous user involvement and user participation means that the users’ voices are heard throughout the development project and they can actually make a difference in the system. Understanding the context don’t just mean that the developers and the project team must understand the working context of the target area but also that they must understand the organizational context. The
project team should know and understand the organizational culture where they are developing the system. Also the whole organization should commit to the project so that there are no disagreements and differences in the organization and management.

It is very important that the specifications are made properly and the objectives of the project are clearly defined otherwise it might lead to a failure. Also implementation plans should be realistic because overambitious plans may result a failure. Not understanding the organizational context might cause a failure. If the users don’t accept the system it will fail so organizations shouldn’t underestimate the user acceptance.

In this study we tried to evaluate how these critical success and failure factors were taken into account during the Pudong project. With this analyze we tried to find out the reasons for success or failure in the Pudong project and also we attempted to find some things to improve and to learn from these experiences.
5. EVALUATION OF TECHNOLOGY ACCEPTANCE IN THE MATERNITY PATHWAY

5.1 User acceptance

User acceptance can be defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support. Determining user acceptance of a system is a difficult but important part of human factors research and application. While there is currently no complete theory or model that explains and predicts acceptance, there is an emerging understanding of the key variables in the technology, the user and the implementation process that affect acceptability.

To be accepted, a technology must satisfy basic usability requirements and be perceived as useful by its intended user community. User experience and training will impact acceptance levels as will the manner in which the technology is implemented to contribute to organizational goals and working practices. Acceptance theorists are interested in understanding the factors influencing the adoption of technologies as planned by users who have some degree of choice.

The literature on acceptance is broad, ranging from case studies of accepted technologies, to the individual psychological characteristics of acceptors or resistors (see e.g. Raitoharju, 2007). The literature can provide us with some understanding of what makes users accept or reject a system but, since the issue is complex, it is unlikely that a single-variable explanation can be derived of the level of acceptance any information technology will receive among its intended users.
The most well-known of technology acceptance models is the TAM-model (Davis, 1989; Davis et al., 1989; Venkatesh et al., 2003). The main features of the TAM-model are described in table 2.

Table 2: The TAM-model features

<table>
<thead>
<tr>
<th>Main dependent construct(s)/factor(s)</th>
<th>Behavioral Intention to Use, System Usage</th>
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<tbody>
<tr>
<td>Main independent construct(s)/factor(s)</td>
<td>Perceived Usefulness, Perceived Ease of Use</td>
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TAM is an adaptation of the Theory of Reasoned Action (TRA) to the field of IS. TAM posits that perceived usefulness and perceived ease of use determine an individual's intention to use a system with intention to use serving as a mediator of actual system use. Perceived usefulness is also seen as being directly impacted by perceived ease of use. Researchers have simplified TAM by removing the attitude construct found in TRA from the current specification (Venkatesh et al., 2003). Attempts to extend TAM have generally taken one of three approaches: by introducing factors from related models, by introducing additional or alternative belief factors, and by examining antecedents and moderators of perceived usefulness and perceived ease of use (Wixom and Todd, 2005). TRA and TAM, both of which have strong behavioural elements, assume that when someone forms an intention to act, that they will be free to act without limitation. In practice constraints such as limited ability, time, environmental or organisational limits, and unconscious habits will limit the freedom to act.

Diagram/schematic of theory

Source: Davis et al. (1989), Venkatesh et al. (2003)
5.2 Factors under study in the maternity pathway case

The technology acceptance factors according to the TAM-model are perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness is defined as the degree to which a user believes that using the system will enhance his or her performance. Perceived ease of use is defined as the degree to which the user believes that using the system will be free from effort. According to TAM, both perceived usefulness and perceived ease of use, have a significant impact on a user's attitude toward using the system (Davis, 1989; Raitoharju, 2007)

In this study we focus with technology acceptance on these factors: perceived usefulness and perceived ease of use. These measures are very suitable on this situation, because while using them there is no need to define the type of IT used, the user groups or the organizational level of the users. Measure, perceived ease of use, gives us information on the system quality, but does not describe it completely. The measure, perceived usefulness, gives us information on the information quality of the system as described in (DeLone and McLean, 2003).

The measures were operationalised according to (Davis, 1989; Raitoharju, 2007) with the following questions:

1. **Perceived ease of use (PEOU)**, measures the extent to which the respondent considers that:
   - It is easy to get IT work as wanted
   - The use of IT is flexible
   - The use of IT is easy.

2. **Perceived usefulness (PU)**, measures the extent to which the respondent considers that the use of IT
Quickens / makes faster the completion of his/her work tasks
- Improves the quality of his/her work
- Makes his/her work easier.

Additionally questions were included to collect information on the actual use, encountered positive/negative points and opinions on the future:

1. How many hours in a week you use IT?
2. What are the good points with IT systems you use?
3. What kind of problems you have had with IT use?
4. Other comments / opinions / possibilities for the future?
   a. How do you see the future?
   b. What kinds of IT systems you think are needed in your work?
   c. What are the most important functions / aspects in an IT system from your viewpoint?
   d. What kind of IT system you would like most?
6. RESULTS OF USER ACCEPTANCE AND SUCCESS FACTORS EVALUATION

6.1 Technology acceptance results

The maternal system and the regional system were not yet in use either in the Weifang health centre or in the East hospital.

In Weifang health centre the health professionals had participated a week ago in a training program for a part of a system, and they had managed to send data of a pregnant woman to other district organization. This was their first experience with the regional system and the new maternal system.

The health professionals interviewed had no knowledge on why the regional system is not yet in use. While waiting for the regional system they use their own maternal system and when the new system has been installed, they do not know what happens to their own maternal system: Do they stop using of their own system or have 2 systems parallel in use? The interviewed persons did not either have any knowledge on the new system, its functionalities and characteristics, because they had not had any possibility to participate in the system planning and specification.

The professionals were worried about the future situation: How the situation will change and what kinds of systems they will have finally in use. They consider the Pudong project very important because they expect that the regional system development will
enable data and information sharing in the district and will reduce duplicate work. The health professionals look forward to have the regional system in use.

In Weifang health centre the health professionals are used to use health IT systems, and they consider the systems very helpful for care practices. Doctors have been happy to use the systems and their experiences with the systems are very positive.

On the new maternal and regional system they do not have any experience or even any knowledge on what kind of systems they will finally have. However, they are looking forward to have the systems in use. So they expect to have a lot of benefits from these systems. Currently, they are doing a lot of duplicate work as they prepare manual and digital versions of patient documents at the same time for the governmental purposes.

In East hospital the regional system was not yet in use. Parts of the regional system are under piloting, but not in routine use. The interviewed person considered, however, that the Pudong project is a very important and she believed that there would be a lot of benefits from the project for different users when the regional system is in use. The hospital IT department offers strong support for the project, though they do not have a very clear picture of the project. The hospital IT department could not get any money from the project for the development, though the IT department has very limited financial resources. Additionally the hospital has problems with human resources, because they have only 3 persons working in their health IT department, and these 3 persons are maintaining all the systems they use in the hospital. They believe that the regional system in the future would be a big step forward when information can be shared and duplicate work with data access and storage can be avoided.
From the health organization viewpoint they see that the government should give more support and guidelines to this kind of regional health IT development work. Especially guidance and guidelines are needed for patient data safety, confidentiality and privacy management.

6.2 Success and failure factors

Functional factors:
There are a lot different systems used in East hospital and Weifang community health care center, but there is hardly any integration between them. Information cannot be shared intra-organizationally or inter-organizationally. The interviewees told that there is a plan to implement a new centralized database, which will enable regional information sharing. The users didn’t know when the system will be up and running. The interviewees also stated that the used systems were created without any standards, so there probably will be problems with the information sharing, because obviously there will be a lot of data conversion and other necessary work.

The interviewees felt that most of the systems were built by governmental decisions and needs and they hoped that the new system will help their work. Now the situation makes them do duplicate work. Currently healthcare providers can develop their own systems, but the municipality wants to have one regional system which is developed from different point of view than current systems. The interviewees felt that there is not going to be a lot of integration between these systems. The interviewees also told that they weren’t involved in the requirements specification of the new system and didn’t know if any other users were involved.
The project manager said, however, that the new system is almost working. The new system is going to be an intranet service for the Pudong area healthcare providers. With this intranet healthcare professionals can share information between the different organizations. They are able to see patients’ data from other organizations. The project manager told that system security and patients’ privacy are very important factors for new the system. Security solutions are based on national guidelines and the firewalls are being tested.

**Organizational factors:**

The interviewees told that information systems are very important for the organizations and the users. They felt that information systems are part of a better patient treatment and the organizations managers understand this and support the information system development. The interviewees told that, although information systems are seen as an important asset, lack of resources are creating some problems. They felt that there are not enough personnel working on information management and systems. One the interviewees told that there is not enough money available for information technology and the interviewee also feared that lack of resources might slow down the progress in information systems and regional system in some organizations.

The interviewees told that one of the things that could create problems for regional information sharing is that the hospitals and community healthcare centers are at different levels of development. Some organizations are used to use information systems and technology in their work, but some healthcare providers are not.

Healthcare providers are using information systems in their work and the organizations support the development of new systems and workflows, but nowadays the developed
systems create duplicate work for the users because they have to use also paper based system. If the organizations want to achieve proper advantages and change in their care processes, they have to reduce the duplicate work.

**Managerial factors:**

The interviewees wished more actions from the government on information systems and regional information sharing. They hoped that the government would make extensive plans and guidelines for information systems in healthcare. The interviewees also wished for a new legislation and guidelines for information privacy and how to handle electronic patient information. They felt that absence of legislation is blocking the information sharing.

The interviewees also felt that a lot of money is being invested overlapped. Many different parties are investing on similar things. The interviewees hoped for a better plan for investments, they wished for more guidance from the government for how to invest money in IT. The interviewees also hoped more detailed plans for regional information sharing from the government. Some of the interviewees felt that they don’t know what their organizations role is in this pilot project and what they are supposed to do. They didn’t really know what was going on and what is going to happen in the future.

The project manager told that the project is going well and they have almost fulfilled their targets for this year. The project manager said that information can be shared between community healthcare centers and hospitals in the pilot organizations. Information can be shared through an intranet service. In the project the management has also considered the effects of the system to the workflow, and the project manager said that there are not going be too many changes to the workflow. The interviewees also told that all the
organizations are eager to share information, but they acknowledge how important patients’ privacy is.

**Cultural factors:**
The interviewees told that attitudes towards information technology and systems are very positive. The positive attitude has grown in the past few years and the healthcare professionals feel that information systems are vital for their work, although they currently cause some duplicate work. The interviewees told that the management of their organizations support information system development and understand the importance of the systems. The interviewees also had high expectations for regional information system and sharing. They wished that the new system would help their work. The positive attitude towards information systems is also shown in that the healthcare providers are investing their own money in regional information system development. Also one East hospital employee is working fulltime in the Pudong pilot project.

The management of healthcare providers support the regional information system, but they are currently paying more attention to their own systems. The interviewees hoped for more motivation for working in the pilot project, because currently they do not get anything from their work in the project.

The interviewees told that users in healthcare organizations would like to participate in the developing project, but they are not currently involved and the local government makes the decision on what kind the system will be. Users do not really know anything about the new system and they fear that it will create more work for them. There is going to be a public seminar for healthcare professionals about the new system where users can tell their ideas and comments. The new system will be evaluated and modified according to the feedback and comments.
7. DISCUSSION AND CONCLUSIONS

From the technology acceptance perspective the users did not have the new systems yet in use. However, they were very positive in waiting for the new systems. They had good earlier experiences on the use of health IT systems and they expected to have a lot of benefits when they have these new systems in use. They had a good picture of the Pudong project, and its progress, though they had little knowledge on the project objectives and the current project situation. In October 2008 they were in a duplicate work situation, storing paper-based information manually into computers and waiting for the new systems to change the situation. However, they perceived to have a useful system in use.

The success and failure factors analysis had to be done in a situation where the system was not yet in use. The first success factor was the work from the workflow. According to the interviewees the workflow was not analyzed, at least not in the interviewed persons’ organizations. The project manager said that the regional system will have only little effect to the current workflow. The interviewees also told that they don’t know anything about the system and they have not been part of the development project. Continuous user participation is seen as a success factor in the scientific literature. However, in this situation the project management, pilot organizations and the future users seemed to be committed to the project and new system. Also it seemed that all stakeholders were waiting for the system and there were no internal conflicts.

Based on the interviews it seemed that the specifications were made without user participation and the project objectives were not clear for pilot organizations or the future users. It seemed that they didn’t really know what was going to happen and what their
role is in the new system and what kinds of effects it will have. Also the interviewees had no idea when the system is ready and what will happen to old systems and how things are done in the future. Lack of user participation and communication might result in problems in user acceptance and also raise resistance towards change when the system is to be taken into use.

The interviews raised questions about the future of the regional system: will it help the healthcare professionals and the providers? Will it change workflows in a positive way or will the system create more work for the users? Will the system be used and accepted by the users and will it finally be a success? These questions remained open due to the fact that the regional system had not yet been installed into use.

7.1 Conclusions

Due to the small number of persons involved in the interviews the results cannot be generalised. We cannot draw profound conclusions on the basis of these interviews. The situation with the Pudong project was not as advanced as expected before the interviews, and therefore we did not get any information about the real use or usefulness of the system. And we cannot finally draw any conclusions on the success or failure of the regional information system. We can only raise some issues on the current situation and hope that these issues will be analysed later and that we can learn from these experiences.

Important issues found in this study can be summarised:

- In order achieve national, or regional interoperable integrated IT systems environment the regional or national government should take a guiding and monitoring position in the IT development projects. The regional developments
and applications should be compliant with the national infrastructure and apply the same principles and harmonized technological decisions.

- There is a need for harmonized guidelines, rules and laws for safety, security and privacy management of health related data. These guidelines and normative rules should be provided by the Chinese Government and applied nationwide in the same way.

- The study showed that standards and harmonized approaches are needed to achieve interoperability of systems in the regional health IT network.

- This is not an easy task in this Pudong case as there are many different systems by many vendors in health organizations and they are based on various information models and technologies. However, harmonization and standardized approach are the only way to guarantee successful integration.

- Health care organizations, health care providers, need financial and human resources to be able to develop and implement health IT systems.

- In this Pudong regional information systems case the government had allocated additional money for IT development.

- A very important aspect from earlier studies and experiments is that health IT has to serve the users’ needs to be successful. The whole systems design and development should be based on the users’ needs. User involvement is a key issue and there exist many approaches and methods for that.

- By now, this showed to be a weak point in the Pudong regional project and should be improved in the future.

China-Finland eHealth partnership project has aimed to study and support applicability of the methods of needs analysis and requirements specification, evaluation, service-
oriented architectures, standards assessment and interoperability in the multicultural cooperation and context in Shanghai Pudong regional information systems project. A detailed needs analysis was performed with the maternity pathway and reported in English for the Chinese partners support. Materials and discussions on available and used standards and architecture decisions have been produced and made available. Evaluation methods have been described and materials delivered with an important notice that evaluation should be an integral part of the regional health IT project during the whole lifecycle. Finnish companies have explored possibilities to develop their products to meet the needs of the Chinese market and to integrate their health IT systems with the regional health IT systems infrastructure.

What has been achieved with the China-Finland eHealth Partnership cooperation? A lot of knowledge and information has been exchanged, and certainly the Chinese partners have learnt a lot when having information on the Finnish experiences in the health IT domain. The Finnish partners have surely also learnt on different situations and existing assumptions in China. However, there are big cultural differences between the two participating countries, e.g. in language, in cultural behaviour, and most importantly in the ways and means how health care is organised, managed, delivered and used. Maybe these cultural differences are the most important reason why the results of this Finnish-Chinese cooperation are not very visible in this Pudong regional health IT project. Adoption of results and experiences from one cultural environment to another environment takes time and requires that the learnt knowledge and information is explicated, socialised and transformed into tacit knowledge applicable in the application environment.

To optimise learning and knowledge transfer in this kind of multicultural collaboration we could apply the model developed in (Sainio, 2007). The model is specifically targeted
for knowledge transfer in strategic alliances of East-West software companies. The model covers epistemological, ontological and cultural dimensions of knowledge transfer and the main challenges are the following (Sainio, 2007):

- **Epistemological challenges**: knowledge is seen as a valuable asset of a company and is shared with the partner only in the presence of appropriate levels of trust, commitment and collaborative learning strategy. Knowledge in a software company can be highly complex and systemic requiring sufficient absorptive capacity from the receiving party and transparency from the side of possessing party.

- **Ontological challenges**: the partners need to develop interorganizational learning practices. Without shared ontologies, knowledge sharing is not possible. Crossing the borders of entities (individual, team and organization), causes discontinuity of underlying assumptions of knowledge and raises the need to validate the used ontology again. For successful interorganizational learning, both partners need to have sufficient absorptive capacity.

- **Cultural challenges**: those dimensions of culture that restrict the flow of information and knowledge in an organization are the ones affecting knowledge transfer most (e.g. verticalness of a culture). Culture as perceived as an ontological entity, demands that representatives of different cultural orientations ensure the use of shared ontology, i.e. all communication should be double-checked so that the misunderstandings are avoided.

Knowledge sharing requires appropriate levels of trust, commitment and collaborative learning strategy, and the partners need to have interorganisational learning practices. Cultural aspects may restrict the flow of information and knowledge if the partners are not able to communicate without misunderstandings. IS research has shown that the
cultural aspects are an important part of all IT development and application and it seems that in this project we paid too little attention to the cultural differences.
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