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# ASSESSING FINNISH HEALTH CARE INFORMATION SYSTEM PROJECTS: HOW AND WHY DO THEY USUALLY FAIL?

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## ABSTRACT

The role of information technology is constantly growing but carrying out information system projects has proven to be very difficult in Finland. Especially projects within the public healthcare have been unsuccessful. Finland is one of the leading IT countries in the world but facing many challenges in retaining its position.

The aim of the research was to find out the reasons behind the massive health care information system project failures that have occurred in Finland during the past years. The empirical material was a sample if news articles on the topic. The information was then deepened with related literature, which discussed, for instance, information systems procurement, and features related to especially health care information system projects.

A coherent strategy both for the state's overall IT operations and for the development of HCIS, and good knowledge in information systems procurement play important roles in the success of the projects. By having good knowledge in project procurement, public buyers will be able to divide projects into smaller parts and to reduce their dependency on the vendors. Managing the project after the procurement is actually a relatively small part, if the two foundation parts are in order. End-user participation and proper monitoring and evaluation are essential during the entire project.

In the future, the emphasis should be on successful examples instead of constantly focusing on negative outcomes. The media should not indulge in exaggeration. Cooperation between the buyers and vendors, between different buying organizations, and within the buying organizations should be enhanced.

**KEYWORDS: Health care information systems, information systems, IT project management, public information system projects**

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**ABBREVIATIONS**

| | |
|---|---|
| **HCIS** | Health care information system |
| **HIS** | Hospital information system |
| **HIE** | Health information exchange |
| **EHR** | Electronic health record |
| **PCIS** | Patient care information system |
| **ERP** | Enterprise resource planning |
| **SDM** | Software development model |
| **TAM** | Technology acceptance model |
| **NAO** | National Audit Office |
| **MSAH** | Ministry of Social Affairs and Health |
| **NIHW** | National Institute for Health and Welfare |
| **HUS** | Hospital District of Helsinki and Uusimaa |
| **HUCH** | Helsinki University Central Hospital |
| **HS** | Helsingin Sanomat |
| **LL** | Lääkärilehti |
| **TS** | Talouselämä |
| **STM** | Sosiaali- ja terveysministeriö |
| **TEM** | Työ- ja elinkeinoministeriö |

# 1 INTRODUCTION

There are quite many infamous examples of Finnish IT project management from the recent years. Many public information system projects have failed to meet their objectives; the projects have exceeded in time and costs, the implementations have caused problems, and the results have remained limited. We have all seen the headlines screaming the expensiveness of Apotti, suffered from the failed implementation of VR's new ticket system in 2011, and read about the failed electronic voting. Actually, I myself voted twice in the 2008 municipal elections, since the system lost some of the votes on the first time.

Especially projects within the public healthcare have been unsuccessful. There are probably many, failed private IT projects as well, but they can be hidden from the public more easily. Instead, failures in public projects are fair game for the media: media is horrified of the big budgets and exceeded schedules. Same factors are constantly pointed out as reasons for the failures: poor management, buyers' lack of expertise, oligopoly of vendors, and so on.

I was interested in the topic even before I started at the University of Vaasa in 2012. I worked as project manager in several small information system projects and kept wondering, why the public sector wasn't able to succeed in one single project after so many failures. Nobody seemed to be able to learn from previous mistakes. Then again, I pondered whether the media was just overreacting and trying to find scandalous headlines. There are many similar failures in the construction industry, too, but they have not been discussed in the publicity in a similar way.

In this research, I study some of the major Finnish health care system projects, which have somehow failed to accomplish the goals that were set for them. I try to indicate how the outcomes differed from the original plans and to point out the possible reasons behind the distinction. Also, I try to find out what could be developed in the future, in order to get better results.

## 1.1 Generic background

The role of information technology is constantly growing, even for those companies – or for that matter, states – the core business of which is not related to IT. Benefiting from information technology requires big investments but can result in major savings,

too. Though, profiting from IT investments is not self-evidence, as has been seen in Finland. Carrying out information system projects has proven to be extremely difficult, for some reason. The amount of money does not alone determine the success of an IT project, rather than how the projects are managed. (Kouhi 2013: 7-9.)

Finland is often compared to Estonia, which is a success story and textbook example of how a state's information systems should be developed. Estonia has a consistent strategy, according to which it develops itself towards being an information society. At the same time with Estonian citizens using electronic ID for identifying themselves and performing all of their formal transactions online, Finland has failed in the electronic identification card, several citizen portals, such as Suomi.fi and Asiointitili, the electronic voting, license register of the Police, and so on. (e.g. Estonian Ministry of Economic Affairs and Communications 2006; LL 10.8.2012; TE 14.8.2012; HS 29.11.2013a-c.)

There are positive examples, too, but for some reason only the failures are emphasized in the public discussion. For instance, in the early 00's, the Ministry of Justice succeeded in renewing the entire election system of Finland quickly and economically, and the quality of the system was good. Even the Ministry of Social Affairs and health, a facet that has recently faced a lot of criticism, has succeeded in delivering an occupational health related system around year 2010. (Forselius 2013: 9.)

Media has played a big role in the discussion becoming so frantic. It is constantly comparing Finland to Estonia, even though many specialists say that it is not reasonable, due to the different backgrounds of the two countries (e.g. TE 22.5.2013; HS 24.9.2012; HS 10.9.2012; YLE 20.9.2012). It is interesting to compare the reportage of construction projects, since they have traditionally suffered from similar problems. For instance, the completing of Länsi-Metro has been delayed several times and will significantly exceed its original budget (HS 10.2.2014) but it has not raised a similar discussion.

So, why is it important to study this matter? At this point, the public discussion has become very one-sided and accusing. There is a lack of co-operation within the public buying organizations, and also between the buying organizations and vendors (e.g. TE 2.10.2011; HS 14.10.2012). As already mentioned, the role of information technology is constantly growing and Finland has to keep up with the pace. Even though Finland is

one of the leading IT countries in the world (YLE 20.9.2012), we have to resolve many issues related to the scatteredness and age of the systems (TE 9.10.2009; HS 24.9.2012).

In Australia, the state of Victoria – being of the same size as Finland – succeeded in halving its IT budget between 1996 and 2002 (Forselius 2013: 9). By developing the state's IT strategy and improving the knowledge in information systems project management, it is very much possible for Finland to achieve similar savings. We are on the right track: the current problems have been noticed and admitted, and there are projects that aim at developing the situation. For instance, the Ministry of Finance started a program for developing the evaluation of information system projects (Ministry of Finance 2010).

## 1.2 Aim and limitations of the study

The aim of the research is to find out the reasons behind the massive health care information system project failures that have occurred in Finland during the past years. The intention is clarify how it is possible that public IT projects keep being delayed by several years, exceed their costs multiple times, and result in systems that do not fulfill the need of the end users, and that cannot be developed further. The hypothesis is that there must be a lack of knowledge in one or several fields of project management. In the conclusions, I will hopefully be able to partly answer on how the failures could be prevented the next time. Before that, the study will be steered by the following questions:

- How did the researched health care information system projects not meet their objectives?
- What are the possible reasons behind the failures?

The empirical material was limited to only include health care information system projects due to the huge amount of information available on all sorts of failed information system projects. Still, due to the generalizing nature of the study, the results can be utilized for all public information system projects. The study does not aim at providing very specific solutions – it is not possible due to the empirical material – but at pointing out the most problematic factors and fields. Concentrating on and developing the skills within them is crucial for succeeding in similar projects in the future.

## 1.3 Research method and reliability

This research is a qualitative research, in which the method was to use public documents to collect the needed empirical material. The research was conducted by collecting a sample of news articles in three Finnish news media: Helsingin Sanomat, YLE, and Talouselämä. A couple of other articles were also used, since they were linked to the ones found on these pages. Different keywords, such as information system (tietojärjestelmä) and names of the different projects, were used to find the articles. Often, the articles were linked to several other articles on the same subject, which helped to find more information.

All in all, 94 news articles were used in the empirical part of this Thesis. The number of articles was limited to year 2013 and before, since it would have been difficult to write the Thesis simultaneously with the situation changing all the time. The changes were taken into account in the conclusions. Also, in case of ePrescription, there was a lot of regional news available on Yle.fi, so not all of it was used. For instance, there was a new article each time the system was implemented in a new municipality.

The articles were then divided by project and organized by publishing date. Articles that did not have to do with a certain project, but with the general situation, formed their own entity. Also, there were several articles that dealt with more than one of the projects. All articles were read through in order to form a big picture of the situation. Then, different methods were used to analyze the information; notes, mind maps, timelines.

There are many issues related to evaluating the reliability of a qualitative research, objectivity being one of the most important ones (Tuomi & Sarajärvi 2009: 134). In this particular research, major issues were related to the quality of the empirical material. Using only public documents for the empirical part would give very limited and shallow results. Therefore, the study was conducted so that the empirical material was dealt with before the theoretical part. The idea was to study the news articles to find the most obvious reasons for failure – after all, they have been quite thoroughly discussed in the media – and to then compare the findings with theory, in order to dig deeper into the problems and to maybe find new points of view.

Also, the size of the sample is always an important aspect when determining the reliability of a study (Tuomi & Sarajärvi 2009: 85). In this research, saturation was the

main criterion for determining the adequate sample size. Saturation refers to a situation where the material starts to repeat itself, in other words, adding more material will not result in any additional value (Tuomi & Sarajärvi 2009: 87). All three news media provided pretty much with the same information – and it also started to repeat itself at a very early stage – so including other sources of information or more articles from the existing ones was not considered essential.

In general, the Finnish news media can be considered reliable but reading such a big amount of articles related to one single topic revealed a surprising amount of preferences and carelessness. Objectivity of the researcher is one key component in research reliability (Tuomi & Sarajärvi 2009: 140) so it was important to examine both the sources and information critically. For instance, Helsingin Sanomat provided several opinion pieces from their editors, such as the article on Espoo doing the right decision when withdrawing from Apotti (HS 23.1.2013). Also, the projects and especially their budgets were often mixed with each other in the media, mainly in Talouselämä (TE 1.11.2009; TE 14.8.2012). The Ministry of Social Affairs and Health even organized a press conference concerning the mix-ups (HS 22.9.2012a).

This Thesis aims at finding new, objective points of view to a widely discussed subject that is not always examined in a very objective way. The goal is not to find a specific theoretical model for health care information systems project management – that is, in my opinion, impossible – but to dig deeper into the subject in order to find issues that should be more carefully considered in the future. The research method and its level of reliability support this aim.

## 1.4 Structure of the Thesis

The Thesis consists of four chapters: introduction, empirical data, theory, and conclusions. The introduction explains the main purposes and background of the study, and introduces the research questions. Research methods and evaluation of the reliability are also discussed in the introduction. The second chapter presents the empirical data, in other words the information collected and summarized from the news articles. Further hypothesis, based on which the theory was chosen, is also presented. After that, the theoretical part discusses some related literature, such as information system procurement, and special features that are related to health care information system projects. The last chapter summarizes the study, and makes conclusions and suggestions for the future.

## 1.5 Terms and abbreviations

The scientific articles that were used in the theoretical part of this Thesis all focused on slightly different sorts of health care information systems. Still, the main idea in all of the information systems – whether they are called hospital information systems, patient care information systems etc. – is that they provide patient data information cross-organizationally. So, health care information system (HCIS) is used as a superordinate term for all of the different systems. List of abbreviations is provided before.

# 2 EMPIRICAL DATA

The empirical part of the Thesis is divided into six parts. The first one describes the general situation in Finland, when it comes to public use of information systems and related projects. The second one focuses on health care information systems. The following three subchapters all deal with certain projects: Kanta, ePrescription, and Apotti. The last subchapter summarizes the empirical part.

## 2.1 Generic situation of public Finnish IT (project) management

Foundations for developing new information systems in Finland are not in order (HS 24.9.2012). According to one estimate, there are 7 000 different information systems in the Finnish public administration, and these systems work very poorly with each other (TE 9.10.2009). The government has stated that the situation already is a problem for productivity and hindering the development of new systems (HS 17.9.2013). Still, according to many international studies and national experts, Finland is one of the leading IT countries in the world (YLE 20.9.2012).

Public IT projects cost yearly hundreds of millions of euros (HS 26.3.2013). Finland uses the second most money on electronic public services in Europe, with respect to the GNP. Finland invests 3 percent of its GNP into these services. Estonia seems to get better results with less money. Jani Ekman from Cap Gemini Consulting says that Finland is a forerunner but its systems are old and not easily transformed into modern days. (HS 29.5.2013.) Often, there seems to be a will to build new systems instead of integrating the old ones (TE 9.10.2009).

In Finland, big public sector IT projects have failed and, almost without exception, resulted in chaos (TE 2.10.2011; HS 26.3.2013; TE 30.1.2013). Projects are poorly managed, inefficient and the same vendors are used time after time. They fail because of bad leadership and unprofessional vendors (HS 26.3.2013). There is simply not enough knowledge to manage the projects. In addition, the monitoring is insufficient and there are not enough resources for the project in general (HS 7.9.2013). Results have mostly remained regional. Poor coordinating has led to several small and overlapping projects (YLE 10.1.2012a).

Professor Matti Rossi from Aalto University says that one major problem in Finland is that all problems are tried to be solved at once. Projects are so slow that the world

changes during them (YLE 20.9.2012; TE 2.10.2011). According to the National Audit Office, the heart of the problem is, that "the state's IT operations are led by no one". A leading inspector at the office, Tomi Voutilainen, says that the state's IT units just "potter around" with things by themselves and keep overlapping each other's projects. They have new strategies before old projects have even been implemented, and it seems like they implement new projects just to cover up old mistakes. (TE 15.12.2008.) Mistakes should always be documented and learnt from in general, not just inside the organization. Failures are not discussed in public. It should not be a shame to abort an unsuccessful project. (HS 7.9.2013.)

In the public administration, IT operations are scattered between 50 different operators in different ministries, institutions, and departments. Therefore, the state is going to put up its own IT company to merge all the operations into one financial unit. Timo Valli, Director of Public Government IT, says that this will result in savings of at least 60 million euros pro year. The company will be in action in 2014. (HS 22.9.2012b; TE 7.11.2013.) Half of the state's ICT costs come from purchased services and a third from personnel costs. The new company will have 1 000 employees and an annual turnover of 300 million euros, which will make it one of the five biggest operators in Finland. The company will sell its services to the state without them having to be tendered. (HS 22.9.2012b.)

It is important to ask the end users, what services they would want to use and why. After all, what determines the success of an information system is whether people will start using it or not (TE 9.10.2009). According to a study, 41 percent of Finnish people do not use electronic public services – and this figure does not include people who do not use Internet at all. Biggest reason for not using the services is that some of them require traditional paper work in addition to the electronic service (HS 29.5.2013). In many municipalities, an electronic service still means that you can only print out a form online (HS 29.11.2013c).

### 2.1.1 Vendors and contracts

One factor that is pointed out as a big problem is the so-called vendor or contract trap. It is beneficial for vendors to try to tie the customer to the contract and to their services (HS 7.9.2013). Buyers know that the vendors will try to gain as much monetary benefits as they can, but they do not have enough know-how to stand up for themselves. On the

other hand, vendors are aware of buyers not having enough knowledge and are willing to take advantage of the situation (HS 14.10.12).

Even if the National Audit Office's reports show the mistakes clearly, the same vendors are used project after project (TE 2.10.2011). The bids are often organized so that only a few big vendors can take part in them. Then the chosen vendor can charge huge amounts for changes in the system, since the interfaces are not open for anyone else to develop. When outlining the contract, you always need to consider who owns the data and the coding, says PhD in Economics Maria Alaranta. (HS 7.9.2013.) Future needs have to be put into the contract in order to avoid costly changes afterwards. (HS 14.10.2012.)

New ways to execute projects need to be found in co-operation with the private sector. Communications between the vendor and the buyer is important. Splitting the projects and contracts into smaller parts may be one solution. Also, there is need for more skillful officials. (HS 17.9.2013.) Many facets keep highlighting the importance of open interfaces. They will help prevent unfair contracts and make it easier for smaller vendors to compete in the market (TE 9.10.2009; HS 7.9.2013).

### 2.1.2 Legislative issues

There has been a lot of discussion on different laws and regulations slowing down the development of public information systems and processes related to them. For instance, in 2008 the Ministry of Traffic and Communications started to plan a law concerning electronic identification. This law did not take into account that the systems in use for electronic identification are necessarily not the same in the future – we use mobile banking accounts now but it is possible that a better system emerges at some point. Also, laws, regulations and, thus, also finished IT systems are often blamed for only taking the public sector into account. (TE 15.12.2008; TE 9.10.2009.)

The Public Procurement Act was regulated in 2007 and it is claimed to be the reason for the vendors' dominant role in the market. The act determines how to buy things that are financed with tax money. Mostly, the procedure is open, which means that politicians and officials decide what they want, ask for bids and then accept the lowest offer. The procedure does not work when the purchased object is an information system. Few municipalities have enough knowledge to determine all needed features in advance. This results in poor contracts and costly changes. (HS 14.10.2012.)

Also, boundaries in authority between different public facets cause problems. Of course, since there are 7 000 different, poorly integrated information systems in the Finnish public administration, certain standards need to be placed (TE 15.12.2008; TE 9.10.2009). Voluntariness does not necessary work so the Data Administration Act allows state operators to be forced into using a certain system (HS 29.11.2013c).

## 2.2 Generic situation of health care systems

Even though Finland is among the leading countries in the world in IT, the situation in health care systems is not as good. Finland has not had a clear insight on where it is going and as a result, we have an expensive and scattered "system of systems" that is very inefficient. Even though renewing the systems is expensive, it is even more expensive to do nothing. (HS 24.1.2013; HS 26.8.2013.) Social and health care cover almost half of the expenses of municipalities (TE 9.10.2009).

Like all public IT projects, health care projects are criticized for being expensive, and delayed, and the results being limited (TE 4.2.2011; HS 15.5.2012). A report made by the National Audit Office shows, that the monitoring for developing information systems for public health care is not sufficient. Unsuitable systems can end up in use, because no one is monitoring the operations logic of the systems (TE 2.10.2011).

The Finnish Funding Agency for Innovation, Tekes, has issued grants for social and health care IT projects. There was a scandal, when the National Audit Office stated that these grants had not been monitored sufficiently. Some of the grants hade been directed to big IT vendors, which caused disruption in the market. (YLE 10.1.2012a; HS 26.3.2013; HS 7.9.2013; HS 29.11.2013c.) Also, HL7, which is an association created for developing health care IT system implementations, had prepared several projects among insiders, and without caring for the disqualification (HS 29.11.2013c).

First, the public administration finances the software development and then, after the software is finished, pays for it again. It is not acceptable use of public assets and can be considered abuse of dominant position in the market, says the leading inspector of NAO, Tomi Voutilainen. These vendors have blocked the market from new products and smaller vendors and slowed down the integration of the many different systems. (YLE 10.1.2012a.) NAO states that during years from 2000 to 2008, more than 10-15 million euros has been wasted. In addition, municipalities finance half of these projects on their own, so the actual sum is double. NAO found that the Ministry of Social Affairs and

Health and Tekes have even acted against the law. They were believed guilty of transgression in direct procurement and grant decision-making. The grants could be collected back. (YLE 10.1.2012b.)

Both the Ministry of Social Affairs and Health and Tekes claimed that the critic was unnecessary: there was no illegibility in their projects and they had already corrected many obscurities in their internal audits. MSAH also claimed, that they have gotten national results in their projects. Tekes admitted, that the results have remained regional. (YLE 10.1.2012a; HS 21.8.2013a.)

The National Bureau of Investigation even started an investigation concerning the actions of the Ministry of Social Affairs and Health. The ministry is supposed to ensure that the patient data systems bought by municipalities and health care districts work together, and was now suspected to have neglected the monitoring. (HS 21.8.2013a.) Later, the investigation was closed since the suspected crimes were either too old to be prosecuted anymore or very minor (HS 29.11.2013).

### 2.2.1 Situation in other countries

There has been a lot of discussion and debate on how different systems and processes work in Estonia. Estonia has never had its own big IT companies, so they have been free to choose their vendors (HS 24.9.2012). They have also started from a scratch without the burden of old systems (HS 29.5.2013). Estonians name the decision making process as one of their strengths. Necessary laws have been changed to support electronic services. 65 percent of the population use public e-services, and the identification for the services can be done even with a mobile phone. (LL 10.8.2012; TE 14.8.2012.)

In Estonia, vendors have not gotten such a dominant position as in Finland. Taavi Einaste, who is the eHealth-director of the system vendor Nortal, says that there are a lot fewer different health care systems in Estonia than what there are in Finland. The Finnish-Estonian company is interested in getting more assignments in Finland, and maybe even participating in the tendering of Apotti, the new patient data system for the Hospital District of Helsinki and Uusimaa (HUS). Nortal's predecessor CCC has previously developed patient care systems for University Central Hospitals in Finland. (LL 10.8.2012; TE 14.8.2012.) Estonia has a general strategy behind all of its public and private IT operations: the country aims at creating services that can be used as examples for the entire Europe (HS 17.9.2013).

Denmark is often considered a forerunner, too. The country has created a well-working portal for its citizens. The idea is to provide a platform where both public and private operators can offer their services all in one place. Canada has a similar project called Service Canada, which aims at collecting all the social and health services into one place. (TE 9.10.2009.) Denmark tried to build a similar patient data systems like the Finnish Apotti but the project was aborted after a failed pilot phase (HS 7.9.2013).

### 2.2.2 Current patient data systems

As much as half of the working time of health center physicians in Helsinki go to using different computer systems, and a lot of that time is wasted. When a physician logs in to the computer, he or she has to open four different systems. In case of being on-call in a hospital, the number increases by two. Then there is the new ePrescription system. Using the health care information systems is not easy, says Associate Chief Physician Timo Lukkarinen. (HS 16.7.2012a.) Poorly integrated systems are not that much of a risk to the patients, but a slow-down for the physicians' daily work (HS 16.7.2012b).

A study made by The Finnish Medical Association shows that physicians harshly criticize the current systems. The chairwoman of the association's eHealth team, Tiina Lääveri, reckons that one reason behind the criticism is the fact that programmers do not understand how the systems are going to be used in the future. On the other hand, it is hard for the end-users to explain that to the programmers. (HS 16.7.2012b.)

Logica's Pegasos-system has been criticized for being too stiff. The user interface cannot be modified and there has to be 3-4 other systems simultaneously open. The logic behind the system is not clear and often there are too many possible ways to proceed, says Chief Physician of Töölö Health Center Mikko Valkonen. Physicians also wish that the system would compile statistics automatically. The systems have not been able to keep up with the legislation and statistical requirements. Lääveri even thinks that systems could and should be intelligent enough to prevent human mistakes, such as prescribing drugs with hazardous synergistic effects, from happening, and to guide physicians in decision-making. (HS 16.7.2012a; HS 16.7.2012b.)

The development of the widely used patient data system began in the late 90's. In Helsinki, Pegasos was put to use in 2002, and later in many other municipalities, too. Logica claims that the system has been constantly developed further. Janne Romo, IT Manager at the Töölö Health Center, believes that the vendors have not been interested

in developing the systems, because market in Finland is so small and the are few vendors to choose from. (HS 16.7.2012a.)

Luckily, there are positive examples, too. In Central Finland, the work of emergency duty physicians became 10 percent more efficient when the 15 information systems that were used in the region were merged. Romo and Lukkarinen are positive about the new Apotti-system, which will replace the old systems used in Helsinki. Lukkarinen hopes for Apotti to include such information as the patient's dental and special health care history, and also social care history. The medical history of a patient in different organizations could then be combined with the permission of the patient. This would help especially when taking care of the elderly and comorbidity. (HS 16.7.2012a; HS 16.7.2012b.)

### 2.2.3 Other related systems

As said, there is a huge amount of different public information systems in Finland. The communications between these systems needs to be developed, so new solutions for data transfer need to be come up with. Another big issue is the identification. In order to use electronic systems, you need to be identified somehow. Developing health care systems requires development of other, related systems, too. (TE 15.12.2008; HS 14.10.2012.)

Electronic ID card is an electronic identification system that is maintained by the Population Register Centre. The card enables a secure online identification (TE 15.12.2008). An electronic ID card was developed in Finland already in 1999 – as the first country in the world – but the implementation failed, since different officials kept fighting with each other about the winning technology. The system cost 40 million euros and is used by practically no one (HS 14.10.2012). In Estonia, the electronic ID card has been the foundation for all information systems. The card became obligatory for each citizen in 2002 and now they can, among other things, vote, use Internet banking and sign loan papers online (HS 24.9.2012). The reader is a smaller device that costs around 10 euros (HS 29.11.2013).

Estonia will also help Finland to create a service, where citizens have access to all registers that contain information about them, such as population register and property register. Estonia already has such a service and will provide Finland with the open source code. The solution is called X-Road and it enables a secure and efficient transfer

of data between different organizations, both public and private. At the same time, citizens get a web portal, where they can access all their information at once. X-Road is a back office solution that will enable services that are more efficient and have a better quality. The system has already been tested in Espoo. (HS 17.9.2013; HS 29.11.2013c.)

All old and new services in Finland could be integrated with X-Road. Citizens could find and look at information in one place. It would also benefit officials, since they could search for information at its original source without having to save it to their own server. Jari Porrasmaa, specialist at Ministry of Social Affairs and Health, thinks that it is useless to start importing patient data to the X-Road, since the Kanta system has just been built, and Apotti will be integrated with Kanta. Still, he thinks that the X-Road could be used for appointment making, and maybe parents could see their children's electronic prescriptions, which is not possible in Kanta. (HS 29.11.2013c.)

## 2.3 Kanta

Kanta is an electronic repository for patient data: it is a central patient data archive for municipalities, private practices, and central hospitals. Patient data information will be transferred in a standardized form so that it can be searched and examined beyond organizational borders. Pharmacy systems and all the different patient data systems in Finland will be integrated with Kanta. (TE 1.11.2009; HS 22.9.2012a.) In the future, if a municipality wants to change patient data systems, it can store all information in Kanta, and then transfer and save it to the new system later on. An IT vendor does not have to be included in the process, so monetary savings will be achieved. The system uses an open interface. (HS 7.9.2013.)

The planning of a system like Kanta started already in the 90's. The original idea was to boost the efficiency of public health care by improving the communications between different operators, and to improve drug and patient safety. Physicians would be able to see all the drugs prescribed to a patient and be able to evaluate the synergistic effects of them. (YLE 8.10.2009; YLE 10.11.2009.) The actual Kanta project was started in 2003 (HS 14.10.2012).

The Kanta entity consists of four parts: eArchive, ePrescription, pharmacy database and the eHealth Portal, a web portal for citizens to access their personal health care information (TE 1.11.2009). The first part of Kanta to be developed is the ePrescription, and second is the eArchive (HS 29.5.2013). The eArchive is supposed to be

implemented in September 2014 and every health care operator – no matter public or private – should be in the system in autumn 2015. Sticking to the schedule is important also because people now have the legal right to choose where they are treated (HS 15.5.2012). The eHealth Portal will be launched at the same time with the first ePrescriptions. The identification will happen with the electronic ID card or with mobile banking login (YLE 10.11.2009).

The project will have an effect on both primary and special health care, pharmacies, health care organizations, several vendors, and all citizens (TE 1.11.2009). Since being able to see their own medical history in Kanta, patients are hoped to become more interested in their own health and to take more responsibility for it. Though, Maritta Korhonen, Development Manager at National Institute for Health and Welfare, fears that it may also increase patients' eagerness to make their own diagnosis. Therefore, the system will include links to reliable sources of information. (HS 29.5.2013.)

Kanta is also supposed to decrease drug misuse, since people are not able to get the same prescription from different physicians anymore. Also, it can be seen, which physicians describe noticeable amounts of certain drugs. (HS 29.5.2013.) Although patients are able to make limitations to who can to see their information – for instance, they can block occupational health care visits from the system – while testing the system in Eastern Savo and Northern Carelia, less than one percent of the 150 000 patients made such limitations. (HS 29.5.2013.)

Kanta is estimated to cost 400-500 million euros (TE 14.8.2012). When the system is put to use, license fees from the users are used to finance it (HS 10.8.2013). The organization responsible for the system is the Ministry of Social Issues and Health (HS 22.9.2012a). Other facets that participate in the development are Kela, the social security institution in Finland, and the National Institute for Health and Welfare (HS 10.8.2012).

### 2.3.1 Project progression and issues

Kanta project has had problems with financing, schedules, incoherent management, and lack of resources (HS 10.8.2013). There have been many technical problems and, once again, the many existing information systems have not interacted with each other (YLE 8.10.2009). The specifications of eArchive and ePrescription were made by different vendors (TE 2.10.2011). Many people say that, once again, the problem in the project

has been the pursuit of perfection. First, the idea was to develop the patient transactions on local, municipal level but the plans soon escalated to health districts, and then to the entire country. The project became way too ambitious. Implementing a national system requires hundreds of decisions within both the public and the private sector. (YLE 8.10.2009.)

The Act on the Electronic Processing of Client Data in Social and Health Care and the Act on Electronic Prescriptions became valid already in 2007. A transition time of several years – until spring 2011 – was given but the schedule had to be re-estimated since the Kanta project was well delayed. In September 2009, a new schedule was made. The plan was to put the system to use gradually. The Minister of Social Affairs and Health, Paula Risikko, said that the new plan would be to import the information into Kanta in smaller sections. The first phase would include basic information, such as the medical history of a patient, list of drugs, laboratory results and referral letters. The testing started first in the health center of Kuopio and the health district of Eastern Savo. (YLE 8.10.2009; TE 1.11.2009; YLE 10.11.2009.)

In 2011, the schedule was delayed again due synchronizing issues between different systems and processes (TE 2.10.2011). A new operative unit at the National Institute for Health and Welfare (NIHW) was founded and, at the same time, the schedule was intentionally postponed. Head of the new unit, Vesa Jormanainen, thought that after the new unit was founded, management of the project improved significantly. Five regional coordinators at the NIHW were pointed out to help health districts and municipalities with the project. (HS 10.8.2013.)

In September 2012, Kanta was thought to be ready in 2014 (HS 22.9.2012a). In August 2013, the aim was to have the system in full use by 2016. Annakaisa Iivari, Director at the Ministry of Social Affairs and Health, considered the schedule very challenging. The system developed by Kela and Fujitsu was already finished but it would have to be integrated with all different regional patient data systems. Oldest systems are from the 80’s. (HS 10.8.2013.) Public sector has seven different systems, which will all be integrated with Kanta. In addition, there are several different systems used by the private sector (HS 7.9.2013).

### 2.3.2 Costs

Once again, Finland has been compared to Estonia. In Estonia, the entire system – including the patient data system and Estonia's corresponding systems to Kanta and ePrescription – cost 10 million euros. Even though we have to keep in mind that they created the system from scratch and did not have to deal with dozens of existing systems that do not work together (HS 10.9.2012; TE 14.8.2012), some experts say that these are just excuses. (YLE 7.5.2013.)

In September 2012, Teemupekka Virtanen, a specialist at the Ministry of Social Affairs and Health, estimated that the project would manage to stay within its budget, which was 200 million euros. The National Audit Office calculated that the price would be twice as big. Leading inspector at the NAO, Tomi Voutilainen, stated that the sum of 200 million euros was not a valid estimate, since it only included costs until 2014, by which just some parts of the final amount of information would be in the system. He did not agree with MSAH thinking that the investment will repay itself by the end of 2017. According to NAO's opinion, there will be no significant savings and the systems will repay itself at some point in the 2020's. (HS 1.10.2012.)

Voutilainen says that their calculations are based on the entire costs, including implementation. Also, their price tag includes the costs of the private sector (HS 1.10.2012). Both facets have calculated that the costs for the public sector will be 200 million euros. The difference is due to the cost estimates for the private sector, which, according to MSAH are 20-30 million euros, while NAO presents a sum of 225 million. This is the price for private practices, organizations, and foundations. (HS 10.8.2013.)

Director of the Financial Administration Unit at the NAO, Vesa Jatkola, claims that their previous calculations have been very accurate. They believe that, due to the number of so many different patient data systems, the private sector will pay a lot more fore Kanta than what the public sector does, since the public sector only uses seven different patient data systems. MSAH's calculations are based on the simple fact that the private sector is one-fourth the size of the public sector. Most of the money will be used for training. (HS 10.8.2013.)

## 2.4 EPrescription

EPrescription is a system designed for writing and managing electronic drug prescriptions, and it is a part of the Kanta entity. A physician will write the prescription on the computer and transfer it to the Prescription Center, which is maintained by Kela. In the pharmacy, a pharmacist will then get the prescription from the Prescription Center and provide the patient with the prescribed drugs. (HS 9.9.2012.)

The system is supposed to improve patient security and give physicians the ability to better control the synergistic effects of the drugs prescribed to a patient, says project manager Johanna Andersson. This will help especially when taking care of the elderly. Patients can renew their prescriptions in any pharmacy, and the prescriptions are safe in the system and cannot be lost. (YLE 5.4.2011; HS 15.5.2012.) Adults can check their own prescriptions online. Patients can still get a paper version upon request but in 2014 that will no longer be possible, in case the amendment of Ministry of Social Affairs and Health gets passed (HS 10.9.2013; HS 21.10.2013).

A problem with the ePrescription project, too, has been the variety of different information systems that are in use in the country (YLE 5.4.2011). EPrescription has to be integrated with two pharmacy systems, seven different public sector patient data systems, and several corresponding private sector systems (TE 4.2.2011). The lack of a common system has slowed down the ePrescription project, says MSAH. (HS 10.9.2013.) Also, the system has been criticized, once again, for having been designed to be too comprehensive and, therefore, the result being very stiff (YLE 8.10.2009).

### 2.4.1 Project progression

The development of ePrescription started already in 1990 and for the last ten years, the project has been urgent. The leading inspector at the National Audit Office, Tomi Voutilainen, says that constant haste has been one reason for the delay. The preparations were not made properly and, thus, faults have been revealed. Fixing them has made the schedule even tighter. The project has not had a proper plan and even the legislation has lagged behind. (TE 4.2.2011.) One delay in the beginning was due to deciding on the electronic identification. In Finland, there has always been a doctor's signature on the prescription, whereas, in some EU countries doctors can make prescriptions by just sending an email (YLE 8.10.2009).

EPrescription was supposed to be tested with two different patient data systems, two pharmacy systems and the Prescription Centre. After that, the system would be implemented first within the public health care and then within the private sector in 2010 and 2011 (YLE 10.11.2009). The implementation was postponed due to technical reasons in autumn 2010. Originally, it was supposed to start in 2009 and by the end of 2010, half of all prescriptions were supposed to be electronic (TE 4.2.2011; YLE 4.5.2011).

A new schedule was made, according to which all pharmacies should have the ability to deal with ePrescriptions by April 2012. Public health care would have to write all prescriptions electronically as of April 2013, and private health care a year later. Permanent Secretary in Ministry of Social Affairs and Health, Kari Välimäki, estimated that the system would be implemented in major part of Finland during the year 2011. (TE 4.2.2011; HS 15.5.2012.)

Project progression: Milestones

The millionth ePrescription was written in April 2012. Though it sounds like a big number, the annual number of prescriptions written in Finland is 51 million. (HS 15.5.2012.) In May 2012, one third of the operators within the public health care had put ePrescriptions to use. Not one operator from the private sector had joined the project, even though more than one million Finns use occupational health care provided by the private sector. (HS 15.5.2012.) In October 2012, ePrescription was in use in half of the health centers and hospitals in Finland. The share would soon rise, since, at that point, the implementation in the Helsinki and the HUS region was taking place (HS 21.10.2012).

By April 2013, 1,5 million electronic prescriptions had been written. 70 percent of prescriptions written with a patient data system were electronic. Still, there were big regional differences in the use of ePrescription. In the metropolitan area, Central Finland and Northern Carelia region, the use was extensive, whereas especially within the health districts of Kanta-Häme, Vaasa, and Northern Ostrobothnia, there was significant variation within the district. Some explained that the differences were due to lack of resources – writing an electronic prescription is slower than writing a traditional paper version. Project Manager Riitta Konttinen from the National Institute for Health and Welfare commented that some health districts made the decision to put the system to use immediately everywhere, and some took a slower approach. Also, possible

changing of information systems may have slowed down the implementation. (YLE 2.4.2013.)

By the end of May 2013, 10 million electronic prescriptions had been written. Also, a light version of the systems was being designed. This version would enable prescription writing on a mobile phone or through a browser, and would therefore not link the use of ePrescription to a patient data system. Physicians could write electronic prescriptions anywhere. (HS 29.5.2013.) In October 2013, 80 000 - 100 000 ePrescriptions were written every day (TE 23.10.2013).

### 2.4.2 Costs

In 2011, the Ministry of Social Affairs and Health estimated the costs of ePrescription to be 70 million euros in years 2007-2015. The investment of pharmacies would be 21 million euros and municipalities would pay 5-10 million in implementation cost. Annual costs for these operators would be 0,5 and 2 million euros. (TE 4.2.2011.) In Estonia, a system similar to ePrescription cost less than a million euros and was put to use in less than a year, in 2010. Two years later 90 percent of all prescriptions were electronic (TE 14.8.2012).

### 2.4.3 Issues

Kotka was one of the first municipalities to implement the ePrescription in April 2011. The project was delayed both in Kotka and in another pilot city, Turku, because of compatibility issues with other systems. Jaakko Vuolasto from MediIT in Kotka says, that the legislators had unrealistic schedules. (YLE 5.4.2011.)

In September 2011, the writing of ePrescriptions had to be aborted in Päijät-Häme, Eastern Savo and Kotka. An error in the system was noticed in seven health centers in Lahti on September 22nd. Due to the error, there was a possibility of false drugs having been prescribed to patients: either ones that were not in use anymore or drugs that were meant for other patients. A leading physician at Päijät-Häme, Petteri Jyrkinen, was afraid that the problem would escalate, so they decided to communicate about the problem widely, in order to avoid patient damage. 140 000 electronic prescriptions had already been written before the error was noticed. (YLE 23.9.2011; YLE 24.9.2011; TE 26.9.2011.)

The use of ePrescriptions could be continued in Turku and Kemi-Tornio, since they used the other one of the two possible patient data systems, which, at that point, were used for writing ePrescriptions (YLE 23.9.2011). The problem applied only to Tieto's Effica patient data system (TE 26.9.2011). Even before this problem, the Logica's Pegasos had worked slightly better than Effica (YLE 14.5.2012).

Tieto Oyj immediately started an investigation on the error. Sinikka Rantala, the regional manager for the ePrescription project in Päijät-Häme, hoped that the reason behind the error would be found quickly. She was not aware of similar errors in other regions. Development Manager Anne Kallio from the Ministry of Social Affairs and Health thought that the error was very rare but would have to be investigated carefully before implementing the system in more regions. (YLE 23.9.2011.)

The Ministry of Social Affairs and Health had an emergency meeting with Tieto, Kela, and the health center that had first noticed the problem. Tieto had quickly located the error, which they described as "illogicalities in the system". Combining certain options while using the system caused problematic situations. (YLE 24.9.2011.) Tieto claimed that the error was not caused by an error in the programming, rather than physicians having difficulties using the new system. The logic behind the prescription writing process was improved (TE 26.9.2011).

The errors were fixed during the following weekend but the system remained banned for testing. During the weekend, pharmacies had to verify all electronic prescriptions by calling the physician and, after that, physicians started writing paper prescriptions again. Development Manager Anne Kallio stated that the ban would not be ceased before the testing had been done properly. Luckily, there were no knowable cases, in which the patient would have gotten wrong drugs. (YLE 24.9.2011; TE 26.9.2011.)

The ban was cancelled on October 5$^{th}$ and Kotka put the system to use two days later. Improvements made to the system would not allow the physicians to open several patients' information at the same time, in order to prevent mix-ups in the prescriptions. Also, physicians would receive more training on how to use the system. (YLE 6.10.2011.)

For Kotka, the project cost hundreds of thousands of euros. Being a pilot city did not entitle it to any reductions in the price of the final system. The Health Director of Kotka, Anne Hiiri, thought that it was a mistake to become a pilot city. The project cost almost

half a million euros, of which Kotka paid some 80 percent. Anyhow, patients were mostly satisfied with the new system. (YLE 28.9.2011.)

Later on, the implementation was easier, since most of the problems had been fixed earlier. In Espoo, for example, the implementation was executed in phases. The system was first piloted in one health center. Then, the system would be put to use in other health centers, hospital wards, and nursing homes. Dental care would be within the system a few months later. (HS 9.9.2012.)

After the system had been in use for a while, other major problems emerged. Pressing the tabulator would tenfold the dosing of drugs. Also, prescriptions simply disappeared from the system. In Forssa, the system was not put to use in special health care and even in primary health care the usage was limited. There were reported to be 150 programming errors and physicians found it very difficult to use the system. After having spotted the errors, they tried to contact the vendor in vain. Only after the matter became public, the officials reacted to the issue. (YLE 14.5.2011.) The National Institute for Health and Welfare forbid the use of the tabulator while writing the instructions for dosing the drug. (YLE 14.5.2012.)

In April 2013, another problem emerged. The number of characters in the text fields had been limited so that all necessary information could not fit into them. NIHW and Kela were investigating how the problem could be solved, since it had caused a lot of feedback. Riitta Konttinen from NIHW said that the problem would be expensive and slow to fix; it would take approximately 1,5 years. Konttinen did not think that the issue would cause any risk for patients. Pharmacists always go through the prescription with the patient for one more time, and there is also the possibility to still use paper prescriptions. Physicians participate in the designing process of such systems but it is the user experience that tells the final truth. The feedback would be paid attention to and the system would be developed further. (YLE 2.4.2013.)

There were regional problems, too. In Southern Carelia, the system got very slow and had to be fixed in May-June 2013. At its worst, technical problems caused hours of extra time to be wasted for the physicians. Otherwise, the situation in the Southern Carelia health district (EKSOTE) was good: 92 percent of the prescriptions written were electronic and the percentage was best in the entire country. According to Veli-Pekka Helvola, IT Manager at EKSOTE, the share of ePrescriptions has usually been lower in organizations, which also take care of special health care. In EKSOTE, good planning

and training were factors that led to the good share. EPrescription was put to use in EKSOTE in January 2011. (YLE 7.6.2013.)

EPrescriptions are very expensive to use for small private practices; especially for dentists, who only write two prescriptions pro week, on average. According to calculations made by the Finnish Dental Association, the investment costs can be up to 127 euros pro prescription. The use of ePrescriptions requires a patient data system that is compatible with Kanta, and, also the information security needs to be ensured (TE 23.10.2013.) Not everyone has the technical skills to purchase and maintain such systems, and to get Kela's approval for them. A psychiatrist even put up an address on behalf of keeping the paper prescription (HS 21.10.2013).

## 2.5 Apotti

Apotti is a new health care information system of the Hospital District of Helsinki and Uusimaa (HUS). The system is supposed to be both a patient data and an ERP system (YLE 8.5.2013; HS 26.8.2013) and it will affect the health care of over a million people (YLE 24.1.2013b). Apotti can be put to use in 2016, at the earliest (HS 13.11.2012), but the current schedule aims at 2017 (YLE 13.12.2012) or at 2018 (YLE 8.5.2013).

The purpose of the system is to replace several other systems that are now in use, so that physicians can find all relevant patient information in one place. An electronic patient data system improves patient service and safety, since the patient data, including allergies, medical history and medication, is available for all health care institutions (YLE 11.12.2012; HS 26.8.2013). The system should improve the communication between different units and save time for physicians, who now have to work with many different systems (HS 13.11.2012; YLE 21.1.2013; HS 3.2.2013). Professor and Chief Physician, Mauno Vanhala, even claims that poor patient data systems have caused a serious decrease in the number of patients taken care of each day (HS 19.9.2013).

The goal is to include many kind of information into Apotti. In addition to the system being a patient data and an ERP system, patients can save information about, for instance, their exercise habits into the system. The ERP features will, for instance, help optimize the placing of patient to different departments, and improve the utilization of different equipment. (YLE 8.5.2013.) In the end, Apotti is more than just a technological tool. The project aims at renewing and standardizing policies and processes in the whole country (HS 4.11.2013). The Head of Social and Health Services

in Espoo, Juha Metso, says that even good systems do not help if the processes are bad (YLE 24.1.2013b).

### 2.5.1 Project progression

Apotti started from HUS, Helsinki and Vantaa needing new patient data systems. Later on, Kerava, Kirkkonummi, Espoo and Kauniainen joined the project but both Espoo and Kerava decided to withdraw from the project at a later stage (HS 21.8.2013b). To begin with, Espoo was in a different situation than many of the other cities, since it has a newer patient data system that works fine. Also, a remarkable share of Espoo's inhabitants uses occupational health care instead of public (HS 24.1.2013).

Originally, the tendering for Apotti was supposed to start already in September 2012 but at that point, not one of the six municipalities had decided on the matter (YLE 12.9.2012). There has been delays in the decision making process. In September 2012, the Health Committee of Helsinki decided that they needed more time to consider the Apotti project before they would agree on Helsinki being a part of it, so they left the issue on the table for three weeks (HS 11.9.2012; YLE 12.9.2012).

In October 2012, the Departments of Social Services and Health Care in Helsinki decided to put the Apotti project on hold for more research. The committees insisted on the officials looking for possibilities to purchase the system in smaller parts. Also, they wanted a risk analysis for delays in different options. The chairman of the city board thought that the further investigations were a positive thing but he hoped that the issue could be dealt with again soon. The issue was processed further five weeks later with some additions; it should be made possible to add the social services to the same system later on. (HS 2.10.2012; HS 13.11.2012; YLE 13.12.2012.)

In January 2013, the city council of Espoo suggested, and the city board later on approved on, the city withdrawing from the Apotti project (YLE 21.1.2013; HS 21.8.2013b; TE 28.1.2013). Espoo thought that the project was too ambitious and had too big a goal. To renew all systems and processes at once would be a risky job, especially when the entire social and health care system in Finland is soon going to be reorganized. In addition, the city thought that the system fails to take the private sector into account, and it is not said that a system designed for special health care will be suitable for primary health care. (HS 23.1.2013; HS 24.1.2013; TE 30.1.2013; HS 26.8.2013.)

Espoo intends to develop its own customer data system so that the data will be available for different operators, not just those within health care. Espoo wants a more agile system that is free from committing to one vendor but develops its own system to be compatible with Apotti, Kanta and the Finnish X-Road. The city claims that the seven different counterparts in the Apotti project do not have a mutual strategy, a management system or models for service production. Also, the project includes huge operational and financial risks. (YLE 21.1.2013; HS 21.1.2013; HS 24.1.2013; HS 28.1.2013; YLE 28.1.2013.)

Espoo's decision was criticized for complicating the work at its Jorvi Hospital, which is part of the Helsinki University Central Hospital's (HUCH) emergency clinic group. Therefore, the residents of Espoo are now in an inferior position when it comes to communication and patient safety. The Head of Social and Health Services in Espoo, Juha Metso, admits that the situation is not ideal as it is. Espoo will develop its own system that is compatible with both Apotti and Kanta. (YLE 24.1.2013a; HS 24.1.2013.) Espoo did not find the project too expensive (HS 28.1.2013).

Juha Metso did not believe that Espoo backing out would affect the costs of the remaining counterparts, since HUS pays half of the costs in the preparation phase (YLE 24.1.2013b, YLE 28.2.2013). In the end, Espoo leaving increased the preparation phase costs for Helsinki for about 340 000 euros (HS 24.4.2013). The remaining municipalities would have to re-evaluate their participation. After the negotiations have been finished and the vendor has been chosen, each municipality will make their decision. It is possible to join the project at a later phase, within a few years time. These municipalities will pay their share of the preparation phase afterwards. (YLE 28.2.2013.)

Kauniainen decided to continue in the project in May 2013, since they did not think they would have enough resources and IT knowledge to cope on their own. Still, the situation may change if the new SOTE-reformation will force the city to join Espoo's social and health services (YLE 29.5.2013). Vantaa made the decision to continue with the project in June (HS 17.6.2013). Kerava, on the other hand, decided to draw out in August. The IT administration of Kerava recommended that the city would join the project in the second phase in 2020, together with Tuusula and Järvenpää. There were many reasons behind the decision. The city doubted the suitability and necessity of the system, and that it might be put to use unfinished. They feared that they wouldn't have gotten enough authority compared to the costs. Also, the Social and Health Director of Kerava

had resigned and the project would have had to be started with a substitute. (TE 20.8.2013; HS 21.8.2013b.)

Project progression: New leader

In February 2013 it was announced that the Apotti project would get a new leader, in order to strengthen the ICT know-how within the project. According to the job advertisement, the applicant was expected to have experience in successfully managing big IT and change projects. The previous leader, medical doctor Antti Iivanainen, would continue with developing operations. There was no mistrust of him. (YLE 13.2.2013; TE 5.3.2013; HS 21.5.2013.)

33 three applicants were interested in the position but most of them were consultants and IT managers, and very few of them had executive experience or knowledge on health care information systems. It seemed like those with most experience in these systems decided not to even apply for the position. It would be very difficult to choose the new leader for the project. (TE 27.3.2013.)

The Social and Health Department Development Manager of Kerava, Hannu Välimäki was chosen to be the new head of the Apotti project in May 2013. Previously, he had worked for Itella and Basware, gotten a lot of experience in both business administration and information systems, and – according to his own words – decades of experience in buying information systems. (HS 21.5.2013; HS 22.5.2013.) Välimäki's first statement was that it would be time to do one big IT project right – there would be enough money, manpower and experience to succeed. He thought that the project would finish on time and within the budget. Also, such a big project would attract many vendors, which increases the negotiation power of the buyer. Finding a solution and a vendor would not be a problem, and the contract should be signed by the end of year 2014. (TE 22.5.2013; HS 22.5.2013.)

Still, the schedule – according to which the building of the systems will happen during years 2015-2016 and the implementation in 2017 – is very tight. The decision-making process in the municipalities plays a big role and may cause surprises. Also, it is hard to tell an exact budget before the contract is signed. The public discussion on the project has been very negative, and Välimäki thinks that it is needless to compare the systems between Finland and Estonia. (TE 22.5.2013.)

### 2.5.2 Costs

Renewing the patient data systems in the whole of Finland is estimated to cost 1,8 billion euros (HS 8.7.2012; HS 10.9.2012). The price for HUS's Apotti is approximately 350-450 million euros during ten years. The costs consist of, among other things, licenses, training of personnel, converting the old patient data, and tailoring the system to suit the Finnish system and legislation. Training of personnel is considered to be a huge expenditure, since HUS is one of the biggest public sector employees in Finland. (HS 10.9.2012; YLE 19.11.2012.) HUS pays for half of the expenses and municipalities for the other half, according to their population. (HS 4.6.2013.) Since municipalities finance the operations of HUS, it means that also those municipalities, who do not participate in the project, will still have to pay for the system (HS 26.8.2013).

In September 2012, there was even a 400-person demonstration against the costs of Apotti. The demonstrators insisted on the politicians responsible for deciding about the project having reliable and neutral information on the situation. The demonstrators also demanded for a proper risk assessment and making it possible for small and medium sized companies to take part in the tendering, too. (HS 11.9.2012; YLE 13.12.2012.) Even after the demonstration, there was a lot of public discussion on the subject on Facebook (YLE 12.9.2012).

The Director of Social and Health Office in Vantaa, Ari Toiva, says that it is seldom when information systems raise this much interest. Anyhow, the discussion on the costs has not been quite right. Currently, Vantaa uses 5 million euros a year on patient data systems and after the implementation of Apotti, the sum will be 4 million euros. Of course, during the transition phase, the city will pay for both systems but, still, the repayment time is estimated to be no more than 7-8 years. (YLE 12.9.2012.)

Many other experts agree with Toiva, saying that the relevance of costs has been exaggerated in the discussion. They claim that even the renewing of the patient data systems in the whole of Finland would repay its costs of 1,8 billion euros in seven years. The ICT Director of the Public Administration, Timo Vallin, thinks that the sum is enormously big but that one system would benefit the country more than the current patchwork of systems. (YLE 14.9.2012.)

The director of the Apotti project, Antti Iivanainen, says that, currently, the annual sum used on patient data systems in the metropolitan area is 50 million euros, and the sum does not include system development costs. The costs of the new system will be about the same and the new system will enable better patient service. The current situation is not satisfactory. (YLE 14.9.2012.) Still, Iivanainen admits that the project is risky. The price of many similar systems has multiplied in the implementation phase (YLE 14.9.2012.)

Costs have been compared to Estonia all the time (YLE 14.9.2012; YLE 20.9.2012). The Estonian expert, who was one of the designers of their patient data system, Madis Tiik, and other experts say that the prices – 1,8 billion and 11 million euros – are not comparable, since the structure of both the health care systems and societies in the two countries are different. In Estonia, municipalities do not produce health services but the operators are all private facets, which get orders from insurance companies. In Finland, there are 350 different operators with different systems. Tiik thinks that the biggest costs in Finland will result from taking down old systems, building new ones and standardizing them. (YLE 17.9.2012; YLE 20.9.2012.)

### 2.5.3 Issues

The project has faced a lot of critic. It is considered too expensive and vulnerable (YLE 21.1.2013). IT expert and non-fiction author Tapio Järvenpää says that there are big risks concerning the project management methods, cost calculation, and the aggressive implementation schedule of Apotti. The system should be developed together with a network of vendors instead of HUS purchasing it from just vendor. There should also be strict national standards to mark out guidelines for such information systems. Furthermore, according to Järvenpää, Finland should have focused on purchasing a national system instead of letting health districts develop their own solutions. (YLE 7.5.2013.)

Järvenpää claims that by purchasing a system that has not previously been used, HUS is giving the vendor a monopoly status to develop it. He doubts, whether there will be enough knowledge to maintain the system. It is also a risk that if HUS purchases a mammoth system from one vendor, all the experts will be tied to maintaining that system and no other operator can purchase the same system later on. (YLE 7.5.2013.) Even internationally, it has been a trend to favor mammoth-like systems that promise to solve all problems as once. Such projects are hard to manage and often fail, as happened

in UK and Denmark. Risks increase, if the system is not build on current foundations and by scaling them. (TE 30.1.2013.)

Like Järvenpää, many other experts, too, doubt that the facets buying Apotti have enough knowledge to succeed in the gigantic project. They fear of vendor trap (TE 30.1.2013; YLE 8.5.2013). Software developer Otso Kivekäs says that not one of the 47 persons in the project team seem to have any education in information technology. It is understandable that doctors do not know how to purchase such software, thus, HUS should immediately strengthen its IT know-how (YLE 12.9.2012).

Kivekäs claims that HUS wants to buy of-the-shelf software since it does not have the knowledge to do anything else. American software does not necessarily work in Finland, even if some tailoring was made. Finland should learn from Denmark, where just the basic standards are defined on a national level, and each health districts can then have changes done in co-operation with any vendor they choose. If a vendor first sells software and then charges for any changes, updates and fixes, it is in their interest that the software does not work properly and requires lot of work afterwards, says Kivekäs. (YLE 12.9.2012.)

Patient data systems are very complicated and technically challenging. It is difficult to do the specification of features in advances, which often leads to vendor traps and costly changes afterwards. Important for the success of the project is that the development is divided into phases, and that the approach is modular, scalable and takes future changes in the environment into account. A kernel system like Apotti does not fill these criteria. Maria Alaranta, a PhD at the University of Copenhagen, wonders if Apotti is flexible enough for the future innovations that we will definitely need, when the population gets older. (TE 30.1.2013.)

The Director of the Apotti project, Antti Iivanainen, and the Technical Director, Jari Renko, say that some of the critic is based on false information. The Apotti project is often mixed with the Kanta entirety (STM 21.9.2012; HS 22.9.2012a.). The first phase is just to renew the system of HUS and some of its member municipalities. According to Iivanainen, the goal is to purchase a system that is scalable in the future. Apotti will be integrated with other systems, even such that are still under development, like Kanta and the Finnish X-Road. (YLE 8.5.2013.)

HUS will buy a big software entity, to which possible additional modules then can be joined (YLE 19.11.2012). The Chief Administrative Physician of HUS, Lasse Lehtonen claims that the project is too big for smaller vendors having enough resources to cope with, among others, the responsibility issues. Lehtonen wants to be sure that the systems works and, therefore, requires that there are user experiences on the system, in other words that it is an of-the-shelf software. (YLE 12.9.2012; HS 2.10.2012.) One alternative for tendering would be to build up an own system but it would be extremely difficult (YLE 14.9.2012).

Iivanainen claims that is better to purchase a big system, since the buyer is then more interesting for the vendors and will have better negotiation power. It will be made sure that the development will not rely on only one the vendor but, still, having just a technical framework, where different vendors would buy the needed modules, would require too much technological skills and time of the personnel (YLE 8.5.2013). Sitra recruited Madis Tiik, the Estonian expert, who was one of the designers of their patient data system, to Finland and says he is available for more research on the patient data systems. (YLE 17.9.2012; HS 17.9.2012.)

Also, in the Apotti project, procurement is conducted by direct purchasing, which is a better way than open procedure. The buyer can clarify its needs in comprehensive negotiations with one or several vendors before committing to the deal (Act on Public Procurement 30.3.2007/348). It reduces the risk to exceed the schedule or the budget. (HS 14.10.2012.)

Issues: Security

In several other systems, needs to fix the information security have been found at a later stage, which can be very costly. The costs can be 6-10 times bigger if changes are made afterwards. Information security should be tested thoroughly in the pilot phase so that possible needs for fixing can be done on the expense of the vendor. (YLE 19.11.2012.)

In the US, patient data of 21 million people has ended up in the wrong hands in just a couple of years, mostly because of employees handling the data carelessly. Companies in the information security industry have been interested in the Apotti-project. Information security should be taken into account already when outlining the contract, since patient data is very private information. The biggest concern is that the system will be too big to control. It is easier to monitor security in the interfaces of different

systems. ICT Development Director of HUS, Mikko Rotonen, says that the experts' viewpoints will be taken into account. (YLE 19.11.2012.)

There are other risks, too. For instance, in Northern Carelia a fault in the grid resulted in no one being able to use the patient data system. When a patient data system crashes, there is no information available on the patient (YLE 11.12.2012).

Issues: Vendors

Vendors have constantly been criticized for selling too expensive and unnecessary software with such contracts that tie the buyer to them so that they are able to change what ever they want to (HS 4.11.2013). The Sirius project caused a scandal in 2012. In 2010, the Finnish Innovation Fund, Sitra, started a project called Sirius that was supposed to help in the selection of a patient data system. Accenture delivered a report, which recommended two systems: Cerner and Epic, of which Epic got the best reviews. A year after two project ended, it turned out that Accenture had become the designer and implementer of Epic in Finland. Sitra was not aware of the connection. Accenture has not agreed to comment on the issue. (HS 8.7.2012; HS 10.9.2012; YLE 12.9.2012.)

Municipalities and health districts can decide for themselves, which patient data systems they will acquire. The Sirius project will provide information to help with the decision (HS 8.7.2012). Also, the success of the Apotti project may have an effect on what other municipalities and health districts decide, so it is possible that the entire sum of almost two billion euros goes to one vendor (HS 10.9.2012).

Accenture and Epic were one of the vendors or joint ventures of vendors who took part in the tendering and handed out their offer for the system by November 2013. The negotiations with three to six vendors should start in February 2014 and the final vendor will be chosen and the contract signed by spring 2015. The following vendors and joint ventures of vendors entered the competition (YLE 5.11.2013):
Atos IT Solutions and Services Oy
BearingPoint Finland Oy
CGI Suomi Oy
ChipSoft ZIS B.V.
CompuGroup Medical Sweden Ab
Epic and Accenture
IBM Finland Oy Ab

Indra Sistemas S.A. and Affecto Finland Oy
InterSystems Corporation
Tieto Healthcare & Welfare Oy

### 2.5.4 Patient data systems in other countries

As mentioned, the systems in Finland have often been compared to the ones in Estonia. In Estonia, the entire system – including the patient data system and Estonia's corresponding systems to Kanta and ePrescription – cost 10 million euros. More than 95 percent of physicians in Estonia use the electronic patient data system. (HS 10.9.2012.) In the Estonian patient data systems, the amount of buttons and steps has been reduced for better usability. Doctors can edit their view by choosing their most used features to the front page. In addition, new reports can be created without outside help. The system works as a cloud service. (LL 10.8.2012.)

Denmark has focused on data transfer. Their system simply transfers patient data between different organizations, which means that doctors could keep using their old systems and that the new solution required very little investments and had only minor risks. The operators put the system into use voluntarily. (TE 30.1.2013.) Now Denmark has a working system, where citizens can see their own diagnosis, make appointments and even send messages directly to their doctors. Doctors see the patient's entire medical history. (HS 3.2.2013.)

Representatives of many other countries visit Denmark to learn from their success. Another factor in their success is MedCom, which is an organization that is responsible for standardizing information between municipalities, IT vendors and the state. The Main Architect of the IT systems in the Århus Health District, Mogens Engsig-Krup, also points out that the systems got to develop slowly. A similar success story would not be possible anymore. (HS 3.2.2013.)

There are failures, too. In UK, developing the patient data system took 9 years and cost 3,15 billion euros. The project is about to be aborted. In Germany, 1,7 billion euros were wasted before they decided to abandon their project. In France, the system seems to be failing for a second time and the Netherlands gave up several years ago. (HS 3.2.2013.)

## 2.6 Summary

There is an overall lack of a coherent IT strategy in Finland. This can be seen in legislation, decision-making, and organizing of IT operations. The legislation is lagging behind and sometimes even hindering the development of the IT infrastructure in the country. The Act on Public Procurement does not support the procurement of information systems, and many other acts fail to take the private health care sector into account. The legislation should not be too strict but in a country with this many (7000) public information systems, common standards are needed.

The complexity and tardiness of public decision-making is not considered when making the IT project schedules. Another structural problem seems to be the organizing of the state's IT operations. The operations are scattered and lead by no one, which has lead to many small and overlapping projects. New strategies are made before old projects are finished, sometimes in order to cover up old mistakes. Now the state is putting up a new IT company to solve these problems. Overall, there should not be a shortage in resources – Finland uses the second most money on public electronic services in Europe.

Monitoring is clearly insufficient, since issues with some projects have even lead to official investigations. Neglecting of monitoring has lead to small and overlapping projects, and to poorly integrated systems. There are no common models to follow when executing public IT projects. Failing projects are not aborted in time. Better documentation could lead to learning over organizational borders and to public discussion about the mistakes.

Problems in health care information system projects seem to match the overall situation very well. One of the fundamental issues is that the foundations are not in order – there are simply too many different public information systems that are not integrated with each other. Some of the systems are very old and it is very difficult to integrate them with the new ones. There seems to be a lack of consistency: should the old systems be integrated or new ones be built, and should the systems be nation-wide or regional? National systems would reduce scatteredness but they may cause problems with vendors. Anyway, the lack of a common strategy causes the results to remain limited and only regional.

Vendor trap is an often-used word – and a very feared situation when it comes to information system projects. Vendors are accused of several transgressions and abuse of

dominant market positions. The market in Finland is very oligopolistic. Same big vendors are used again and again, despite the previous problems, because purchasing one system from one vendor is an easier solution than creating a framework for several different vendors and systems to fill in. Projects could be divided into smaller parts and more open interfaces used but buyers claim that big projects attract more vendors, which then gives the buyer better negotiation power. Skeptics are afraid of big projects and systems resulting in the vendor's monopoly to further develop the system. Also, in a small country like Finland, all available resources may end up being tied to maintaining the system of one single operator, so that no one else can purchase the same system in the future.

There is a lack of knowledge in how to co-operate with the vendors. The overall atmosphere seems to be very confronting: both facets keep blaming the other one. Programmers do not understand the end-users and physicians find it hard to communicate their wishes further in the development process. Final systems are said to be stiff and difficult to use. There are illogicalities, technical problems and programming errors. Faults have been very slow to fix, since vendors do not seem interested in fixing them and developing the systems further. Systems have problems with keeping up with the legislation, and they lack ability to compile statistics and artificial intelligence. There are too many systems to be used simultaneously and end-users do not receive a proper amount of training. Still, most of the problems are just slowing down the physicians' daily work and do not risk patient safety.

One distinctive cultural issue can be pointed out: there seems to be a will to try to solve all problems at once – a certain pursuit of perfection – which causes the plans to escalate. Projects are too ambitious and the aims too big, which makes them so slow that the world changes around them. Plans and specifications get old before the projects reach their goals. Often, it is difficult to do system specifications in advance so future needs are not taken into account in the contracts. For instance, many facets highlight the importance of being able to add social services to health care systems in the future.

There are several very basic project management issues that the news articles point out. The projects are expensive, delayed and inefficient. Still, these are just the outcomes and there must be some reasons behind these problems. Overall, the preparations are bad. Management is said to be poor and incoherent, there are not enough resources and knowledge and the schedules are too tight and even aggressive. This results in bad

quality. Also, budgeting seems to be a problem: cost calculation fails and the estimates of different facets vary significantly.

Commitment has been a problem especially in the Apotti-project. Missing of a clear authority leads to doubts. Espoo claimed that there is a lack of a mutual strategy and a management system, and mutual models for service production in the project. After all, it is just not about a information system but about integrating a big amount of various processes, too. They consider the project too risky and want to develop a more agile system that is not tied to one vendor. Kerava doubted the suitability and necessity of the whole system. The upcoming SOTE-reformation causes confusion everywhere.

Commitment goes hand in hand with the public image of the projects – especially since politics is involved. Politicians have to keep their voters in mind and if the overall public attitude is negative, they will probably reconsider their own opinions. Poor commitment will then further contribute to the negative public image. Public discussion of the projects is often based on false facts and irrelevant comparisons. More reliable and neutral information should be available both for the experts and the public.

Finland is often compared to Estonia, which seems to have nothing but successful and cheap public information systems. The difference is that Estonia got to start from scratch without the burden of old systems, and vendors have not gotten such a dominant market position. Also, the health care systems of the two countries are totally different. But above all, Estonia seems to have a common IT strategy, which is supported by their efficient decision-making and legislation. They use the electronic identification as a basis for all their systems.

Denmark is another country that is often referred to when talking about successful public IT projects. Their solution is to have certain standards on national level but to then let the regional operators decide on the rest. Also, they have aborted unsuccessful projects. The news articles present these two countries as pure success but we have to keep in mind that they may want to maintain and boost such an image, since they are involved in introducing and selling their systems and knowledge to other countries.

There are positive things are examples, too. In Central Finland, 15 information systems that were used in the region were successfully merged. In the Southern Carelia health district (EKSOTE), the use of ePrescription has been extensive due to good planning and training. Espoo succeeded in the gradual implementation of the same system. Some

districts have measured the patient satisfaction with the system and the results have been good.

Hannu Välimäki, the new leader of the Apotti project, thinks that there is enough money, manpower and experience to succeed in the project. A new lighter and end-user friendlier version of Apotti is being designed: this version will enable physicians to write electronic prescriptions anywhere without a patient data system.

Further hypothesis

A clear and coherent IT strategy plays an important role both on national, project and municipal level.

- Part of the success of Estonia is due to its good IT strategy. Both decision-making, legislation and the overall culture support the development of a good IT insrastructure. On a project level, lack of a clear strategy may cause confusion and uncommitment. In municipalities, a good strategy can help to improve system implementations, and to clarify and speed up the decision-making.

Better models for monitoring and evaluation of projects are needed

- Insufficient monitoring leads to small and overlapping projects, which means wasted resources and limited results. When executing public IT projects, the following of common models could give better results. Better documentation could lead to public discussion about the mistakes and to learning over organizational borders. Regional differences could be used for benchmarking.

Better models for procurement are needed

- The Act on Public Procurement does not serve procurement of information systems. There should be better instructions and more infromation available on what to take into account and how to prevent the most common mistakes from happening. By developing the procurement, buyers will be able to use more vendors, which will reduce the current problem of only a few usable vendors.

The current software development method/s are not the best option

- Another software development method could be the solution to many current problems: end-users feel that they are not participated in the development process, they find the systems poor and the further development of them

insufficient. Also, the original developing is so slow that the final systems are out-dated.

End-user participation in both designing and implementing an information system pretty much determines the success of the project

- What determines the success of an information system is whether it will be used or not. Involving end-users in the development of the system, and providing them with proper training in the implementation phase will increase their commitment and result in better usage of the system.

# 3 THEORY

The theoretical part of this Master's Thesis consists of four different parts. The first subchapter shortly presents the prevailing situation that affects the success of the health care information systems: the health care system in Finland, the decision-making process, the Act on Public Procurement, and the vendor market structure. The meaning and importance of IT strategy is presented shortly in the second subchapter.

The third subchapter introduces project procurement according to Pekka Forselius' book on successful information system procurement. It is considered de facto standard in Finland and covers procurement preparation, choosing the vendor and solution, monitoring, and finishing of the project. A Finnish book is used, since law and established policies are factors that highly affect and contribute to the success of procurement.

In order to get the end-users to use the system, we need to understand the factors that contribute to their acceptance of the systems. The fourth subchapter discusses what the end-users' hopes for health care information systems (HCIS) are in the light of recent studies, and which software development method (SDM) would be best in order to fulfill the wishes. According to the news articles, there are significant problems in the design and development processes of HCIS. The chapter also presents implementation and evaluation related issues.

## 3.1 Structural and legislative basis

The success of different countries' HCIS projects is not directly comparable. All countries have different political and health care systems that affect the planning and execution of such projects. The European Union enjoins public tendering but on the contrary to public belief, according to the Finnish MEP Sirpa Pietikäinen, EU does not force or encourage to do purchasing based solely on the price (YLE 4.2.2013).

### 3.1.1 Health care system in Finland

The basis of the Finnish health care system in Finland is the municipal social and health care that is sponsored by the government In addition, the private sector produces health services. The Ministry of Social affairs and Health is responsible for controlling and developing the social and health care system. (STM 2013a: 10.)

Municipalities are responsible for organizing health care services for their inhabitants. They can either produce the services for themselves or together with joint municipal authorities, or purchase the services from private sector operators, other municipalities or third sector organizations. The services are principally funded with municipal tax income but the government sponsors the services with certain subsidies that are similar to equalization payments. Municipalities form health districts that are responsible for providing special health care services in the region. There are 20 health districts in continental Finland. Åland has its own system. Each health district is a part of one of the five university central hospital districts. (STM 2013a: 11-12.)

Private health care sector supplements the public one by selling their services for municipalities, joint municipal authorities or directly to end-customers. Private sector produces circa one fourth of all health care services in Finland. A major share of these services is due to the Finnish occupational health care system. Each employer is responsible for providing its employees with occupational health care services, which can be bought from either public or private sector. In 2010, the entire health care expenses were 16,0 billion euros, which is 8,9 percent of the GNP. Both figures are close to the OECD-average. (STM 2013a: 12, 14; TTL 2014.)

The upcoming SOTE-reformation aims at combining social and health services, and primary and special health care in order to reduce overlapping services and shortfalls in them, and to optimizing resources. Responsibility of producing the services will be on a more solid basis. The idea is to divide the country into SOTE-districts, which are formed around province capitals of Finland. These joint municipal authorities are responsible for organizing all services in their district. Municipals with over 20 000 inhabitants can choose to form their own primary districts and be responsible for their own primary health care services. (STM 2013b; STM 2014.) The reformation has faced a lot of criticism. It is now in the point where the government will appoint a team to consider the financing of the social and health services (HS 2014).

### 3.1.2 Municipal decision-making

Finnish municipalities are self-ruled. The municipal council has the highest authority. It is elected in the municipal election every fourth year. The council appoints members of the municipal board, which is responsible for preparing and executing the council's decisions. The council also appoints different committees that direct the producing of

public services. Committees vary according to the municipality but most common are education, social and health, and town planning committees. (Suomi.fi 2012.)

The decision-making process is often following: the municipal board appoints committees to make different research and reports, which the board then has to approve of, before the issue at hand moves forward for the municipal council to decide on. In some cities, even the committees can decide whether to move on with a proposal. (Helsingin kaupunki 2013; Kunnat.net 2014.)

### 3.1.3 Act on Public Procurement

The Act on Public Procurement enjoins that governmental and municipal officials have to tender their procurements according to it. The purpose of the act is to optimize the use of public assets, to promote quality issues in purchasing, and to ensure equal opportunities for all companies and organizations to take part in the tendering. In goods and service procurement, the act only applies to purchases worth of more than 30 000 euros. The threshold enjoined by the European Union is 137 000 euros. (Act on Public Procurement 30.3.2007/348.)

The act says that buying facets have to organize their operations in the best possible way to ensure their economic efficiency. There are several different alternatives for tendering methods. Primarily, the tendering should be conducted with either the open or restricted method. In the open method, the buyer publishes a public notification, and all willing vendors can quote. In the restricted method, vendors reply to the notification and the buyer can choose, which vendors are allowed to quote. In many other methods, the process is based on a more negotiating policy. (Act on Public Procurement 30.3.2007/348.)

The act is going to be renewed by 2016 in order to increase the possibilities for direct procurement. Also, the current act does not fill the EU criteria. The renewal aims at several improvements compared to the current act: simplification of the process, better recornition of quality factors, increasing of thersholds, and better possibilities for the small and medium-sized companies to participate in tenderings. (TEM 2013.)

## 3.2 IT strategy

The biggest benefits from information technology are gained when IT operations are well lead and in align with the company's overall strategy (Kouhi 2013: 15). IT strategy should and cannot be considered a separate topic – neither the strategy itself nor the execution of it. IT strategy should be linked to the business strategy of a company but, in addition, it is linked to the operative organizing of the IT. (Räty 2006: 6.)

Turban & Volonino (2010: 488) present a model where the business strategy, IS strategy and IT strategy are all separate from each other but are aligned and have interdependencies. Business strategy determines the direction of the business, IS strategy what is required for the business strategy to be implemented, and the IT strategy how it can be delivered. Even the Finnish Kouhi (2013: 34-35) divides the management of IT into strategic, tactical and operational.

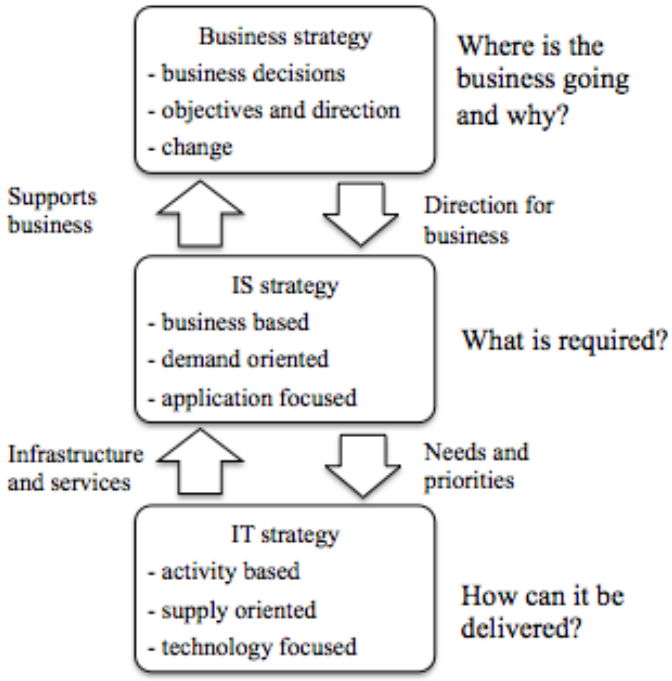


**Figure 1**. The relationship among business, IS, and IT-strategies according to Ward and Peppard 2002 (Turban & Volonino 2010: 488)

The strategic alignment model by Henderson & Venkatraman (1993) is a widely used model for presenting the division and interdependencies of strategic and operational areas. Horizontally, the model is divided into business and information technology functions. Vertically, there are internal and external areas. External IT areas refers to the

IT strategy and internal to information systems infrastructure and processes. (Räty 2006: 6, 13.)

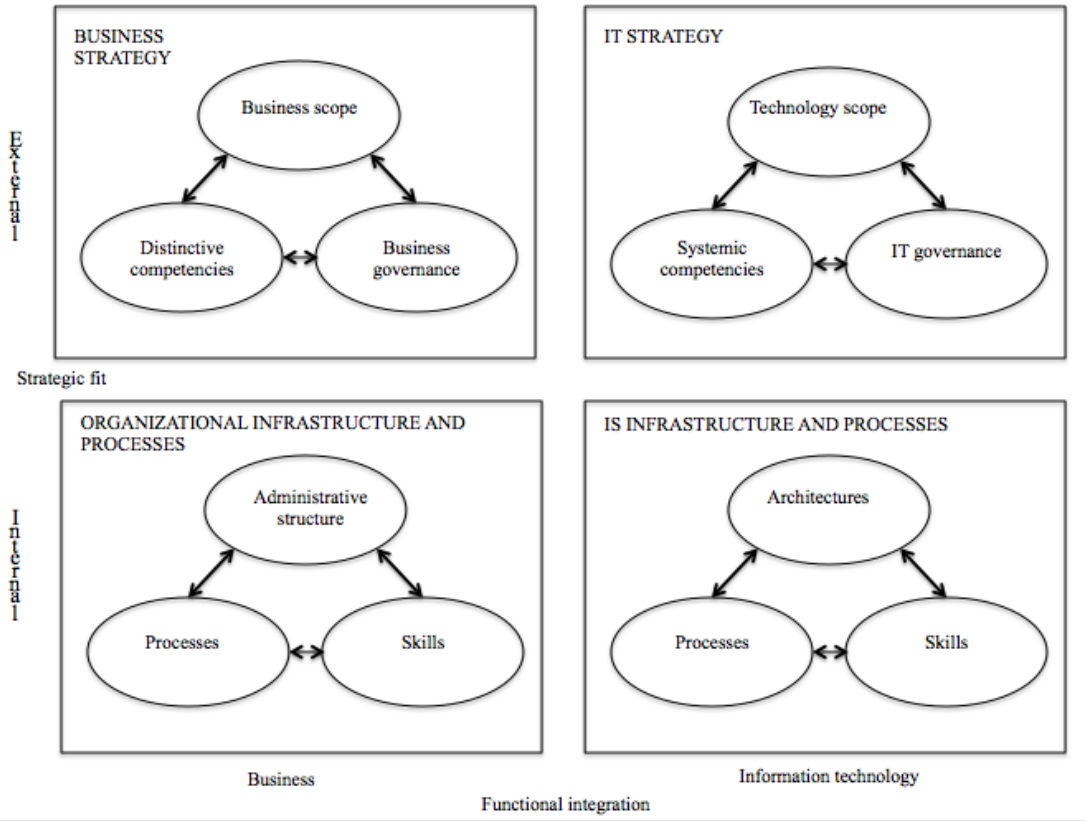


**Figure 2**. The strategic alignment model by Henderson & Venkatraman 1993 (Räty 2006: 13)

IT operations should be lead similarly to all other departments. All big decisions, such as investments in new facilities and entering a new market, are done in cooperation with the company management and the unit management. IT decisions should follow the same pattern. There is a Finnish study on how well the company management knows what happens in the IT operations – only 11% of the managers claim that they do know and an alarming one fifth of the respondents admit that they have no idea what IT operations are doing. (Kouhi 2013: 15, 17.)

The IT strategy of Estonia

In year 2006, Estonia created the "Information Society Strategy 2013." It was created since the country had reached a level, where the projects, services, and technologies were all interdependent on each other. There was a need for a long-term general plan.

The strategy is a framework that sets the objectives for the future. Common and coordinated goals and processes are needed to increase the efficiency of ICT in the country. (Estonian Ministry of Economic Affairs and Communications 2006.)

The strategy is coordinated by the Ministry of Economic Affairs and is in line EU-level plans. Development of the strategy is based on the Principles of Estonian Information Policy that was adopted already in 1998. Its follower for years 2004-2006 was approved in 2004, and the Information Society Strategy 2013 came into force in 2007. (Estonian Ministry of Economic Affairs and Communications 2006.)

## 3.3 Information systems procurement

Procuring information systems is a challenging task, due to the complex nature of the process. There are technical, juridical, organizational, and psychological factors that affect it. Experience plays a big role but many organizations face a situation where they start a new information system project without previously acquired knowledge. Forselius (2013: 14, 17) divides the procurement of information systems into four parts that are procurement preparation, choosing the system and the vendor, monitoring the procurement, and finishing it.

Martikainen et al (2012: 108) suggests that procurement processes should be more transparent and involve end-users. Forselius (2013: 68-69), too, highlights the importance of users being involved in the process. They should be involved in determining both the system and quality specifications. Also, careful documentation of the entire process is essential for the success of the project.

There are special challenges in public procurement. There are many regulations that steer the public procurement and do not necessarily guarantee the most economical result. Biggest problems are caused by thresholds and appeal periods. Thresholds cause artificial adapting in sizing of the projects – for instance, a big project may be divided into smaller ones in order to avoid exceeding the threshold. Or vise versa, if one project transgresses the threshold, all kinds of matters is included in the project in order to avoid new tendering. Appeal periods may significantly delay public projects. (Forselius 2013:19-21.)

Information technology is such a major part of business these days that it is recommendable that IT management takes part in strategy making and, on the other

hand, that general management participates in creating the IT strategy. Often, developing the business strategy starts a separate IT strategy process giving it its goals and restraints. A part of the IT strategy is the software strategy that determines what sort of software is procured. There are differences in the procurement process and the outcome, depending on the following type of software. (Forselius 2013: 22, 56-57.)

*Off-the shelf software*
Off-the-shelf software procurement focuses on mapping out the supply on the market, comparing the products, and then choosing and implementing one system. Off-the-shelf software is often relatively inexpensive and quick to implement but requires changes in processes.
*Custom software*
When software is tailor-made, the focus is on buying a service and finding the best vendor. This type of software requires significantly more resources for requirements determination, as well as testing and implementation. If the complex project is managed well, custom software has often better usability and possibilities for further development.
*Integrated off- the shelf software*
Much off-the-shelf software needs tailoring. The software may be integrated to existing systems, supplemented with more functions or old information be converted to it. This way the software will be better suitable for the buying organization. Still, the integration may reduce the cost and time benefits that are usually related to off-the-shelf software.

### 3.3.1 Procurement preparation

Information system procurement should not be started without a clear need that stems for the business. The preparations phase of the procurement correlates strongly with the success of the entire project. The bigger the procurement is, the more carefully it should be planned. A good procurement plan should always produce the following documents: system requirements, IT architecture requirements, sizing calculations, and requirements for delivery. (Forselius 2013: 25-26.)

A new procurement should always have the support of the management. Without clear support, determined steering, and visible monitoring by the management, the benefits of the new system often remain only partial. There has to be a clear owner of the project for it to succeed. The visibility and presence of the owner motivate the facets and persons participating in the project. The owner has to have enough power to make

necessary decisions and to, in case needed, take responsibility for failures. (Forselius 2013: 27-28.)

Specifications

The process of determining system requirements is often the most time-consuming and laborious part of the preparation phase. Carefully planned requirements have a clear positive impact on the success of the project. They aim at creating an understanding of the quality of the new system between the buyer and the vendor. They are also used for planning the project budget, schedule, and resources, controlling changes and monitoring, and testing and approving the final information system. In case there is a lack of knowledge in this area in the organization, external help should definitely be obtained somewhere else than from the vendor. (Forselius 2013: 29-30.)

The process of determining system requirements includes following phases that should all be carefully executed and documented (Forselius 2013: 30-41):

- Common level description of the information system
- User descriptions
- User stories
- Explaining the terminology
- The Entity Relationship Model
- Business-oriented process descriptions
- Situations of use
- System functions

Later on, more specific requirements, technical planning and testing are performed. User stories, process descriptions and situations of use are excellent material to help with the testing.

The appropriate level of system requirements is related to pricing. If the intention is to purchase a fixed-price system, the requirements have to be perfect. In case the budget is not fixed, the pricing can be time-based and requirements completed at a later phase. If the budget if limited but flexible, a certain rate can be used that enables one situation of use being determined and carried out at a time. (Forselius 2013: 40.)

Another thing related to the system requirements are quality requirements. Quality requirements should always be connected to systems requirements so that they are both valid and can be verified. Quality issues should always be considered even if specific

system quality requirements increase the price of the project. There are many models and standards, such as ISO, for instance, to help with setting the quality requirements. (Forselius 2013: 44-45.)

Project sizing & budgeting

Each information system purchase is an investment. The more complex the project is, the more difficult it is to calculate the costs and benefits (Forselius 2013: 19). It is not reasonable to determine the size of a project just in euros or man-years. Price and results do not necessarily correlate with each other, and information system delivery is a branch within which it is particularly important to focus on the results. (Forselius 2013: 50-51.)

The Finnish Software Measurement Association has created a model for evaluating the workload of software projects. It consists of four different aspects that are the functional comprehension of the software, two project-specific factors (circumstances and reuse), and the level of return on similar projects. There are also expenses that are not directly related to the system, such as training of users. A business case should always include investment expenses, future operating costs, and estimated revenues. (Forselius 2013: 51-51, 54.)

### 3.3.2 Selection of vendor and solution

If the preparation phase is conducted properly, about half of the work should be done when moving to the selection of vendor and solution. The project should be approximately halfway time-wise, too. Few people believe that it is actually quite simple to develop an information system, if the requirements are well examined and documented. Forselius (2013: 71) gives examples on several successful public projects, in which the preparation phase has lasted about as long as the operational phase – in one project it lasted twice as long.

The purpose of this part of the procurement process is to find a vendor who can execute the plans in the best and most efficient way possible. The selection phase consists of following actions (2013: 71):

- Starting the selection process
- Drawing up an invitation to tender
- Drawing up an offer (vendor candidates)
- Comparing offers and drawing up a proposal for decision

- Making the decision for procurement
- Making a contract with the selected vendor
- Projecting the procurement

Drawing up an invitation to tender should not be difficult if the procurement plan is properly made. Specific enough system description and requirements should be found in the plan, and they can be attached to the invitation. The invitation itself should be very concise and short but it can have even hundreds of pages of attachments (Forselius 2013: 75.)

The number of offers can often be reduced by adding different requirements for the vendor into the invitation. The problem in Finland is that the requirements are often too specific, leaving many potential vendors outside the competition. Unreasonable claims may speed up the process but result in the best solution remaining out of sight. (Forselius 2013: 83.)

Terms of agreement

In addition to the general terms of terms of agreement, such as terms of payment and warranty, it is important to agree on the vendor committing to the future development of the system and on the ownership of the source code. It is possible to use an escrow-paragraph, which enjoins the source code to be deposited by a third party. Other terms should include conditions for i.a. acceptance and maintaining of the system, copyright and ownership issues, and solving controversies (Forselius 2013: 79).

Pricing of the project is one of the most challenging things when making a contract. The price should always be agreed on already in the beginning of the project. Especially the content of maintenance costs is often unclear for the buyer, and the vendor may try to take advantage of it by adding all sorts of modification work into the fee. The contract should only cover costs for actual maintenance, and additional work is charged separately. (Forselius 2013: 79.)

According to the public opinion, contract pricing is riskier for the vendor and hourly pricing riskier for the buyer. Contract pricing requires better specification of system requirements. In case the specifications are inadequate, the vendor will have to charge more to be on the safe side. If the requirements are completely incomplete, the only

option is to use hourly pricing. It is often said that if you pay for hours, you will get hours. (Forselius 2013: 50, 80.)

Forselius (2013: 80-81) presents one model that is used in Finland. Such hybrid models aim at allocating both the risks and benefits. The estimated work load is priced according to contract pricing, and the exceeding work load will be priced according to a significantly reduced hourly rate. The hourly rate can even be reduced further step by step. There may also be a limit for the maximum chargeable amount. This model can also be applied so that the savings for falling below the work load will be divided between the buyer's and vendor's project teams.

Evaluation criteria and comparison of the contracts

The evaluation and comparison process has four phases: pre qualification, scoring, filling out the evaluation chart, and comparison of the best alternatives. Comparing offers aims at finding the overall best solution and vendor. The evaluation criteria should always be carefully considered and decided on beforehand. Presenting the criteria is obligatory in public sector's invitations to tender, unless the decision is based on the price only. (Forselius 2013: 82, 88.)

The evaluation criteria can be divided into two: unconditional and conditional requirements. Not fulfilling the first one will lead into immediate rejection of the vendor at hand. The evaluation can be targeted at evaluating i.a. the vendor's organization, its solutions and services, project organization, price of the system, terms of agreement, availability of maintenance, and warranty. The most used criteria are solutions and services, price, and schedule for delivery. Evaluating the vendor's organization is extremely important, since the knowledge of the personnel is one major factor that determines the success of the project. (Forselius 2013: 83, 90-91.)

When comparing the costs, it is important to examine them for the entire product life cycle, including maintenance and further development. It may be useful to look at the ratios of the workload, such as the amount of testing compared to the entire workload. This will help when evaluating the overall efficiency of the project. (Forselius 2013: 89.)

There are many problems that may arise when comparing the offers. First of all, some vendor may offer a solution that is based on an entirely new idea. Within the public

sector, if this idea is worth to be implemented but does not fill the original criteria, the procurement process will have to be started all over again. Sometimes the criteria are not set early enough or are not sufficient or relevant. Weighing the criteria is also very challenging. (Forselius 2013: 88, 95-96.)

Even though the criteria would be sufficient, sometimes the offers are still not comparable. They may lack information or be contradictory. It may even be a tactic for vendors to try and hide their weaknesses. They may also try to hide different expenditures in order to make the offer look more economical. (Forselius 2013: 96.)

After selecting the finalists, the next step is personal meetings, which are often necessary in order to evaluate the vendor's professionalism, experience and ability to co-operate. Checking references is probably the most important way of revising a vendor's ability to deliver a certain solution. Reference clients often answer questions very honestly, especially if the vendor's representatives are not present. Another good practice is to meet the future project manager. Instructions for use often reveal a lot from the vendor. Test use is the most thorough way to familiarize with the system but it is also laborious and expensive. (Forselius 2013: 92.)

Negotiations & proposal for procurement

After selecting the final vendor, the negotiations will be continued to reach an agreement of all system specifications and terms of agreement. The recent trend is that information system projects are getting bigger and bigger, so it is naive to expect that vendors would not try to take advantage of the situation. The buyer should always get suspicious is the vendor does one of the following (Forselius 2013: 92):

- It appears that the price in does not include all costs.
- The vendor pressures to make the decision by a certain deadline.
- The vendor presents two bad solutions. The intention is to make one look so bad the other one seems reasonably good.
- The vendor claims its leeway in pricing to be smaller that it actually is.

All participants will be informed about the final decision and the reasoning behind it. Within the public sector, the decisions are public. The execution of the project can start after 21 days of the announcement, at the earliest. Before that there is an appeal period, during which the decision can be challenged. (Forselius 2013: 98.)

### 3.3.3 Procurement monitoring & finishing of the project

Even if the project got to start as planned, there are still pitfalls ahead. Proper monitoring is definitely needed for an information systems project to succeed. It is a lot easier to react to a problem immediately when it appears, instead of waiting for it to cumulate. Each person working in the project is equally responsible for pointing out possible problems. There should be clear models and policies for dealing with the problems. (Forselius 2013:101-102.)

Monitoring the progress of an information systems project can be problematic due to lack of proper indicators. Actualized workload does not necessarily correlate with the completeness of the project. It is important to determine some essential indicators before the project starts. Such can be (Forselius 2013: 104):

- Finished tasks / tasks planned
- Finished workload / entire workload
- Time spent / time planned

Project quality can be measured from two different viewpoints: quality of the delivery process and quality of the product itself. Process quality is often easier to monitor. Poorly specified system requirements make it very difficult to monitor product quality. (Forselius 2013: 105.)

After the project is finished, both the buyer and the vendor should take some time to evaluate what they succeeded and failed in, so that the procurement process can be developed in the future. Their experiences should always be documented in order to spread out the knowledge in the organization. The final report of the procurement should repeat what was made, how it was made, and how the outcome matched the original plans. Also, it is important to collect feedback from different members of the project. (Forselius 2013: 106-107.)

The work is not done after the implementation, but the development and fine-tuning of both the system and processes continue. (Forselius: 2013: 108.)

## 3.4 HCIS project special features

There are some special features that need to be considered when dealing with health care information system projects. One of the main points of HCIS is that the systems

exceed organizational limits, which increases the complexity of the projects. Developing a system that meets the requirements of all the end-users, and that will hence also be accepted and used, is challenging. Proper evaluation needs is required since the failure of HCIS can have more severe effects than the failure of many other information systems.

### 3.4.1 Acceptance of health care information systems

Since the use of information systems is increasing within the field of health care, it is important to understand the factors that contribute to the acceptance of the systems among the end-users. After that, we are able to determine what sort of a system should be designed, what is the best method to design it, and how the system should be implemented. Cheng & Hsiao (2012) conducted a survey to study the factors influencing the physicians' acceptance of hospital information systems (HIS). They made the following observations:

*"Top management support significantly influences perceived usefulness of HIS".*

- This support will ensure that there are enough resources available for the project.

*"Project team competency and system quality significantly influence perceived ease of use of HIS."*

- Project team members should have previous experience both in information systems adoption and within the field of health care, and have good communication skills.
- System quality consists of such things as system reliability, response and security.

*"Perceived usefulness and perceived ease of use influence acceptance of HIS by physicians."*

- Phycians' positive attitude toward the system makes them more likely to accept it.

The following figure was drawn to clarify the dependancy and relations of these results. Managers should make sure that the systems introduced to physicians' have their own support, the project team members are qualified for HIS projects, and that the systems are usefull and easy to use. Perceived usefulness has a significantly bigger effect on the acceptance of the system than what the perceived ease of use does. (Chen & Hsiao 2012.)

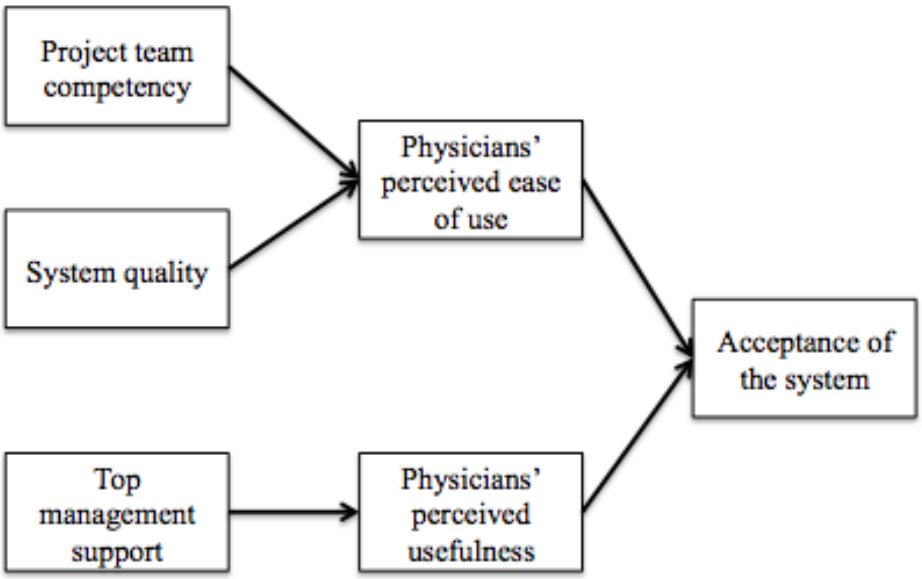


**Figure 3**. Factors affecting the physicians' acceptance of information systems; based on the article of Chen & Hsiao (2012)

The technology acceptance model (TAM) is a well-known and widely used model for understanding the factors that affect the acceptance of information systems. Though, it is also criticized for being too technologically oriented – human and organizational characteristics should be taken into account, too. Human factors are user satisfaction and the actual system use, and organizational factors include organizational atmosphere and structure. Quality of the system, information, and service make up the technical factors. (Chen & Hsiao 2012: 811.)

Other studies point out the importance and effect of adequate training, the design method, user participation in the project and communication between the counterparts. All in all, studies show that a well-designed system and a favorable environment will have a positive effect on system acceptance, which will further positively affect doctor-patient relationships, communications, the working environment, and the overall quality of care. (Chen & Hsiao 2012: 811-812.)

### 3.4.2 Preferred type of HCIS and development

Cross-organizational Health Information Exchange (HIE) has lately been raising more interest on both regional, national and European level. The main purpose of HIE systems is to give clinicians access to patient data regardless of where the previous

treatment has been done, in order to improve efficiency, patient safety and quality of care. For instance, comprehensive use of HCIS systems may result in less overlapping examinations and duplicate tests. (Hyppönen et al 2013: 2.)

In Finland, the different organizations providing primary and health care services have historically had their own patient data systems. Even if tailoring and selecting systems thould be localized, a recent study (Hyppönen et al 2013: 2-3) showed that integrated systems result in better use and user satisfaction. There were three different types of regional HIE-systems in the study:

- Type 1 Master patient index model
    - Centralized database, users from different organizations have access to an index of the original data, data items viewed separately
- Type 2 Web distribution model
    - Users have access to a web based record with multiple patient data, full potential missed since physicians can only see the data of those patients, which they have referred
- Type 3: Regional Virtual EHR model
    - Access to patient records in other institutions, if patient grants access, multiple data includinc medication lists

Compared to the users of type 1 master patient index systems and type 2 web distribution models, the users of type 3 regional virtual systems were more willing to use the electronic EHR system rather than manual means. Also, overall experiences were more positive for those who use type 3 integrated systems. (Hyppönen et al 2013: 2, 13.)

The main concern for physicians is the time-consuming of the patient data exchange (Martikainen et al. 2012: 98; Hyppönen et al 2013: 2). Even if the data would be available, it is not used if the search for it is too time-consuming and laborious. The most important aspect for physicians is the availability of data, which is mostly fulfilled in local systems but not in regional ones (Hyppönen et al 2013: 11-12). Physicians simply hope for information systems that would be reliable and fast. (Martikainen et al. 2012: 108). Poor performance of information systems reduces the likelihood of their implementation being successful (Berg 2001: 143).

End-user involvement in HCIS development

A large amount of studies show that end-users should be involved in the development of HCIS, especially when the system is an off-the-shelf application. Systems are better adopted if end-users are involved in the design process. Also, information systems and work processes should be developed hand in hand – simultaneously and in line with each other. Currently, users are adjusting their work to fit the HCIS, even if it should be vice versa. (Martikainen et al. 2012: 111.)

Martikainen et al. (2012) conducted a study where they asked Finnish physicians about their opinions and participation in the development process of the HCIS that they use. The responding physicians were very critical when it came to the current systems, and also concerning the current methods of their participation in the development of new system. They feel that the development is guided by something other than their needs. Observation is not used as a method for the developers to obtain knowledge from their work but the most common form of user participation is plain user testing. (Martikainen et al. 2012; Martikainen et al. 2014.)

Physicians feel that there is a clear lack of user-centeredness in HCIS development. (Martikainen et al. 2012: 108.) They criticized their own organizations for not involving enough clinical physicians in the development work. The systems are designed entirely by physicians in administrative positions. (Martikainen et al. 2014: 190.) They also did not feel that they can make an impact in the development process, nor did they not know how to give feedback concerning the current systems. Physicians thought that neither their own organizations' managers, nor the vendors were interested in their feedback. Even if the developers got their feedback, the physicians would never get a message to confirm it. (Martikainen et al. 2012: 106-107.)

Later on, Martikainen et al. (2014) asked the developers' viewpoint on the same issue. The sample included all software developers, and customer support and sales personnel of one major Finnish HCIS provider. The answers were compared with the physicians' opinions and they were pretty much the opposite. Majority of the developers thought that they work with users, are interested in end-user feedback and take their opinions in account.

There were significant differences between different EHR system providers (Martikainen et al. 2012: 108.) but according to the physicians, IT systems providers

also lack the ability to correct possible errors rapidly and according to their wishes. Software developers agreed on this issue. What they disagree on was the corrections being made according to the end-users wishes. Only 8 percent of the physicians thought that this was the case so maybe it is not the end-users who accept the corrections. (Martikainen et al. 2014: 197.)

There are many possible reasons for the differences in the two respondent groups' opinions. Even if physicians feel that the vendors are not interested in their opinions, the vendors' employees may still be. Also, developers may work with the customer representatives instead of the actual end-users, and there may not be a channel through which the developers could answer to the physicians' feedback. (Martikainen et al. 2014: 197.) Feedback methods should be developed and the entire development process should be more transparent. (Martikainen et al. 2012: 108.)

There is clearly a need to improve the communication between developers and end-user. (Martikainen et al. 2012: 100, 108.) There is an information failure between the end-users and representatives, and developers and customer support. This causes the information not to move between the developers and end-users. Developers were able to point out weaknesses in the development process but neither they nor physicians had any actual suggestions for improving the collaboration between the two groups. (Martikainen et al. 2014.)

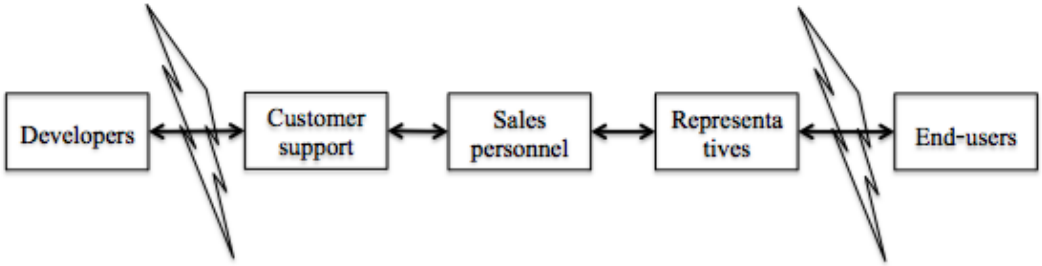


**Figure 4**. Information flow between the different counterparts in an HCIS development project; based on the articles of Martikainen et al (2012), and Martikainen et al (2014)

Physicians think that the developers lack knowledge in the field of health care, which is confirmed by the fact that the responding developers had very little or no work experience in the field of health care. The average respondent worked in the software development department and had more than 10 years of experience in IT development work, of which 1-5 years was in HCIS. Customer support personnel had more

experience in health care, 35 percent more than six years. (Martikainen et al. 2014: 189.) Physicians suggest that vendors should have physicians who work for them (Martikainen et al. 2012: 108).

All in all, Finnish clinicians have serious doubts concerning the usefulness and adoption of HCIS. On the other hand, they are very willing to participate in the development of IT systems. Thus, most of the physician thought that the development should be done within the standard working hours. The most preferred method would be to have a close contact with the developers in order to discuss and to be able to give direct feedback. (Martikainen et al. 2012: 108.)

Software development methods

Different software development methods have recently raised more interest in the field of health care. There is a clear need to improve the methods that are used in health care information systems development (Martikainen et al. 2012: 111). In this subchapter, the two biggest orientations in software development are presented: Software Development Life Cycle models are a more traditional technique for software development, and agile methods aim at a more flexible approach and result.

Software Development Life Cycle (SLDC) is a structured project management technique. It divides complex tasks into smaller sections so that they are more easily manageable. The traditional SLDC method has been criticized for not being relevant anymore – one size does not fit all. SLDC should always be tailored according to the project at hand. (Ragunath, Velmourougan, Davachelvan, Kayalvizhi & Ravimohan 2010: 112.)

Typically, a software development project includes the following phases: initiation, planning, design, development, testing, implementation, and maintenance. The SLDC model describes in which order the phases should be executed. In the General Life Cycle Model, phases produce deliverables that are needed for the next phase. In the waterfall model, the progress is going downwards like a waterfall. (Ragunath et al 2010: 112-113.)

The advantages of different SLDC models are that they are simple and easy to use: phases are completed one at a time and each phase produces specific deliverables. Some of the biggest disadvantages are that no prototypes or software are developed until a

very late stage. The model is poor for very complex projects, and adjusting the project scope during the project can be impossible (Ragunath et al 2010: 114.)

Agile Manifesto is a statement of values by a group of industry experts, who wanted software development to become quicker and more responding to change (Martin 2003: 4). Their core statement is following: *"--- we have come to value individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following plan."* (Agile Manifesto 2001.)

First of all, the most important factor for successful projects is people – but bad processes can make even the best people useless. Second, there should be a focus on human-readable documents instead of huge documents that are very laborious to maintain and utilize. Third, there is a big difference between ordering commodities and software. The latter cannot be ordered by just writing a description of the software, and ordering it with a fixed schedule and price. It is an easy way of ordering software and therefore tempting but such attempts keep on failing. In successful projects, developers and customers work in close co-operation. (Martin 2003: 5.)

What finally determines the success of a software project is often its ability to respond to change. Business environment and customer requirements change causing that the software or project cannot be planned very far into the future. The idea of agile software development is to evolve the big picture of the software over time, simultaneously as the project moves forward. Agile software development can prevent some of common errors made in software development. Such errors are:

- The system being too complex and therefore difficult to change, since on change triggers several others
- The system being impossible to divide into reusable components
- The system containing infrastructure that has no direct purpose or benefits
- The system containing repeating structures that could be unified (Martin 2003: 4-6, 85, 88.)

Human-Computer Interface

There is a clear need for improvements in user interfaces and human-computer interaction (Martikainen et al. 2012: 100, 110). A poor user-interface will reduce the chances of an information system to be successfully implemented (Berg 2001: 143). A

poorly designed interface that is hard to use may result in user resistance (Chen & Hsiao 2012: 811.)

Jakob Nielsen is a Ph. D. with 79 US patents for easier Internet use. He has established a movement and several methods for fast and cheap user interface improvements. He is a cofounder of the Nielsen Norman Group (NNG), a company, which does user experience research and consulting, and the former VP of research at Apple Computer. Nielsen has written numerous books and articles on the topic. (NNG 2014.) Nielsen's main points are following. Usability consists of five elements: learnability, efficiency, memorability, errors, and satisfaction. Another key attribute is utility, which refers to the functionality of the design. Together, usability and utility determine the usefulness of the system. Nielsen suggests that 10 percent of a design project's budget should be spent on usability. (NNG 2012.)

The best way to study usability is user testing. The testing should involve representative users, who perform representative tasks with the system. The examiner should observe the users without interrupting them, and make notes on what is going smoothly and what is causing difficulties. Testing just five users should be enough if you run several small tests and make iterative corrections. (NNG 2012.)

### 3.4.3 HCIS implementation

According to many studies, successful implementation of patient care information systems seems to be very difficult in many organizations all over the world. The more complex the system is, the harder it is to succeed. Alike the technology acceptance model (TAM), the implementation process of PCIS is often considered excessively technologically oriented, too (Berg 2001; Chen & Hsiao 2012: 811). Many of the issues are actually organizational instead, and social sciences should not be overlooked when discussing successful PCIS implementations. (Berg 2001: 143.) Many studies show that contextual aspects need to be understood in order to succeed in an HCIS implementation (Martikainen et al. 2012: 99).

The success or failure of a system should always be tied to the project at hand. A Finnish study shows that the implementation strategy should be flexible and localized (Hyppönen et al 2013: 2). Organizational issues play a key role, since they determine whether the project is a success for that specific organization. Technical difficulties may appear because of poor management. Berg (2001) studied how to determine success and

failure listed three myths that prevail when talking about PCIS implementation. He used a sociotechnical approach and came up with the following three myths:

*"PCIS implementation is the technical realization of a planned system in an organization."*

- Implementing a PCIS requires two-way interaction and transformation between the technology and the organization.

*"You can leave IS implementation to the IT department."*

- In order to be successful he implementation process need the support of both management and end-users.

*"IS implementation can be planned, including the required organizational redesign."*

- Being an organizational change process, too, an information system implementation has always its uncertainties.

Implementing an information system is a transformation process, where the system plays the part of the change agent. Launching of a system will most likely affect the work processes, and ways of communication. It may even affect the relationships of different groups of staff, since there may be new rules for availability of and access to the information, and changes in the processes of entering information to the system. PCIS implementations should be seen as processes of organizational development, and even used as tools for strategic changes. (Berg 2001: 154.)

An information systems implementation should not be just a technical project that is left for the IT department to take care of. There should be people in top-managerial positions and from other departments, too, in the project team. End-users should always be participated in the implementation of HCIS (Martikainen et al. 2012: 108). The importance of end-user involvement cannot be highlighted too much but, still, the approach is often limited to only comprehend discussing system specifications and implementation plans, instead of the end-user actually getting to use the system in their work settings (Berg 2001: 148).

When implementing an information system, the planning and intended control of the process should not be too tight. The system will most likely affect the current work processes of the organization but this transformation should not be controlled too much. There is always a certain amount of uncertainty related to the implementation process, due to the complexity of health care processes and information systems, and the number of counterparts involved in the project. (Berg 2001: 150, 154.)

### 3.4.4 Evaluation of health care information system projects

*"Evaluation can be defined as the decisive assessment of defined objects, based on a set of criteria, to solve a given problem."* (Ammenwerth et al. 2003: 126.)

Evaluating health care information systems has been proven to be difficult, due to the complexity of the field (Ammenwerth et al. 2003: 126). As can be seen in the previous subchapters, different factors that have to do with HCIS development and evaluation are also closely related to evaluation of health care information systems. Chen & Hsiao (2012: 811) suggest that user acceptance is necessary in order to evaluate the success of the system. Then again, user acceptance compiles of physicians' perceived system quality and project team competency.

Many studies show that acceptance of a system is directly proportional to the success of it, too. System acceptance will further positively affect doctor-patient relationships, communications, the working environment, and the overall quality of care (Chen & Hsiao 2012: 817). The success of a system can be determined in many ways. Sticking to the budget or the schedule may be a success for one organization, while others measure savings, wideness of use or reduction of errors in the performance (Berg 2001: 145).

According to Ammenwerth et al (2003: 127), the success of an HCIS project depends on following things:

- Introduction of the technology to the organization
- Quality of the system
- Training of end-users
- Support
- Motivation of users and
- The actual use.

Berg (2001: 145) suggests success factors to be effectiveness, efficiency, worker satisfaction, commitment, or patient satisfaction. He highlights that different counterparts may have different opinions of the factors. Hyppönen et al (2013: 11) point out that even with the same system, there may be regional differences in the success.

Proper evaluation needs to be done since health care information systems are costly and their failure can have serious negative effects on patients. Traditional clinical trial evaluation methods are not enough, nor basic IT evaluation models. Health care information system evaluation has its own unique features that should be taken into account – and each system is unique, too. Just like Berg (2001) and Chen & Hsiao

(2012) earlier, Ammenwerth et al (2003: 126) highlight the fact that the human players in HCIS health care projects need to be considered along the technical aspect. Evaluation has to take the organizational environment into account.

According to Ammenwerth et al (2003: 126), evaluation should be made during the entire lifecycle of an information system. It can be of help when deciding on the technology, when measuring the system usability, acceptance and patient satisfaction, and when studying the cost-effectiveness of the system. Clearly defined models for health care information systems evaluation may help to conduct better evaluation. The framework should be detailed and support the evaluation during the entire project from planning to execution. Different evaluation methods can be used during different phases of the project:

- Systems development phase: technical veridation and validation
- Implementation and post-implementation phase: pilot and feasibility studies, cost-benefit and cost-effectiveness studies
- Routine use phase: monitoring

There has been little research done on how the HIE systems actually fulfill the benefits that are expected. Rather, the studies have focused on end-user satisfaction (Hyppönen et al 2013: 2). Sultan et al (2014) conducted a study on a hospital information system in Pakistan. They also studied the financial benefits of the system by measuring the asset utilization and return on investment. A quick payback time is also an indicator of low risk. Their study also found i.a. the following interconnections between different benefits. Some can be hard to assess so qualitative results need to be drawn from factors that can be measured quantitatively.

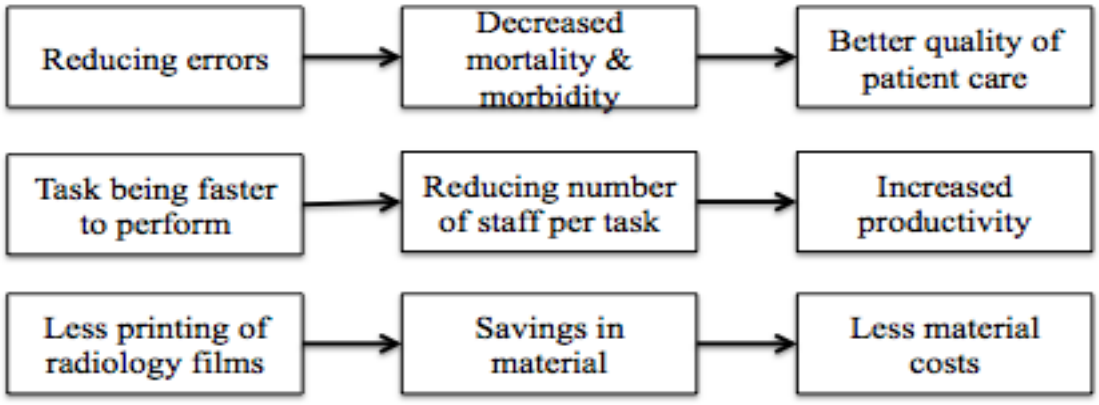


**Figure 5**. Benefits of implementing a hospital information system; based on the article of Sultan et al (2013)

Ammenwerth (2003: 127-131) listed three things that make the HCIS evaluation so difficult:

*"Complexity of the evaluation object"*

- The evaluation object is not just the hardware and software but the interaction between the system, the users and the organizational environment.

*"Complexity of the evaluation project"*

- Health care is a complex environment with many different professional groups and many external factors, such as legislation, influencing it.

*"Motivation for evaluation"*

- Proper evaluation can only be conducted if there are enough resources assigned by the project management.

To help with evaluation, they suggest the following actions. Possible solutions for the first problem could be to define the technology and environment in detail in the beginning: software, hardware, the general technical infrastructure, and the number, experience, and motivation of users. All changes in these factors should be carefully documented. The project could also be divided into smaller modules. Anyway, evaluation should always be long-term. The project may have adverse effects, too. (Ammenwerth 2003: 127-131.)

In order to avoid difficulties caused by the complexity of the evaluation object, the evaluation should be started early enough. It should focus on the most important aspects, and not try to measure everything, since it is rarely possible. The evaluation criteria should be clear early enough, and additions can then be made if needed and possible. Measurement methods should be adequate. Motivation issues can be avoided by ensuring that the project management and personnel are motivated. Financial compensation can be provided, if necessary. (Ammenwerth 2003: 127-131.)

# 4 CONCLUSIONS

When comparing the results with the original hypothesis, which claimed that there must be a lack of knowledge in one or several fields of project management, we see that the results point to another direction. The main problem is not project management, rather than the lack of a coherent strategy and ways of working. Of course, project managerial issues play a part in the entity. The further hypothesis, which was made after having dealt with the empirical material, was more accurate. A clear and coherent IT strategy plays an important role both on national, project and municipal level, and better models for monitoring and evaluation of projects, and for project procurement are needed. Software development methods should be developed but that alone will not provide a solution. End-user participation does not determine the success of an information system project but it has a significant indirect effect.

The following, very simplified model was drawn to present the conclusions of this study. The main idea is that health care information system projects, alike all other public IT projects, are like a three-stage pyramid. A good strategy forms the bottom of the pyramid, on top of which comes project procurement. The managing of the project after the procurement is actually a relatively small part, if the two foundation parts are in order. Evaluation needs to be executed during the entire project in order to succeed in projects and to develop IT project management further.

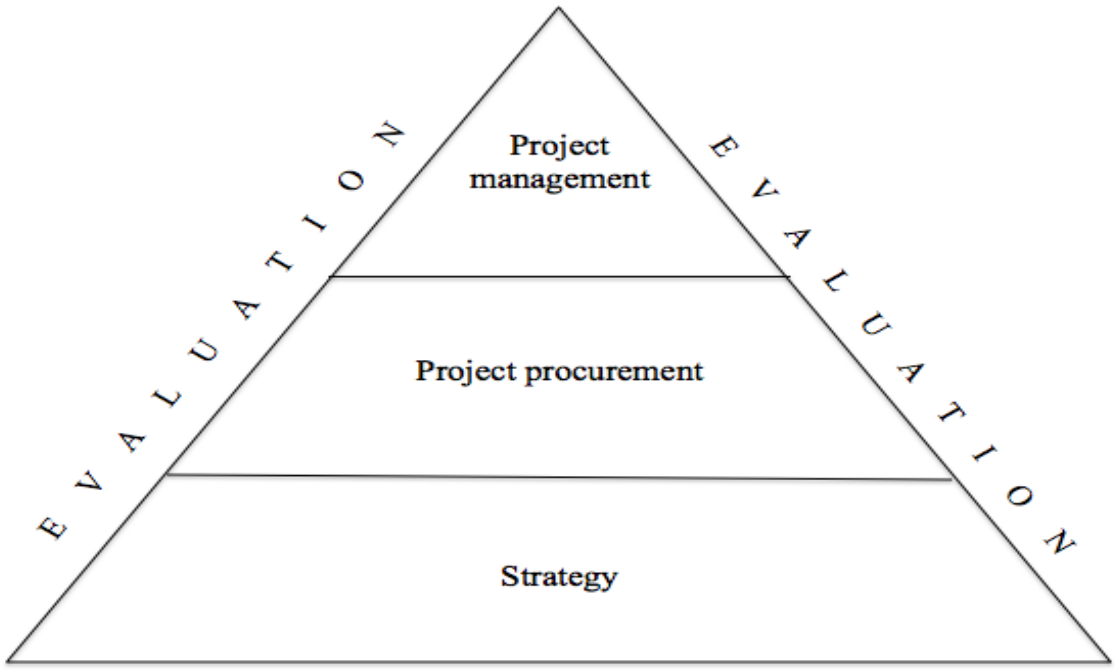


**Figure 6**. The final model for improving HCIS project management in Finland

The basis of everything is a coherent IT strategy both for the state's overall IT operations and for the development of health care information systems. The strategy has to include organizing of operations, legislative issues, and decision-making. Estonia's starting point has been better than Finland's – they do not have a similar existing patchwork of systems and such oligopoly of vendors – but they have also contributed to their success with a comprehensive information society strategy.

Finland should have a more consistent plan on how to develop both existing and future systems. Needs of both the public and the private sector, as well as the needs of both special and primary health care have to be taken into account. Also, wishes to include social care into health care systems in the future should be considered. The strategy should also aim at influencing the prevailing culture, in which all problems are tried to be solved at once and aborting of unsuccessful projects in time is not considered an option. A culture that values IT projects and enhances their importance will most likely result in better interest in and, finally, knowledge of IT project management. Improved knowledge will improve decision-making.

Project procurement can be divided into four parts: procurement preparation, choosing the system and the vendor, monitoring the procurement, and finishing it (Forselius 2013: 14, 17). By having good knowledge in project procurement, public buyers will be able to divide projects into smaller parts and to reduce their dependency on the vendors. The culture should be more cooperative rather than confronting, and end-users should be involved in the project as of the procurement. A cooperative and interactive operations model will allow the organizations to use and benefit from more agile software development methods, and involving the end-users will automatically lead to a better Human Computer Interface. The entire procurement process should be more transparent for all counterparts.

Procurement preparation is by far the most important part – it can and should make for up to half of the time and work load of the entire project. The system specifications that are created during this phase should be done carefully, since they will be used for pricing, budgeting, scheduling, resource planning, change control, and monitoring of quality. When selecting the vendor and solution, the focus should be on the terms of agreement: future development and maintenance of the system, ownership of the source code, and criteria for approval. The buying organization should be aware of certain pitfalls during the negotiations. Evaluation criteria must be clear from the very

beginning and include the entire life cycle of the project. The invitation to tender should not have too specific requirements for the vendors.

One key issue in the management of a HCIS project is that the project has top management support and a clear owner, who takes responsibility for the project. For instance, the new leader of the Apotti project, Hannu Välimäki, has been speaking in favor of the project in the public, and taken a clear role as the front man of the project. The role should be clear within the project, too. Management should be transparent and it is extremely important to continue with the end-user involvement through the entire project. Communications between buying organizations and vendors should be improved; above all, the flow of information and feedback between developers and end-users should be enhanced. Communications is, in principle, easier in smaller organizations, so allowing smaller vendors to tender for and to execute development projects could have a positive impact on communications.

Implementing an information system is not just a technical project but also a simultaneous development of both systems and work processes. Project management should emphasize the role of human factors during the entire project, and especially during the implementation phase. The execution should not be left for just the IT department. The implementation strategy should be flexible and localized, since it is an organizational change process and the plans are very likely to change during the implementation.

Proper evaluation of HCIS projects needs to be done in order to control the cost-effectiveness of the projects but, above all, to ensure patient safety. Traditional clinical trial or IT evaluation models are not enough – human players need to be considered, once again. The success of a system can be determined in many organization and project related ways but one common factor is that the evaluation framework should cover the entire lifecycle of the project, and be determined before-hand. It is important not to try to measure everything but to focus on the most important factors, and to be able to transform qualitative results into quantitatively measurable factors.

What determines the final success of an information system project is whether the system will actually be used, and the effective usage of HCIS strongly correlates with the end-users' acceptance of the system. Acceptance is influenced by perceived usefulness and ease of use. Both factors can be affected by careful execution of the procurement phase, continuous interaction between all project members and by

providing adequate training both before and after the system is implemented. The Ministry of Finance has a program for developing the evaluation of information system projects but it only concerns state-owned projects (Ministry of Finance 2010). There is a clear need for common evaluation models for regional and municipal projects, too. By benchmarking to previous similar and successful projects, many organizations and municipalities could compensate their lack of knowledge in information system projects.

All in all, the situation in Finland is not hopeless. There are many positive examples of successful information system projects, even within the health care sector, and awareness of the matter is rising. Resources and knowledge are just a matter of will: Finland is already cooperating with Estonia in several projects and their expertise is available for further utilization, too. The coming changes in the Act on Public Procurement put more emphasis on qualitative issues and will allow more flexible tendering by improving the position of small and medium sized companies in the process (Kuntalehti 2014). The brand new SOTE-reformation divides the country into five SOTE-regions that are responsible for organizing all health services in their district (HS 25.3.2014). The reformation will hopefully lead into more uniform development of health care information systems – at least within the districts. The coherent development of the different districts should be ensured.

The role of media is important when transmitting information on tax-financed health care information system projects but reporters should not indulge in exaggeration – and definitely not in providing false information as sometimes happens. The situation in Finland is not even close to good but one thing is for sure: by focusing solely on the negative issues, the improvements will remain limited. As said, the situation is not hopeless, since we have positive examples, too. Such successful projects should be used for benchmarking, in order to spread knowledge. A coherent and comprehensive IT and HCIS strategy is needed, and monitoring and evaluation play a key role in implementing it. When the legislation is in order, it is just a matter of cooperation – cooperation between the buyer and the vendor, between different buying organizations, and within the buying organizations so that the end-users opinions will be heard.

## 4.1 Recommendations

Putting up the state's new IT unit gives an excellent opportunity for concrete improvement actions. Finland should examine the operations of other countries, such as

Estonia and Denmark, and utilize their experience and knowledge. The operations of the new unit should include the following fields:

- Creating a strategy
- Enabling related research
- Setting up a technical framework
- Building operations and evaluation models
- Enhancing cooperation with vendors
- Consulting and training
- Evaluating and monitoring

First step would be to create a common strategy and to communicate it to all public facets. The strategy should be created together with municipal counterparts and public organizations so that it would not be just a top-down set of recommendations. It should include a good communications plan, in order to improve the prevailing culture and to highlight the importance of health care information systems and IT project management. The strategy should also include a long-term plan for research so that the current results of research made by, for instance, the Technical Research Centre of Finland (VTT) and different universities could be utilized in its full potential.

The new unit should create a technical framework, in order to ensure the uniform development of public information systems. As mentioned earlier, Denmark has an organization called MedCom, which is responsible for standardizing information between municipalities, IT vendors and the state. The unit should study current operations models in different municipalities and public organizations – and why not private health care organizations, too – so that it could provide concrete information about best practices when executing and evaluating health care information system projects.

The unit should also enhance cooperation with vendors, and serve municipalities and organizations by offering relevant consulting and training. Improving the knowledge in project procurement is especially important. Above all, the evaluation and monitoring of information system projects should be done more carefully. Even if the National Audit Office would execute it, the process should follow guidelines that are based on the state's IT strategy. The monitoring and evaluation process should be transparent itself but also improve the transparency of the projects in general.

Finland has definitely got the technical skills that are needed to stay at the top of the list when considering the leading IT countries in the world. It is the management practices that need to be brought to this century. The current situation could be compared to a company that lacks a coherent strategy, and the units of which therefore work totally separately from each other. The new IT unit should cover the roles of the executive committee, administration and support functions but still value bottom-up ideas and operations models, so that best practices could be utilized. Some of our top business leaders could be consulted, in order to adopt more flexible and business-like operations models.

## 4.2 Scope for further study

In my opinion, future research should focus more on success, rather than on failures. By studying failed projects, you will only learn what not to do. There should be more examples of successful projects, in order to be able to create standardized ways of working. Health care information systems are a very specific field of study but they should also be studied in a larger context. A lot could be learned from determining common factors behind the leading IT countries and successful health care information systems projects, and by comparing best practices between different countries. Also, public information system projects should not be considered totally separate from private ones. Above all, the research should be very practice-related and, as already mentioned, make suggestions for improvements instead of just pointing out failures.

# 5 REFERENCES

Act on Public Procurement 30.3.2007/348.

Agile Manifesto (2001). Manifesto for Agile Software Development [cited 13.3.2014]. Available on the Internet: <http://agilemanifesto.org/>

Ammenwerth, E., Gräber, S., Herrman, G., Bürkle, T. & König J. (2003). Evaluation of health information systems—problems and challenges. *International Journal of Medical Informatics* 71, 125-135.

Berg, M. (2001). Implementing information systems in health care organizations: myths and challenges. *International Journal of Medical Informatics* 64, 143-156.

Chen, R-F. & Hsiao, J-L. (2012). An investigation on physicians' acceptance of hospital information systems: A case study. *International Journal of Medical Informatics* 81, 810-820.

Estonian Ministry of Economic Affairs and Communications (2006). Estonian Information Society Strategy 2013 [cited 13.3.2014]. Available on the Internet: <www.epractice.eu/files/media/media_186.pdf>

Forselius, P. (2013). Onnistunut tietojärjestelmän hankinta. Vantaa: Talentum Media Oy.

Helsingin kaupunki (2013). Helsingin kaupungin päätöksentekojärjestelmä [cited 6.2.2014]. Available on the Internet: <http://www.hel.fi/hki/helsinki/fi/P__t_ksenteko+ja+hallinto/P__t_ksenteko>

Helsingin Sanomat (2014). Aihe. Sote-uudistus [cited 6.2.2014]. Available on the Internet: <http://www.hs.fi/aihe/soteuudistus/>

Hyppönen, H., Reponen, J., Lääveri, T & Kaipio, J. (2014). User experiences with different regional health care information exchange systems in Finland. *International Journal of Medical Informatics* 83, 1-18.

Kouhi, M. (2013). Tuottava IT. Viro: Helsingin Kamari Oy.

Kunnat.net (2014). Päätöksenteko. Asian valmistelu [cited 6.2.2014]. Available on the Internet: <http://www.kunnat.net/fi/asiantuntijapalvelut/laki/hallintojuridiikka /paatoksenteko/asian-valmistelu/Sivut/default.aspx>

Kuntalehti (2014). Vipua hankintoihin 1/2014 [cited 4.4.2014]. Available on the Internet: < http://www.kuntalehti.fi/Pdfarkisto/KL-1401.pdf>

Martikainen, S., Viitanen, J., Korpela. M. & Lääveri Tiina (2012). Physicians' experiences of participation in healthcare IT development in Finland: Willing but not able. *International Journal of Medical Informatics* 82, 98-113.

Martikainen, S., Korpela. M. & Tiihonen, T. (2014). User participation in healthcare IT development: A developers' viewpoint in Finland. *International Journal of Medical Informatics* 83, 189-200.

Martin, R. C. (2003). Agile software development: principles, patterns and practices. Upper Saddle Rive, NJ: Pearson Education.

Ministry of Finance (2010). Valtion tietojärjestelmähankkeiden arviointitoiminnan kehittäminen. *Valtiovarainministeriön julkaisuja*, 30/2010.

NNG (2012). Usability 101. Introduction to usability [cited 14.3.2014]. Available on the Internet: <http://www.nngroup.com/articles/usability-101-introduction-to-usability/>

NNG (2014). Jakob Nielsen [cited 14.3.2014]. Available on the Internet:. <http://www.nngroup.com/articles/author/jakob-nielsen/>

Ragunath, PK., Velmourougan, S., Davachelvan, P., Kayalvizhi S. & Ravimohan R. (2010). Evolving a New Model (SLDC Model-2010) for Software Development Life Cycle (SLDC). *International Journal of Computer Science and Network Security* 10:1, 112-119.

Räty, E. (2006). Liiketoiminnan ja informaatiotekniikan strategisen linjakkuuden vaikutus suuryritysten IT:n tehokkuuteen. Helsinki: Helsingin Kauppakorkeakoulu.

Sosiaali- ja terveysministeriö (2012). Tiedotteet. Verkkouutiset. Terveydenhuollon tietojärjestelmistä liikkeellä väärää tietoa. 21.9.2012 [cited 13.1.2014]. Available on the Internet: <http://www.stm.fi/tiedotteet/verkkouutinen/-/view/1826768>

Sosiaali- ja terveysministeriö (2013a). Terveydenhuolto Suomessa. Sosiaali- ja terveysministeriön esitteitä. Tampere: Sosiaali ja terveysministeriö.

Sosiaali- ja terveysministeriö (2013b). SOTE-uudistus – järjestämislain valmistelu [cited 6.2.2014]. Available on the Internet: <http://www.stm.fi/c/document_library /get_file?folderId=1447910&name=DLFE-28181.pdf>

Sosiaali- ja terveysministeriö (2014). Sote-uudistus osana kuntauudistusta [cited 6.2.2014]. Available on the Internet: <http://www.stm.fi/vireilla /kehittamisohjelmat_ja_hankkeet/palvelurakenneuudistus>

Sultan, F., Muhammad, T. A., Khokhar, I., Qadri, H., Abbas, M., Mukhtar, A., Manzoor, W. & Muhammed, A. Y. (2014). Development of an in-house hospital information system in a hospital in Pakistan. *International Journal of Medical Informatics* 83, 180-188.

Suomi.fi (2012). Valtio ja kunnat. Kunnat ja kunnallishallinto [cited 6.2.2014]. Available on the Internet: <http://www.suomi.fi/suomifi/suomi/valtio_ja_kunnat /kunnat_ja_kunnallishallinto/index.html>

Tuomi, J. & Sarajärvi, A. (2009). Laadullinen tutkimus ja sisällönanalyysi. Lithuania: Kustannusosakeyhtiö Tammi.

Turban, E. & Volonino, L. (2010). Information technology for management: Transforming organizations in the digital economy. Hoboken, NJ: Wiley.

Työ- ja elinkeinoministeriö (2013). Asettamispäätös. Hankintalain kokonaisuudistuksen ohjausryhmä sekä valmistelusta vastaava ryhmä [cited 6.2.2014]. Available on the Internet: <http://www.hare.vn.fi/upload/Asiakirjat/19733/211406_tem096.pdf>

Työterveyslaitos (2014). Työterveyshuollon järjestäminen [cited 6.2.2014]. Available on the Internet: <http://www.ttl.fi/fi/tyoterveyshuolto/jarjestaminen/sivut /default.aspx>

| **Appendix 1: List of news articles used in the Thesis** |
|---|
| Helsingin Sanomat 15.5.2012. Resepti tulee, arkisto takeltelee. |
| Helsingin Sanomat 8.7.2012. Konsulttiyhtiö Accenturen kaksoisrooli ihmetyttää. |
| Helsingin Sanomat 16.7.2012a. Päätetyö ahdistaa lääkäreitä. |
| Helsingin Sanomat 16.7.2012b. Toimimattomat ohjelmat syövät työtehoa. |
| Helsingin Sanomat 9.9.2012. Sähköiset reseptit käyttöön Espoossa. |
| Helsingin Sanomat 10.9.2012. Näkökulma: Potilastietojärjestelmän posketon hinta kuohuttaa. |
| Helsingin Sanomat 11.9.2012. Kymmenet mielenosoittajat protestoivat potilastietojärjestelmän kustannuksia. |
| Helsingin Sanomat 17.9.2012. Sitra houkutteli Viron potilastietojärjestelmän pääarkkitehdin Suomeen. |
| Helsingin Sanomat 22.9.2012a. STM: Kunnat vastaavat itse järjestelmistään. |
| Helsingin Sanomat 22.9.2012b. Valtio perustaa oman it-yhtiön. |
| Helsingin Sanomat 24.9.2012. Kivijalka jäi rakentamatta. |
| Helsingin Sanomat 1.10.2012. Professori: Ministeriö ei kerro terveysarkiston oikeita kuluja. |
| Helsingin Sanomat 2.10.2012. Apotti-hankkeelle lyötiin jarrua Helsingin lautakunnissa. |
| Helsingin Sanomat 14.10.2012. Hankintalakia käytetään usein väärin. |
| Helsingin Sanomat 21.10.2012. Sähköinen resepti käytössä puolessa terveyskeskuksista ja sairaaloista. |
| Helsingin Sanomat 1.11.2012. Verkkoapteekista saa nyt myös reseptilääkkeitä. |
| Helsingin Sanomat 13.11.2012. Kiistelty Apotti-hanke nytkähti eteenpäin. |
| Helsingin Sanomat 12.12.2012. Helsinki hyväksyi Apotin. |
| Helsingin Sanomat 21.1.2013. Espoo sanoo ei yhteiselle potilastietojärjestelmälle. |
| Helsingin Sanomat 23.1.2013. Espoolla oli järkisyyt Apotin hylkäämiseen. |
| Helsingin Sanomat 24.1.2013. Espoo korostaa itsenäisyyttään. |
| Helsingin Sanomat 28.1.2013. Espoon valtuusto aloitti kautensa hylkäämällä Apotin. |
| Helsingin Sanomat 3.2.2013. Tanska on yksinäinen onnistuja. |
| Helsingin Sanomat 26.3.2013. Julkiset it-hankkeet epäonnistuvat usein. |
| Helsingin Sanomat 29.3.2013. Potilaat saavat piilottaa tietojaan lääkäreiltä uudessa arkistossa. |
| Helsingin Sanomat 24.4.2013. Helsinki sitoutuu Apottiin Espoosta huolimatta. |
| Helsingin Sanomat 21.5.2013. Puolen miljardin Apotti-hanke sai uuden vetäjän. |
| Helsingin Sanomat 22.5.2013. Apotti-hankkeen uusi isäntä lupaa välttää karikot. |
| Helsingin Sanomat 29.5.2013. Sähköiset palvelut vievät paljon rahaa. |
| Helsingin Sanomat 4.6.2103. Hus hyväksyi Apotin. |
| Helsingin Sanomat 17.6.2013. Vantaa sitoutuu potilastietojärjestelmä Apottiin. |
| Helsingin Sanomat 10.8.2013. Terveysarkiston käyttöönotto saattaa taas lykkääntyä. |
| Helsingin Sanomat 21.8.2013a. Krp alkaa tutkia sosiaali- ja terveysministeriön toimia potilastietojärjestelmissä. |
| Helsingin Sanomat 21.8.2013b. Kerava horjuttaa Apottia jäämällä sen ulkopuolelle. |
| Helsingin Sanomat 26.8.2013. Apotti-järjestelmä tulee kaikkien kukkarolle. |

Helsingin Sanomat 7.9.2013. IT-järjestelmän tilaaminen on taitolaji.
Helsingin Sanomat 10.9.2013. Yle: Paperireseptit poistumassa lakimuutoksella.
Helsingin Sanomat 17.9.2013. Viro auttaa Suomea valtavan uuden verkkorekisterin luomisessa.
Helsingin Sanomat 19.9.2013. Professori: Perusterveydenhuollon romahtamisen syynä keikkalääkärit ja tietojärjestelmät.
Helsingin Sanomat 21.10.2013. E-resepti tulee kalliiksi pienille lääkäriyrityksille.
Helsingin Sanomat 4.11.2013. Apotilla on nyt näytön paikka.
Helsingin Sanomat 29.11.2013a. Virolaiset ohittavat byrokratian asioimalla internetissä.
Helsingin Sanomat 29.11.2013b. Näin samat palvelut toimivat Suomessa.
Helsingin Sanomat 29.11.2013c. Poliisi lopetti esitutkinnan potilastietohankkeen valvonnan laiminlyönneistä.
Helsingin Sanomat 5.12.2013. Viro ehdottaa Suomelle sähköistä koulutusyhteistyötä.
Helsingin Sanomat 10.2.2014. Länsi-Metro viivästyy lisää.
Helsingin Sanomat 25.3.2014. Husin toimitusjohtaja Aki Lindén: Tämä kaavio ratkaisi sote-uudistuksen mallin.
Lääkärilehti 10.8.2012. Uutta it-ajattelua Virosta?
Talouselämä 15.12.2008. Sähköisen tunnistuksen sotku pahenee.
Talouselämä 9.10.2009. Digipalvelut vaativat yhteistyötä.
Talouselämä 1.11.2009. Kansallinen terveysarkisto myöhästyy.
Talouselämä 4.2.2011. 21 vuotta kestänyt it-projekti ei ole vieläkään valmis – syynä kiire.
Talouselämä 26.9.2011. Tieto: Lääkärit eivät osanneet käyttää eReseptejä.
Talouselämä 2.10.2011. Suomella on pitkä it-mokahistoria.
Talouselämä 14.8.2012. Suomi käytti terveydenhuollon it-projektiin jopa 50 kertaa enemmän kuin Viro.
Talouselämä 28.1.2013. Espoolta lopullinen niitti Apotti-suunnitelmille.
Talouselämä 30.1.2013. Apotti on liian suuri riski.
Talouselämä 5.3.2013. It-murheenkryyni etsii uutta johtajaa.
Talouselämä 27.3.2013. Nämä 33 hakevat johtamaan Suomen jättimäistä it-hanketta.
Talouselämä 22.5.2013. Apotti-ohjelman johtaja vakuuttaa, että tällä kertaa kaikki onnistuu.
Talouselämä 20.8.2013. Nyt myös Kerava hylkäsi Apotti-hankkeen – KU: Saattaa liittyä 2020.
Talouselämä 23.10.2013. Käsittämätön määrä lääkkeitä: Suomessa kirjoitetaan pelkkiä sähköisiä reseptejä lähes 10 000 päivässä.
Talouselämä 7.11.2013. Taas alueellistetaan: Valtion jättimäinen it-keskus perustetaan muualle kuin pääkaupunkiseudulle.
YLE 8.10.2009. Sähköinen potilasasiointi karahti kiville.
YLE 10.11.2009. Risikko: Sähköisen potilasasioinnin siirtymäaikaa muutetaan.
YLE 5.4.2011. Kotka siirtyi e-resepteihin.
YLE 23.9.2011. Sähköisten reseptien käyttökieltoa laajennettiin.
YLE 24.9.2011. Lääkärit tarkistelevat sähköisiä reseptejä viikonlopun yli.
YLE 26.9.2011. Kotka luopuu eReseptistä toistaiseksi.

YLE 28.9.2011. Sähköinen resepti –hanke tuli Kotkalle kalliiksi.
YLE 6.10.2011. Sähköinen resepti otetaan takaisin käyttöön.
YLE 10.1.2012a. Selvitys: Valtio tuhlannut miljoonia terveydenhuollon IT-hankkeissa.
YLE 10.1.2012b. STM ja Tekes tyrmäävät kritiikin IT-hankkeista.
YLE 14.5.2012. Sähköisessä reseptissä paljastunut vakavia turvallisuusriskejä.
YLE 7.6.2012. Sähköisten reseptien uusiminen kangertelee.
YLE 12.9.2012. Arvosteluryöppy yllätti potilastietojärjestelmän valmistelijat.
YLE 14.9.2012. Potilastietojärjestelmän valmistelijat: Hinta korostuu keskustelussa liikaa.
YLE 17.9.2012. Sitra värväsi potilastietojärjestelmän rakentamisesta vastanneen asiantuntijan Virosta Suomeen.
YLE 20.9.2012. It-hankkeista jo “riittävästi itseruoskintaa”.
YLE 19.11.2012. Apotti-järjestelmän tietoturva epäilyttää ammattilaisia.
YLE 11.12.2012. Sähköinen potilastietojärjestelmä on turva ja uhka.
YLE 13.12.2012. HUSin uusi potilastietojärjestelmä myötätuulessa.
YLE 21.1.2013. Apotti-potilastietojärjestelmä ei kelpaa Espoolle.
YLE 24.1.2013a. Ylilääkäri: Espoon Apotti-päätös voi vaarantaa potilasturvallisuuden.
YLE 24.1.2013b. Espoo ei jätä naapureita pulaan vetäytyessään Apotista.
YLE 28.1.2013. Espoon valtuusto hylkäsi Apotti-järjestelmän.
YLE 4.2.2013. Hankintalaki uudistuu, nykyistä tulkitaan miten sattuu.
YLE 13.2.2013. Apotti-hankkeelle uusi johtaja.
YLE 28.2.2013. Apotista uudet päätökset kesäksi.
YLE 2.4.2013. E-reseptien käytössä suuria alueellisia eroja.
YLE 5.4.2013. E-reseptin suunnitteluvirheen korjaaminen on hidasta ja kallista.
YLE 7.5.2013. IT-asiantuntija: Husin uusi potilastietojärjestelmä menossa pahasti pieleen.
YLE 8.5.2013. Apotti-järjestelmä kehittyy vuorovaikutuksessa.
YLE 29.5.2013. Kauniainen haluaa edelleen mukaan Apottiin.
YLE 7.6.2013 Sähköisten reseptien uusiminen kangertelee.
YLE 5.11.2013. Potilastietojärjestelmän kilpailutus etenee.