

**GOVERNING THE IMPLEMENTATION OF A COMPLEX
INTER-ORGANIZATIONAL INFORMATION SYSTEM NETWORK**

– The Case of Finnish Prescription

Lauri Salmivalli

Sarja/Series A-3:2008



TURUN KAUPPAKORKEAKOULU
Turku School of Economics

Copyright © Lauri Salmivalli & Turun kauppakorkeakoulu

ISBN 978-951-564-590-6 (nid.) 978-951-564-591-3 (PDF)

ISSN 0357-4652 (nid.) 1459-4870 (PDF)

UDK 65.012.45

004.7

681.324

615 (480)

614 (480)

Esa Print Tampere, Tampere 2008

ACKNOWLEDGEMENTS

Writing this thesis has been a long and multifaceted process. Numerous people have helped me during the process and made the publication of this dissertation possible and now it is time to thank you all. Yet, so many people have been involved in this process that I cannot simply mention but some of you without making another book.

The process took a bit longer than anticipated, partly due to challenges in the collection of empirical material and publication of results. Partly, because life offered me many interesting new challenges while dragging the dissertation project along. In retrospect with hindsight, it would have been smarter to finish the dissertation first. I'll try to keep this in mind next time.

Despite the different places I worked and visited during this process I feel that my academic home has always been Information Systems Science at Turku School of Economics. Professor Reima Suomi is the person who introduced me the academia and has guided me patiently through this long and sometimes painful, but always exciting path. Reima has always allowed me great independence and freedom of action in my research yet supporting and guiding me through this labyrinth.

My two official examiners Dr. Ilkka Winblad and Dr. Ton Spil have done a magnificent job to make the manuscript into thesis with their valuable insights and comments. It has been a great privilege to have experts from e-health field to review the manuscript. I also wish to thank Dr. Winblad for accepting the invitation to act as the opponent of my thesis.

Similarly, I have been privileged to co-author several Finnish experts from their fields with the articles of my dissertation: I want to thank especially Dr. Hannele Hyppönen and other authors: Prof. Pirkko Nykänen, Prof. Olli-Pekka Hilmola, Prof. Hannu Salmela, Mr. Timo Kestilä, Dr. Pekka Ruotsalainen, and Mrs. Marja Pajukoski.

Within the ISS faculty I have had many valuable discussions and received valuable help and comments from many different persons, especially I wish to thank Hannu, Kessu, Japi, Reetta, Timo, Teemu and Jussi. In addition, I'm grateful to Birgit for taking care of practical matters during this process.

During my post-graduate studies I made an interesting and eye-opening excursion to Ryerson University, I wish to thank Prof. Ojelanki Ngwenyama for arranging me this opportunity and all his help. I had also unfortunately short but pleasant period at Turku Health Offices, thank you Mika for your

mentoring. Finally, I ended up as being head of development at TSE Pori unit, once again magnificent but too short visit. I wish to thank Pori staff, and especially “my girls” Petra, Sara, Outi, Iris, Mari, Anu, Eevaleena, Anna-Mari and Sini. With Pertti we had many good discussions during our long trips between Pori and Turku.

I wish also to thank rector of TSE, Tapio Reponen and Turku School of Economics Association for their support during my postgraduate studies and arranging financing for many important excursions, conferences and visits. My new employer, Net Effect Ltd. has given me the time to wrap up the thesis, which is gratefully acknowledged.

I never felt that dissertation would not eventually finish. I had several financiers who have supported my work generously and shed light to the importance of my research. I wish to express my gratitude for the following beneficent for their financial support and their trust to my work: Hans Bang stiftelsen, the Finnish Foundation for Economic Education, Instrumentarium Scientific Foundation, The Finnish Cultural Foundation, Marcus Wallenberg foundation, Matti Koivurinta Foundation, Turun kauppaseuran säätiö and Turku School of Economics Association. Without the support from these foundations I could not have been able to concentrate on the research.

Last, but not least I wish to thank my family, friends and relatives for their support, especially Riina, light of my cloudy days.

Turku, 8th of April, 2008.

£

LIST OF ABBREVIATIONS

AFP	Association of Finnish Pharmacies
AR	Action Research
CAR	Canonical Action Research
CPR	Collaborative Practice Research
DB	Data Base
ECE	Early Childhood Education
EDI	Electronic Data Interchange
EHR	Electronic Health Record, sometimes referred to as a
EMR	Electronic Medical Record; or
EPR	Electronic Patient Record
EPS	Electronic Prescription System
ETP	Electronic Transmission of Prescriptions
EU	the European Union
HCIS	Health Care Information System
ICT	Information and Communication Technology
IOR	Inter-Organizational Relationships
IOIS	Inter-Organizational Information Systems
IOS	Inter-Organizational Systems
IS	Information System
ISDM	Information System Design Method
ISS	Information Systems Science
IT	Information Technology
MIS	Management Information System
MRQ	Major Research Questions
NAM	the National Agency for Medicines
NAO	Network Administrative Organization
NHI	National Health Insurance
PBM	Pharmacy Benefit Management
SII	the Social Insurance Institution of Finland, Kela
SSL	Secure Sockets Layer
SSM	Soft Systems Methodology
STM	The Ministry of Social Affairs and Health
UP	University Pharmacy

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	3
1 INTRODUCTION	11
1.1 Background of the research.....	11
1.2 Motivation for research	12
1.3 Research domain	14
1.3.1 Overview of the research domain.....	14
1.3.2 Health care and pharmacy sector in Finland	17
1.3.3 The case of electronic prescription pilot in Finland	19
1.4 Research questions	22
1.5 Outline of the study	25
2 METHODOLOGY	29
2.1 Information Systems Science	29
2.2 Research paradigm	30
2.3 Research approach.....	31
2.4 Methods of the study	35
2.5 Limitations of the chosen research approach and methods.....	36
2.6 The generalizability, relevance, and validity of the thesis	36
2.7 Rationalization of methods.....	38
2.7.1 Interdisciplinary IT evaluation in the EPS implementation ..	39
2.7.2 EPS as a national infrastructure.....	39
2.7.3 EPS in lieu of business models.....	40
2.7.4 Building Inter-organizational Cooperative Network for IT Collaboration	40
2.7.5 Governing the implementation of a complex IS network	40
2.7.6 Rationalisation of methods summarised.....	41
3 THEORETICAL FRAMEWORK.....	43
3.1 Background of the theory formulation	43
3.2 Inter-Organizational Systems	45
3.3 IOS Adoption and implementation	49
3.3.1 IS adoption and implementation in general.....	49
3.3.2 IOS implementation in Health care	51
3.3.3 The rationale to implement EPS.....	54
3.3.4 The governance of the Finnish EPS implementation	59
4 REVIEW OF THE RESULTS	67
4.1 Interdisciplinary IT evaluation in the EPS implementation.....	67
4.2 EPS as a national infrastructure	69

4.3	EPS in lieu of business models.....	70
4.4	Building Inter-organizational Cooperative Network for IT Collaboration	71
4.5	Governing the implementation of a complex IS network	72
5	SUMMARY AND CONCLUSIONS	77
5.1	Theoretical Implications.....	77
5.2	Practical Implications	79
5.3	Limitations of the study.....	80
5.4	Summary of implications	80
5.5	Further Research.....	81
6	REFERENCES	83
PAPER 1:		
	TESTING A THEORETICAL FRAMEWORK FOR INTERDISCIPLINARY IT EVALUATION: THE CASE OF THE FINNISH ELECTRONIC PRESCRIPTION.....	99
PAPER 2:		
	ORGANIZING FOR A NATIONAL INFRASTRUCTURE PROJECT: THE CASE OF THE FINNISH ELECTRONIC PRESCRIPTION.....	125
PAPER 3:		
	BUSINESS PLURALISM OF ELECTRONIC PRESCRIPTIONS: STATE OF DEVELOPMENT IN EUROPE AND THE USA.....	137
PAPER 4:		
	BUILDING INTER-ORGANIZATIONAL COOPERATIVE NETWORK FOR IT COLLABORATION.....	157
PAPER 5:		
	GOVERNING THE IMPLEMENTATION OF A COMPLEX INFORMATION SYSTEMS NETWORK: - THE CASE OF FINNISH ELECTRONIC PRESCRIPTION.....	167

LIST OF FIGURES

Figure 1. Graduated Levels of Electronic Prescribing (eHealth Initiative 2004) p. 25.....	15
Figure 2. The Structure of Finnish Health Care System (adapted from Kumpusalo et al 1991; Suomi & Salmivalli 2002)	18
Figure 3. Centralized database solution for the Finnish Medicine Prescription System (The Social Insurance Institution of Finland 2001; Hyppönen et al. 2005c)	20
Figure 4. The cyclical processes of action research (Susman & Evered 1978) p. 588.....	32
Figure 5. The formalized structure of SSM as a learning system (Checkland & Holwell 1998b) p. 160	34
Figure 6. Formation of Cooperative Alliances (Kumar & Van Dissel 1996, p. 282)	46
Figure 7. A Framework for IOS (Hong 2002 p. 264).....	48
Figure 8. Revised CHIN implementation model (Payton 2000 p. 317)	52
Figure 9. Forms of Network Governance (Provan & Kenis 2007)	61

LIST OF TABLES

Table 1. Features and benefits of electronic prescription at each level. (eHealth Initiative 2004 p. 26)	16
Table 2. Summary of original research papers.....	27
Table 4. Summary of Network Evaluation Relationships (Provan & Milward 2001) p. 416.....	56
Table 5. Key Predictors of Adoption of Network Governance Forms (Provan & Kenis 2007)	62
Table 6. Key Governance Features of the Finnish EPS applied in Provan & Kenis (2007) framework	63
Table 7. Finnish EPS implementation governance framework.....	64
Table 8. Summary of implications	81

1 INTRODUCTION

The objective of this study is to understand the implementation process of the Finnish Electronic Prescription System (EPS). By comprehending the underlying rationale behind the implementation decisions, health care policy makers have a foundation for arranging high quality health services and the governance of implementation processes can be critically evaluated. Furthermore, this study aims to contribute to the research of health care information system network implementation process governance.

This Chapter represents the starting points of this study. First, the background of the research is introduced, and then motivation for research and the research domain are described. Research questions are presented in section 1.4. Finally, the structure of the study is summarized in Chapter 1.5.

1.1 Background of the research

Several national health care systems of western countries are facing enormous pressures due to, e.g., demographic shifts in their populations and consequential demand for health care. Healthcare policy makers and researchers are looking for the means to constrain the soaring costs of health care (Al et al 2004; Adang et al 2005). Many Western governments are seeking methods to rationalize their health policies and improve the quality of health care sector.

Health care information systems (HCIS), including electronic prescription systems (EPS), are seen as one approach to rationalization and improving efficiency in the health care sector. For example, the European Union (EU) has set eHealth as a policy priority, expecting Information and Communication Technologies (ICT) to be utilized in order to provide better quality health care Europe-wide. (Communication from the Commission to the Council 2004)

Policy, strategy and financial steering have been strong for over 10 years both on national and EU levels, pushing implementation of information systems and electronic patient data transfer in health care. (Communication from the Commission to the Council 2004; 2005). European Commission eHealth Conference (2007) Declaration makes a proud statement of: *“eHealth will enable higher-quality, effective healthcare that is safe, empowering, and*

accessible for patients, and cost-effective for governments. A reliable organisational and technical framework will also support a growing market for European industry. To provide Europeans with a continuity of healthcare that is accessible across borders, high-quality and efficient, the European Union will build on existing national and regional healthcare systems and services.”

Many EU member states as well as countries outside EU have taken Electronic Prescription Systems (EPS) as key strategic applications, with which governments seek to show the benefits of ICT in health care. Various EPSs have been tested, implemented, or are being implemented in several European countries and America.

Among others, the implementing countries include: *Canada* (Taylor & Tamblyn 2004); *Denmark* (Demkjaer et al 1999); *Germany* (Brill et al 2005); *the Netherlands* (Boonstra 2003; Schuring & Spil 2003; Boonstra, et al 2004; Spil et al 2004); *Portugal* (Freire 2006); *Spain* (Pina Vera 2006), *Sweden* (Bastholm Rahmner et al 2004); *The UK* (Mundy & Chadwick 2002; Mundy 2003; Mundy et al 2003; Mundy & Chadwick 2004); *the US* (Bobb et al 2004; Koppel et al 2005; Teich et al 2005) and *Finland* (Hyppönen et al 2007; Hyppönen et al 2005c; Hyppönen, et al 2006)

1.2 Motivation for research

Research on the implementation process of multi-organizational networks of health care information systems is still relatively novel, especially on the aggregate national level (Johns 1997; Ammenwerth, et al 2003; Dedrick, et al 2003; Wang et al 2003; Burke & Menachemi 2004).

Health care information systems are and have been implemented without proper preliminary analysis on the pros and cons of the systems. Doing a proper analysis of the impacts of HCIS is, however, an exceedingly difficult task. Health care information systems usually consist of numerous varying systems and subsystems often traversing institutional and organizational boundaries, making management and liability issues enormously challenging. Technical challenges seem to be the lack of integration of systems and their poor interoperability. (Itkonen 1999; Nykänen 2000; Bakker 2002).

There is significant amount of evidence that a large number of HCIS initiatives are failures in both the private sector and the public sector. (Armoni 2000; Heeks et al 2000; Heeks 2006). Furthermore, the more ample the technology or the broader the span of the implementation, the more difficult it appears to attain success (Berg 2001). This thesis does not elaborate on the

general IS success factors, such as factors defined by, e.g., (DeLone & McLean 1992; Seddon et al 1999).

The implementation of EPSs is an 'irreversible' intervention in the large, multifaceted and deep-rooted actor-network of hospitals, doctors, clinics, pharmacies, authorities, commercial executors (e.g., software vendors) and patients with occasionally divergent objectives (Salmivalli 2006; see also Mundy & Chadwick 2004). Despite this, the anticipated benefits seem on quick glance worth the effort: EPS technologies are anticipated to answer the challenges of rising drug costs and increasing patient demand, e.g., through rationalizing the medication practices of physicians by providing:

- a.) Up-to-date information about the cheapest medication
- b.) Reducing overlapping medication;
- c.) Reducing medication errors and adverse drug interactions;
- d.) Decreasing prescription handling costs; and
- e.) Increasing efficiency in several organizations (e.g., a reduction in telephone prescription queries from pharmacies to physicians).

Among these improvements, electronic prescriptions are expected to provide more accurate and up-to-date statistical information about medication practices and hence increase the efficiency of pharmaceutical distribution and improve the planning of national health policy in the long run as well. (see, e.g., (Boonstra 2003; Bastholm Rahmner et al 2004; Bell et al 2004b; Mundy & Chadwick 2004)

Regardless of the potential and magnitude of EPS initiatives, the research on Electronic Prescriptions Systems is still a relatively new area in the academic literature (Niinimäki & Forsström 1997; Schiff & Rucker 1998; Keet 1999; Middleton 2000; Teich et al 2000; Boonstra 2003; Schuring & Spil 2003; Bastholm Rahmner et al 2004; Bell et al 2004a; Bell et al 2004b; Bobb et al 2004; Boonstra et al 2004; Mundy & Chadwick 2004; Spil et al 2004; Koppel et al 2005; Pizzi et al 2005) and research from the network governance perspective of these systems are still lacking. Therefore, the underlying rationale and management of implementation process of EPS should be critically studied from the network governance perspective.

1.3 Research domain

1.3.1 Overview of the research domain

This thesis discusses the implementation case of Finnish electronic prescription system. The empirical part of the study was conducted as a member of inter-disciplinary research team evaluating the implementation process of Finnish EPS, the research process is described more in detail in Chapters 2.3 and 2.4, and the limitations of the chosen approach in Chapter 2.5. Research domain of the evaluation was Finnish health care sector, but evaluation included the comparison of Finnish EPS to equivalent solutions in other countries. The Swedish system was most thoroughly studied and reported (Hyppönen, Salmivalli & Tellinger 2006).

There is no single definition of electronic prescription. In this study, we define the Electronic Prescription System (EPS) as representative of the entire socio-technical system, with various actors and subsystems. Electronic prescriptions are sometimes referred to as Electronic Transmission of Prescriptions (ETP) (e.g., Middleton 2000; Mundy & Chadwick 2004), but we feel that transmission is only part of the electronic prescription system: equally important are the storage and treatment of prescriptions electronically. However, we acknowledge the fact that the starting points and context, implementation process and technical solutions for EPS differ from one country to another (e.g., Hyppönen et al. 2006). The Finnish EPS is described in detail in Chapter 1.3.3.

An American study (eHealth Initiative 2004) has identified six different levels of electronic prescribing, namely:

1. Electronic drug reference only, no prescribing capability;
2. Stand-alone prescription writer, with no medication history or supporting data;
3. Addition of basic supporting data, such as allergies, demographics, and formulary information, which can be used by the system to generate alerts;
4. Medication management – long-term tracking and monitoring of each patient's active medications;
5. Connectivity among practices, pharmacies, payers, intermediaries of PBMs (Pharmacy Benefit Management organizations), and patients;

6. Integration with a more complete electronic health record (EHR, sometimes referred to as an Electronic Medical Record (EMR)); or Electronic Patient Record, EPR).

Figure 1 describes the 6 levels of electronic prescribing.

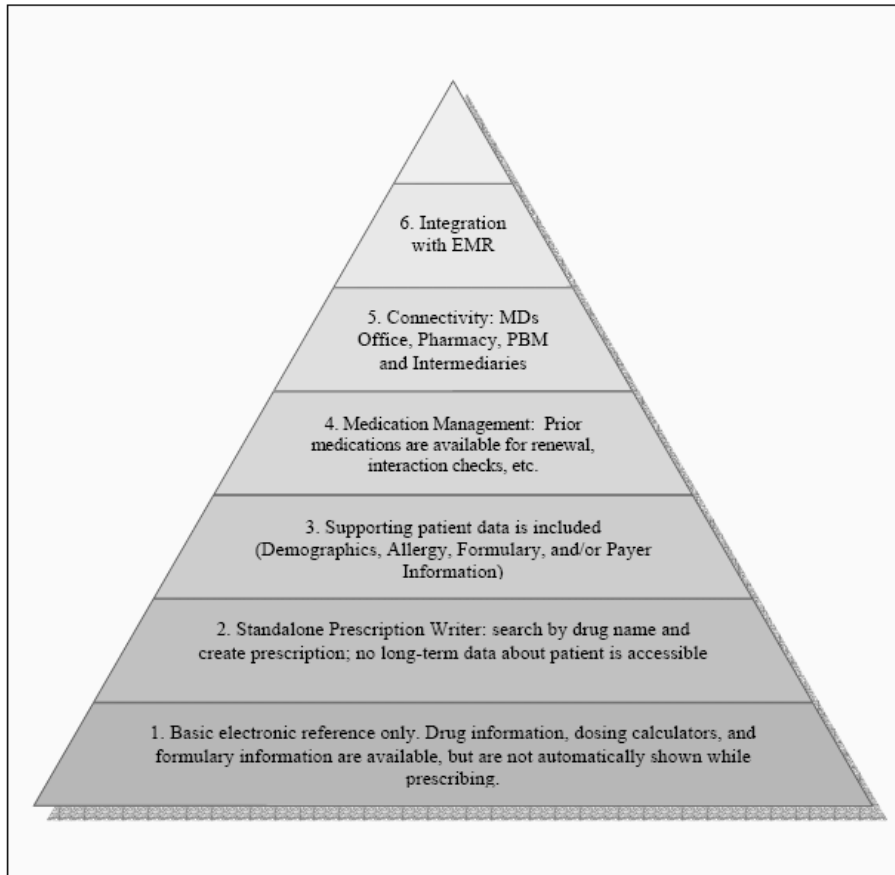


Figure 1. Graduated Levels of Electronic Prescribing (eHealth Initiative 2004)
p. 25

The same study lists benefits of each respective level of electronic prescription sophistication. In addition to the detailed list, the study cites the following estimated benefits:

- Direct patient access to review personal medication regimen, suggest corrections and changes, and submit refill and renewal transactions.
- Aggregate databases to support the greater understanding of the impact of prescription drugs on public health.

- Additional communications regarding benefits changes, formulary updates, drug utilization reviews and other important information. (eHealth Initiative 2004)

Table 1 summarizes the estimated benefits.

Table 1. Features and benefits of electronic prescription at each level. (eHealth Initiative 2004 p. 26)

Level	Description	Additional Benefits
1. Electronic Prescription Reference	“Reference handbook” information is available in one system and links drug information, general formulary information, and interactions checkers.	Information is available in one place and integrated to facilitate handwriting of prescriptions. May prevent errors passively if user opens it at the relevant moment. Improves convenience.
2. Standalone Prescription Writer	Allows one to search for a particular drug and create a prescription. Generally-used dosages are included.	No patient-specific information on allergies, drug history, health plan, or medication history is included. Safety enhanced through legibility and standard dosages.
3. Patient-specific Prescription Creation or Refilling	Includes some combination of demographics, formulary, allergies, and plan information.	Allows tailoring of prescription to patient unique needs and desires. Provides safety benefits from clinical decision support for allergies. Enables consideration for elderly or pediatric patients. Also reduces callbacks. Formulary checking improves cost and compliance.
4. Medication Management	Access to prior medication history and current regimen is available, either through prior entries or through linkage to an external database, or both.	Significantly enhanced safety levels from warnings for drug-drug interactions, therapeutic duplications. Allows efficient refills and renewals, possibly including reminders.
5. Connectivity	Transmission of a “clinically certified” prescription to the dispensing site requested by the patient. Enhanced linkages between all parties involved in patient medication management.	Additional assurances that the medication order is consistent with the clinical intent, dosing guidelines, and health plan design. Reduces transcription errors, speeds dispensing. Allows for additional interaction checks and lowers administrative costs.
6. Integration with EHR	Medication ordering automatically linked to the comprehensive health record used to provide clinical care. Includes access to lab and test results, problem lists, diagnoses.	Many enhancements to quality: problem-based ordering, disease management reminders, drug-lab result conflicts, renal dosing, drug monitoring needs. Integrates medication ordering into the overall process of medical care delivery.

The next Chapter briefly lists special organizational characteristics of the health care domain in general; after that, the Finnish health care sector is described briefly to ensure that the reader understands the operating and decision-making environment in which the Finnish EPS was piloted. After

describing the health care sector in Finland, the reader is introduced to the developing process of EPS in Finland.

1.3.2 Health care and pharmacy sector in Finland

This Chapter describes the Finnish health care sector briefly in order to acquaint the reader with the research domain on the general level. The Finnish health care sector has been described (e.g., OECD 2005) and analyzed (e.g., Häkkinen 2005) in more detail in other publications.

The Finnish health care system resembles those of other Nordic countries and the UK in the sense that it covers the whole population and its services are mainly produced by the public sector and financed through general taxation. A distinctive feature of the Finnish system is the National Health Insurance (NHI) scheme, which partly reimburses the same services that are funded by taxation, but also other services, e.g., medications prescribed by a doctor, private sector examinations and treatments performed or prescribed by a doctor or dentist, and transportation services. (Järvelin 2002; Häkkinen 2005)

Furthermore, the Finnish system is exceptionally decentralized: the main duty for organizing health care in 2007 is borne by 416 local authority municipalities round the country. The local authorities are *inter alia* responsible for organizing primary and specialist medical care for residents of the municipality. In order to provide specialist care, the country is divided into 21 hospital districts, and each municipality must belong to one of the hospital districts. Each hospital district has a central hospital of its own, five of which are university hospitals. (Järvelin 2002; Häkkinen 2005).

Finnish public health care is supplemented by private health care actors, especially in the larger municipalities. Private health care units offer private medical and dental services in addition to physiotherapy and occupational health care services. Figure 2 presents the traditional division of Finnish health care into private and public sector care and, on the other hand, into primary and specialist health care. Access to specialist medical care requires referral by a physician except in cases of emergency. The aim is for the patient to receive information on the timing of examination and the commencement of treatment within two weeks from the arrival of the referral at the hospital. (Kumpusalo et al 1991) Altogether there were approximately 16,500 physicians in both the public and private sector in 2003 (317 persons per physician). (Stat 2005)

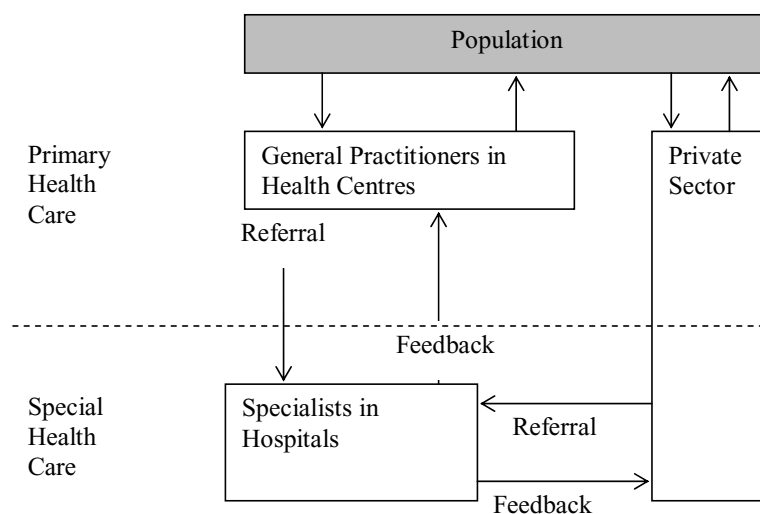


Figure 2. The Structure of Finnish Health Care System (adapted from Kumpusalo et al 1991; Suomi & Salmivalli 2002)

Health care costs have been increasing in Finland in real terms since 1995 and have been rising faster than other public spending. In 2003, health care spending was 10.7 billion euros with real growth of 2.9 per cent relative to the previous year. (Stakes 2006) During the same year, the reimbursable costs of medication reached 1422 million euros, and the compensation paid from this was 917.5 million euros (6.8 % growth). In 2004, the reimbursable costs of medication totalled 1538 million euros, and the compensation remitted was 1014.6 million euros (10.6 % growth). The increase in the costs of medication was temporarily hindered by generic substitution commenced in 2003, but the proportion of medication costs from all health care spending has been in the area of approximately 16 per cent. (Lamberg 2006)

In Finland, medicines may be sold to the public only by pharmacies and subsidiary pharmacies with the exception of sparsely populated areas, where non-prescription products may be sold by medicine dispensaries owned by pharmacies. An order by doctor, dentist, or veterinary surgeon is needed for the purchase of prescription medicines from a pharmacy. (National Agency on Medicines 2004)

There were 601 pharmacies in Finland in 2003. Pharmacies are privately owned. The University of Helsinki also has the statutory right to run one pharmacy in Helsinki and subsidiary pharmacies with the permission of the National Agency for Medicines. Moreover, the University of Kuopio has the statutory right to run one pharmacy in Kuopio. (National Agency on Medicines 2004; Stat 2005)

Permission to own and operate a pharmacy is granted by the National Agency for Medicines (NAM). The Agency announces vacancies and grants the privilege to the applicants of its choice. Proprietary pharmacists are required to have a M.Sc. in Pharmacy. Pharmacies dispensed approximately 38.5 million prescriptions in 2002, from which 28.1 million prescriptions were granted compensation from Kela, the Social Insurance Institution of Finland (SII). Approximately 80 per cent of all medication expenditure derives from prescription medicines. (National Agency on Medicines 2004; Stat 2005)

All in all, the current Finnish manual system for medicine prescription is relatively sound. The patient receives a printed (either filled in by hand or computer-generated) prescription form for medication from the doctor, containing identification data concerning the patient and physician. There is space for two drugs and an area intended for dispensing and renewal information. The patient brings the forms to a pharmacy, where the pharmacist feeds in the data from the prescription to a pharmacy program designed to dispense the medication. The program calculates the price for the drugs, deducting the amount of national insurance if the client has the social insurance card with him/her. The program prints bar code slips with the price which the pharmacist attaches to the drugs. The pharmacist marks on the form the amount of medication which is dispensed and returns the form to the client with the medication. The second page of prescription is left at the pharmacy for invoicing the national insurance office for the insurance share of the medication price. (Hyppönen et al 2005c)

1.3.3 The case of electronic prescription pilot in Finland

In Finland, the first experiments in electronic prescribing were card-based trials, organized by the Social Insurance Institution during 1989-1993 in three areas. The system was abandoned, due to the lack of the processing capacity and prescription software being inadequate to produce an efficient prescribing process. There were also suspicions about the card-based system as a national solution. (The Social Insurance Institution of Finland 2001)

The Ministry of Social Affairs and Health (STM) commenced a project in 2000 in order to draw conclusions on experiences from earlier trials and to recommend a national concept for electronic prescribing to synchronize the development work. This was done in line with the National Strategy for the Implementation of Information Technology in Social and Health Care (1996). Based on the Ministry's assignment, in 2001 the Social Insurance Institution of Finland published a preliminary disquisition of electronic prescription with the National Agency for Medicines (Social Insurance Institution 2001).

The model suggested in the report was based on electronic storage as well as the retrieval of prescriptions, which requires the patient's written consent. The physician creates an electronic prescription with either a stand-alone electronic prescription program or a program integrated with the electronic patient records systems. The prescription is signed with the physician's secured electronic signature. Instead of printing a prescription, it is transferred from the doctors' offices to the national database, where it is stored. The patient receives a printed "memory slip" instead of a prescription. At the pharmacy, pharmacists use their electronic identification card together with the patient's social security number to retrieve the patient's prescriptions by means of computers connected to the national database. Information transfer to and from the database is secured against unauthorized access with Secure Sockets Layer (SSL)-technology. (The Social Insurance Institution of Finland 2001; Hyppönen et al. 2005c) Figure 3 describes the centralized database system of electronic prescription.

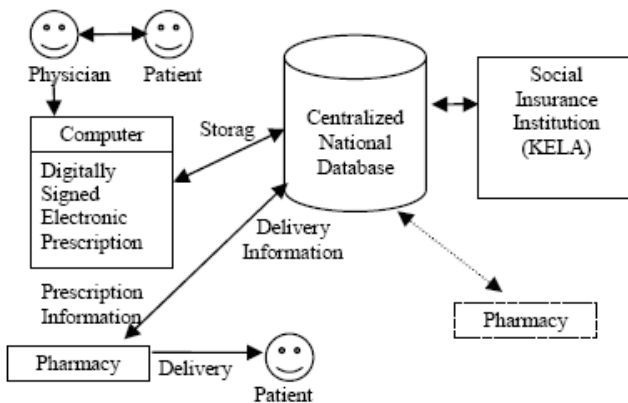


Figure 3. Centralized database solution for the Finnish Medicine Prescription System (The Social Insurance Institution of Finland 2001; Hyppönen et al. 2005c)

The disquisition summarized as follows: *“It is proposed in the report that the described model of action should be tested. As regards piloting, in particular the most important qualities of the new system should be tested, including the consent procedure, links to the basic systems, the general procedures in processing prescriptions at the doctor’s reception, in the pharmacy and the Social Insurance Institution, electronic signature, other technology, databases and technical functions related to them, agreement procedures in the administration of the database, and data security.”*

It is worth noting that the report states the following regarding the costs and benefits of the planned system:

“Within the context of the time available, the project group has not even attempted to assess the overall costs of the electronic prescription system. However, it is clear that in the event of the success and more prevalent use of the electronic system, this will result in various work savings connected with the rationalization of the many functions of the separate stages. In addition, it may be justifiably assumed that the better management of the patients' overall medication regimen enabled by a concentrated prescription database in both the physician's reception and at the pharmacy will lead to the more rational use of medications than at present. This has positive impacts not only for the individual patient but for the community as a whole.

Prescription information is connected with a large number of various commercial interests. In the proposed operational model, the processing of prescription data is entirely characterized by the operations of the authorities. The goal is that the savings to the public economy brought about by the rational use of medications will cover the construction of the system as well as the costs incurred from its upkeep. On the basis of the results of the pilot project, reliable assessments on the profit yields and costs caused by the electronic prescription system are only now being implemented.” (The Social Insurance Institution of Finland 2001, p.68, translated from Finnish by an official translator)

In 2002, the Ministry established a national project to construct and pilot the system suggested in the report. The Ministry selected four separate regions for clinical tests of the pilot system. Regions comprised of units of health care organizations, pharmacies represented by the Association of Finnish Pharmacies (AFP) and pharmacy sublets represented by the University Pharmacy. A national steering group coordinated the local pilots.

An experimental decree on electronic prescribing was issued in 2003. The decree laid down provisions on preparing, signing, technical content, altering and delivery of e-prescriptions. There were also provisions on informing patients and obtaining their consent, defining the rights of access to the database, and maintaining e-prescription information in the national database.

The actual technical construction of the system took 2 years, and the first clinical pilot started in 2004. By the end of 2005, two out of four piloting health care units had implemented EPS integrated in the Electronic Patient Record (EPR), and in one area, an integrated pharmacy system was implemented to dispense electronic prescriptions. In spring 2005, the organization of the national e-prescription pilot was changed thoroughly; the part-time project manager of the pilot was changed to a major consultancy company, which reorganized the administration of pilot entirely. (Salmivalli

2006) The amount of produced e-prescriptions remained very small: during the entire pilot, 1075 electronic prescriptions were written, 436 were dispensed in total and 137 on a partial basis. The writing of electronic prescriptions was terminated on 30 June 2006 – on the same date, the steering group ended its work. The project was taken over by the Social Insurance Institution (SII/Kela) 1.7.2006.

The permanent law on electronic prescription came into force 1 April 2007, and on 29 May 2007, the Social Insurance Institution of Finland announced that Fujitsu Services Ltd. had won the public procurement on constructing the EPS. According to the plans, implementation is beginning in 2008, first in 2 – 3 areas. The objective is that by 2010 half of all prescriptions would be electronic nationwide (Mediutiset 2007b; 2007a).

1.4 Research questions

The theoretical approach of this dissertation is introduced in detail in Chapter 3. The research originates in its broadest sense from the *network* research tradition that has evolved in different disciplines and especially from the research tradition of *inter-organizational relationships* (IOR).

Perhaps the most fundamental difference between a network and an organization is the lack of a single authority to ensure coordination of actions. Absence of a single authority has led networks to employ a wide array of mechanisms to be used for building and maintaining commitment to joint efforts. These mechanisms have intrigued researchers in many fields, e.g., economics (Williamson 1985), strategic management (Thorelli 1986), organization science (Ouchi 1979), marketing (Wilkinson 2001), sociology (Leblebic et al 1991), public administration (Provan & Milward 2001), information systems (Malone et al 1987; Choudhury 1997) and strategic information systems planning (Johnston & Vitale 1998; Salmivalli et al 2008).

An inter-organizational relationship (IOR), in turn, can be defined as “*a social action system on the premise that it exhibits the basic elements of any organized form of collective behavior*” (Van de Ven 1976). These IORs include strategic alliances, partnerships, coalitions, joint ventures, franchises, research consortia and various forms of network organizations (Ring & Van de Ven 1994; Salmivalli et al. 2008).

Within information systems science, the theoretical framework draws from the research tradition of inter-organizational systems (IOS). Information systems science (ISS) as a field is described in section 2.1 and inter-organizational systems in section 3.2.

This thesis aims to contribute in the health care IS research by studying the implementation process of EPS from the inter-organizational information systems (IOS) research and network perspective. The study has two Major Research Questions (MRQ). The research questions have *two key dimensions*: firstly, *health care as operating domain* and secondly, the *network aspect* involved in the implementation process.

“Traditional business” information technology can be seen as a strategic tool for change in staying competitive, streamlining functions, innovating new ways of doing business, or creating novel business opportunities (Scott Morton 1990). In health care, the situation is more convoluted, as organizations within health care operate within an environment very different from many other fields of service and the manufacturing industry. Actors in the health care field possess such organizational features that research findings from other industrial or service sectors may not necessarily generalize to the health care sector. (Blair & Boal 1991; Salmivalli & Nissilä 2004)

Tähkää (2007) adds that health care has been a traditionally isolated area of business, where it has been difficult to bring new ideas from other disciplines without first having it approved by the health care staff. The professionals in health care are highly educated and hence do not easily accept paradigms and tools from other disciplines, being more likely to highlight the differences between their own discipline and other industries. (cf. Suomi et al 2001; Turunen 2001; Tähkää 2007). Additionally, in Finland, health care is dominated by the public sector.

Networks form the second dimension of the Major Research Questions. This thesis adopts concepts developed by Provan in particular (e.g., Provan & Milward 2001; Provan, Fish & Sydow 2007; Provan & Kenis 2007). The thesis uses Provan and Milward’s (2001) division of the network into three different levels, namely: *Community* (Macro) level; *Network* level; and *Organization* level analysis to answer on the first MRQ (Provan & Milward 2001). Suitably, for this thesis Provan and Milward have used the public sector as the domain in their research.

At the most wide-ranging level of analysis, the community level, the networks should be judged by the contribution they make to the communities they are trying to serve. On the network level, analysis focuses on how individual organizations form a functioning network of sovereign actors. Finally, on the organization/participant level, analysis is required, as organizations are always partly motivated by self-interest. Despite the broader value that may go to clients and the community in general as a result of the integrated delivery of services through a network, network members still strive to ensure the survival of their own organizations. Therefore, the first major research question is formulated as follows:

MRQ-1: *What is the intrinsic rationale to implement Electronic Prescription Systems at various levels of the network?*

The first research question is of a very fundamental nature, and it aims to explain why inter-organizational information systems are implemented in health care. The answer to the first MRQ illustrates the opportunities and problems related to the EPS, and provides the basis for the second MRQ.

The second MRQ tackles with the governance of EPS implementation, it has the same key dimensions as the first one, and it is a natural extension of the first MRQ. Inter-organizational information system networks in health care possess some features that make the governance worth researching.

An interesting issue is the existence of public actors and their influence on other (e.g., non-public) actors and the collaboration between these actors. Another interesting point concerns the level of voluntariness in such networks, i.e., are the actors involved in the network voluntarily or not? This question has been created by the first MRQ. An exciting viewpoint is provided in a recent study by (Rodríguez et al 2007), in which they elaborate on *mandated* collaboration, where collaboration is imposed on separate organizations by a third party. This is particularly suitable for describing public sector network initiatives in which there is usually a governmental body imposing its will on individual actors. Hence, the second MRQ is:

MRQ-2: *How is the implementation process of Electronic Prescription System governed?*

The answer to the second MRQ provides a framework to analyze the governance of Finnish EPS. By *governance*, we mean ‘directed influence of social processes’ on the general level covering all sorts of guidance mechanisms connected with public policy processes. The forms of guidance are not restricted to conscious or deliberate forms of guidance. Nor is governance limited to public actors (adopted from (Kickert et al 1997; see also, e.g., Jones et al 1997) for definitions of network governance). *Network management* is a term closely related to network governance: It is aimed at coordinating strategies of actors with varying goals and preferences with regard to a certain problem or policy measure within an existing network of inter-organizational relations. (Kickert et al. 1997)

The purpose of the second MRQ is to look beyond the technical issues of the implementation process. As less than 10 per cent of implementation failures originate from technical problems – and the majority of them occur as a result of human and organizational issues (Halonen 2007) – a holistic approach is called for. Furthermore, the complexity of the research subject

requires a general level investigation and rational organization before getting into detailed research questions. Naturally, the individual research papers have more detailed research questions, but the purpose of this thesis is to deduct an aggregate level knowledge from individual research papers.

The general objective of this dissertation is to create new knowledge for the field of health care IOS implementation, a field remarkably little studied thus far, by providing a framework for the EPS implementation governance process. Furthermore, the pragmatic objective is to formulate guidelines for organizations planning to participate in the EPS implementation venture in the future.

1.5 Outline of the study

This thesis consists of two parts: first part is the overview of the dissertation and second part consists of the original research papers. There are five chapters in the overview: the introduction presents the motivation for research, research domain and research questions. The second chapter anchors this study methodologically in Information Systems Science and describes the methodological approach and methods of the study. The third chapter presents the theoretical foundations of this study, originating from the inter-organizational information systems (IOS) research tradition and broadening the knowledge into the implementation of IOS in health care. The central results of the five original papers are presented in Chapter 4, comprising a review of the results. Finally, Chapter 5 summarizes this study with some practical and theoretical implications and suggestions for future research.

The five original research papers form the second part of this study. The first paper, "*Testing a theoretical framework for interdisciplinary IS evaluation: The case of Finnish Electronic Prescription*", has been published in the International Journal of Healthcare Technology and Management. The paper describes the background of the EPS pilot in detail as well as its evaluation process. The starting points of the paper are in multi-disciplinary IS evaluation, and the paper introduces a framework to evaluate IS development, implementation and diffusion in a specific context. The framework presented is based on three theoretical concepts: the activity system, actor network and development life-cycle.

The second paper was published in the proceedings of The 38th Hawaii International Conference on System Sciences (HICSS-38), and is called "*Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription*". This paper studies the EPS pilot from the infrastructure perspective. It is argued in this paper that implementation of

EPS differs from many other “traditional” IS implementation projects. Furthermore, this paper briefly introduces EPS-implementation experiences from other countries.

The third paper is entitled “*Business pluralism of electronic prescriptions: state of development in Europe and the USA*”, and it has been published in the International Journal of Electronic Healthcare. In this paper, the development process between European and American EPS systems is compared, and business opportunities of the systems are studied. The paper argues that the situation of electronic prescriptions is similar with airline or credit card industry. Both of these are vital for international and local economies, but the business models have developed well after the initial idea.

The fourth research paper “*Building Inter-organizational Cooperative Network for IT Collaboration*” is published in the proceedings HICSS-41, the 41st Hawaii International Conference on System Sciences. The focus of research is on the processes through which IT decisions are made within large inter-organizational networks with several network players. The paper concentrates on an investigation into the processes through which three public sector networks attempted to reach collaborative agreements on the use and management of IT. The theoretical background derives from network theories in organization science. The empirical part of this research was conducted in three networks: in addition to the EPS network, a case of deployment of IT in early childhood education (ECE) and information systems’ governance structure for social welfare service sector in one regional area are presented, and the cases are compared.

Fifth and last paper was published in the proceedings of ACIS 2006 conference, and is entitled “*Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription*”. Theoretical approach of the study is built on inter-organizational networks and their governance, and the paper introduces some theoretical thoughts on possible EPS governance methods.

Table 2. Summary of original research papers

<i>Paper nr.</i>	<i>Title</i>	<i>Published in</i>	<i>Year</i>	<i>Authors</i>
<i>Paper I</i>	Testing a theoretical framework for interdisciplinary IS evaluation: The case of Finnish Electronic Prescription	The International Journal of Healthcare Technology and Management	2007	Hyppönen, H. Salmivalli, L. Nykänen, P. Ruotsalainen, P. Pajukoski, M.
<i>Paper II</i>	Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription	The proceedings of 38 th Hawaii International Conference on System Sciences	2005	Hyppönen, H. Salmivalli, L. Suomi, R.
<i>Paper III</i>	Business Pluralism of electronic prescriptions – State of development in Europe and the USA	The Int. Journal of Electronic Healthcare	2006	Salmivalli, L. Hilmola, O-P.
<i>Paper IV</i>	Building Inter-organizational Cooperative Network for IT Collaboration	The proceedings of 41 st Hawaii International Conference on System Sciences	2008	Salmivalli, L. Salmela, H. Kestilä, T.
<i>Paper V</i>	Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription	the proceedings of the 17 th Australasian Conference on Information Systems	2006	Salmivalli, L.

Table 2. Summarizes the original research papers presented in this thesis. Results of the papers are presented in detail in Chapter 4, “Review of the results”.

2 METHODOLOGY

This chapter describes the methodological foundations of this research and it distinguishes the selected research approach. We begin this chapter by anchoring this research in the Information Systems Science, and then the concepts of paradigm, approach and method are discussed. This study originates primarily from Information Systems Science (ISS) and social sciences on a more general level.

2.1 Information Systems Science

The field of Information Systems (IS) research is relatively novel, having evolved into a dominating area of study in the early 1970s. Some of the earliest seminal works date from the late 1960s and in the research on the Management Information System (MIS) (Ackoff 1967). According to Culnan (1986), the conceptual fundamentals of MIS can be traced back to Leavitt and Whisler's (1958) prediction of the coming of "Information Technology." (Culnan 1986).

The research on IS does not merely concern the systems themselves, but also such issues as *organization, users and information*. Mason and Mitroff already determined in 1973 that an MIS consists of, at minimum, "*a PERSON of a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution, where the evidence is made available through some MODE OF PRESENTATION.*" ((Mason & Mitroff 1973) p. 475))

In 1980 (Ives, Hamilton & Davis 1980) defined MIS as a "*computer-based organizational information system which provides information support for management activities and functions*" (p. 910). Then they assessed five commonly-used frameworks for MIS research from which they formed an integrated model for IS research. The model of Ives et al. (1980) (p. 917-919) consists of

- 1.) *Environmental variables:*
 - The external environment,
 - The organizational environment,
 - The user environment,
 - The IS development environment, and

- The IS operations environment;

2.) *Process variables:*

- IS development,
- IS operations and
- IS use; and

3.) *The IS subsystem (ISS)*

- ISS content,
- Presentation form and
- Time of presentation.

Lee, Gosain & Im (1999) refer to IS research as an *interdisciplinary field*, and IS research has been regarded as originating from *computer science*, *management science* and *organization science*, which constitute the necessary foundations for the discipline (Lee, Gosain & Im 1999 See also, e.g., Culnan 1986). This cross-disciplinary character of IS research has led to a variety of theoretical constructs that allow any phenomena to be examined from numerous idiosyncratic perspectives. Overall, one can say that the field of IS research is extraordinarily fragmented and heterogeneous, and IS research has been lacking cumulative research tradition (cf. Benbasat & Zmud 1999; Goles & Hirschheim 2000).

2.2 Research paradigm

The concept of paradigm in IS research is somewhat amorphous. Traditionally, the *positivist* paradigm has been dominant. Orlikowski & Baroudi (1991) followed Chua (1986) and used threefold classification: positivist, interpretive and critical. Goles & Hirschheim (2000) base their work on the Burrell and Morgan's (1979) four paradigms: *interpretivist*, *functionalist*, *radical humanist*, and *radical structuralist* and elaborate on the possibility of paradigm pluralism in terms of *pragmatism*. (Chua 1986; Orlikowski & Baroudi 1991; Goles & Hirschheim 2000)

In practice, only interpretivism represents a real alternative paradigm to positivism (Goles & Hirschheim 2000 cf. (Walsham 1995). Chen & Hirschheim (2004) list three categories in which interpretivism differs from positivism:

- 1.) *Ontologically*, interpretivists stress the subjective meaning of the reality constructed and reconstructed through a human and social interaction process.
- 2.) *Epistemologically*, interpretivists assume that scientific knowledge should be acquired through the understanding of human and social interaction by which the subjective meaning of the reality is created.

3.) *Methodologically*, interpretivists contend that in order to understand the meaning rooted in human and social interaction, researchers should engage in the social setting explored and understand how the interaction takes place from the participants' perspective, e.g., through field studies that engage researchers in the real social setting. ((Chen & Hirschheim 2004) more on interpretivist research in IS, cf. (Orlikowski & Baroudi 1991; Orlikowski 1993; Walsham 1995; Becker & Niehaves 2007)

This thesis builds on the interpretivist research paradigm. However, the purpose is not to take too strong a stance in the paradigmatic debate within IS research field, but more to justify the research approach and methodological choices of the thesis. One should note that IS research as a field studies phenomena that are multidimensional, complex and dynamic. Therefore, a diversity of viewpoints, methods, and variables is needed to conduct research in the field. (Lee 1991; Lee et al. 1999)

2.3 Research approach

The selected research approach of this study is *Action Research (AR)*. IS research is claimed to be an especially appropriate field for the use of action research. There are various definitions of action research, but one of the most commonly cited is that of Rapoport's (1970), who defines AR in the following way: "*Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework*" ((Rapoport 1970), p. 499).

By definition, AR aims to solve a present practical problem and, at the same time, increase scientific knowledge. What makes action research unique is the researcher's role. Action research places researchers in a 'helping role' within the organizations being scrutinized. In other research methods, the researcher seeks to examine organizational phenomena but not to change them; in action research, the researcher is involved in creating organizational change and simultaneously studying the process. Hence, the action researcher becomes part of the study and interprets the inter-subjective meaning of the observations. Furthermore, the unique nature of each social setting calls for consideration of the social values of organization members. (Baskerville & Wood-Harper 1996; Grant & Ngwenyama 2003; Baskerville & Myers 2004; Iversen et al 2004; Cole et al 2005)

One of the best known AR models is Susman & Evered's (1978) action research cycle (Figure 4) consisting of: *diagnosis, planning, intervention,*

evaluation and reflection. The model has been further developed by, e.g., (Davison et al 2004).

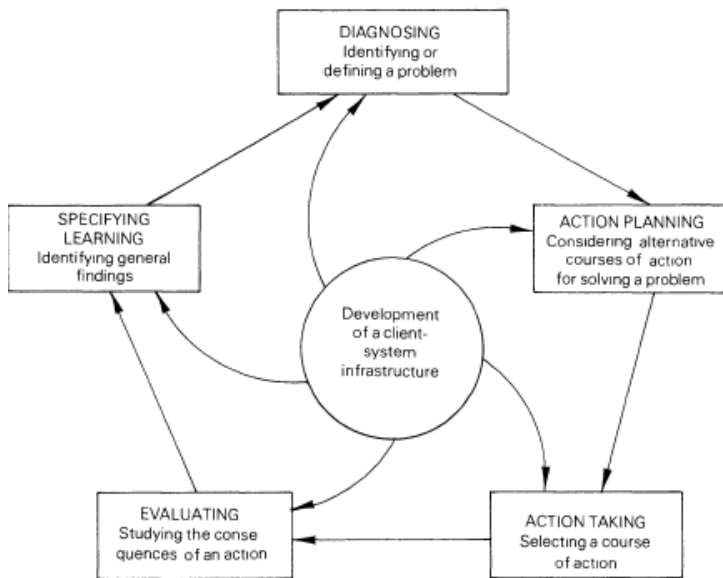


Figure 4. The cyclical processes of action research (Susman & Evered 1978) p. 588

There are several different action research approaches, distinguished by different models, structures and goals (Davison et al. 2004). Baskerville and Wood-Harper 1998 identify and describe the unique characteristics of 10 forms (p.96): *Canonical Action Research (CAR)*, *Information Systems Prototyping*, *Soft Systems*, *Action Science*, *Participant Observation*, *Action Learning*, *Multiview*, *ETHICS*, *Clinical Field Work* and *Process Consultation*. Other forms falling into AR approach are, e.g., *Critical Theory Paradigm* (Ngwenyama & Lee 1997), *Reflective Systems Development* (Mathiassen 1998), and *Collaborative Practice Research (CPR)*, as one variation of CAR (Mathiassen 2002). Baskerville & Wood-Harper (1998) present key characteristics and assumptions for the 10 forms identified according to the *process model* (iterative, reflective or linear), *structure* (rigorous or fluid), *typical involvement* (collaborative, facilitative or experimental) and *primary goals* (organizational development, system design, scientific knowledge or training).

Once again, it is not meaningful to lock-in the debate within the action research field, but to understand the potential and limitations of the chosen approach. This research originates from the *Soft Systems Methodology (SSM)* studies. SSM is best known as an information system design method (ISDM),

but it can also be used as a general problem structuring method that may or may not be used in the production of an information system design as one of many possible solutions. In general, it can be used for any problem situation involving human activity. (Gregory 1995; Checkland & Holwell 1998b) The early stages of the SSM are more concerned with the identification of *who is involved* in the problem and *what the problem is* rather than with the solution of the problem.

According to Rose (2002), the biggest deficiencies of the “traditional” approach is that in, e.g., traditional project management literature the *goals* are presupposed to be obvious or predestined, the primary legitimization is technological and/or economic (e.g., profit maximisation), supporting the interests of management and their representatives, and organizations studied characteristically exclude the social, political or cultural dimensions of analysis.

Coupric et al (2007) distinguish between *hard* and *soft* problems: Hard problems are issues illustrated by the fact that they can be well defined: One can assume that there is a definite solution and one can identify a number of specific goals that must be completed. For hard systems philosophers, systems exist in the world and have an external reality independent of the observer. Human action is presumed to be in essence goal-seeking, rather than relationship maintaining. The *what* and the *how* of a hard problem can be resolved early on in the methodology. (Cf. Rose 2002)

Then again, soft problems are problematical to define. Soft problems are not separate problems but more problem situations. This all suits the problem area of the Finnish EPS implementation pilot and the research questions of the dissertation. The research questions of the study are at a very general level. In the author’s opinion, first the general prerequisites of the system and its organization should be studied before getting deeply into detailed level analysis of the individual sub-parts of the system (Coupric et al 2007). This study aims to deepen the knowledge of EPS in a very broad management perspective level.

SSM has been developed especially by Peter Checkland after working with a number of ‘hard’ system methodologies that were insufficient for dealing with very complex problems with a large social component (Flood 2000).

According to Checkland (1985) the essence of SSM is constructed around the concept of the *human activity system* meaning that “*whenever we describe purposeful human activity, we include an interpretation, a taken-as-given point of view or Weltanschauung*” (p. 822). SSM acknowledges that in human activity systems there are no *right* and *wrong* descriptions, but various possible descriptions based on distinct taken-as-given images of the world.

Checkland & Holwell (1998b) summarized the general principles of SSM, which Puhakainen (2001) has condensed as follows:

- SSM is usually associated with ill-defined problems that tend to be strategic and important, rather than with well-defined, technical problems
- SSM is a process for managing
- SSM compares models with real-life
- SSM is learning and action, aimed at improving something existing
- Finally, SSM is more a set of principles of a method rather than a precise method, and it has to be adapted by its users to the demands of the situation and their own mental modes and casts of mind. (Puhakainen 2001)

As set in the principles, the SSM process should be seen as a learning cycle instead of a linear process, Figure 5 describes the idealized formal structure of SSM as a learning process (in detail in Checkland & Holwell 1998b, p.158-162).

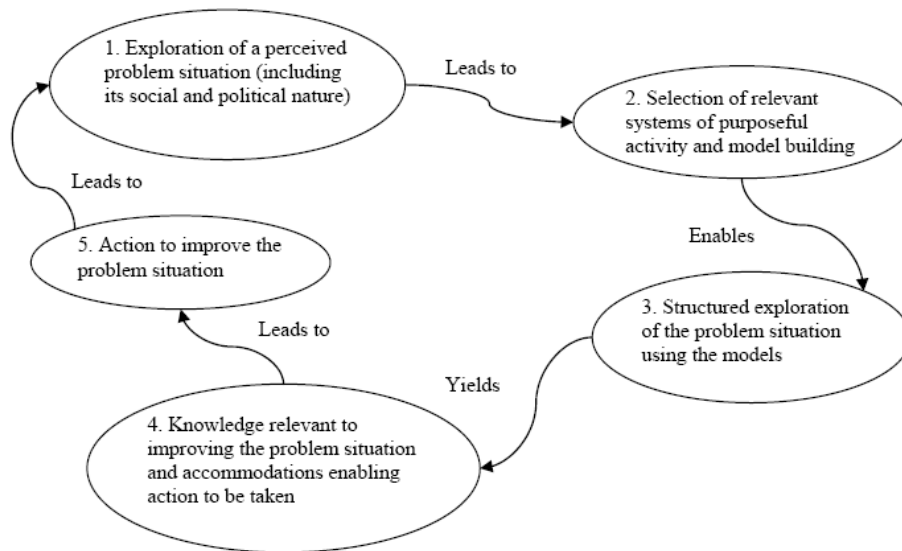


Figure 5. The formalized structure of SSM as a learning system (Checkland & Holwell 1998b) p. 160

2.4 Methods of the study

The evaluation process in whole was multidisciplinary and the research included a variety of different data collection and analysis methods from various fields of science. The evaluation team consisted of experts from the following fields:

- Educational Science (Work Research)
- Information Systems Science
- Jurisprudence
- Management research
- Technology research

The author of this thesis concentrated on the IS management issues, and on widely speaking on the ‘business logic’ issues of EPS. Yet one should bear in mind that the whole evaluation process was inter-disciplinary in nature, meaning that, e.g., issues of management research were reflected to ISS and jurisprudence (e.g., in data privacy issues) and vice versa.

Methods of data collection during the entire evaluation process included the following:

- *Observation* (e.g., through filming the working processes at pharmacies and doctor’s offices)
- *Questionnaires*
- *Interviews*
- *Document analysis*

The nature of the evaluation assignment called for a wide array of data collection methods in order to answer all the questions emerging from different fields of science. Apart from the practical requirements, collecting different sorts of data from diverse sources with distinct methods allows wider range of coverage, which in turn can provide more comprehensive picture of the unit being studied that would have been achieved with using only one method. (for combination of qualitative and quantitative methods cf. Kaplan & Duchon 1988; Tähkäpää 2007)

The emphasis in this thesis is on qualitative data, especially on data collected from interviews, but some quantitative data is also used in order to supplement and support the results gained from interviews. The reason for using qualitative methods originates from the need to understand the underlying rationale behind the Finnish EPS pilot.

2.5 Limitations of the chosen research approach and methods

Action research, soft systems methodology and qualitative data collection are exposed to a number of threats, which can be controlled if the researcher is aware of the limitations of the chosen approach and methods.

Kock (2004) has engaged in extensive research on AR in information systems studies and has identified three main threats inherent in action research, which can all be evaded with proper “antidotes”:

1. *The uncontrollability threat*: meaning that the researcher’s degree of control over the research environment and the subjects is always incomplete. The essence of this threat is that environment being studied will change in a manner that is completely unexpected for the researcher.
2. *The contingency threat*: meaning the difficulty to generalize research findings or difficulty to apply research findings in contexts different from the one in which they were generated, i.e., highly contingent findings contain little external validity.
3. *The subjectivity threat*: culminates on the fact that the personal involvement of action researcher can push one into interpreting the research data in particular and potentially subjective ways, resulting that interpretations can end up being completely wrong. (Kock 2004)

Baskerville & Wood-Harper (1996) have presented similar problems within AR, additional claims towards AR include *lack of rigor*, which means fitting the research methods to the problem to produce valid scientific explanations, and the use of multiple methods to produce valid research constructs; and *masquerading consulting as research*. (Baskerville & Wood-Harper 1996 p.240-1)

The main weaknesses of Soft systems methodology are, according to Flood (2000) and Puhakainen (2001), are that SSM is amorphous and very difficult to lay out in steps to follow, and that SSM does not fully acknowledge the importance of organizational power and politics.

2.6 The generalizability, relevance, and validity of the thesis

Issues that the researcher should always explicate are the generalizability, reliability and validity of one’s research. Generalizability is a key issue to researchers and users of research, it denotes, among other things, to the *validity* of a theory in a different setting than the one where it was empirically tested and confirmed. In other words, generalizability represents the utility of a distinct theoretical construct outside the environment in which it was

developed. A theory lacking generalizability has very little use. (Lee & Baskerville 2003; Tähkäpää 2007)

There are two extreme approaches into generalizability: on the other hand, positivists would claim that any field of research should be nomothetic in order to qualify as scientific and hence work towards the ideal of discovering universal or general laws. On the other hand, interpretivists would say that the aim of universal laws is inappropriate in the study of human-related issues, because social constructions are unique, and therefore require idiographic theorizing instead (Lee & Baskerville 2003).

Baskerville (1996) has described generalization process in detail, dividing generalization into two stages and between nomothetic and idiographic approaches. This thesis, once again, attempts to balance between the extremes, but it is evident that due to the nature of the research and employed methods, this study does not attempt to make any statistically valid “strict” generalizations, and therefore the generalization process is idiographic ((Baskerville 1996) c.f. (Klein & Myers 1999)). The question in essence is how well the results presented in this thesis generalize into the research of health care IOS. This question is dealt with later in the summary chapter.

Relevance concerns the usefulness of research to its audience, i.e., other researchers or practitioners. Relevance is seen as an important criterion for assessing IS research. Benbasat & Zmud (1999) have defined dimensions of relevance in detail, summarizing the relevant research as being focused on the concerns of practice, providing real value to IS professionals and applying a pragmatic rather academic tone. Ideally, relevant research would also describe how the ideas discussed or actions suggested would be implemented in practice, allowing for contextual differences that are important to individual readers (*ibid.*). This thesis aims at having high relevance for decision-makers in health care and for developers and implementers of health care information systems.

Validity inherently denotes that a theory, model, concept or category describes reality with a good fit. (Gummesson 2000). Action Research’s validity as a mode of inquiry leading to defensible and potentially results is sometimes questioned. Checkland & Holwell (1998a) examine the differences of action research weighed against typical natural sciences, and underline some problems of AR, such as the lack of hypotheses or the challenges of recoverability. As the aim of this thesis is to provide an explanatory view of socio-technical phenomena, this thesis does not attempt to validate the findings in the strictest positivist sense. Therefore, the measure of validity in this thesis should be on the extent and accuracy to which the proposed explanations of the mechanisms behind the described phenomena reflect the

nature of the phenomena in question, this issue being dealt with in more detail in the summary chapter.

2.7 Rationalization of methods

As mentioned above, by definition action research aims firstly to solve a present practical problem and secondly to increase scientific knowledge at the same time. In AR, the researcher is involved in creating organizational change and simultaneously studying the process. Action research was seen as very suitable research approach for this thesis.

The empirical part of the study was conducted as a member of interdisciplinary research team evaluating the implementation process of Finnish EPS. The evaluation team had its mandate from the Ministry of Health and Social Affairs, and the evaluation assignment was led by the National Research and Development Centre for Welfare and Health (STAKES).

The research was conducted in the Finnish health care sector in 2004-2006 in two consecutive projects. The purpose of evaluation was to give on-time evaluation feedback from the implementation process for the steering group of the EPS pilot. The head of the evaluation team presented evaluation results in the steering group meetings, where the steering group members had a chance to interact and argue with the evaluation team's results. The evaluation team also arranged consensus seminars for a wider audience to discuss the evolution of the Finnish EPS pilot.

The evaluation team produced two extensive reports on the evaluation of the pilot, which reflected its progress and also provided normative suggestions on how the pilot could be improved. (Hyppönen 2005; Hyppönen 2006 in Finnish). In the first phase, the role of the evaluation team was participatory and the team provided constant on-time evaluation on the progress of the pilot (Hyppönen 2005). In the second phase, it was evident that the pilot would be delayed, and the organization of the pilot was also rearranged when the role of the evaluation team became more that of an external observer. Nevertheless, the team still followed and commented closely on the development process.

In addition to two final reports, a number of academic papers have been published from the implementation of Finnish EPS (Suomi & Salmivalli 2002; Hyppönen et al 2005a; Hyppönen et al 2005b; Hyppönen et al. 2005c; Hyppönen et al. 2006; Salmivalli 2006; Salmivalli & Hilmola 2006; Hyppönen et al 2007; Kestilä et al 2007b; Salmivalli et al. 2008). Five of the papers are included in this dissertation. Following sections introduce briefly methods used in each individual paper.

2.7.1 Interdisciplinary IT evaluation in the EPS implementation

The first paper summarizes the whole evaluation project and the methods of this paper are therefore multifarious. The data used in this paper was collected foremost for the purposes of the evaluation. As the evaluation team was interdisciplinary the methods used were various. Researchers made interviews to representatives of participating organisations and sent questionnaires to physicians and pharmacists in the piloting areas with questions from different viewpoints of the evaluation. Furthermore, representative of the team participated in the project meetings and project documents were analysed. Data about work processes, participating actors and their roles were collected by observation and videotaping.

This thesis author's responsibilities in data collection included mainly performing semi-structured interviews to managerial level of EPS representatives. In addition, a benchmarking study comparing the Finnish pilot system with various other systems implemented in other countries was also conducted. This was done as a desk-top study. The team listed key elements in the Finnish system to compare how they were realised in alternative e-prescription models. The framework used to analyse the Finnish system was used to generate themes for data collection about other countries' systems. Yet, much of the analysis and advancement of the evaluation process occurred in joint meetings and discussions between the researchers.

2.7.2 EPS as a national infrastructure

The empirical part of the second paper consists of a desktop-study focusing on the different national electronic prescription systems. Documentation was collected in spring 2004 via internet with Google-search engine. Documentation was searched from all registered domains with English, French, German, Norwegian Portuguese, Spanish, Dutch, and Swedish – keywords with over 8000 hits. The hits were studied more in detail and were reported in the first final report of EPS evaluation (Hyppönen (ed.) 2005). Based on the search engine results research was focused to compare the intended Finnish system with experiences from English, Danish, Dutch and Swedish projects and systems.

2.7.3 EPS in lieu of business models

The third paper employs further the international comparison data used in the first paper. Additionally we made for this paper analysis of the financial statements for three American companies developing electronic prescribing systems. The data was collected from the internet sites of the three companies (WebMD, Accredo and MIM Corporation) during autumn 2004. The turnovers and profits/losses were calculated from the financial statements of the companies.

2.7.4 Building Inter-organizational Cooperative Network for IT Collaboration

The fourth paper was a comparative case study research consisting of three different cases. The cases were chosen from the Finnish well-being services industry, consisting of mainly public sector organizations.

The data in general was collected from documents, interviews and participatory observation (including researcher diaries and group discussions). The author of the thesis was only involved in the data collection and analysis of the EPS case. Empirical part of the paper was collected from fifteen semi-structured interviews made to main actors in the Finnish ePrescription pilot. Interviewees were on the management level in their organizations.

The three cases were then compared and analysed jointly by the authors, this paper has been developed further from Kestilä, Salmivalli, Salmela, Vahtera (2007) based on the comments and feedback received.

2.7.5 Governing the implementation of a complex IS network

The fifth paper uses same data as the fourth one. The data used was collected from fifteen semi-structured interviews made to representatives of the EPS pilot. Each interview lasted approximately an hour and was collected between 2004 and 2005. The interviews had ten themes with sub-questions. The interviews were recorded, transcribed to text document and analyzed with qualitative analysis software (NUDIST Vivo).

2.7.6 Rationalisation of methods summarised

This thesis acknowledges the existent challenges of the chosen approach and attempts to apply the methods used to overcome the threats. The theme interview was chosen as the main information gathering method of the thesis, as it was seen as the most appropriate mean of gathering information from a highly preliminary stage of the implementation process, where there was not necessarily enough quantitative data to be collected.

The material collected was used and analyzed by an inter-disciplinary research team, and the results reported in the thesis are published in international journals and established conferences, having gone through a double-blind revision process.

Riege (2003) has listed through literature review several measures to increase the soundness of quantitative research, applying the design tests of *construct validity*, *internal* and *external validity*, and *reliability*. These tests can also be applied to qualitative research (for a more detailed original list, see (Riege 2003, 82-83). This thesis has used the following techniques from Riege's list:

- 1.) Techniques which may be used to increase *construct validity*:
 - Use of several sources of evidence in the data gathering phase, e.g., the triangulation of interview tapes, documents, artifacts and others for protection against researcher bias (Flick, 1992; Peräkylä, 1997).
 - Formation of a chain of evidence in the data gathering phase, i.e., use of verbatim interview transcripts and notes of observations made during field trips which permit the supply of adequate citations and cross checks of particular sources of evidence (Hirschman, 1986).
 - Reviewing of draft case study reports in the report-writing stage, i.e., allowing key informants and research assistants to review interview transcripts, parts of the data analysis and the final report outlining the findings and, if necessary, changing questionable sections (Yin, 1994).
- 2.) Techniques which may be used to increase *internal validity*:
 - Assurance of the internal coherence of the findings in the data analysis stage, which can be attained by crosschecking the results (Yin, 1994).
- 3.) Techniques which may be used to increase *external validity*:
 - Comparison of evidence with the existing literature in the data analysis stage in order to clearly outline contributions and generalize those within the scope and boundaries of the research, not to a larger population (Yin, 1994).

4.) Techniques which may be used to increase *reliability*:

- Full usage of theories and ideas for each research phase (LeCompte and Goetz, 1982).
- Observations and actions recorded as concretely as possible (LeCompte and Goetz, 1982).
- The use of multiple researchers who continually provided information on methodological decisions (LeCompte and Goetz, 1982).
- Recording data mechanically, e.g., by using a tape recorder or video tape (Nair and Riege, 1995).
- Use of peer review/examination (LeCompte and Goetz, 1982).

The following chapter presents the theoretical framework of this study.

3 THEORETICAL FRAMEWORK

This chapter introduces the theoretical approach of this study. The study follows the paths of health care information technology (IT) research conducted for some time at Turku School of Economics, Information Systems Science (ISS). Three doctoral theses have been completed recently in ISS with the following perspectives:

- Stakeholder perspective in health care IS evaluation (Turunen 2001)
- Strategic IS management in health care (Täkkäpää 2007)
- IT acceptance in health and social care from a cultural perspective (Raitoharju 2007)

3.1 Background of the theory formulation

Generally speaking, research into health care information technology has been growing rapidly lately in the Finnish ISS field, producing doctoral dissertations at a steady pace. (cf. (Han 2005; Harkke 2006)

The theoretical purpose of this study is to contribute in the implementation of Inter-organizational systems (IOS) research in a specific context: namely, the health care sector. The foundations of the theoretical framework originate from Information Systems Science (ISS) and IOS research. (Elgarah et al 2005) have conducted an extensive review on IOS literature between 1993 and 2002. They chose four paradigmatic lenses through which they analyzed the literature: *Causal Agency* (Markus & Robey 1988), *Transactions Cost Economics* (Williamson 1991), *IOR Motives* (Oliver 1990) and *IOR Typology* (Hall 1999). This study does not choose any particular paradigmatic stance in terms of IOS research but rather presents different viewpoints firstly focusing on IOS adoption and implementation issues and secondly on IOR (Inter-Organizational Relationships) issues. The research domain of health care is viewed through the lenses of the IOS research tradition in general.

The theory development principally follows the path of Carroll & Swatman's (2000) framework for building theory in IS research. A lack of consensus on exactly what the theory is potentially explains why it is so difficult to develop strong theory in the social sciences (c.f. Sutton & Staw 1995). We adopt the definition of theory from Neuman (1991, 30) as “a

system of interconnected ideas that condense and organize knowledge". (Carroll & Swatman 2000, see also Beshers 1957)

However, present IOS implementation literature cannot fully describe the implementation process of the Finnish EPS. An IOS implementation case in health care is a complex venture

- *Organizationally*, as it traverses several organizational boundaries (Christiaanse & Huigen 1997)
- *Technologically*, as it requires state-of-the art technology with high reliability and minimal downtimes. (Whitten & Rowe-Adjibogoun 2003)
- *Environmentally*, health care is a complex system composed of a network of highly interactive and interdependent elements. (Tan, Wen & Awad 2005)

It would be unfair to elevate the health care IS field above all other branches of "industry" in terms of complexity. Several multinational companies have been able to develop and implement inter-organizational systems simultaneously in various countries and continents facing different sorts of legal, cultural and operational surroundings (e.g., Johnston & Yetton 1996; Peffers & Tuunainen 1998; Kotlarsky & Oshri 2005; Größler et al 2006). However, there is evidence from significant number of HCIS implementation projects that have turned out to be failures (e.g., Southon, et al 1997; Barlow et al 2006).

Furthermore, the Finnish EPS implementation case has some features making it peculiar even within the field of health care IOS. The EPS project is basically nationwide, an irreversible IOS venture consisting of a network of organizations having various sizes, backgrounds and objectives, which make governance extremely difficult. Additionally, finding the "business logic" behind EPS is difficult, as the benefits and costs of EPS may appear on varied levels.

It seems that no single theory appears to be able to fully explain the whole implementation process of EPS: therefore, this study aims to contribute in the IOS literature by providing a framework for EPS implementation by combining a variety of research approaches.

This chapter is organized as follows: first we revise the contemporary IOS and implementation literature, then we present the health care IOS literature. Finally, we introduce a theoretically novel framework of EPS governance.

3.2 Inter-Organizational Systems

The research on Inter-Organizational Systems (IOS), sometimes referred to as Inter-Organizational Information Systems (IOIS, cf. da Silveira & Cagliano 2006), has its origins from 1966, when Kaufman estimated in the Harvard Business Review (44:1, p 141-155) that an interlink of computer systems may bring vast changes to an organization's traditional operation and therefore improve productivity.

One of the first forms of inter-organizational communication via information technology was EDI (Electronic Data Interchange). Hill & Ferguson (1989) have defined EDI as "*the movement of business data electronically between or within firms (including their agents or intermediaries) in a structured, computer-processable data format that permits data to be transferred without re-keying from a computer-supported business application in one location to a computer-supported business application in another location.*" (Hill & Ferguson 1989). Iacovou et al (1995) made a difference between EDI and other IOS: in EDI, each organization has independent application systems; other IOSs are based on a single application system utilized by several users (Iacovou et al 1995). For this dissertation, we adopt the definition used by Kumar & Van Dissel (1996), according to which IOSs are information and communication technology (ICT)-based systems that transcend legal organizational boundaries. (Kumar & Van Dissel 1996)

Johnston & Vitale (1988) classified IOSs into three diverging dimensions, namely: *the business purpose of the system*, defining why the IOS is needed; *the relationship between the sponsoring organization and the other participants*, referring to actors linked by the system (e.g., customers, dealers); and *the information function of the system*, referring to the functions the system is intended to perform (e.g., boundary transactions, internal usage, etc.).

Kumar & Van Dissel (1996) studied collaborative development projects in their seminal work from the cooperation and conflict management perspective. They claim that traditional IOS literature has relied on economic arguments, spiced up with technical feasibility to explain the emergence of cooperative networks; but in addition to economic/rational and technical arguments, a socio-political perspective is required to explain the collaboration between companies. Kumar and Van Dissel (1996) have listed four main factors explaining the emergence of cooperative alliance. They are: *environmental forces*, *motives of the cooperative parties*, *the enabling role of IT* and *the support role of IT*, as seen in Figure 6. The work of Kumar and Van Dissel is seminal in many ways, but it seems to rely on the assumption that organizations participate as cooperative alliances voluntarily. Also,

environmental forces do not explain mandated collaboration – a case in which collaboration is imposed by a third party on separate organizations, and a situation well-known in the health care sector. (Rodríguez et al. 2007)

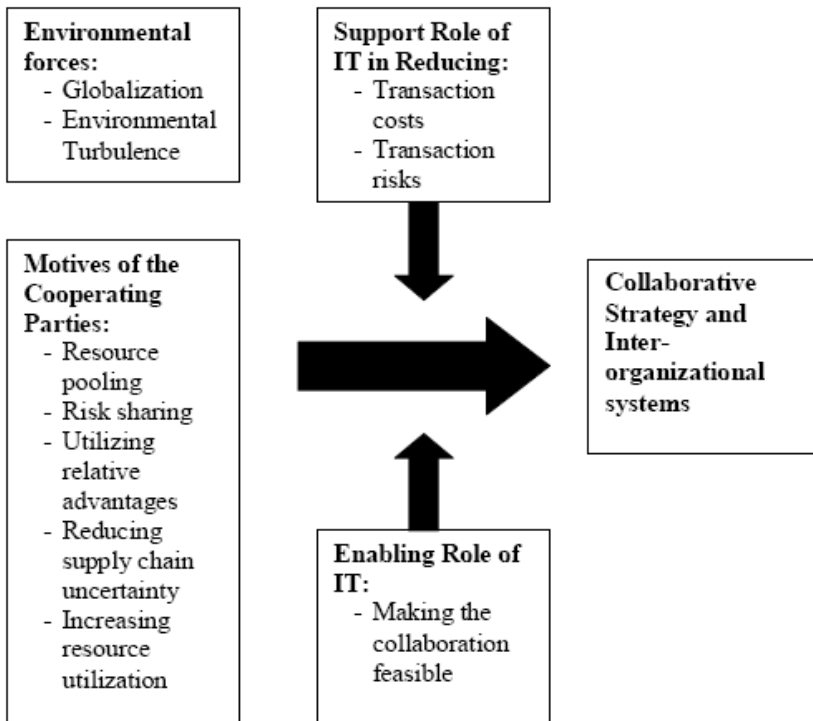


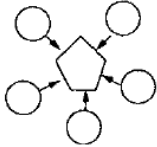

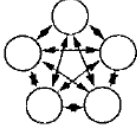
Figure 6. Formation of Cooperative Alliances (Kumar & Van Dissel 1996, p. 282)

According to Klein et al (2004) a typical taxonomy to distinguish between different IOSs is space/time taxonomy, i.e., when and where interaction takes place. Kumar & Van Dissel follow Thompson's (1967) conception of association between technology and interdependence, and they present a three-part classification for IOS: *pooled information resource*, *value/supply chain IOS* and *networked IOS*.

The first type, *pooled interdependence*, is an inter-organizational sharing of common IS/IT resources. Typical resources shared in a pooled fashion include e.g., common databases, common communication networks, and common applications. The primary motivation for such cooperation includes: economies of scale, cost and risk sharing, and participation externalities. (cf. Konsynski & McFarlan 1990) The second type of IOS, *value/supply chain IOS*, supports customer-supplier relationships (i.e. pipeline management

systems), and are more like strategic necessities than strategic advantages. These types of IOSs institutionalize *sequential interdependences* between organizations. The third type, networked IOSs, operationalize and implement *reciprocal interdependences* between organizations and are typically joint ventures between various partners, each partner providing a different specific advantage. The networked IOS tend to be relatively little structured to a large extent. Most of the structure in systems usually comes from the participants and use process. The Finnish EPS has elements of all interdependencies but mostly those of reciprocal interdependency, making the coordination challenging and increasing the potential for conflict. Table 3 represents the three-class typology for IOS. (Kumar & Van Dissel 1996)

Table 3. Interdependence, Structure and Potential for Conflict (Kumar and Van Dissel 1996) p. 287

Type of Interdependence	Pooled Interdependency	Sequential Interdependency	Reciprocal Interdependency
Configuration			
Coordination Mechanisms	Standards & Rules	Standards, Rules, Schedules, & Plans	Standards, Rules, Schedules, Plans, & Mutual Adjustment
Technologies	Mediating	Long-Linked	Intensive
Structurability	High	Medium	Low
Potential for Conflict	Low	Medium	High
Type of IOS	<i>Pooled Information Resource IOS</i>	<i>Value/Supply-Chain IOS</i>	<i>Networked IOS</i>
Examples of Implementation Technologies and Applications	Shared Databases Networks Applications Electronic Markets	EDI Applications Voice Mail Facsimile	CAD/CASE Data Interchange Central Repositories Desk-Top Sharing Video-Conferencing

Again, Hong (2002) introduces the concept of horizontal and vertical linkages with emphasis on the roles of organizations joining IOS. Based on *role linkage* and *system support level* dimensions Hong classifies IOS into four basic types: 1.) *Resource pooling*, 2.) *Operational cooperation*, 3.) *Operational coordination*, and 4.) *Complementary cooperation*. The framework perceives that how participants' roles are linked (horizontal vs.

vertical) and what major motivators direct the IOS development (strategic vs. operational). Horizontal linkages are formed via interconnection of organizations performing common value activities, i.e., homogenous organizations share a common role, whereas vertical linkage engages the various roles of contributing organizations that add value to existing products or services. Motivation on the part of operational support is primarily geared towards supporting routine operations, whereas strategic support is more that of an information partnership. (Hong 2002) Figure 7 represents Hong's framework.

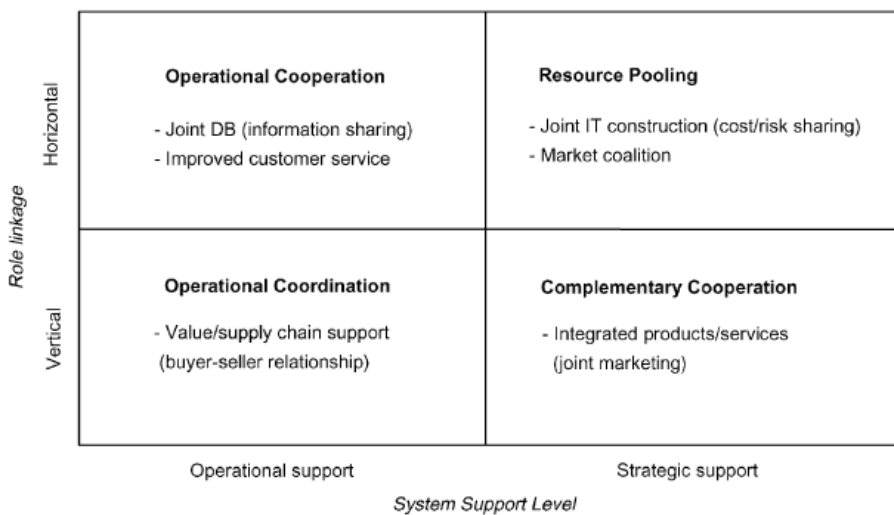


Figure 7. A Framework for IOS (Hong 2002 p. 264)

The Finnish EPS cannot be unambiguously placed to a certain category in Hong's framework. The Finnish EPS has elements of *operational cooperation* in terms of a centralized database and attempt to improve customer service. There is also an element of *Resource Pooling* as the system has been jointly constructed (cost/risk sharing). Similarly, there is a hint of *Operational Coordination*, as the EPS is supposed to support the "value" or service chain as well as *Complementary Cooperation* in terms of integrated services (e.g., the patient's medication can be checked by another physician or at the pharmacy).

It seems that dominant IOS literature cannot fully explain phenomena in all contexts, e.g., health care, where the relationships between markets, competition and buyer-sellers differ significantly from the "traditional" business environment. The research on health-related markets has emerged

recently, as market-oriented health care reforms are being proposed or endorsed in many countries (Smits et al 2007). Smits et al. (2007) have researched health care markets more in detail, and they suggest that health care markets exist between *users of care* (patients or clients), *providers of care* (e.g., hospitals), and *purchasers of care* (e.g., insurance companies). There is a clear difference to many "traditional" fields of business, where the user and purchaser of services or goods are one and the same. All of this makes the research of "business rationale" particularly interesting and important. In the next chapter, we deepen the prevailing conception of IOS with a specific context after briefly discussing the general features of IOS adoption and implementation.

3.3 IOS Adoption and implementation

3.3.1 IS adoption and implementation in general

Rogers (1995) has defined adoption as "*a decision to make full use of a new idea as the best course of action available*". That is to say, adoption entails some kind of evaluation of an innovation in order to determine if it will greatly satisfy the needs of the potential adopting organization as well as the sustained use of the innovation (i.e., full implementation). Intra-organizational adoption is relatively well-studied in the literature (Frambach & Schillewaert 2002; Speier & Venkatesh 2002), whereas *IOS adoption* still remains a relatively unexplored area. (Hausman et al 2005)

We define *IS adoption* as one part of the *IS implementation* process. *IS implementation* process can be seen to include a variety of different activities: Cooper & Zmud (1990) are well-known for their six stage implementation model, consisting of the following stages: *Initiation, Adoption, Adaptation, Acceptance, Routinization, and Infusion* (p. 124). The stages should not be considered in an overly sequential manner: rather, the activities may occur in parallel.

Information systems in general are implemented in organizations in order to improve the effectiveness and efficiency of the organizations involved. (Hevner et al 2004). Lucas (1981) has characterized *IS implementation* as: "*An on-going process which includes the entire development of the system from the original suggestion through the feasibility study, systems analysis and design, programming, training, conversion, and installation of the system.*" (p. 14)

IS implementation has been widely described in the literature from numerous different perspectives (e.g., Ginzberg 1981; Markus 1983; Nutt 1986; Cooper & Zmud 1990; Newman & Robey 1992; Sabherwal & Robey 1993; Klein & Sorra 1996; Nutt 1998), and it is inappropriate to go through IS implementation in general within this context.

Furthermore, *IOS implementation* has been discussed in the IS field extensively, especially in the manufacturing industry context, e.g., (Cox & Ghoneim 1996; Bensaou 1997), whereas public sector IOS implementation research is still at its infancy (e.g., Kinder 2000) and public – private partnerships in IOS research are still lacking. The retrieved health care IOS literature is revised in the following chapter.

There are a number of studies examining the anticipated benefits of IOS. One of the first lists is by Barrett & Konsynski (1982), who have listed incentives for the development of an IS* (Inter-Organizational Information Sharing System i.e. IOS). These are economic, and involve three potential benefits for the participating organizations:

- *Cost reductions*
- *Productivity improvements*: in terms of cost avoidance, cost displacement and increased productivity
- *Product/market strategy*: meaning possibilities to achieve competitive edge, market leadership/-share, or new product/market areas through the use of IS*. (Barrett & Konsynski 1982 p. 101)

Klein et al. (2004) claim that there are two dominant motives for the development of IOS: firstly, IOS as enablers of innovative, networked business models; and second, IOS as enablers for the transformation of existing inter-organizational relations.

Iacovou et al. (1995) have divided the perceived benefits of IOSs into *direct* (e.g., reduced transaction costs, improved cash flows, reduced inventory levels) and *indirect* (e.g., increased operational efficiency, better customer service) benefits. Complete lines of research have emerged with the research into achieving various benefits with IOS in terms of, e.g.: business process reengineering (Riggins & Mukhopadhyay 1994), competitive advantage (Konsynski & McFarlan 1990), and knowledge management (Ciborra & Andreu 2001).

The same observations about the poor fit of contemporary IOS literature also apply in the IOS adoption/implementation literature. It seems justifiable to argue that health care IOS adoption/implementation should be scrutinized as its own research domain. In the following chapters, we review the exiguous health care IOS implementation literature and then examine the case of EPS in detail.

3.3.2 IOS implementation in Health care

Despite the magnitude of IOS implementation literature in general, literature on IOS implementation in health care is still virtually non-existent. The reasons for this can only be conjectured, one possible explanation being that IOS research in the field of health care is still relatively novel or invidious for one reason or another. Traditionally, health care organizations have concentrated on themselves, and information systems have been intra-organizational, scattered and deficient in connections between their operational units and other information systems. (Raghupathi 1997; Mercer 2001; Raghupathi & Tan 2002)

Based on an e-library database review, it can be claimed that there is no existent *health care IOS* research paradigm and even less a *health care IOS implementation* paradigm. The need for such a paradigm can naturally be questioned, but as the volume of health care IOS literature increases, this issue will be of increased importance. Munkvold (1999) claims that it is necessary to focus on particular implementation contexts, rather than trying to develop general models of innovation processes.

Further, there is evidence that a particular health care information system implemented successfully in one country does not necessarily turn out to be a success in another one and health care system context. (Southon et al. 1997; Southon et al 1999) Therefore, studying IOS implementation in a very specific context is theoretically interesting.

We revise first the exiguous literature on health care IOS, then some of general health care IS literature, especially in terms of expected benefits and implementation, which is developed further in the following chapters.

One of the first health care IOS papers is by Kim & Michelman (1990) in which they dissect health care IS from competitive advantage perspective based on Porter's work. The US health care domain *per se* does not suit the Scandinavian health care IOS research, as the competitive milieu is rather different from America's. However, Kim and Michelman point out the importance of *political factors*, which also applies in our research domain. They note that integration of the present isolated systems may not be straightforward task as it cuts across political boundaries. The integration can lead to considerable organizational changes in work-flow, communication patterns, reporting relationships and internal control processes. Additionally, the integrated system may change the balance of power among units within the organization. (p. 204)

A more similar case compared to Finnish EPS was the introduction of EDI in the Scottish Health Service (Spinardi et al 1997). The authors note that in the public sector, the state does not have to negotiate the form of electronic

commerce with the competitors, but it can impose it by direction. Therefore, according to authors, public sector organizations may be more able to develop and implement a strategic vision for the usage of EDI. Public sector lacks the incentive to use EDI to differentiate their services from competitors, but they are under pressure to deliver services with fewer resources, and hence, the focus of EDI implementation is more on gaining improvements in operational efficiency. The paper provides several similar observations as in the case of Finnish EPS. However, we would argue against the claim that public sector is better able to develop and implement a strategic vision of IOS usage: in our case, it would seem to be quite the opposite, as shown later.

Payton has studied the implementation of Community Health Information Networks (CHIN) and is thus far presenting the only known implementation model for us for health care IOS. The model consists of four different components: *push/pull factors*; *behavioural factors*; *shared systems topologies*; and *IOS enablers*. The model is descriptive, but it only presents prevailing factors without any causality, hierarchy or dynamics. Figure 8 presents Payton's model of CHIN implementation (Organizational A&C in *Behavioral Factors* refers to Organizational Control and Autonomy). (Payton 2000 cf. Payton & Brennan 1999; Payton & Ginzberg 2001)



Figure 8. Revised CHIN implementation model (Payton 2000 p. 317)

An interesting research on Canadian mental health services networks, made by Fleury (2005), is worth noting. She extends the work of Leutz (1999) and his “five laws on health care and social services integration”. Furthermore,

IOS in the health care domain has been researched from the *institutional dimensions in complex network setting* perspective (Christiaanse & Huigen 1997); *Network strategy* perspective (Gfrörer et al 2001); *Markets versus hierarchies* comparison perspective (Hackney et al 1997); and *Stakeholder* perspective (Barlow et al. 2006).

Implementation of health care information systems (HCIS) in general has been discussed widely in the literature (e.g., Berg 2001; Conrad et al 2002; Doolin 2004; Gagnon et al 2005; Lapointe & Rivard 2005). A well-acknowledged fact is the relatively high rate of failed HCIS initiatives. Several studies estimate that 30% or more of the HCIS implementations fail. (Southon et al. 1997; Mitev & Kerkham 2002; Barlow et al. 2006)

Research acknowledges that technical issues explain only minority (<20 %) of implementation failures, whereas organizational issues are usually the most important interpreter of failures (Aarts & Peel 1999; Hackney & McBride 2002). Paradoxically, it seems that technology is seen as “void of values” and it is expected to solve clinical, financial, management and quality problems but without realizing the organizational and technical complexities, human resources implications and associated costs. (Mitev & Kerkham 2002)

Barriers of successful HCIS implementation have also been extensively discussed in the literature. Mercer (2001) refers to an American study (Deloitte & Touche 1999) and lists some of the most significant barriers to the successful implementation of information technology in health care. Barriers are listed in order of priority:

1. Lack of adequate financial support
2. Vendors do not fully understand the needs of clients
3. Difficulty in proving quantifiable benefits
4. Lack of top management support
5. Lack of a strategic plan
6. Rapid obsolescence
7. Time required to implement
8. Difficulty in providing adequate training to end users
9. Difficulty in recruiting and retaining qualified staff.

Similar lists have been presented by e.g., Southon et al. (1999) and Mitev and Kerkham (2002). Once again, we have to ask what makes such a list characteristic to health care? In the author’s opinion, the above-mentioned list could pose problems in any field of business. However, again in the view of the author, failures during the HCIS implementation process could be prevented, at least in some cases, before the actual implementation process. According to the literature, supported by empiric results, it seems that the actual rationale to implement a health care IOS is *vague* for the adopting organizations.

Expected benefits and the need to rationalize contemporary health care processes are listed in a myriad of HCIS publications as reasons or validation for the implementation of health care IS. However, we argue that:

There is very little evidence of realized benefits from health care information systems, and organizations are participating health care IS (IOS) projects with too unclear expectations. Further, expectations are usually unrealistically high. Differing rationales and the lack of mutual vision of participating organizations makes governance of IOS implementation extremely difficult.

Generally speaking, an implementation decision should be driven by a clear conformity on sets of benefits, which should be testable upon completion of the implementation. In the health care field, potential benefits are recognized, but there are very few examples of sustained success. This study found considerable amount of evidence that benefits gained through HCIS are difficult to estimate. (Southon et al. 1997; Southon et al. 1999; Mitev & Kerkham 2002; Barlow et al. 2006)

Southon et al. (1999) note that there seem to be two sets of benefits that are offered when discussing about implementation of a new HCIS. *Firstly*, rather broad benefits: e.g., “to improve the quality of care”, “support of management and clinicians”; and *secondly*, a long list of very detailed items: e.g., “decreased phone calls”, “decreased form handling”. The general set of benefits are too vague to relate to, let alone quantify, whereas the specific benefits are too numerous, and individually too trivial to spend valuable time tracking and measuring in any credible way.

This notion is emphasized in the case of Finnish EPS implementation case: balancing between general, national level benefits and detailed user-level benefits to motivate end-users adopting the new technology. In the following chapters, we discuss the rationales to implement the EPS and the governance of EPS implementation in Finland.

3.3.3 The rationale to implement EPS

Sections 3.2 and 3.3 listed general features of IOSs and issues related to their implementation. In section 3.3.2, we discussed the IOS within the health care context and made a claim that organizations in health care field enter IOS implementation projects with overly vague expectations.

Firms operating in a competitive environment usually have several reasons to adopt IOS, such as: cost reductions, productivity improvements or market strategy related motives (e.g., Barrett & Konsynski 1982). Public sector

rationales do not usually relate to competitive factors but more on gaining operational efficiency (e.g., Spinardi et al. 1997).

Theoretically, a completely novel situation would be a network of partners consisting of actors from different institutional fields: public sector organizations (e.g., hospitals), private firms (e.g., pharmacies) and authorities (e.g., the Social Insurance Institution of Finland) added to trusteeship and other organizations associated but not directly involved with the IOS at hand. The complexity of the case arises when part of the network members operate in a commercial environment, some operate in the public sector, trusteeship organizations attempt to impose political lobbying, and governmental authorities are expected to steer the IOS implementation.

The first research question presented in section 1.4 asks: *What is the intrinsic rationale to implement Electronic Prescription Systems at various levels of the network?* The thesis uses Provan and Milward's (2001) division of the network into three different levels, namely: *Community* (Macro) level; *Network* level; and *Organization* level analysis to answer on the first research question. Table 4 summarizes network evaluation relationships.

Table 3. Summary of Network Evaluation Relationships (Provan & Milward 2001) p. 416

<i>Levels of network analysis</i>	<i>Key stakeholder groups</i>	<i>Effectiveness criteria</i>
<i>Community</i>	Principals and clients <ul style="list-style-type: none"> • Client advocacy groups • Funders • Politicians • Regulators • General public 	<ul style="list-style-type: none"> • Cost to community • Building social capital • Public perceptions that the problem is being solved • Changes in the incidence of the problem • Aggregate indicators of client well-being
<i>Network</i>	Principals and agents <ul style="list-style-type: none"> • Primary funders and regulators • Network administrative organization • Member organizations 	<ul style="list-style-type: none"> • Network membership growth • Range of services provided • Absence of service duplication • Relationship strength (multiplexity) • Creation and maintenance of network administrative organization • Integration/ coordination of services • Cost of network maintenance • Member commitment to network goals
<i>Organization/participant</i>	Agents and clients <ul style="list-style-type: none"> • Member agency board and management • Agency staff • Individual clients 	<ul style="list-style-type: none"> • Agency survival • Enhanced legitimacy • Resource acquisition • Cost of services • Service access • Client outcomes • Minimum conflict for multi-program agencies across multiple networks

Provan and Milward's (2001) presentation provides an excellent starting point for our analyses. However, their starting point is in analyzing the effectiveness of networks. Even so, the author of this dissertation suggests that in order to analyze the effectiveness of networks, the rationale to participate the network at all levels should firstly be studied, i.e., *who is to benefit from such 'effectiveness' at various levels?*

Actors on the three different levels are: *principals*, *agents* and *clients*. Principals monitor and fund the network and its activities, agents work in the network as administrators and service-level professionals, and clients are the actual receivers of the services provided by the network.

The most wide-ranging level of analysis is the community level. The networks should be evaluated by the contribution they make to the communities they are trying to serve. Community level can be understood in the case of Finnish EPS as the macro level or national level. Provan and Milward agree that measuring the actual effectiveness of a network at the community level is problematic. Nevertheless, they state that the goal of most public networks is to enhance client services through improved access, utilization, responsiveness and integration while maintaining or reducing costs.

Based on the preliminary disquisition, (The Social Insurance Institution of Finland 2001) *community/macro level* benefits were basically the only ones even proposed (c.f. section 1.3.3.) The objective was that savings resulting from the rationalized use of medication would cover the expenses of building and maintaining the system. As no calculations were done, it is impossible to compare the costs of the present paper-based system on the electronic system.

However, it seems inevitable that during the transition period, both systems would be in use and hence increase the operating costs. Macro level beneficiaries would be in the role of compensator – especially the Social Insurance Institution – and indirectly society as a whole in terms of reduced medication costs. Macro-level benefits would require a significant volume of e-prescriptions from all prescriptions and the latest proposals would still allow paper prescriptions – diluting the benefits of electronic prescriptions (e.g., counterfeiting prescriptions would still be possible).

Even if a network is a success at the community/macro level, it must still become a viable inter-organizational entity in order to survive. Some networks possess a Network Administrative Organization (NAO), which acts as administrator, coordinator and disseminator of funds. NAO is both the agent of the community and the principal of the network participants (c.f. section 3.3.4 for a more detailed description of NAO).

The network level analysis focuses on how individual organizations form a functioning network of sovereign actors. At the *network level*, it is more difficult to form a unitary view of rationale. Justification of a network is earned if it can provide essential services for its clients. In the case of the Finnish EPS, it is questionable whether the network level rationale was achieved, as the quantity of electronic prescriptions totalled 800 and the aggregate total of dispensed medication is approximately 40 million annually in Finland. Most of the suggested value-added services were never

implemented in the pilot: for example, the possibility to check the patient's total medication, adverse drug effects warnings, or the patient's possibility to check his/her total medication from the net.

Finally, the *organization/participant level* analysis is needed as organizations are always partly motivated by self-interest. Despite the broader value that may go to clients and the community in general as a result of the integrated delivery of services through a network, network members still strive to ensure the survival of their own organizations. The presumption is that organizations adopt EPS in order to gain benefit as individual actors. Organizations adopting EPS are hospitals and health centres, private pharmacies and University Pharmacy sublets. Hospitals are not seeking a competitive edge from EPS but more operational efficiency, whereas the question of pharmacies is somewhat complicated. Pharmacies operate in the private sector, but competition in terms of price, place (location) and product differentiation is limited by legislation, meaning that pharmacies do not operate under the laws of free competition, but more as something akin to a mixture of the public and private sectors. Pharmacies could benefit from, e.g., time savings created by quicker processing of electronic prescriptions, but it is questionable whether such savings would lead to actual savings in terms of e.g., the reduction of personnel, since the processes are already relatively smooth due to bar codes, division of assignments and so on.

The organizational level rationale received minimal attention at the preliminary disquisition, which may have been a mistake, since health care systems have strong professional autonomy (Fottler 1987) and physicians in particular act as gatekeepers to the successful adoption of new technology, by deciding whether to prescribe traditional or electronic prescription. Pharmacy personnel do not have such wide autonomy, as they must deliver ordered prescriptions regardless of their media.

As presented later on in the first original research paper (Hyppönen et al. 2007), end users (i.e., physicians) in the piloting organizations were relatively pleased with the existing system, whereas the expectations with regard to the e-prescription system were mixed: physicians did not consider that EPS could solve the present challenges of prescribing but that EPS would primarily benefit the pharmacies. Consequently, the organizational level rationale remained vague and the essential support of users was never fully achieved.

All in all, it seems that the EPS pilot was first and foremost a macro level IOS venture, but the rationale and reasoning were implicit. It also seems that at least some of the reasons for the EPS pilot were political. Primarily benefits would appear first on the community/macro level for the society as a whole. The possible benefits would be hard to quantify, e.g., improved life quality due to more rational medication.

On the network level, the rationale is harder to define. The intrinsic rationale primarily rests on the Network Administrative Organization. In the case of Finnish EPS, the NAO was the Ministry of Health and Social Affairs, but the power of the NAO was limited because its only resource was a half-time project manager. Also, NAO's power was partly dispersed, since the key player in organizing the implementation was the Social Insurance Institution (under parliamentary control) and not the Ministry. The rationale is similar to that of the macro-level, but on the network level rationale is dispersed to a few strong players: namely, the Ministry, Social Insurance Institution of Finland and the National Agency for Medicines. The presumption is that the organizations are working jointly to achieve a successful network, but the coordination of collaboration should be planned carefully.

The final rationale of individual participants remained somewhat unclear for the whole pilot. The potential danger with implementation of EPS can be derived from the *institutional perspective* IOS literature (DiMaggio & Powell 1983; Teo et al 2003) and the complexity of implemented innovation. Teo et al. (2003) note that when technologies are poorly understood, pressures to mimic the behaviour of others increase. Decision-makers may base their own decisions about complex innovations on their pattern of use and its effects on other counterparts to economize on search and experimentation costs and to reduce the associated risks. Difficulties arise if organizations collectively feel that the innovation (i.e., EPS) is needed no matter what the costs are, and innovation is adopted for the sake of technological pioneering.

Our opinion is that the prerequisite for successful implementation of EPS is that all participating members should:

1. Recognize common problems of the prevailing system to be replaced,
2. Share a compatible vision of the upcoming system
3. Have interest in collaboration, and
4. Acknowledge the gains of the cooperative development of IOS.

By settling these above-mentioned issues, all stakeholders can decide what their intrinsic rationale is to join in the EPS implementation venture, and hence organizations could have a real rationale to implement EPS instead of an artificial need due to institutional pressures.

3.3.4 The governance of the Finnish EPS implementation

Chapter 3 has attempted to point out the lack of IOS and IOS implementation research in the health care domain. This study attempts to fill in some of the blanks in health care IOS implementation research, especially from *governance perspective*. Thus far, the implementation of health care IOS has

not been researched from *governance perspective* outside the Finnish EPS evaluation team (Salmivalli 2006; Suomi 2006; Kestilä et al. 2007b; Salmivalli et al. 2008).

The previous sub-chapter answered the first major research question, and this sub-chapter attempts to answer the second major research question: *How is the implementation process of Electronic Prescription System governed?* The focus is on the governance and management of the EPS network, we make here a distinction between networks as a governance mechanism and governance of networks (e.g., Jones et al. 1997; O'Toole 1997). The purpose is to describe the governance of Finnish EPS implementation in the *normative* sense, i.e., how the implementation process *should* or *could* be organized.

This sub-chapter owes to a recent presentation by Provan & Kenis (2007), which is in many ways seminal lecture to network governance. However, their work is focused on generic network governance level whereas this dissertation focuses on a very particular IOS network governance case. Furthermore, this sub-chapter attempts to develop further ideas of network governance, a field novel in management in general and inter-organizational information systems field particularly. The sub-chapter combines elements from previous IOS, IOR, network and governance research fitted into the Finnish EPS domain (Premkumar & Ramamurthy 1995; Williams 1997; Munkvold 1999; Johnston & Gregor 2000; Payton 2000; Fleury 2005; Hausman et al. 2005).

Provan & Kenis (2007) divide network governance into two ideal forms: *participant-governed* and *network administrative organization governed* networks. Participant-governed networks are governed by the network actors themselves with no external governance entity. Participant-governed networks can be further divided into *shared governance* and *lead organization governance*. Shared governance networks depend utterly on the participation and commitment of all, or at least a majority of the organizations that form the network. This means that the collectivity of network partners make all the decisions and manage network activities, responsibility is shared. In lead organization governance, all major actions and major decisions are coordinated through and by a single participating member, acting as a lead organization. Yet, network participants all share at least some mutual objective as well as maintaining individual goals and they often interact and work with one another. (Provan & Kenis 2007)

The third form of network governance is the Network Administrative Organization (NAO) model, in which a separate administrative entity is set up in particular to manage network and its activities. The key difference between NAO and the lead organization is that NAO is not another member organization providing its own services, but the NAO is established either

through mandate or by the participants themselves, for the exclusive purpose of external network governance. (Provan & Kenis 2007)

Hence, the second dimension in addition to participant-governed vs. externally governed is whether the network governance is *brokered* or *non-brokered*. In an (ideal) non-brokered network, each organization interacts with each other in terms of network governance whereas in brokered networks there are very few organization-to-organization interactions. The network governance takes place through a single organization acting as an exceedingly centralized network broker vis-à-vis issues that are critical for whole network maintenance and survival. Figure 9 describes the two dimensions of network governance.

	Non-Brokered	Brokered
Participant Governed	Shared	Lead Organization
Externally Governed	Not Applicable	Network Administrative Organization

Figure 9. Forms of Network Governance (Provan & Kenis 2007)

The Finnish EPS pilot had features of all three governance forms. Ministry of Social Affairs and Health was NAO of the pilot as external facilitator of the venture with a project manager expressing the Ministry's directive. However, the pilot had a strong lead organization, i.e., the Social Insurance Institution, acting as the broker in many practical issues and as the possessor of the centralized e-prescription database. Finally, the decision-making in the steering group of the pilot was referred in interviews as a 'debating club', indicating elements of shared responsibilities and shared governance.

It seems vindicated to make a claim that the Finnish EPS pilot was not merely successfully governed. There is not a single issue to point out: rather, it represents a novel IOS implementation situation with no existing tools to deal with such a case. Governance took different forms during the pilot, which is not necessarily a negative phenomenon as networks evolve over time, but the application of various governance mechanisms at the time seemed to result in uncertainty in the network.

The question remains concerning how a particular form of governance should be adopted in order to facilitate successful network governance. Provan & Kenis (2007) suggest four contingencies that affect the adoption of a particular governance form:

- Trust
- Number of participants
- Goal consensus, and
- Need for network level competencies.

In essence, according to Provan & Kenis (2007), trust becomes less dense as the number of participants increases, as network goal consensus declines, and as the need for network level competencies increases, brokered forms of network governance are likely to become more effective than shared governance networks. Table 5 summarizes the key predictors of adoption of different governance forms.

Table 4. Key Predictors of Adoption of Network Governance Forms (Provan & Kenis 2007)

<i>Governance Forms</i>	<i>Trust</i>	<i>Number of Participants</i>	<i>Goal Consensus</i>	<i>Need for Network Level Competencies</i>
Shared Governance	High Density	Few	High	Low
Lead Organization	Low Density, highly centralized	Moderate number	Moderately low	Moderate
Network Administrative Organization	Moderate density, NAO monitored by members	Moderate to many	Moderately high	High

The implementation of Finnish EPS seems to follow relatively well the framework suggested by Provan & Kenis (2007) and the general features of NAO governance. Trust was not seen very high among the interviewees, which is naturally a handicap in networks generally, but not fatal in brokered networks. Number of participants was relatively high in the pilot, and the

figures would be rising sharply with new participating organizations. The need for network level competencies is high as the EPS network needs all actors in order to succeed (e.g., physicians, compensation authorities, pharmacies, etc.), which cannot be replaced. In the Finnish EPS case, the network participants were not chosen by their competencies as such, but also as mandated ‘choices’. Secondly, Provan & Kenis do not consider ‘competency asymmetry’ in their model as the competencies are not necessarily equally needed in the network, e.g., the physician can still have a choice between traditional and electronic prescription, whereas pharmacies must deliver prescriptions regardless their media. Yet, the biggest discrepancy seems to be in the goal consensus of NAO led networks. We suggest that the Finnish EPS pilot had the following elements of the framework suggested by Provan & Kenis (2007):

Table 5. Key Governance Features of the Finnish EPS applied in Provan & Kenis (2007) framework

<i>Governance Forms</i>	<i>Trust</i>	<i>Number of Participants</i>	<i>Goal Consensus</i>	<i>Need for Network Level Competencies</i>
Shared Governance	High Density	Few	High	Low
Lead Organization	Low Density, highly centralized	Moderate number	<i>Moderately low</i>	Moderate
<i>Network Administrative Organization</i>	<i>Moderate density, NAO monitored by members</i>	<i>Moderate to many</i>	Moderately high	<i>High</i>

We claim that in the case of Finnish EPS the goal consensus was relatively low. At least the ‘goal’ of the initiative was somewhat vague for the participants. Another reservation we want to make is the elusiveness of ‘goal consensus’, in our first major research question we divided the rationale of EPS implementation into three different levels, namely, *Community/Macro* level; *Network* level; and *Organization* level. Similarly, we suggest that, at least in the case of Finnish EPS, the goal consensus should be divided into different levels.

For example, all the network members can most likely agree on the noble macro-level goal of, say, reducing medication errors and adverse drug interactions. The question that then arises is how much A) the network level B) the participant level are prepared to sacrifice their resources to achieve this indisputably important goal. Therefore, we suggest a change in Provan & Kenis (2007) framework, namely changing the goal consensus into *level of*

goal achievement. The goal achievement is connected with the level on which the system benefits are appearing. Consequently, we suggest replacing “Need for Network Level Competencies” with more IOS specific “Level of IOS benefits appearing primarily”. Therefore, our model of EPS governance would look as follows:

Table 6. Finnish EPS implementation governance framework

<i>Governance Forms</i>	<i>Trust</i>	<i>Number of Participants</i>	<i>Level of goal achievement</i>	<i>Level of expected IOS benefits appearing primarily</i>
Shared Governance	High Density	Few	<i>Participant</i>	<i>Participant</i>
Lead Organization	Low Density, highly centralized	Moderate number	<i>Network</i>	<i>Network</i>
Network Administrative Organization	Moderate density, NAO monitored by members	Moderate to many	Community/Macro	Community/Macro

Our framework presented in Table 7 suggests that in NAO-governed IOS implementation (i.e., the case of Finnish EPS implementation pilot) the significant elements are:

- Trust
- Number of participants
- Level of goal achievement
 - Participant
 - Network
 - Community/Macro
- Level of expected IOS benefits appearing primarily
 - Participant
 - Network
 - Community/Macro

Based on the empirical research, it seems that framework applies at least to the Finnish EPS. What remains to be tested is whether we can claim that in the shared governance model, goals and expected benefits are set on the participant level, and that in the lead organization, model goals and benefits are set on the network level.

With the framework created in the surroundings of Finnish EPS case we cannot, however, describe it as a health care IOS venture in the purest sense,

as it includes actors from several varied institutional fields within the health care “industry”. Therefore, we can not assure that results of this study are generalizable in all health care settings, nor outside health care field. Yet, we believe that such networks comprising partnerships between public and private sector actors shall increase in the future. Secondly, at least some of the lessons learned from this venture can be utilized in similar ventures in other countries.

The following chapter reviews the empirical results of the dissertation as original published articles.

4 REVIEW OF THE RESULTS

This chapter will review the results of each separate research task as original, published articles in this thesis. The original papers form the second part of this dissertation.

4.1 Interdisciplinary IT evaluation in the EPS implementation

The first original article of the dissertation is: Hyppönen, H., Salmivalli, L., Nykänen, P., Ruotsalainen, P. and Pajukoski, M. (2007), '*Testing a theoretical framework for interdisciplinary IT evaluation: the case of the Finnish Electronic Prescription*', (originally published in the International Journal of Healthcare Technology and Management, Vol. 8, Nos. 1/2, pp.42 - 65).

The paper begins by illustrating the background of EPS pilot thoroughly, describing the current situation of prescribing in Finland and historical background of the various electronic prescription initiatives. Secondly, the paper portrays aims and methods of the whole evaluation process, including data collection and analysis. Data collection was organized in two streams:

- Line 1: Study of the technology development project
- Line 2: Study of the changes in services.

After illustrating the background of the evaluation project paper introduces a framework to evaluate IS development, implementation and diffusion within a specific context of EPS. The framework presented is based on the theoretical concepts of *activity system*, *actor network* and *development life-cycle*.

The main findings of the evaluation group in the paper were that:

- Technical difficulties in writing the e-prescription and sending it to the national database (the existing old hardware and software did not necessarily support rapid processing of data, there were differences in medication databases, and problems existed in authentication and with the firewall).
- Difficulties in the medication delivery process (pharmacies selected by the Association of Finnish Pharmacies for the pilot were not suitable for most clients: they were too far away from the doctor's office and patients were not able to go to pharmacies which they regularly visited. Since the integrated systems were still under construction, pharmacies

also had to use an unreliable and time-consuming stand-alone delivery system).

- The above-mentioned problems caused clients to hesitate in giving their consent to participate in the pilot.

The main recommendations given by the evaluation group to the pilot project were, based on the constructive evaluation noted that:

- The pilot needed to be reorganized administratively so that it had sufficient resources, a concrete plan, working groups and a clear division of labor required in a major technology project.
- The implementation frame needed to be simplified so that experiences could be collected more comprehensively from one or two regions.
- The work in the pilot needed to concentrate on producing a detailed description of the prescription process, actors, their roles and technologies used in information processing.
- Technical and functional requirements of the system need to be documented, as well as a common testing system with documented results for others to learn from.
- Emphasis needed to be shifted from technical piloting to usability and user acceptance.

Results presented in this paper go through the entire evaluation process and were included in the final report of the project. However, the same issues were raised from time to time throughout the whole process. Overall, this paper is a summary of the whole EPS implementation evaluation process and the article gives reader a “big picture” of the EPS pilot *per se* and the exhaustive evaluation of the implementation process.

This paper also underpins the author’s role in the entire evaluation process. Section 4.2.3 “Organisational management research” in the original research paper presents some of the main issues from the business administration perspective. The following sentence synthesizes the main message of findings from the business administration perspective quite well: “*Objectives for EPS at national level were quite inadequately operationalised in the pilot. There was neither a project plan for the implementation nor a budget. Costs were not unambiguously calculated, neither were any estimates made on the possible economic benefits that the system could produce*”.

The first paper contributes to both research questions by providing general background information of the case. Secondly, the paper describes the challenges that the EPS pilot faced and gives normative suggestions to the governance of the pilot, in order to make it more successful. Papers II-IV go more into detail on selected viewpoints or sub-questions of the EPS implementation.

4.2 EPS as a national infrastructure

The second original article is: Hyppönen, H., Salmivalli, L., Suomi, R., (2005) ‘*Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription*’ (originally published in the proceedings of the 38th Hawaii International Conference on System Sciences January 3-6, 2005, Hilton Waikoloa Village, Big Island, Hawaii).

This paper studies the EPS-pilot from the infrastructure perspective: the electronic prescription system is considered as a national infrastructure. The infrastructure is understood in this instance to have the following features:

- It is directly or indirectly controlled by public organizations and political decision-making
- It is available for anyone willing to pay the usage fees and obeying the rules set for its users
- It is not primarily there in order to bring profit for its owner
- Many structures base themselves on infrastructure
- The society as a whole is highly dependent on the infrastructure
- Information on the infrastructure is open for the most part to anyone.

This paper argues that implementation of EPS differs from many other “traditional” IS implementation projects, because EPS has features of the national infrastructure and should not be judged solely by scales adjusted to more contemporary IOS implementation projects.

This paper is conceptual in nature, though it has an empirical section consisting of two different components. The first part of the data was collected from the written documentation of the Finnish EPS initiative and was supplemented by expert interviews: at this stage, the implementation process was at its infancy and the production of electronic prescriptions had started in one area. The second part of data collection consisted of a desk-top study mapping electronic prescription initiatives around the world and comparing different national solutions into the Finnish one.

The main results of the paper suggest that the Finnish EPS initiative had elements of the infrastructure project, but there are also several shortcomings in terms of national infrastructure prerequisites. The paper lists objectives of EPS projects and obstacles for the implementation of EPS internationally. The paper suggests using a so-called SMART rule (Martin 2002) when setting up project objectives:

- Specific: clearly defined with completion criteria
- Measurable: one knows when the objectives have been achieved
- Achievable: within the current environment and with the skills that are available
- Realistic: not trying to achieve the impossible

- Time bound: limited by a completion date.

Quite interestingly, Social Insurance Institution of Finland later established a National Actor (KANTO, *Kansallinen toimija*) initiative in order to establish a national actor to organize the development of electronic prescription inter alia, with highly similar features to those suggested in the original research paper II. Furthermore, in current plans, EPS is included in the National IT Architecture.

Also, this paper provides normative rules for the steering group of the pilot. In addition, this paper contributes to the second major research question of how EPS should be governed. The viewpoint in this paper suggests that the EPS should be ‘authority-run’ instead of arranging it as ‘traditional business’. Then again, the next paper perceives a business model approach to EPS implementation.

4.3 EPS in lieu of business models

The third original article of the dissertation is: Salmivalli, L., Hilmola, O-P., ‘*Business Pluralism of electronic prescriptions – State of development in Europe and the USA*’ (originally published in *International Journal of Electronic Healthcare*, Vol. 2, No. 2, 2006 pp. 132 - 148).

As the second paper examined EPS from the national infrastructure and not-for-profit perspective, this paper examines EPS initiative from the business models perspective. The paper presents business model approaches that are linked in the health informatics domain. The empirical part of the paper consists of primarily quantitative data collected from American companies providing electronic prescriptions. The empirical examples show that electronic prescriptions have been implemented in both Europe and the USA, but the business models (in terms of e.g., revenues) of electronic prescriptions have not matured. Electronic prescriptions can allegedly provide benefits for users as well as on the national level, but turning the benefits into profitable business seems to be an arduous task.

Based on the results of the paper, it seems that starting points of the EPS in terms of ‘business’ or financial success are somewhat challenging: even if the EPS were to be taken into full use, it does not guarantee that the initiative would be financially feasible. This fact is emphasized especially in the health care sector, traditionally government led, where the making of financially successful inventions seems to be a difficult task.

This is an indication of an infrastructure element: similarly, e.g., the airline industry on aggregate is struggling on the profitability marginal and struggling on the edge of bankruptcy. In *Fortune* magazine (11/22/99), one of the world’s

most famous investors, Warren Buffet, listed inventions that had changed the life of Americans but have been financially unfeasible in the long run. Buffet says about the car manufacturing industry in the interview as follows: “*So here is an industry that had an enormous impact on America – and also an enormous impact, though not the anticipated one, on investors.*” This means that the car manufacturing industry has changed the lives of millions of people, but the industry as a whole has not been able to generate wealth for its owners. In the same interview, Buffet says about airlines: “*Move on to failures of airlines. Here’s a list of 129 airlines that in the past 20 years filed for bankruptcy. Continental was smart enough to make that list twice. As of 1992, in fact – though the picture would have improved since then – the money that had been made since the dawn of aviation by all of this country’s airline companies was zero. Absolutely zero.*”

4.4 Building Inter-organizational Cooperative Network for IT Collaboration

The fourth original published article is: Salmivalli, L., Salmela, H., Kestilä, T., (2008) ‘*Building Inter-organizational Cooperative Network for IT Collaboration*’ (originally published in the proceedings of 41st Hawaii International Conference on System Sciences January 7-10, 2008, Hilton Waikoloa Village, Big Island, Hawaii).

The fourth paper is comparative in nature and describes three Finnish eGovernment projects from the inter-organizational relationships (IOR) evolution perspective. The paper attempts to answer the question of *How to build and maintain inter-organizational cooperative network for IT collaboration?* The scientific purpose of the paper is to explain the outcomes of early negotiations, i.e., why the process succeeds or fails.

In the first case, the aim was to create an information systems’ governance structure for social welfare service sector in one regional area in Finland (Vasso-Case). The second case: ‘ICT in the Finnish Early Childhood Education’ demonstrates the creation of ICT utilization oriented network within the context of early childhood education (ECE), and the third case concerns the implementation of EPS. The framework presented in this paper originates from Kestilä, Mäkipää, Salmela & Salmivalli (2007a) and (Kestilä et al. 2007b), with further analysis of ICT collaboration.

Based on the results gained in the three cases, it appears that active participation of network level organization is important in IOS governance. In the early stages of network building, the core group at the network level should design the initial proposal for the content and governance of network

collaboration. Both in the Vasso case and in the electronic prescription system case, this work was not completed, either because of lack of vision, resources and/or attention.

In the cases concerned, the initial development idea was invented outside the actual service network. Furthermore, the initial idea was suggested by IT-oriented people, rather than by welfare service professionals. In all three networks, the early stages of network formation appears to have similarities with the process framework presented by (Ring & van de Ven 1994). Formal, legal and psychological contracts were important for gaining organizational and personal level commitment in network-related IT governance. Furthermore, in the more successful cases, the individual level psychological contracts were achieved first. After that, the network formation proceeded to financial contracts and finally to the definition of formal network structure and authority. Organizational level commitment to planning requires personal commitments. It seems that a single committed person may not be sufficient to ensure organizational commitment. There is a need for several persons who sell the idea of network collaboration inside their own organization. In the Vasso and ECE case, it was the expected future benefits that were the most important theme in the early phases of network building. The early discussions and group work focused on the benefits of IT. This in turn improved the arguments about the benefits that each participating organization will gain. An obvious reason for the failure of electronic prescription pilot was the participants' missed common conception of future IOS benefits.

This paper contributes especially to the second major research question and building of the EPS governance framework. The strength of this paper is in its multi-case approach, through which we were able to compare three networks, their evolution and governance.

4.5 Governing the implementation of a complex IS network

The fifth and last original publication is Salmivalli, L., (2006) '*Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription*' (originally published in the proceedings of ACIS 2006, the 17th Australasian Conference on Information Systems, 6th-8th December 2006, Adelaide, Australia).

The paper focuses on the network governance issues of the Finnish EPS initiative, illustrating firstly concepts of networks and governance and describing differences between public and private sector management and distinctions between various operating environments (i.e., markets and

hierarchies). Furthermore, the paper introduces three different perspectives or ‘ideal types’ of network management listed by Kickert et al. (1997):

1. *Instrumental perspective*: i.e., refinement of the classical rational ‘steering’ approach. The main argument is that regulatory instruments do not apply in a network situation because they are uniform and one-sided. In the network situation, more refined instruments – such as incentives, communicative instruments or covenants – should be employed.
2. *Interactive perspective*: stresses the multitude of actors and their interactions in particular. Network management is about contributing to and providing conditions for the process of finding a common purpose more, than attaining governmental goals.
3. *Institutional perspective*: emphasizes the role of institutions which shape the strategies and intentions of actors. Network management has to build on these institutions.

The paper attempts to answer questions A) What is the intrinsic rationale to implement electronic prescription system? and B) How is the implementation of EPS network governed? The first research question was divided into *National level*, *Organizational level*, and *User level* motives to implement (adopt) EPS. The division followed intuitively the one presented by (Provan & Milward 2001; Provan & Kenis 2007) and described in section 1.4 in conjunction with the research questions. The author became familiar with Provan’s classification after the paper at hand was published, but the division used in the paper was very similar to that of Provan and Milward’s.

Key findings of the first research question suggest that there is a clear aspiration on the national level for the ePrescription system – real or invented. The interviewees shared the mutual understanding that an EPS pilot is required and that it could generate benefits on the *national level*. Expected benefits mentioned related to rationalization of medication and medication costs, bringing health care up-to-date and increasing the productivity of health care generally, as well as improving the quality of care. Even so, the measurability and provability of the expected benefits remained unclear through the entire project.

Organizations participating in the pilot did not receive any financial incentives for participation: rather, they were expected to allocate resources for the pilot. Hence, all of the individuals participated in the project among their other tasks. A part-time project manager was the only person receiving a salary from the project, whilst software vendors naturally billed for the development work funded by the Ministry. The organizations did not expect

financial savings from the system: on the contrary, organizations expected EPS to create more costs in terms of IT personnel and the upgrading of existing systems. The main benefits expected on the *organizational level* were related to time-saving and quality improvements in care. The paper suggests that costs and benefits appear on varying levels. Costs seem to be concentrated on individual organizations, whereas benefits are generated on the national level, and are often difficult to calculate (e.g., how to calculate improvements in life quality due to the more rational medication of the patient).

All in all, the findings suggest that organizations involved in the pilot were surprisingly committed, considering the fact that the generation of actual benefits is somewhat tentative, and would at any rate require that a significant proportion of all prescriptions are electronic. As long as there are two systems: one for the paper prescriptions and one for electronic prescriptions, the benefits are not generated – at least on the full scale – but instead, the costs of both systems are running.

User level motivation was the third identified dimension affecting the implementation project. *User level motivation* is twofold: primary users are physicians and pharmacy personnel. Findings suggest that the critical success factor is user-acceptance on the part of physicians. Pharmacy personnel have fewer choices, as they have to dispense prescriptions regardless of format: paper or electronic. Physicians, on the other hand, can choose between paper and electronic prescription and threshold to use ePrescription may be considerably high if they do not perceive advantage from using EPS. Interviewees stated that user feedback from the system was that it was slow to use and physicians had to explain patients the data security issues related to the system and ask their written consent, which in turn created extra work and time losses for physicians.

The second research question of the original paper dealt with the governance of EPS implementation. Findings claim that the organization of the EPS implementation project was a failure. The time scale of the project was drawn out constantly, the pilot was under-resourced both in terms of money and personnel, and responsibilities were unclear. The EPS steering group was considered too large and decision-making was difficult. Decision-making was further aggravated by the fact that there were no prepared drafts on the basis of decision-making. Part-time project manager had little means to influence the network. There were no rewards to be offered for good performance, nor penalties for under-performance. Hence, the main tools to be used were based on actors' voluntary cooperation. Furthermore, the project manager did not have the wholehearted trust of all actors, which in turn was seen to complicate management.

Findings of the paper suggest that the main governance method falls under *interactive perspective* described above. One of the main objectives of network management according to the interactive perspective is to find a common objective for the network. According to the results, it remains uncertain whether common objectives benefiting all participants was really found in the pilot. As the expense of entry was comparatively low and expected benefits for participants relatively precarious, organizations may have joined the pilot “just in case”. The second possible explanation presented in the paper is opportunism and the wielding of power.

5 SUMMARY AND CONCLUSIONS

This chapter will summarize what we have learnt from this study both theoretically and practically. The general purpose of this dissertation was to create new knowledge in the field of health care IOS implementation governance. This dissertation has attempted to contribute to health care IOS implementation research especially from the network governance perspective by developing further a network governance framework. Furthermore, the pragmatic objective was to formulate guidelines for organizations and policy makers planning to participate in the similar ventures in future.

Research motivation originated from the notation that the implementation process of multi-organizational networks of health care IS is still very little studied, especially on the aggregate network level. Further, there is a considerable amount of research published that a significant number of HCIS initiatives are failures in both the private sector and the public sector. As the implementation of EPSs is an ‘irreversible’ intervention in large, multifaceted and deep-rooted actor-network the research on the process was both interesting and hopefully useful.

Next, we revise firstly theoretical implications of this research, and after that the practical implications. In section 5.4 we discuss limitations of the study, and finally this study is concluded in section 5.5 “Conclusions and Further Research”.

5.1 Theoretical Implications

From a theoretical standpoint, the main contribution of this study was to increase understanding of network governance in a specific health care IOS implementation situation. Hence, the study had two main domains from which the theoretical contribution was derived: firstly, *health care as operating domain* and secondly, the *network aspect* involved in the implementation process.

The first objective of the research was to explain why inter-organizational information systems are implemented in health care through our first major research question:

MRQ-1: *What is the intrinsic rationale to implement Electronic Prescription Systems at various levels of the network?*

The second objective of the research tackled with the governance of EPS implementation and it had same key dimensions as the first Major Research Question and is natural extension of the first MRQ. The governance models can only be studied after the rationale to implement an IOS is clarified:

MRQ-2: *How is the implementation process of Electronic Prescription System governed?*

The existent literature on the IOS, IOS adoption, IOS implementation, and the application of the afore-mentioned in the health care environment was revised in Chapter 3. Based on the literature, we claimed that there is generally very little research made on the health care IOS implementation and that there is no research conducted from the network governance perspective.

After identifying the need for health care IOS research from the governance perspective, we presented the results of this research from empirical material in Chapter 4. With the five original articles, we studied the EPS implementation case from varying theoretical perspectives. Each original research paper had more detailed research questions that contributed in our major research questions.

Our research suggests that *firstly*, as stated in section 3.3, that *there is very little evidence of realized benefits from health care information systems, and organizations are participating in health care IS (IOS) projects with too unclear expectations*. Our finding is theoretically novel as the *potential* benefits of health care (inter-organizational) information systems have been widely discussed in literature (Southon et al. 1997; Southon et al. 1999; Mitev & Kerkham 2002; Barlow et al. 2006), but actual realized benefits are rare in the literature. The second important observation is that *in the case of inter-organizational health care information systems, the benefits may appear on one level, and the costs on another*.

We applied the three-level network structure originally introduced by (Provan & Milward 2001) to point out the disparity between general, national level benefits and detailed organization/user-level benefits and the difficulty to motivate organizations/users to adopt the new technology. We feel confident that similar division between different participant levels at networks can also be used in various IOS implementation settings to investigate the benefits of the venture at different levels and hence find out the intrinsic rationale of different actors to join the network.

Second theoretical contribution of this thesis is adding new knowledge in the governance of health care IOS implementation process. The main contribution of this study is identifying the governance mechanism of the Finnish EPS implementation process and secondly improving the presented governance model by adding two new dimensions into it. A theory is a validated and tested framework, whereas a model is a preliminary framework (www.metodix.com). The model presented in this thesis requires further validation, and one of the future research lines will be test of this model. To conclude, implementation of health care IOS is not only about the technical feasibility of a system, but also a complex net of different actors with different backgrounds and relationships, and with divergent objectives.

5.2 Practical Implications

The main pragmatic value of this study is to provide a holistic view of a health care IOS implementation venture. The information can be utilized by various stakeholders operating in the health care field, especially in Finland, but also in other countries with a similar operating environment. Results may be used also outside the health care field in complex IOS network ventures where a knowledge of network governance is required.

Remarkably, a significant number of health care IS projects fail due to reasons presented in section 3.3.2. Yet our research suggests that the benefits of health care information systems to each participant (level) should be questioned more carefully in implementation ventures. The second important finding is making a decision between the infrastructure and ‘business’ organization of systems to be implemented. This is a question that may or even should interest health policymakers, as the results offer insights for the latter as well as payers of the current health care system who are concerned with ensuring a rational and efficient prescribing system. Our results suggest that EPS has many elements of national infrastructure. The findings that benefits are not appearing on the individual participant/organizational level support the claim that finding payers from the participant level could turn out to be challenging. The system should be able to provide significant added value for participants in order to justify the ‘business organization’ of the EPS, and still finding a proper and just business model would be a hard task. This does not mean that the EPS system should be done at any cost. Instead, if a system is to be financed by taxpayers, policymakers have an even larger responsibility to reveal the overall ‘efficiency’ of the system.

5.3 Limitations of the study

A major limitation of this study is that the empirical findings of the research were gathered from only one case. One can always argue as to whether such a narrow scope permits wide-ranging generalizations. Limitations have been attempted to identify and overcome with means presented in sections 2.5 and 2.6.

The main limitation seems to be that results presented in this research remain at quite a general level. Despite the time, resources and efforts put into the EPS implementation, the visible results remained relatively minor. Therefore, the evaluation team had comparatively few matters to be measured from the 'before' and 'after' stages decreasing the quantity and quality of actual findings from the pilot. Also, the original purpose was to complete a more thorough analysis on the costs and benefits of the system, but this goal remained unattainable simply because such data did not exist, and still do not exist at the time of writing.

This brings us to the potential limitation of weak verifiability of the results. The EPS pilot organization at the time has already terminated, and a new EPS initiative is expected to start in 2008: verification of concurrent results could turn out to be problematic. However, the dissertation consists of five separate articles that have undergone peer review, and it can be argued that the results have also undergone critical evaluation prior to publication. Thus, at least partly, the focus of the thesis shifted from the implementation focus to more general network management – or governance – issues.

Generally, the main purpose of this research was not to validate an existing theory but rather to create new knowledge in terms of a novel framework, and therefore strict (statistical) validation of the results is unnecessary.

5.4 Summary of implications

Sections 5.1 and 5.2 presented key findings from theoretical and practical perspectives and section 5.3 the limitations of this study. This sub-chapter summarizes the main implications that are presented in Table 8.

Table 7. Summary of implications

	<i>Theoretical implications</i>	<i>Practical implications</i>
1	Evidence of health care information systems, and IOS in particular, benefits are scarce.	Health care IOS implementation requires comprehensive dissection.
2	Costs and benefits of health care information systems may appear on various levels.	EPS has elements of a national infrastructure whose costs may be difficult to provide rationales for to individual participants.
3	Health care information systems implementation is not a mere technical venture.	Possible benefits seem to appear most likely on the network or macro level.
4	Contemporary literature on health care IOS implementation cannot fully explain the governance of EPS implementation.	Generation of benefits will take a long time and requires a high usage percentage of the system.
5	The governance of health care IOS implementation requires a Network Administrative Organization with adequate tools to operate	Current business models do not appear feasible for the EPS system.

From the theoretical perspective, particularly interesting implications are numbers 2 “Costs and benefits of health care information systems may appear on various levels” and 5 “The governance of health care IOS implementation requires a Network Administrative Organization”. These require further research.

Interesting findings from the pragmatic perspective are, in particular, numbers 2 “EPS has elements of national infrastructure, whose costs may be difficult to provide rationales for to individual participants” and 4 “Generation of benefits will take a long time and requires high usage percentage of the system”. The next sub-chapter will elaborate further on future research.

5.5 Further Research

This study leaves plenty of space for future research. First line of research is testing and further developing the framework presented in the coming EPS initiative and other large-scale health care IOS initiatives that are being launched or are emerging in the near future, e.g., ventures related to the national architecture.

The second research line of interest is studying other networks and testing our model in other environments. This work has been partially started in (Salmivalli et al. 2008), but more thorough research is called for.

A number of interesting issues were discarded from this research due to lack of available data. An issue of enormous interest is the rigorous cost-benefit analysis of current health care systems, especially on the various levels of IOS networks.

6 REFERENCES

- Aarts, Jos - Peel, Victor (1999) Using a descriptive model of change when implementing large scale clinical information systems to identify priorities for further research. *International Journal of Medical Informatics*, Vol. No: 56, 43-50.
- Ackoff, Russell L. (1967) Management Misinformation Systems. *Management Science*, Vol. 14, No: 4, B147-B156.
- Adang, E - Voordijk, L - Jan van der Wilt, G - Ament, A. (2005) Cost-effectiveness analysis in relation to budgetary constraints and re-allocative restrictions. *Health Policy*, Vol. 74, No: 2, 146-56.
- Al, Maiwenn J. - Feenstra, Talitha - Brouwer, Werner B.F. (2004) Decision makers' views on health care objectives and budget constraints: results from a pilot study. *Health Policy*, Vol. No: 70, 33-48.
- Ammenwerth, Elseke - Gräber, Stefan - Herrmann, Gabriele - Bürkle, Thomas - König, Jochem (2003) Evaluation of health information systems - problems and challenges. *International Journal of Medical Informatics*, Vol. 71.
- Bakker, Albert R. (2002) Health care and ICT, partnership is a must. *International journal of Medical Informatics*, No: 66, 51-57.
- Barlow, James - Bayer, Steffen - Curry, Richard (2006) Implementing complex innovations in fluid multi-stakeholder environments: Experiences of 'telecare'. *Technovation*, Vol. 26, 396-406.
- Barrett, Stephanie - Konsynski, Benn (1982) Inter-Organization Information Sharing Systems. *MIS Quarterly*, Vol. 6, No: Special Issue: [1982 Research Program of the Society for Management Information Systems], 93-105.
- Baskerville, Richard (1996) Deferring Generalizability: Four Classes of Generalization in Social Enquiry. *Scandinavian Journal of Information Systems*, Vol. 8, No: 2, 5-28.
- Baskerville, Richard L. - Wood-Harper, A Trevor (1996) A critical perspective on action research as a method for information systems research. *Journal of Information Technology*, Vol. 11, No, 235-246.
- Baskerville, Richard - Myers, Michael D. (2004) Special issue on Action Research in Information Systems: Making IS Research Relevant to Practice - Foreword. *MIS Quarterly*, Vol. 28, No: 3, 329-335.
- Baskerville, Richard - Wood-Harper, A.T. (1998) Diversity in Information Systems Action Research Methods. *Journal of Operational Research Society*, Vol. 7, No: 2, 90-107.
- Bastholm Rahmner, P. - Andersén-Karlsson, E. - Arnhjort, T. - Eliasson, M. - Gustafsson, L.-L. - Jacobsson, L. - Ovesjö, M.-L. - Rosenqvist, U. - Sjövikar, S. - Tomson, G. - Holmström, I. (2004) Physicians'

- perceptions of possibilities and obstacles prior to implementing a computerised drug prescribing support system. *International Journal of Health Care Quality Assurance*, Vol. 17, No: 4, 173-179.
- Becker, Jörg - Niehaves, Björn (2007) Epistemological perspectives on IS research: a framework for analysing and systematizing epistemological assumptions. *Info Systems J*, No: 17, 197-214.
- Bell, Douglas S. - Cretin, Shan - Marken, Richard S. - Landman, Adam B. (2004a) A Conceptual Framework for Evaluating Outpatient Electronic Prescribing Systems Based on Their Functional Capabilities. *J. Am. Med. Inform. Assoc.*, Vol. No: 11, 60-70.
- Bell, Douglas S. - Marken, Richard S. - Robin, C Meili - Wang, C. Jason - Rosen, Mayde - Brook, Robert H. - The RAND Electronic Prescribing Expert Advisory Panel (2004b) Recommendations For Comparing Electronic Prescribing Systems: Results of An Expert Consensus Process. *Health Affairs* No: 25 May 2004.
- Benbasat, I. - Zmud, R. W. (1999) Empirical research in information systems: The practice of relevance. *MIS Quarterly*, Vol. 23, No: 1, 3-16.
- Bensaou, M. (1997) Interorganizational cooperation: The role of information technology - an empirical comparison of US and Japanese supplier relations. *Information Systems Research*, Vol. 8, No: 2, 107-124.
- Berg, M. (2001) Implementing Information Systems in Health Care Organizations: Myths and Challenges, *International Journal of Medical Informatics*, Vol. 64, No. 2 - 3, 143-156.
- Beshers, James M. (1957) Models and Theory Construction. *American Sociological Review*, Vol. 22, No: 1, 32-38.
- Blair, John D. - Boal, Kimberly B. (1991) Strategy Formation Processes in Health Care Organizations: A Context-Specific Examination of Context-Free Strategy Issues. *Journal of Management*, Vol. 17, No: 2, 305-344.
- Bobb, Anne - Gleason, Kristine - Husch, Marla - Feinglass, Joe - Yarnold, Paul R. - Noskin, Gary A. (2004) The Epidemiology of Prescribing Errors: The Potential Impact of Computerized Prescriber Order Entry. *Arch Intern Med*. No: 164, 785-792.
- Boonstra, Albert (2003) Interpretive Perspectives on the Acceptance of an Electronic Prescription System. *Journal of Information Technology Cases and Applications*, Vol. 5, No: 2, 27-49.
- Boonstra, Albert - Boddy, David - Fischbacher, Moira (2004) The limited acceptance of an electronic prescription system by general practitioners: reasons and practical implications. *New Technology, Work and Employment*, Vol. 19, No: 2, 128-144.
- Brill, C.W. - Forster, K. - Keil, W. (2005) Patients' mailbox and electronic prescription. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz.*, Vol. 48, No: 7, 732-5.
- Burke, Darrell E - Menachemi, Nir (2004) Opening the Black Box: Measuring Hospital Information Technology Capability. *Health Care Management Review*, Vol. 29, No: 3, 207.

- Burrell G, Morgan G. (1979) *Sociological Paradigms and Organizational Analysis*. London: Heinemann Books.
- Carroll, J. M. - Swatman, Paul A. (2000) Structured-Case: A Methodological Framework for Building Theory in Information Systems Research. In: *Proceedings of the Eighth European Conference on Information Systems*, ed. by Hans Robert Hansen - Martin Bichler - Harald Mahrer, 116-123.
- Checkland, Peter (1985) Achieving 'Desirable and Feasible' Change: An Application of Soft Systems Methodology. *The Journal of the Operational Research Society*, Vol. 36, No: 9.
- Checkland, Peter - Holwell, Sue (1998a) Action Research: Its Nature and Validity. *Systemic Practice and Action Research*, Vol. 11, No: 1, 9.
- Checkland, Peter - Holwell, Sue (1998b) *Information, systems, and information systems : making sense of the field*. Wiley: Chichester; New York.
- Chen, WenShin - Hirschheim, Rudy (2004) A paradigmatic and methodological examination of information systems research from 1991 to 2001. *Info Systems J*, Vol. 14, No, 197-235.
- Choudhury, V. (1997) Strategic choices in the development of interorganizational information systems. *Information Systems Research*, Vol. 8, No: 1, 1-24.
- Christiaanse, Ellen - Huigen, Jos (1997) Institutional Dimensions in Information Technology Implementation in Complex Network Settings. *European Journal of Information Systems*, Vol. 6, No: 2, 77-85.
- Chua, W.F. (1986) Radical Development in Accounting Thought. *The Accounting Review*, Vol. 61, No: 601-632.
- Ciborra, Claudio U. - Andreu, Rafael (2001) Sharing knowledge across boundaries. *Journal of Information Technology*, Vol. 16, No, 73-81.
- Cole, Robert - Purao, Sandeep - Rossi, Matti - Sein, Maung K. (2005) Being Proactive: Where Action Research Meets Design Research. In *the Proceedings of the Twenty-Sixth International Conference on Information Systems*, ed. by David E. Avison - Dennis F. Galletta.
- Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions Commission of the European Communities, (2004) *e-Health - making healthcare better for European citizens: An action plan for a European e-Health*. http://ec.europa.eu/information_society/doc/qualif/health/COM_2004_0356_F_EN_ACTE.pdf retrieved 22.6.07.
- Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions Commission of the European Communities, (2005) *i2010 - A European Information Society for growth and employment*. European Union. http://europa.eu.int/information_society/europe/i2010/docs/communications/com_229_i2010_310505_fv_en.doc retrieved 22.6.07.

- Conrad, Steven A. - Lin, Binshan - Rycus, Peter T. (2002) Database Technology for Global Support of a Medical Registry: An Implementation Case. *Journal of Database Management*, Vol. 13, No: 4, 62-73.
- Cooper, Randolph B. - Zmud, Robert W. (1990) Information Technology Implementation Reserach: A Technological Diffusion Approach. *Management Science*, Vol. 36, No, 123.
- Couprie, Dale - Goodbrand, Alan - Li, Bin - Zhu, David Soft Systems Methodology: A report.
<http://sern.ucalgary.ca/courses/seng/613/F97/grp4/ssmfinal.html>
retrieved 29.6.07.
- Cox, Benita - Ghoneim, Sherine (1996) Drivers and barriers to adopting EDI: A sector analysis of UK industry. *European Journal of Information Systems*, Vol. 5, No: 1, 24-33.
- Culnan, Mary J. (1986) The Intellectual Development of Management Information Systems, 1972-1982: A Co-Citation Analysis. *Management Science* February, 156-172.
- da Silveira, Giovani J.C. - Cagliano, Raffaella (2006) The relationship between interorganizational information systems and operations performance. *International Journal of Operations & Production Management*, Vol. 26, No: 3, 232-253.
- Davison, Robert M. - Martinsons, Maris G. - Kock, Ned (2004) Principles of canonical action research. *Info Systems J*, Vol. 14, No: 1, 65–86.
- Dedrick, Jason - Gurbaxani, Vijay - Kraemer, Kenneth (2003) Information Technology and Economic Performance: A Critical Review of the Empirical Evidence. *ACM Computing Surveys*, Vol. 35, No: 1, 1–28.
- Deloitte & Touche (1999) *Environmental Assessment: Rising to the Challenge of a New Century*, Detroit, MI.
- DeLone, William. H. - McLean, Ephraim. R. (1992) Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*, Vol. 3, No: 1, 60-95.
- Demkjaer, K. - Johansen, I. - Bernstein, K. (1999) Third generation electronic pharmacy communications. Recommendations based on ten years' experience. *Studies in health technology and informatics*, Vol. 68, No, 278-82.
- DiMaggio, P. - Powell, W. W (1983) The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, Vol. No: 48, 147-160.
- Doolin, Bill (2004) Power and resistance in the implementation of a medical management information system. *Information Systems Journal*, Vol. 14, No: 4, 343-362.
- eHealth Conference 2007 Declaration - Final: *eHealth in Europe: Succeeding Together*
http://ec.europa.eu/information_society/activities/health/docs/events/eh_ealth2007/eh_declaration20070417_en.pdf

- eHealth Initiative (2004) *Electronic Prescribing: Toward Maximum Value and Rapid Adoption -A Report of the Electronic Prescribing Initiative*, eHealth Initiative: Washington D.C.
- Elgarah, Wafa - Falaleeva, Natalia - Saunders, Carol S - Ilie, Virginia - Shim, J.T. - Courtney, James F. (2005) Data Exchange in Interorganizational Relationships: Review Through Multiple Conceptual Lenses. *Database for Advances in Information Systems*, Vol. 36, No: 1, 8-29.
- Fleury, Marie-Josée (2005) Quebec mental health services networks: models and implementation. *International Journal of Integrated Care*, Vol. 5, No: 1.
- Flick, Uwe (1992) Triangulation Revisited: Strategy of Validation or Alternative? *Journal for the Theory of Social Behaviour* 22 (2), 175–197.
- Flood, Robert L. (2000) A Brief Review of Peter B. Checkland's Contribution to Systemic Thinking. *Systemic Practice and Action Research*, Vol. 13, No: 6, 723.
- Fottler, Myron D. (1987) Health Care Organizational Performance: Present and Future Research. *Journal of Management*, Vol. 13, No: 2, 367-391.
- Frambach, T.R. - Schillewaert, N. (2002) Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, Vol. 55, No: 2, 163-77.
- Freire, Fernando Costa (2006) Electronic Prescribing in Portugal. *In the Proceedings of the ePrescribing & Medication Management*, EHTEL International Conference.
- Gagnon, Marie-Pierre - Lamothe, Lise - Fortin, Jean-Paul - Cloutier, Alain - Godin, Gaston - Gagné, Camille - Reinharz, Daniel (2005) Telehealth adoption in hospitals: an organisational perspective. *Journal of Health Organization and Management*, Vol. 19, No: 1, 32-56.
- Gfrörer, Stefan. G. - Raupp, Markus - Schober, Frank (2001) Strategies and IT Integration in Outpatient Doctors' Networks. Upgrade, *The European Online Magazine for the IT Professional* 9-13.
- Ginzberg, M. J. (1981) Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions. *Management Science*, Vol. 27, No: 4, 459-478.
- Goles, Tim - Hirschheim, Rudy (2000) The paradigm is dead, the paradigm is dead. .long live the paradigm: the legacy of Burrell and Morgan. *Omega*, No: 28, 249-268.
- Grant, Delvin - Ngwenyama, Ojelanki (2003) A report on the use of action research to evaluate a manufacturing information systems development methodology in a company. *Info Systems J*, Vol. 13, No, 21-35.
- Gregory, Frank H. (1995) Soft Systems Models for Knowledge Elicitation and Representation. *The Journal of the Operational Research Society*, Vol. 46, No: 5, 562-578.
- Größler, Andreas - Grübner, André - Milling, Peter M. (2006) Organisational adaptation processes to external complexity. *International Journal of Operations & Production Management*, Vol. 26, No: 3, 254-281.

- Gummesson, Evert (2000) *Qualitative Methods in Management Research*. Sage, Thousand Oaks.
- Hackney, Ray - Dhillon, Gurpreet - McBride, Neil (1997) Primary care information technology within the NHS: The concept of markets and hierarchies on systems exploitation. *International Journal of Public Sector Management*, Vol. 10, No: 5, 388-395.
- Hackney, Ray - McBride, Neil (2002) Non-implementation of an IS Strategy Within a UK Hospital: Observations from a Longitudinal Case Analysis. *Communications of the Association for Information Systems*, Vol. 8, 130-140.
- Hall, R.H (1999) *Organizations: Structures, Processes and Outcomes* (7th ed.) Prentice Hall, Upper Saddle River, NJ.
- Halonen, Raija (2007) *Challenges in an inter-organisational information system implementation. Participatory view*. Academic dissertation. University of Oulu.
- Han, Shengnan (2005) *Understanding User Adoption of Mobile Technology: Focusing on Physicians in Finland*. Doctoral Dissertation. Åbo Akademi: Turku.
- Harkke, Ville (2006) *Knowledge Freedom for Medical Professionals - An Evaluation Study of a Mobile Information System for Physicians in Finland*. Doctoral Dissertation. Åbo Akademi: Turku.
- Hausman, Angela - Johnston, Wesley J. - Oyedele, Adesegun (2005) Cooperative adoption of complex systems: a comprehensive model within and across networks. *Journal of Business & Industrial Marketing*, Vol. 20, No: 4/5, 200-210.
- Heeks, R. (2006) Health Information systems: failure, success and improvisation. *Int. J Med Inf.*, Vol. 75, No, 125-137.
- Heeks, Richard - Mundy, David - Salazar, Angel (2000) *Understanding Success and Failure of Health Care Information Systems*. In: *Healthcare Information Systems: Challenges of the New Millennium*, ed. by Adi Armoni, Idea Group Publishing.
- Hevner, Alan R. - March, Salvatore T. - Park, Jinsoo - Ram, Sudha (2004) Design Science in Information Systems Research. *MIS Quarterly*, Vol. 28, No: 1, 75-105.
- Hill, Ned C. - Ferguson, D. M. (1989) Electronic Data Interchange: A Definition and Perspective. *EDI Forum: The Journal of Electronic Data Interchange*, Vol. 1, No, 5-12.
- Hirschman, Elizabeth C. (1986) Humanistic Inquiry in Marketing Research: Philosophy, Method, and Criteria, *Journal of Marketing Research*, Vol. 23, No. 3 (Aug., 1986), pp. 237-249.
- Hong, Ilyoo B. (2002) A new framework for interorganizational systems based on the linkage of participants' roles. *Information & Management*, Vol. 39, No: 4, 261-270.
- Hyppönen, H - Salmivalli, L - Nykänen, P - Ruotsalainen, P - Pajukoski, M (2007) Testing a theoretical framework for interdisciplinary IS evaluation: The case of Finnish Electronic Prescription. *International Journal of Health Care Technology and Management*.

- Hyppönen, H. - Nykänen, P. - Salmivalli, L. - Pajukoski, M. - Ruotsalainen, P. - Vuorela, S. (2005a) Conducting Inter-Disciplinary Research: Evaluation of the ePrescription Piloting in Finland. *Electronic Journal of Information Systems Evaluation*, Vol. 8, No: 3, 187-197.
- Hyppönen, Hannele - Nykänen, Pirkko - Salmivalli, Lauri - Pajukoski, Marja - Ruotsalainen, Pekka - Vuorela, Suvi (2005b) Conducting interdisciplinary research: Evaluation of the ePrescription piloting in Finland. In: *Proceedings of the 12th European Conference on Information Technology Evaluation ECITE 2005*, ed. by Dan Remenyi.
- Hyppönen, Hannele - Salmivalli, Lauri - Suomi, Reima (2005c) Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription. In: *Proceedings of the Hawaii International Conference on System Sciences*.
- Hyppönen, Hannele - Salmivalli, Lauri - Telling, Karina (2006) Implementing electronic prescription systems - A comparison between two approaches. In: *Proceedings of the 6th Nordic Conference on eHealth and Telemedicine*, ed. by Persephone Doupi,
- Hyppönen, Hannele - Salmivalli, Lauri - Telling, Karina (Unpublished) Electronic Prescribing: A Comparison between systems and their implementation in Finland and Sweden.
- Hyppönen, H. (ed.) 2005 Sähköisen reseptin pilotoinnin arviointi, vaihe I Loppuraportti, Stakes, Helsinki.
- Hyppönen, H. (ed.) 2006 Sähköisen reseptin pilotoinnin arviointi, vaihe II Loppuraportti, Stakes, Helsinki.
- Häkkinen, Unto (2005) The impact of changes in Finland's health care system. *Health Econ.*, Vol. 14, S101-S118.
- Iacovou, Charalambos L. - Benbasat, Izak - Dexter, Albert S. (1995) Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology. *MIS Quarterly*, Vol. 19, No: 4, 465-485.
- Itkonen, Pentti (1999) Information technology as tool for change. *International Journal of Medical Informatics*, No: 56, 135-139.
- Iversen, Jakob H. - Mathiassen, Lars - Nielsen, Peter Axel (2004) Managing Risk in Software Process Improvement: An Action Research Approach. *MIS Quarterly*, Vol. 28, No: 3, 395-433.
- Ives, Blake - Hamilton, Scott - Davis, Gordon B (1980) A framework for research in computer-based management information systems. *Management Science*, Vol. 26, No: 9, 910-933.
- Johns, Paul M. (1997) Integrating information systems and health care. *Logistics Information Management*, Vol. 10, No: 4, 140-145.
- Johnston, H. Russel - Vitale, Michael R. (1998) Creating competitive advantage with interorganizational information systems. *MIS Quarterly*, Vol. 12, No: 2, 153-165.
- Johnston, H. Russell - Vitale, Michael A. (1988) Creating Competitive Advantage With Interorganizational Information Systems. *MIS Quarterly*, Vol. 12, No: 2, 152.

- Johnston, K. D. - Yetton, P. W. (1996) Integrating information technology divisions in a bank merger - Fit, compatibility and models of change. *Journal of Strategic Information Systems*, Vol. 5, No: 3, 189-211.
- Johnston, R. B. - Gregor, S. (2000) A theory of industry-level activity for understanding the adoption of interorganizational systems. *European Journal of Information Systems*, Vol. 9, No, 243-251.
- Jones, Candace - Hesterly, William S. - Borgatti, Stephen P. (1997) A General theory of network governance: Exchange conditions and social mechanisms. *Academy of Management Review*, Vol. 22, No: 4, 911-945.
- Järvelin, Jutta (2002) *Health Care Systems in Transition - Finland*. European Observatory on Health Care Systems- WHO Regional Office for Europe.
- Kaplan, B. - Duchon, D. (1988) Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study. *MIS Quarterly*, Vol. 12, No: 4 (December), 571-586.
- Kaufman F. (1966) Data systems that cross corporate boundaries. *Harvard Business Review* 44(1):141-52.
- Keet, Robert (1999) Essential Characteristics of an Electronic Prescription Writer. *Journal of Healthcare Information Management*, Vol. 13, No: 3.
- Kestilä, Timo - Mäkipää, Marko - Salmela, Hannu - Salmivalli, Lauri (2007a) Building Commitment and Trust to ICT Collaboration in Partnership Networks. In: *Proceedings of the 30th Information Systems Research Seminar in Scandinavia, IRIS30*, ed. by Tarja Tiainen - Hannakaisa Isomäki - Mikko Korpela - Anja Mursu - Minna-Kristiina Paakki - Samuli Pekkola.
- Kestilä, Timo - Salmivalli, Lauri - Salmela, Hannu - Vahtera, Annukka (2007b) A Process Model of Partnership Evolution Around New IT Initiatives. In: *Proceedings of the I3E 2007, the seventh IFIP conference on e-Business, e-Services and e-Society*.
- Kickert, W. J. M., E.-H. Klijn, et al., Eds. (1997). *Managing Complex Networks: - Strategies for the Public Sector*. London, Sage.
- Kim, K. Kyu - Michelman, Jeffrey E. (1990) An Examination of Factors for the Strategic Use of Information Systems in the Healthcare Industry. *MIS Quarterly*, Vol. 14, No: 2, 201-215.
- Kinder, Tony (2000) A sociotechnical approach to the innovation of a network technology in the public sector – the introduction of smart homes in West Lothian. *European Journal of Innovation Management*, Vol. 3, No: 2, 72 - 90.
- Klein, H.K. - Myers, M.D. (1999) A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly*, Vol. 23, No: 1, 67-94.
- Klein, Katherine J. - Sorra, Joann Speer (1996) The Challenge of Innovation Implementation. *The Academy of Management Review*, Vol. 21, No: 4, 1055-1080.

- Klein, Stefan - Poulymenakou, Angeliki - Riemer, Kai - Papakiriakopoulos, Dimitris - Gogolin, Marcel - Nikas, Athanasios (2004) IOIS and Interfirm Networks - Interdependencies and Managerial Challenges. In: *Inter-Organisational Information Systems in the Internet Age*, ed. by Sean B. Eom, 170-212. Idea Group Publishing: Hershey, PA.
- Kock, Ned (2004) The three threats of action research: a discussion of methodological antidotes in the context of an information systems study. *Decision Support Systems*, Vol. No: 37, 265-286.
- Konsynski, Benn R. - McFarlan, E. Warren (1990) Information partnerships-Shared data, shared scale. *Harvard Business Review*, Vol. 68, No: 5, 114-120.
- Koppel, Ross - Metlay, Joshua P. - Cohen, Abigail - Abaluck, Brian - Localio, A. Russell - Kimmel, Stephen E. - Strom, Brian L. (2005) Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. *Journal of American Medical Association*, No: 293, 1197-1203.
- Kotlarsky, Julia - Oshri, Ilan (2005) Social ties, knowledge sharing and successful collaboration in globally distributed system development projects. *European Journal of Information Systems*, Vol. 14, No: 1, 37-48.
- Kumar, Kuldeep - Van Dissel, Han G (1996) Sustainable collaboration: Managing conflict and cooperation in interorganizational systems. *MIS Quarterly*, Vol. 20, No: 3, 279-300.
- Kumpusalo E, Ellonen M, Keinänen-Kiukaanniemi S, Mattila K, toim. (1991) *Yleislääketiede*. Vammala: Kustannus Oy Duodecim.
- Lamberg, Marja (2006) *Riippumaton lääketaloudellinen arviointi - selvitys nykytilasta ja tulevaisuudesta*.
- Lapointe, Liette - Rivard, Suzanne (2005) A Multilevel Model of Resistance to Information Technology Implementation. *MIS Quarterly*, Vol. 29, No: 3, 461-491.
- Leavitt, H. - Whisler, T. (1958) Management in the 80's, *Harvard Business Review*, 36(6), 41-48.
- Leblebic, Huseyin - Salancik, Gerald R. - Copay, Anne - King, Tom (1991) Institutional Change and the Transformation of Interorganizational Fields: An Organizational History of the U.S. Radio Broadcasting Industry. *Administrative Science Quarterly*, Vol. 36, No: 3, 333-363.
- LeCompte, Margaret D. - Goetz, Judith Preissle (1982) Problems of Reliability and Validity in Ethnographic Research *Review of Educational Research*, Vol. 52, No. 1 (Spring, 1982), pp. 31-60.
- Lee, Allen S. (1991) Integrating Positivist and Interpretive Approaches to Organizational Research. *Organizational Science*, Vol. 2, No: 4, 342-365.
- Lee, Allen S. - Baskerville, Richard L. (2003) Generalizing Generalizability in Information Systems Research. *Information Systems Research*, Vol. 14, No: 3, 221-243.

- Lee, Zoonky - Gosain, Sanjay - Im, Il (1999) Topics of interest in IS: evolution of themes and differences between research and practice. *Information & Management*, No: 36, 233-246.
- Leutz, Walter N. (1999) Five Laws for Integrating Medical and Social Services: Lessons from the United States and the United Kingdom. *The Milbank Quarterly*, Vol. 77, No: 1, 77-110.
- Lucas, H.C (1981) *Implementation, the Key to Successful Information Systems*. Columbia University Press: New York.
- Malone, Thomas W. - Yates, Joanna - Benjamin, R.I. (1987) Electronic Markets and Electronic Hierarchies: Effects of Information Technology on Market Structure and Corporate Strategies. *Communications of the ACM*, Vol. 30, No: 6, 484-497.
- Markus, M. L. (1983) Power, Politics, and MIS Implementation. *Communications of the ACM*, Vol. 26, No, 430-444.
- Markus, M. Lynne - Robey, Daniel (1988) Information Technology and Organizational Change: Causal Structure in Theory and Research. *Management Science*, Vol. 34, No: 5, 583-598.
- Martin, V., (2002) *Managing Projects in Health and Social Care*, London: Routledge.
- Mason, R.O. - Mitroff, I.I. (1973) A program for research in management information systems. *Management Science*, Vol. 19, No: 5, 475-485.
- Mathiassen, L. (1998) Reflective systems development. *Scandinavian Journal of Information Systems*, Vol. 10, No, 67-118.
- Mathiassen, Lars (2002) Collaborative practice research. *Information Technology & People*, Vol. 15, No: 4, 321.
- Mediutiset (2007a) *Fujitsu toimittaa kansallisen potilastietojärjestelmän*. http://www.mediutiset.fi/doc.te?f_id=1181684 , retrieved 4.6.2007.
- Mediutiset (2007b) *Sähköinen lääkemääräys käyttöön ensi vuonna* (Mari Heikkilä 30.3.2007, 09:45). http://www.mediutiset.fi/doc.ot?f_id=1144657 , retrieved 4.6.2007.
- Mercer, Kevin (2001) Examining the impact of health information networks on health system integration in Canada. *Leadership in health services*, Vol. 3, No: 14, i-xxx.
- Middleton, Helen (2000) Electronically transmitted prescriptions - a good idea? *The Pharmaceutical Journal*, Vol. 265, No: 7107, 172-176.
- Mitev, Nathalie N - Kerkham, Sharon (2002) *Organizational and Implementation Issues of Patient Data Management Systems in an Intensive Care Unit*. In: *Effective Healthcare Information Systems*, ed. by Adi Armoni, Idea Group Publishing: Hersey, PA.
- Mundy, Darren - Chadwick, David W. (2004) Electronic transmission of prescriptions: towards realising the dream. *Int. J. Electronic Healthcare*, Vol. 1, No: 1, 112-125.
- Mundy, Darren P. (2003) Providing a Secure Solution For The Integration Of Electronic Prescription Transfer Within The United Kingdom National Health Service. In: *Proceedings of the UKAIS PhD Consortium*.
- Mundy, Darren P. - Chadwick, David W. (2002) A System For Secure Electronic Prescription Handling. In: *Proceedings of the 2nd*

International Conference on the Management of Healthcare and Medical Technology.

- Mundy, Darren P. - Chadwick, David W. - Ball, Ed (2003) An Application Programming Interface for the Electronic Transmission of Prescriptions. In: *Proceedings of the IFIP*.
- Munkvold, BE (1999) Challenges of IT implementation for supporting collaboration in distributed organizations. *European Journal of Information Systems*, Vol. 8, No: 4, 260-272.
- Nair, G.S. - A.M. Riege (1995) *Convergent interviewing to refine the research problem of a PhD thesis*. Paper presented at Marketing Educators' and Researchers' International Conference, Gold Coast, Australia.
- National Agency on Medicines (2004) *Suomen lääketilasto 2003 - Finnish Statistics on Medicines*.
- Neuman, W.L. (1991) *Social Research Methods: Qualitative and Quantitative Approaches*. Allyn and Bacon, Boston.
- Newman, M. - Robey, D. (1992) A Social Process Model of User-Analyst Relationships. *MIS Quarterly*, 249-266.
- Ngwenyama, Ojelanki K. - Lee, Allen S. (1997) Communication Richness in Electronic Mail: Critical Social Theory and the Contextuality of Meaning. *MIS Quarterly*, June 1997, 145-167.
- Niinimäki, Jaakko - Forsström, Jari (1997) Approaches for certification of electronic prescription software. *International Journal of Medical Informatics*, No: 47, 175-182.
- Nutt, Paul C. (1986) Tactics of Implementation. *The Academy of Management Journal*, Vol. 29, No: 2, 230-261.
- Nutt, Paul C. (1998) Leverage, Resistance and the Success of Implementation Approaches. *Journal of Management Studies*, Vol. 35, No: 2, 213-240.
- Nykänen, Pirkko (2000) *Decision support systems from health informatics perspective*. Academic Dissertation, Department of computer and information sciences, University of Tampere: Tampere.
- OECD *Reviews of Health Systems: Finland* (2005) OECD.
- Oliver, Christine (1990) Determinants of Interorganizational Relationships: Integration and Future Directions. *Academy of Management Review*, Vol. 15, No: 2, 241.
- Orlikowski, W.J. (1993) CASE tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development. *MIS Quarterly*, Vol. 17, No: 3, 309-340.
- Orlikowski, Wanda J. - Baroudi, Jack J. (1991) Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research* March, 1-28.
- O'Toole, Laurence J. (1997) Treating networks seriously: Practical and research-based agendas in public administration. *Public Administration Review*, Vol. 57, No: 1, 45-52.
- Ouchi, William G. (1979) A Conceptual Framework for the Design of Organizational Control Mechanism. *Management Science*, Vol. 25, No: 9, 833- 847.

- Payton, Fay Cobb (2000) Lessons learned from three interorganizational health care information systems. *Information & Management*, Vol. 37, No, 311-321.
- Payton, Fay Cobb - Brennan, Patricia Flatney (1999) How a community health information network is really used. *Communications of the ACM*, Vol. 42, No: 12, 85-89.
- Payton, Fay Cobb - Ginzberg, Michael J. (2001) Interorganizational health care systems implementations: An exploratory study of early electronic commerce initiatives. *Health Care Management Review*, Vol. 26, No: 2, 20.
- Peffer, Ken - Tuunainen, Virpi K (1998) Expectations and impacts of a global information system: The case of a global bank from Hong Kong. *Journal of Global Information Technology Management*, Vol. 1, No: 4, 17-37.
- Peräkylä, A. (1997) *Reliability and validity in research based on transcripts*. Silverman, D (ed.) *Qualitative Research. Theory, method and practice*. London, Sage.
- Pina Vera, Maria Jose (2006) Electronic Prescribing in the Region of Andalusia, Spain: Prescription XXI. In: *Proceedings of the ePrescribing & Medication Management, EHTEL International Conference*.
- Pizzi, Laura T. - Suh, Dong-Churl - Barone, Joseph - Nash, David B. (2005) Factors Related to Physicians' Adoption of Electronic Prescribing: Results From a National Survey. *American Journal of Medical Quality*, No: 20, 22-32.
- Premkumar, G - Ramamurthy, K (1995) The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems. *Decision Sciences*, Vol. 26, No: 3, 303-336.
- Provan, Keith G. - Fish, Amy - Sydow, Joerg (2007) Interorganizational Networks at the Network Level: A Review of the Empirical Literature on Whole Networks. *Journal of Management*, Vol. 33, No: 3, 479-516.
- Provan, Keith G. - Kenis, Patrick (2007) Modes of Network Governance: Structure, Management, and Effectiveness. *Journal of Public Administration Research and Theory*, Advance Access published online on August 2, 2007.
- Provan, Keith G. - Milward, H. Brinton (2001) Do Networks Really Work? A Framework for Evaluating Public-Sector Organizational Networks. *Public Administration Review*, Vol. 61, No: 4, 414-423.
- Puhakainen, Jussi (2001) *Electronic Business in Interactive Digital Networks - From Transactional Toward Interactive Focus*. Academic Dissertation. Turku School of Economics and Business Administration: Turku.
- Raghupathi, W. (1997) Health Care Information Systems. *Communications of the ACM*, 40(8).
- Raghupathi, Wullianallur - Tan, Joseph (2002) Strategic IT Applications in Health Care. *Communications of the ACM*, Vol. 45, No: 12.

- Raitoharju, Reetta (2007) *Information Technology Acceptance in The Finnish Social and Healthcare Sector*. Doctoral Dissertation. Turku School of Economics: Turku.
- Rapoport, Robert N. (1970) Three Dilemmas of Action Research. *Human Relations*, Vol. 23, No, 499-513.
- Riege, Andreas M. (2003) Validity and reliability tests in case study research: a literature review with “hands-on” applications for each research phase. *Qualitative Market Research: An International Journal*, Vol. 6, No: 2, 75-86.
- Riggins, Frederick J. - Mukhopadhyay, Tridas (1994) Interdependent benefits from interorganizational systems: Opportunities for Business Partner Reengineering. *Journal of Management Information Systems*, Vol. 11, No: 2, 37.
- Ring, Peter Smith - Van de Ven, Andrew H. (1994) Developmental Processes of Cooperative Interorganizational Relationship. *Academy of Management*, Vol. 19, No: 1, 90-118.
- Ring, Peter Smith - van de Ven, Andrew H. (1994) Developmental Processes of Cooperative Interorganizational Relationships. *The Academy of Management Review*, Vol. 19, No: 1, 90-118.
- Rodríguez, Charo - Langley, Ann - Béland, François - Denis, Jean-Louis (2007) Interorganizational Network Governance, Power, and Mandated Collaboration in an Interorganizational Network. *Administration & Society*, Vol. 39, No: 2, 150-193.
- Rogers, Everett, M. (1995) *Diffusion of Innovations*. Fourth Edition. The Free Press: New York.
- Rose, Jeremy (2002) Interaction, transformation and information systems development - an extended application of Soft Systems Methodology. *Information Technology & People*, Vol. 15, No: 3, 242-268.
- Sabherwal, R. - Robey, D. (1993) An Empirical Taxonomy of Implementation Processes Based on Sequences of Events in Information System Development. *Organization Science*, Vol. 4, No: 4, 548-576.
- Salmivalli, Lauri (2006) Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription. In: *Proceedings of the 17th Australasian Conference on Information Systems*, ed. by S Spencer - A Jenkins.
- Salmivalli, Lauri A.T. - Salmela, Hannu - Kestilä, Timo (2008) Building Inter-organizational Cooperative Network for IT Collaboration. In: *Proceedings of the HICSS-41*.
- Salmivalli, Lauri - Hilmola, Olli-Pekka (2006) Business Pluralism of E-prescriptions State of development in Europe and US. *Int. J. Electronic Healthcare*, Vol. 2, No: 2, 132-148.
- Salmivalli, Lauri - Nissilä, Jussi (2004) Curing Health Care Information Systems with Open Source Software. In: *Proceedings of the ECIS2004*,
- Schiff, Gordon D. - Rucker, T. Donald (1998) Computerized Prescribing Building the Electronic Infrastructure for Better Medication Usage. *The Journal of the American Medical Association*, Vol. 279, No: 13.

- Schuring, Roel W. - Spil, Ton A. M. (2003) *Relevance and Micro-Relevance for the Professional as Determinants of IT-Diffusion and IT-Use in Healthcare*. In: *ERP & Data Warehousing in Organizations: Issues and Challenges*, ed. by G Grant, 218-231. Idea Group Publishing: Hershey.
- Scott Morton, Michael S. (1990) *The Corporation of the 1990's*. Oxford University Press: New York.
- Seddon, Peter. B. - Staples, Sandy - Patnayakuni, Ravi - Bowtell, Matthew (1999) Dimensions of Information Systems Success. *Communications of the Association for Information Systems*, Vol. 2, No: 20.
- Smits, Martin - Janssen, Richard - van Pelt, Paul (2007) Using Electronic Auctions to Improve Market Performance in Health Care. In: *Proceedings of the 20th Bled eConference, eMergence: Merging and Emerging Technologies, Processes, and Institutions*.
- Southon, Gray Frank Charles - Sauer, Chris - Dampney, Christopher Noel Grant (1997) Information Technology in Complex Health Services: Organizational Impediments to Successful Technology Transfer and Diffusion. *J Am Med Inform Assoc*, Vol. 4, No: 2.
- Southon, Gray - Sauer, Chris - Dampney, Kit (1999) Lessons from a failed information systems initiative: issues for complex organisations. *International Journal of Medical Informatics*, No: 55, 33-46.
- Speier, Cheri - Venkatesh, Viswanath (2002) The Hidden Minefields in the Adoption of Sales Force Automation Technologies. *Journal of Marketing*, Vol. 66, No: 3 July, 98-111.
- Spil, Ton A.M. - Schuring, Roel W. - Michel-Verkerke, Margreet B. (2004) Electronic prescription system: do the professionals use it? *International Journal of Healthcare Technology and Management*, Vol. 6, No: 1, 32 - 55.
- Spinardi, G. - Graham, I. - Williams, R. (1997) EDI in the Scottish Health Service: inter-organisational systems and inter-organisational change. *Journal of Strategic Information Systems*, Vol. 6, No: 3, 251-263.
- Statistical Yearbook on Social Welfare and Health Care 2006* (2006) Stakes: Helsinki.
- Stat (2005) *Finland in Figures*.
http://www.stat.fi/tup/suoluk/taskus_terveys.html retrieved 4.5.07.
- Suomi, Reima (2006) What is IT governance and how can it become a problem - an illustration from the Finnish electronic prescription system project. In: *Proceedings of the 12th Americas Conference on Information Systems*.
- Suomi, Reima - Salmivalli, Lauri (2002) Electronic Prescriptions - Developments in Finland. In: *Proceedings of The second IFIP conference on E-commerce, E-business, E-government (I3E 2002)*, ed. by João L. Monteiro - Paula M.C. Swatman - Luis Valadares Tavares, 481-495.
- Suomi, Reima - Tähtkääpää, Jarmo - Holm, Johanna (2001) Organizational and information system metaphors in the health care sector - from harmonised value chain to realistic market models. In: *Proceedings of*

- the The 8th European Conference of Information Systems*, Bled, Slovenia 27-29.6.2001.
- Susman, G.I. - Evered, R.D. (1978) An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly*, Vol. 23, No, 582-603.
- Sutton, Robert I. - Staw, Barry M. (1995) What theory is not. *Administrative Science Quarterly*, Vol. 40, No: 3, 371-384.
- Tan, Joseph - Wen, Joseph - Awad, Neween (2005) Health care and services delivery systems as complex adaptive systems. *Communications of the ACM*, Vol. 48, No: 5, 36-44.
- Taylor, Laurel - Tamblyn, Robyn (2004) Reasons for Physician Non-Adherence to Electronic Drug Alerts. In: *Medinfo 2004*, ed. by Marius Fieschi, 1101-1105. IOS Press.
- Teich, Jonathan M. - Merchia, Pankaj R. - Schmitz, Jennifer L. - Kuperman, Gilad J. - Spurr, Cynthia D. - Bates, David W. (2000) Effects of Computerized Physician Order Entry on Prescribing Practices. *Arch Intern Med*. No: 160, 2741-2747.
- Teich, Jonathan M. - Osheroff, Jerome A. - Pifer, Eric A. - Sittig, Dean F. - Jenders, Robert A. - Panel, The CDS Expert Review (2005) Clinical Decision Support in Electronic Prescribing: Recommendations and an Action Plan. *Journal of the American Medical Informatics Association*, Vol. 12, No: 4, 365-376.
- Teo, Hock Hai - Wei, Kwok Kee - Benbasat, Izak (2003) Predicting Intention to Adopt Interorganizational Linkages: An Istitutional Perspective. *MIS Quarterly*, Vol. 27, No: 1, 19-49.
- The Social Insurance Institution of Finland (2001) *Sähköistä reseptiä koskeva esiselvitys*: Helsinki.
- Thompson, J.D. (1967) *Organizations in action*. Russell Sage.
- Thorelli, Hans B (1986) Networks: Between Markets and Hierarchies. *Strategic Management Journal*, Vol. 7, No: 1, 37-52.
- Turunen, Pekka (2001) *Tietojärjestelmien arviointimenetelmien valinta terveydenhuolto-organisaatiossa: sidosryhmänäkökulma*. Doctoral Dissertation. Turku School of Economics and Business Administration: Turku.
- Tähkää, Jarmo (2007) *Managing the Information Systems Resource in Health Care: Findings from two IS projects*. Doctoral Dissertation. Turku School of Economics: Turku.
- Walsham, G. (1995) The Emergence of Interpretivism in IS Research. *Information Systems Research*, Vol. 6, No: 4, 376-394.
- Van de Ven, Andrew H. (1976) On the Nature, Formation, and Maintenance of Relations Among Organizations. *Academy of Management Review*, Vol. 1, No: 4, 24-36.
- Wang, Samuel J. - Middleton, Blackford - Prosser, Lisa A. - Bardon, Christiana G. - Spurr, Cynthia - Carchidi, Patricia J. - Kittler, Anne F. - Goldszer, Robert C. - Fairchild, David G. - Sussman, Andrew J. - Kuperman, Gilad J. - Bates, David W. (2003) A Cost-Benefit Analysis

- of Electronic Medical Records. *The American Journal of Medicine*, Vol. 1, No: 14, 397-403.
- Whitten, Pamela - Rowe-Adjibogoun, Jill (2003) Researching Health Communication Technology Intervention Projects: The Challenge of Achieving Utilization Levels Sufficient for Evaluation. *Journal of Technology in Human Services*, Vol. 22, No: 3.
- Wilkinson, Ian (2001) A History of Network and Channels Thinking in Marketing in the 20th Century. *Australasian Marketing Journal*, Vol. 9, No: 2, 23-52.
- Williams, Trevor (1997) Interorganisational Information Systems: issues affecting interorganizational cooperation. *Journal of Strategic Information Systems*, Vol. 6, No: 3, 231-250.
- Williamson, Oliver E (1991) Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. *Administrative Science Quarterly*, Vol. 36, No: 2, 269-296.
- Williamson, Oliver E. (1985) *The Economic Institutions of Capitalism. Firms, Markets, Relational Constructing*. The Free Press.
- Yin RK (1994) *Case Study Research: Design and Methods* (2nd Edition) Newbury Park, Sage.

PAPER 1: TESTING A THEORETICAL FRAMEWORK FOR INTERDISCIPLINARY IT EVALUATION: THE CASE OF THE FINNISH ELECTRONIC PRESCRIPTION

Hyppönen, Hannele –Salmivalli, Lauri –Nykänen, Pirkko –Ruotsalainen, Pekka –
Pajukoski, Marja

Special issue “Governing ICT in health care and governing health care with ICT”
in the International Journal of Healthcare Technology and Management. Volume
8 - Issue 1/2 – 2007

Testing a theoretical framework for interdisciplinary IT evaluation: the case of the Finnish Electronic Prescription

Hannele Hyppönen*

STAKES Unit of eHealth and eWelfare, <http://sty.stakes.fi>,
National Research and Development Centre for Welfare and Health
(STAKES), Helsinki, Finland
E-mail: hannele.hypponen@stakes.fi
*Corresponding author

Lauri Salmivalli

Turku School of Economics and Business Administration, Turku,
Finland
E-mail: lauri.salmivalli@tukkk.fi

Pirkko Nykänen

Tampere University, Department of Computer Sciences, Tampere,
Finland
E-mail: pirkko.nykanen@uta.fi

Pekka Ruotsalainen and Marja Pajukoski

STAKES Unit of eHealth and eWelfare, <http://sty.stakes.fi>,
National Research and Development Centre for Welfare and Health
(STAKES), Helsinki, Finland
E-mail: pekka.ruotsalainen@stakes.fi
E-mail: marja.pajukoski@stakes.fi

Abstract: This article describes a multidisciplinary framework and its use in the evaluation of a national medical e-prescription system pilot in Finland. The framework was based on three theoretical concepts: activity system, actor network and development life-cycle. These concepts have been developed within activity theory, developmental work research and sociology of technology. The framework was used to guide the constructive evaluation of the co-development of technology and services from different stakeholders' perspectives.

Keywords: activity theory; actor network theory; constructive evaluation; development life-cycle; e-prescriptions; Finland; information systems; interdisciplinary research.

Reference to this paper should be made as follows: Hyppönen, H., Salmivalli, L., Nykänen, P., Ruotsalainen, P. and Pajukoski, M. (2007), 'Testing a theoretical framework for interdisciplinary IT evaluation: the case of the Finnish Electronic Prescription', *Int. J. Healthcare Technology and Management*, Vol. 8, Nos. 1/2, pp.42–65.

Biographical notes: Hannele Hyppönen, PhD, works as a development manager at the Unit of eHealth and eWelfare in the National Research and Development Centre for Welfare and Health (STAKES), Finland, where she is responsible for assessment and evaluation of eHealth and eWelfare solutions. She has participated in research and development of social and healthcare information systems for over ten years, with numerous publications in the field. Her specialities are social construction and the social impacts of technology, multivoiced analysis of historically and culturally developing institutional activity systems and actor networks. She has also conducted eHealth policy and legislation implementation analysis.

Lauri A.T. Salmivalli, MSc (Economics and Bus. Admin.), is currently completing his PhD at the Turku School of Economics and Business Administration in Turku, Finland. His research is concentrated on healthcare information systems, especially in the implementation and use of electronic prescriptions. He has published a number of journals and international conference papers, and has been involved in governmental and corporate level e-prescription projects. Currently he is a project manager in a 'Management of Medication Information' assignment, funded by Tekes, the Finnish Funding Agency for Technology and Innovation.

Pirkko Nykänen, PhD, is an acting professor in information systems and a senior lecturer in health informatics. She has been involved in R&D and the evaluation of health information systems and technologies since 1975, in VTT Medical Engineering, in the National Research and Development Centre for Welfare and Health and, from 2003, in Tampere University Department of Computer Sciences. She has been a visiting researcher in Lille University, France, and Pennsylvania State University, USA. She chairs the Finnish Society for Social and Welfare Informatics and co-chairs the EFMI WG on the evaluation of health information systems. She has been a reviewer for many scientific journals and conferences and has more than 130 publications in the health informatics domain.

Pekka Ruotsalainen, Dr in Tech, is Research Professor and Senior Lecturer in health informatics. He is an ICT expert, high level specialist and researcher in the field of security management of health information in multi-dimensional information space. He is one of the key experts in Finland creating the national policy targets and IT strategies for social welfare and healthcare, approved by the Ministry of Social Affairs and Health. He has also contributed to the national seamless service chain strategy, and to the strategy for reforming the Finnish healthcare system. He has been a reviewer for many scientific conferences and journals. Currently he is acting as HoD for ISO TC215 (Health Informatics) and leader of its task secure archiving of EHR. At national level he is an active member in many national working groups defining the next generation ICT-architecture for the Finnish healthcare.

Marja Pajukoski, LL.M., works as a legal adviser at the Unit of eHealth and eWelfare in the National Research and Development Centre for Welfare and Health (STAKES), Finland. She is responsible for the cooperation of electronic solutions and the framework of social and healthcare provisions. Her specialities are data protection and the fundamental and legal rights of patients and clients.

1 Introduction

National spending on healthcare has been increasing over recent decades in most western countries. An increasing number of ageing people will escalate the demand for healthcare in the near future, and governments are being forced to seek methods to rationalise their health policies and boost the efficiency of the healthcare sector. (Johnston, 2004; Kwak and Lee, 2002; Stakes, 2004).

New technology has been seen as an important remedy for rationalising the healthcare sector. According to Raghupathi and Tan (2000, p.61), information technology can assist healthcare by 'providing health-related information services and decision support on demand, as well as in managing rising costs and changing organisational needs, thereby improving the quality of health services and patient care, and fighting illness while promoting wellness'.

There has been strong governmental strategic and programme steering, both on national and EU levels towards the implementation of information systems and electronic patient data transfer in Healthcare for over ten years. (e.g. UK: NPfIP-program, Norway: Teamwork). The European Union has set eHealth as a policy priority in the eEurope initiative in 2005 (European Union, 2005). In Finland, one of the cornerstones for governmental steering towards eHealth has been the National Strategy for Utilising ICT in Social Welfare and Healthcare published in 1996. Ever since this, there have been numerous action groups, programmes and heavy investment towards IT applications projects in healthcare. By 2004, most primary healthcare professionals in Finland had access to the internet and used ICT in their work. Electronic patient records were in common use in primary healthcare centres (93.6% used them), and 62% of hospital districts were using electronic patient records. (Kiviahio et al., 2004.) Hospitals would, according to Government Decision in Principle, transfer their systems from paper-based journals to electronic patient records by the end of year 2007.

Electronic prescription systems (EPS) have been seen as a breakthrough application of the use of information technology in healthcare. E-Prescription systems have been, or are being, implemented in several European countries and the USA. Apart from the political pressure to move towards an information society in healthcare, doctors, pharmacists and other stakeholders have also experienced many inherent problems in the paper-based medical prescription system, warranting the search for answers from modern technology. These include the amounts of prescription fraud causing costs for pharmacies, double work in writing the prescription data in the doctor's office as well as the pharmacy, lack of up-to-date information on patients' current medication, errors in prescriptions related to poor handwriting, poor tools for managing adverse drug interactions, rising prescription handling costs. Electronic prescriptions could also provide more accurate and up-to-date statistical information about medication practices in relation to these issues and hence increase the efficiency of pharmaceutical distribution and improve the planning of national health policy in the long run (Bastholm et al., 2004; Bell et al., 2004; Boonstra, 2003; Mundy, 2003).

The use of Information Technology (IT) can offer significant opportunities to increase the efficiency of care; reduce clinical errors, support healthcare professionals and enhance the quality of patient care. Yet, there are some obstacles in the implementation and utilisation of IT in healthcare: Healthcare information systems are costly, and their failures can cause negative consequences to patients and healthcare personnel (Ammenwerth et al., 2003).

Therefore, a thorough *evaluation* of healthcare processes and healthcare information systems (HIS) is of major importance for the users and decision-makers in the healthcare field. When evaluating healthcare information systems one should bear in mind that technology is only one part of an information system. Far too often the human side of information systems is neglected. (Ammenwerth, et al., 2003). The traditional evaluation approaches have not been capable of capturing the entity of the co-development of new technologies and the practices for which the technologies are developed (Brender, 1999; Hyppönen, 2004; Orlikowski, 1991).

The purpose of this study is to test a multidisciplinary theoretical framework generated to link an evaluation of the change of practices to the evaluation of Information Technology development, implementation and diffusion. The basis for this article was set out in a presentation in the European Conference for Information Technology Evaluation held in Turku, Finland in September 2005 (Hyppönen et al., 2005b).

2 Setting the scene for the evaluation of the national e-prescription system

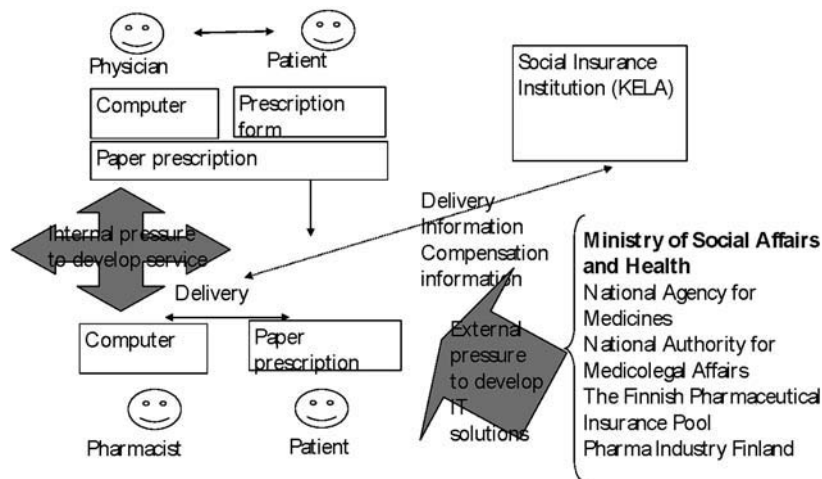
In Finland, only pharmacies and subsidiary pharmacies are allowed to sell medicines to the public, except in sparsely populated areas, where non-prescription products may be sold by medicine dispensaries owned by pharmacies. A prescription from a doctor, dentist or veterinary surgeon is needed to purchase prescription medicines from a pharmacy.

Pharmacies are privately owned. Permission to own and operate a pharmacy is granted by the National Agency for Medicines (NAM). The University of Helsinki also has a statutory right to run a pharmacy in Helsinki, as well as subsidiary pharmacies with the permission of the NAM.

In 2003 there were a total of 601 pharmacies in Finland and approximately 16,500 physicians in both the public and private sector (317 citizens per physician). Pharmacies received approximately 38.5 million prescriptions in 2002, of which 28.1 million received compensation from the Social Insurance Institution (SII). Approximately 80% of all expenditure on medication is due to prescription medicines. (National Agency for Medicines, 2005; Stat, 2005)

The current service for prescribing medicine in Finland is depicted in Figure 1. The patient receives a printed prescription form (filled in by hand or computer) from the doctor. Apart from diagnosis and medication details, it contains the patient's and physician's identification data (patient's name and personal identification number (unique) and doctor's handwritten signature and stamp with social insurance number). It has a place for prescribing two drugs, together with space for the pharmacist's information on dispensing and renewal.

The patient brings the form to a pharmacy, where a pharmacist feeds the data from the prescription into the pharmacy programme for dispensing medication. The programme calculates the price of the drugs, deducting the amount of national insurance if a social insurance card is presented. The programme prints bar code labels with the price, which the pharmacist attaches to the drugs. The pharmacist marks the amount of medication dispensed on the form and returns the form to the client with the medication. The second page of prescription is left at the pharmacy so the national insurance office can be invoiced for the insurance element contained in the price of the medication (Hyppönen et al., 2005a).

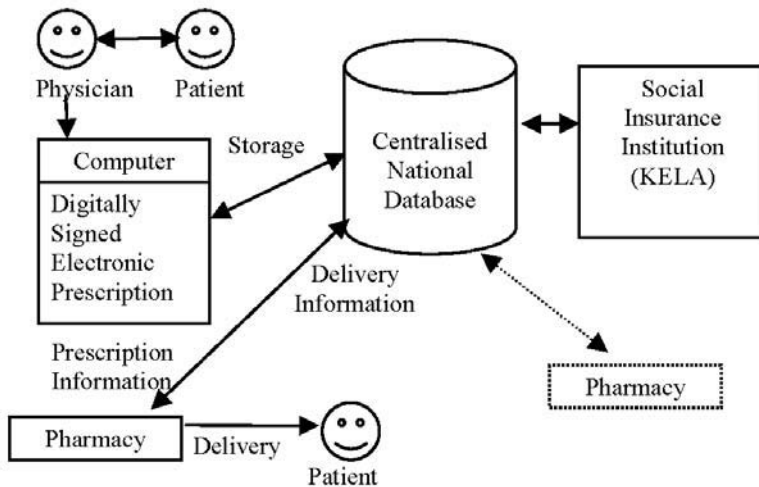
Figure 1 The paper-based prescription service

During the late 1980s – 1990s there were some regional electronic prescription pilots implemented using different technological approaches. They experienced different problems, which acted as one trigger to develop a national solution. As part of the implementation of the National Social and Healthcare Technology Strategy, the Ministry of Health and Social Services (STM) called on the Social Insurance Institution (SII) and the National Agency for Medicines (NAM) to conduct a study in 2001, which aimed to clarify the structure and objectives for developing a national architecture for electronic prescriptions in Finland. The group conducting the study consisted of representatives of stakeholders having interests in the Finnish prescription service (depicted in Figure 1 list at the far right hand corner).

After the study, the Ministry asked the study group to pilot the proposed architecture in practice. The objective was to create a model for a unified national service that would be efficient, safe and flexible. The study recommended a model based on a centralised prescription database, hosted by the Social Insurance Institution (Social Insurance Institution, 2001). The model is depicted in Figure 2.

The model selected is based on one national prescription repository, which can be accessed by medical professionals and pharmacists responsible for care, and the patient himself. A temporary e-prescription act was developed for this pilot. To reach the required level of confidentiality and privacy protection, the patient's informed written consent was required. The doctor creates an electronic prescription with either a stand-alone electronic prescription programme or a programme integrated into the legacy system in use (Electronic Patient Record, EPR and pharmacy system).

To maintain the integrity of the e-prescription it is signed with a developed digital signature by the doctor. Identification and authentication of users (doctors and pharmacists) is based on PKI-services and the use of Smart card (HPC-cards with two PIN-codes). Instead of printing the prescription, it is transformed to a standardised document following HL7 CDA architecture definitions. Furthermore, after the e-signature process the document is transformed to XML-format for data communication. To avoid any disclosure of e-prescription data during transfer to e-prescription data base the document is stored to a digital envelope (SOAP-envelope).

Figure 2 Centralised database solution for the Finnish Electronic Prescription Service

The patient receives a printed ‘memory slip’ instead of a prescription. Pharmacists can retrieve the e-prescription for the patient using the local pharmacy system.

Access to the national prescription database also requires from pharmacists strong identification using a smart ID-card. A patient’s prescription is identified by using the patient’s unique social security number. Patients can also protect the prescriptions with a unique PIN-code (Hyppönen et al., 2005a; Social Insurance Institution, 2001).

3 Aims and methods of the evaluation

3.1 The scope and objectives of evaluation

The Ministry called for an evaluation of the national e-prescription pilot through its research and development organisation, STAKES. The aim was to collect information to form the basis for permanent legislation. Three main objectives were set by the Ministry for the evaluation:

- to provide practical information on the development process of the e-prescription system in order to guide the process
- to evaluate legal and data protection aspects of the Finnish e-prescription model and compare it with other models
- To evaluate the functionality and impact of the system in terms of the technology, its end users and organisations.

The framework needed to be flexible enough to adapt to changes in the speed of the system’s design and implementation (Westbrook and Gosling, 2002, p.8). The timetable for the evaluation was one year (2004), during which time it was intended that the pilot scheme be implemented in all four pilot sites. Since it soon became evident that the implementation schedule would not be achieved, it was agreed with the Ministry to split the evaluation task into two phases:

48 *H. Hyppönen, L. Salmivalli, P. Nykänen, P. Ruotsalainen and M. Pajukoski*

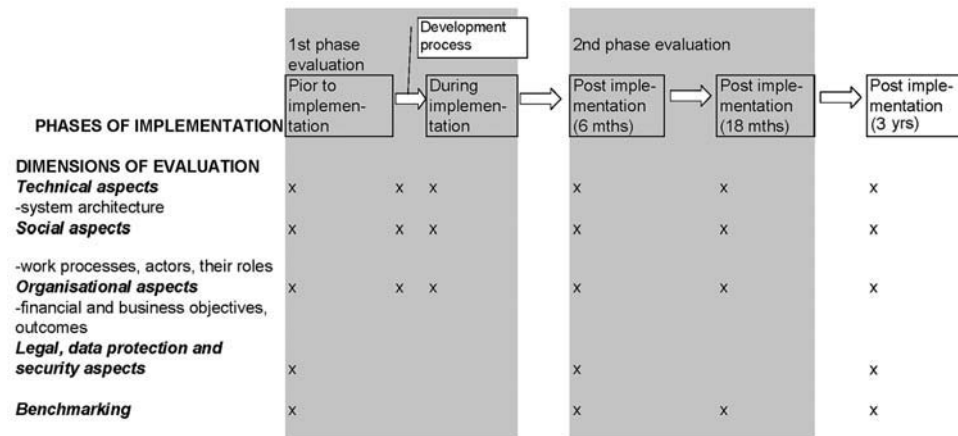
- the contextual analysis (baseline data collection) and analysis of the system's design and implementation process
- the impact evaluation.

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) Therefore, the objectives of evaluation were converted to the following research questions, which were studied from technical, social, organisational and societal perspectives:

- How does the prescription system function prior to the implementation of EPS?
- What are the objectives and needs for development and how is the EPS constructed and implemented?
- How does the EPS prescription system function and fill the needs and objectives?
- What are the impacts of the EPS system?

The scope and phases of the evaluation is presented in Figure 3. The first two research questions were answered in the first phase, and the second two in the second phase evaluation.

Figure 3 The scope of evaluation



3.2 Theoretical framework created to guide evaluation

In order to meet the multiple evaluation needs presented by the Ministry, a multidisciplinary team was formed to finalise and execute the evaluation plan. The team consisted of a professor in information sciences, a doctor of philosophy specialising in healthcare work and innovation research, a researcher specialising in organisational management and the economic aspects of evaluation, a lawyer specialising in social and healthcare legislation and an engineer and research professor specialising in data security questions.

The multi-scientific co-operation called for an overall theoretical framework to guide the work, rationalise data collection and weave the different viewpoints together. The

literature review conducted as a part of an earlier study (Hyppönen, 2004) showed, that there is a very poor theoretical foundation in concepts used in the evaluations of IT in general and IT in healthcare in particular. The approaches used seemed to cover either the Information Systems viewpoint or the system use viewpoint, but there were hardly any theoretical constructions covering both of these, plus the normative viewpoint. MIT professor Wanda Orlikowski concluded over a decade ago, that the reason for this is, that Information Systems development happens in different organisations than the use (Orlikowski, 1991).

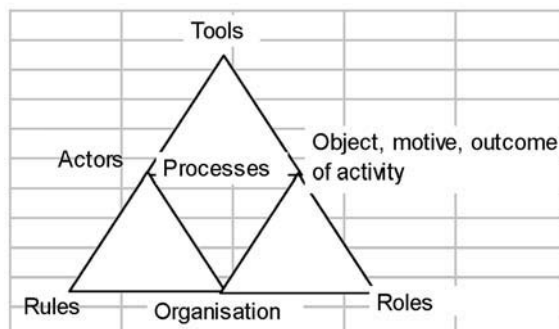
The most promising work found was with authors having used Activity Theory and Actor Network Theory in IS research (e.g. Gregory, 2000; Miettinen, 1999; Nardi, 1996). In her recent doctoral thesis, Hyppönen (2004) had created a theoretical framework using the core concepts of these theories, which seemed promising for a multidisciplinary evaluation of the e-prescription system. The basis for her work came from developmental work research and innovation studies conducted within the field of sociology of technology, e.g. Hasu (2001), Hyysalo (2004), Lehenkari (2000), Miettinen (1999) and Nardi (1996). Both developmental work research and innovation research approaches used are based on constructivist paradigm (in sociology of technology see, e.g. Bijker, et al., 1987; Callon et al., 1986; Latour, 1987; Rip et al., 1995). This paradigm has also been promoted in systems design and use (See e.g. Brender, 1999; Pather and Remenyi, 2004; Wyssusek et al., 2002).

The conceptual framework tied together three theoretical concepts – Activity System, Actor Network and Development Cycle – generating a theoretical model for evaluating the co-development of social and technical systems and the impacts of IT implementation from different stakeholders' and academic viewpoints. The concepts and model produced is presented below.

3.2.1 The concept of Activity System as a core to the multi-disciplinary approach

Key concepts from the interdisciplinary Activity Theory (originating from the work of Vygotsky (1978) and Leontjev (1978), further developed by Engeström (1987) and Cole (1996) have been used in work and organisation research and innovation studies, as well as IS studies (in the field of IS studies, see e.g. Bannon, 1990; Nardi, 1996; Bedny and Meister, 1997). One of the core concepts of the theory is the concept of *institutional activity*, depicted by Engeström as a model of *activity system* (Engeström, 1987). It provided us the key concept for our multi-scientific approach (see Figure 4). Each of the stakeholders depicted in Figure 3 (e.g. healthcare organisations, pharmacies, SII, patients) could be analysed as institutional activity systems, where specific people (actors) within each community use specific tools with specific motives for specific intended outcomes following specific norms.

The model of an institutional activity system is based on the concept of institutional activity as an open, developing system consisting of six main elements. Each of the elements offered a specific viewpoint, through which we could look at the whole system:

Figure 4 Model of an institutional activity system (Engeström, 1987)

- Actors are the workers in the organisation or people within the community, who are in charge of the day-to-day work processes or activities, tasks and operations, with which they shape the object of their work (e.g. illness) to form outcomes (e.g. health) of the organisation. The roles depict the division of work between different professionals participating in the work or people in the patient's near community (e.g. family). The work research approach offered one viewpoint to study the system: that of actors, their work processes, roles and division of work, needs for improving the process and changes in these elements.
- Tools are all the physical technologies and knowledge how to use them to shape the object of work; Computer science offered the viewpoint of the system architecture and interfaces, their use and needs for their improvement in analysis of the system and its change.
- The organisation or community is the institutional context in which the work takes place. The viewpoint of the institutional objectives, motives and outcomes as well as the resources, strategies and plans to achieve them and their realisation, formed the organisational and management sciences viewpoint to the system.
- The rules include all the international, national and organisation-specific laws, standards and other norms, which regulate the activities of the organisation and its workers. It offered the data security, data protection and juridical viewpoint to the activity of each of the participating organisations.

When any one of the elements of this system is changed, it has a potential impact on all the other elements, warranting the evaluation of anticipated and actual impacts from the viewpoint of each element.

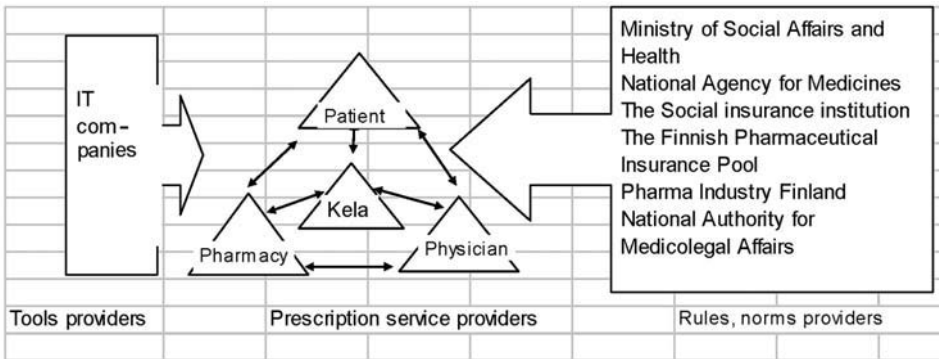
The concept of an activity system enabled us see the activity of each of the participating institutions from these different perspectives, and helped us to collect one basic set of data prior to and after the implementation of a new tool (i.e. electronic prescription) hence making it possible to evaluate the varying impacts for different actors.

3.2.2 Actor network as the basis of the stakeholder analysis of the entire prescription system

Since medical prescription processing requires the co-operation of many organisations and actors, one model of the activity system could not encompass the whole picture. The concept of an *actor network* has been presented by Michel Callon (1986) to depict the structure and dynamics of a network of different actors (e.g. organisations). The Actor Network Theory (ANT) has focused on the development of a technological system from the viewpoint of the network of actors constructing the system. Actors participate as the innovator promises solutions to their problems, and they are kept together with common interests. The core principle in actor network studies is to follow the actors with ethnographic participatory observation; this reveals the technology construction as a complex issue of controlling multiple elements in the network and its processes in order to make them operate towards common goals. (Hyppönen, 2004).

Actor network theory has, however, been criticised for leaving the ‘knots’ of the network as black holes (Miettinen, 1998, 1999). It speaks of the term ‘actors’ meaning everything between individuals, organisations and technical elements, while making no distinction between them. The use of activity theoretical tools have been suggested as a remedy (Miettinen, 1999). This was done in Hyppönen’s conceptual framework with the help of the concept of an activity system. The result was a model of network of activity systems, where each ‘knot’ in the network is depicted as an institutional actor with its own objectives of work, motives, tools, rules etc. Modelling the prescription service and its development networks this way helped us see, not only the common interests, but also the conflicts of interest, which are inevitable in co-operation of multiple stakeholders. The prescription service network with stakeholders having an interest in it (Figure 3), reinterpreted in theoretical terms, is depicted in Figure 5.

Figure 5 Prescription service (Figure 3) theoretically reinterpreted.



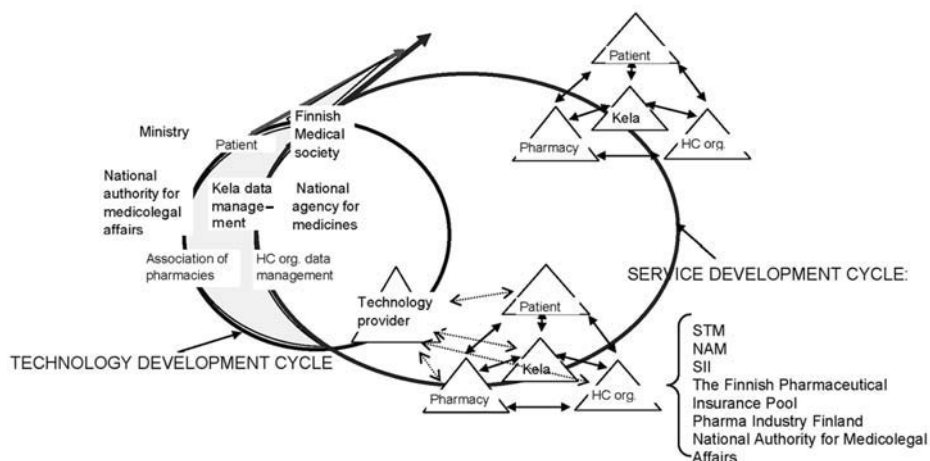
The prescription service involves work performed by many professional groups in each of the participating institutions: doctors and nurses in healthcare organisations, pharmacists and medication workers in pharmacies, reimbursement workers in social insurance institutions, patients and their carers in home communities. When the EPS technology project is initiated, the technology providers are also enrolled into the network.

3.2.3 Cycle of development depicting co-development of prescription service

The evaluation task was not confined to evaluation of the prescription service in the pre- and post-implementation situations. The first objective was to provide input for the development process of EPS. In order to analyse the development process of technology as well as the service where technology would be implemented, we needed a model of change. Hyppönen (2004) used a concept of Cycle of Development originating from developmental work research (Engeström, 1995), where it has been used to study the dynamics of work and service development and organisational learning. Keeping in mind Orlikowski's observation about separate developments of technology and use, Hyppönen depicted the development with two, partly overlapping cycles, that of service development and that of technology development.

With the help of the three theoretical concepts, the overall framework and theoretical evaluation design of EPS could be depicted (Figure 6).

Figure 6 Model for analysing co-development of service and technology



Starting from the top right hand 'corner' of the figure, the first network depicts the prescription service prior to implementation of new technologies. Analysing the service as the outcome of the network of activity systems provided us with answers to the first research question: How does the prescription system function prior to the implementation of the EPS?

The next network (bottom right) depicts the user activity from the point of view of the pressure to change, which comes partly from problems in the present practice, partly from outside (policy pressure, technical pressure) Analysis of these pressures and the concept generated to answer the challenges answered by the first part of the second research question: What are the starting points, objectives and needs for development?

The third network (middle left) depicts the participation of different stakeholders in design and implementation. It helped us analyse, how the EPS was constructed, which actors had an impact on the design, and how the e-prescription system was constructed)

The analysis of implementation takes us round the figure, back to the top right hand corner, but now with EPS-tools. During the first phase evaluation, we were able to evaluate first clinical pilots, and in the second phase, hopefully established use. With this

network analysis, we have answered question 3: How does the EPS prescription system function and meet the needs and objectives of different stakeholders, and this will eventually provide an answer to question 4: What are the impacts of the EPS system?

3.3 Methods and data collected

The pilot was well on its way developing the technical specifications and solutions and testing them, when the evaluation was initiated in the beginning of 2004. The data collection has followed two lines as suggested by Figure 6:

- Line 1: Study of the technology development project (research question 2).
- Line 2: Study of the changes in services (research questions 1, 3 and 4).

In Line 1, we performed analysis of the architecture to be implemented, and pilots where it was implemented, as well as the development process of the system. For studying the architecture, we used the framework of computer sciences, for studying the development process, we used the framework of sociological studies of technological systems. The development analysis was based on ethnographic participatory observation, as suggested by Callon et al. (1986). We participated in the project meetings, analysed documents and interviewed participants. Content analysis was performed on the data to look for decisions made concerning evolution of specifications and the network specifying them. Evaluative interpretations on the design process were presented to the steering group for discussion and to help with decision-making.

For Line 2 we followed the network of activity systems model:

- We collected data on paper-based medication prescribing processes in different institutions. Data about work processes, participating actors and their roles were collected by observation (e.g. Bauersfeld and Halgren, 1996). The changes induced in it by implementation of new e-prescribing tools have been followed by analysing the change in tasks, time spent and roles changed.
- The information processing and the system architecture of the proposed technology together with its usability were studied using specific approaches from computer science (as depicted in Line 1).
- The organisational perspective was studied using specific approaches from economics and business administration. Primarily the data used was qualitative i.e. from semi-structured interviews. In data collection we contacted different organisations and people in different roles (Daamsgaard and Lyytinen, 1998).
- The legal, data protection and security aspects included juridical evaluation (Aerschot, 2000), which was performed by comparing existing legislation related to medical prescriptions, the decree on an experimental electronic prescription system and the functionality of the e-prescription system. The evaluation concentrated on data protection questions. Data security questions focused on comparing the functionality of the system with data security standards.

The interviews and questionnaires to doctors and pharmacists in the piloting organisations included questions from each of these perspectives.

In addition, a benchmarking study comparing the Finnish pilot system with various other systems implemented in other countries was also conducted. This was done as a desk-top study. We listed key elements in the Finnish system to compare how they were realised in alternative e-prescription models. The framework used to analyse the Finnish system was used to generate themes for data collection about other countries' systems.

The analysis of the impact on the prescription service has been planned so that the baseline data collection for work processes will be repeated when the system is established, in order to reveal actual changes in user activities and outcomes, e.g. prescription preparation and delivery times, reduced amount of phone-calls, reduced errors and usability of the implemented system. Evaluation of how usable the system is for patients will also be included, as well as evaluation of the technical functioning, reliability and data protection questions of the system.

4 Key results

4.1 *Line 1 study: Construction and implementation of the e-prescription system*

Different technologies for e-prescription had been piloted in previous local projects for nearly a decade, illustrating the fact that the technology development cycle did not originate from point zero, when the pilot started. The introduction presents some starting points for the national pilot.

When the ePrescription system was planned, different approaches for the system architecture were identified. The options included the following:

- to use email messages to send and receive prescriptions
- to use electronic identification cards to access prescriptions
- to design a system using the existing commercial information system components
- to use a reference database to store information on prescriptions
- to distribute prescriptions to regional servers that are connected to each other
- to use a concentrated database where all prescriptions are stored and accessed.

The decision was made to implement a system using a centralised database that allows all prescriptions to be accessed by pharmacies, physicians and the social security authorities. The prescriptions are signed using digital signatures, and prescriptions are produced in electronic patient record systems that are transmitted to the prescription database. The electronic prescription structure and content were carefully defined to meet the existing requirements.

The piloting of the proposed system was meant to be conducted in 2002–2003. To organise it, the Ministry (STM) established a steering group in May 2002 to direct the implementation of the system. It consisted mainly of the norms-producing actors depicted in Figure 5. Four regions in Finland were selected to pilot the system, with regional representatives invited to join the steering groups. Regional pilots were to work independently and report their progress to the steering group. A pilot manager was named by the Ministry, but no budget or project plan detailing the division of work was set out,

since the pilot was expected to be a straightforward technical implementation exercise. It was anticipated that by the end of 2003, 2% of prescriptions would be electronic and by 2010, 40 and 70% by 2020.

The initial aim was to conduct a technical pilot as a stand-alone system (not integrated with legacy systems). Initial tests with the stand-alone system showed that it did not work reliably. It also took a lot of time to enter medication into two separate systems at the doctor's office and pharmacy. On the basis of the results from these two regions, a decision was taken to wait until an integrated system for doctors and pharmacies was developed. This altered the nature of the pilot from being a restricted pilot test of a stand-alone system to a development project concerning four patient information systems and two delivery systems. The network-like organisation was not adequate in the new situation. The complexity of the piloting increased dramatically. There was no strict plan, division of work, timetable or budget for development work of this magnitude. The steering group ended up wearing two hats: acting as a project group concerned with the technical and implementation details, as well as a steering body making strategic decisions about the direction of the work. The former took over the latter during the course of most meetings.

There were many questions to be considered by the steering group, some of which proved to be beyond the scope of the pilot, thus delaying the project. By the end of 2004, the system had been implemented in two out of the four pilot sites. Only one integrated EPS system had been implemented, other players were still using the stand-alone system. Apart from the delays in the technical integration between the EPS- and pharmacy systems, another integration issue emerged: the pharmaceutical databases used by pharmacies, healthcare organisations and EPS providers were not compatible. The pilot had agreed to use the leading pharmaceutical database provided by the Pharmaceutical Information Centre. The problem was that the EPS and pharmacy system providers, hospitals and other players using the system, process the information it contains for their own use in a non-standardised way, and as a result the contents and timeliness of the databases may vary, leading to the possibility of errors in e-prescriptions. The pilot had limited powers to influence this.

There were also many questions concerning the specifications that still needed resolving, e.g. the question of specifications for electronic signature, for which there were insufficient national instructions. The Act on electronic signature came into force on 1 February 2003. The Act defines the quality requirements for the signature. Legislation does not define concrete technical and functional requirements (e.g. the number of pharmaceutical preparations that can be signed with one pin-code signature). Doctors wanted the possibility of signing several prescriptions with one signature to rationalise the treatment of polypharmacy patients, but data protection experts were hesitant. A decision favouring the viewpoint expressed by doctors was made by the Ministry in November 2004. The decision had serious implications for the prescription programs, which were designed to allow only one signature per preparation.

The first pilot site began testing the system in May 2004 and in the second site in October 2004. The other the two sites still have not started. The number of e-prescriptions has been very modest to date: by December 2004, 300 e-prescriptions had been written, of which 108 had not been delivered, by 31.8.2005 the total number had raised to 658. The main reasons for this were:

56 *H. Hyppönen, L. Salmivalli, P. Nykänen, P. Ruotsalainen and M. Pajukoski*

- Technical difficulties in writing the e-prescription and sending it to the national database (the existing old hardware and software did not necessarily support rapid processing of data, there were differences in medication databases, and problems in authentication and firewall).
- Difficulties in the medication delivery process (pharmacies selected by the Association of Finnish Pharmacies for the pilot were not suitable for most clients: they were too far away from the doctor's office and patients were not able to go to pharmacies which they regularly visited. Since the integrated systems were still under construction, pharmacies also had to use an unreliable and time-consuming stand-alone delivery system).
- The above mentioned problems caused clients to hesitate in giving their consent to participate in the pilot (Hyppönen et al., 2005a).

The main recommendations presented to the pilot project on the basis of the constructive evaluation phase were:

- The pilot needed to be reorganised administratively so that it had sufficient resources, a concrete plan, working groups and the clear division of labour required in a major technology project.
- The implementation frame needed to be simplified so that experiences could be collected more comprehensively from one or two regions.
- The work in the pilot needed to concentrate on producing a detailed description of the prescription process, actors, their roles and technologies used in information processing. Technical and functional requirements of the system need to be documented, as well as a common testing system with documented results for others to learn from.
- Emphasis needed to be shifted from technical piloting to usability and user acceptance.

4.2 Line 2 study: The four scientific viewpoints to the prescription service and its change

4.2.1 Work research

The work processes, actors participating in them and their roles prior to implementation of e-prescription were different in each of the four healthcare organisations participating in the pilot. The office workers, nurses and doctors participate in the process with a different emphasis, depending on the medical speciality and care level. The main workload in health centres comes from prescription renewals. In specialised hospital clinics prescription processing is much less important part of daily work routine. This indicates that maintaining renewal process efficiency is crucial in health centres. Renewal of a paper prescription is a very straightforward and fast exercise for doctors. Time and phases for writing new prescriptions varied depending on the technology used. In secondary care, hospital clinics medical prescriptions form a much less important part of the day's work. The scope of the medication prescribed is mostly narrow. A peculiar

feature compared to health centres was, that the doctors may need to change their offices several times during a day, whereas in a health centre, doctors have their own offices. This proved to be an important question for secure management of ID cards and PIN codes. All four pilot site doctors had a different patient record system with different medication prescribing programmes. In health centres, the use of computerised patient record systems and writing and printing out prescriptions with integrated programmes was a rule, in specialised healthcare an exception. For those still writing prescriptions by hand, the change to EPS was much bigger than for those, who already used computer programmes to write them.

In a pharmacy, the size of the organisation is one variable, which has an impact on the division of work. In small pharmacies, pharmacists are the sole workers, whereas in large pharmacies there are technical assistants. The delivery process also varies, depending on the legacy system in use and on the number of prescriptions delivered for each client. Inputting the prescription data into a pharmacy system takes a lot of time. Delivery time and phases vary depending on the existence of a bar code system. Pharmacies had problems with some handwritten prescriptions, as well as printed prescriptions, where the doctor's imprint and signature were unclear.

End users in the piloting organisations were still relatively pleased with the existing system. The expectations of the e-prescription system were mixed. Users wanted rationalisation of the prescription process, improvements in the safety and quality of prescriptions, and reductions in medication errors and fraud. However, they were somewhat sceptical about the extent to which e-prescription could deliver these benefits. Doctors were not very concerned about the problem with poor hand writing; they did not report many phone calls from pharmacies. Doctors were not willing to change to e-prescription merely to benefit the pharmacies.

The first implementations took place during 2004. The system was technically still so unstable, that it multiplied the tasks and time spent by different actors. Additional tasks had also emerged: for example, informing the patient about electronic data transfer and asking for written consent. This took up to 20 minutes. Patients hesitated in giving consent, because in the pilot they had to go to a specific pharmacy to collect their medication, and were not able to choose the pharmacy themselves.

The evaluation report produced several recommendations to improve the usability of the system in order to simplify work processes and save time. When the system stabilises, we will repeat the data collection on work processes to reveal the actual change. In the second phase, we will also evaluate the change in patient processes and client satisfaction.

4.2.2 Information systems sciences

From the viewpoint of information systems, the implemented e-prescription system architecture and usability, functionality, safety and reliability of this pilot system were studied.

The use of the system in the pilot hospital turned out to be rather complicated as the interfaces between the various system components did not work well and the system was not integrated with the patient record system. These were reflected in users' opinions of the system's usability and usefulness. The usability was considered to be poor and preparation of electronic prescriptions was very time-consuming and complicated. The pilot scheme had been started too early, with regard to the facilities available, and therefore, many technical problems were also encountered during the pilot phase.

The major usability problem occurred in situations where a physician had to use two or more separate systems to produce a prescription: Firstly, the electronic patient record system was accessed to produce the electronic prescription and then to retrieve drug data and information the pharmaceutical database needed accessing. Secondly, digital signature software was used to sign the prescription, together with additional software to send the prescription to the prescription database. This situation revealed that the major problem was a lack of integration between hospital systems and pharmacy information systems. Had the existing system components, i.e. the electronic patient record systems and the pharmacy information systems been fully integrated with the electronic prescription database, then the system's usability and functionality would more likely have been much better. The use of this pilot system required much more time than preparing prescriptions in the old 'manual' way and therefore many physicians opposed the introduction of the system. Also, the system was very sensitive to technical failures due to temporary solutions in implementation. Thirdly, the interface between the hospital and the pharmacy did not function well and this caused delays in accessing the prescriptions from the database and also in drug delivery for patients.

In terms of the information system, the major technical problems were related to the lack of integration, time consuming procedures for creating a digital signature and to the changes in the system logic when systems were upgraded during the pilot. Many of these problems are most likely to disappear once the system evolves and integration has been completed. However, this requires holistic planning of the system and integration of the system with the information systems infrastructure.

4.2.3 Organisational management research

The organisational viewpoint of this paper originates from business administration, and the emphasis of the analysis was on the management aspects. Firstly, one should note that the implementation of such inter-organisational information system is an immensely challenging task due to the scale of the system, and the special requirements set by the nature of the healthcare field.

Actors in the EPS pilot come from divergent institutional fields, including organisations from private and public healthcare sector, governmental and local authorities, and commercial software vendors. It is obvious that organisations possess different underlying rationales to participate in the project. Hence, organisations do have different objectives for the EPS and its pilot project.

Objectives for EPS at national level were quite inadequately operationalised in the pilot. There was neither a project plan for the implementation nor a budget. Costs were not unambiguously calculated, neither were any estimates made on the possible economic benefits that the system could produce.

Part of the reason for this may be due to the administrative structure of the Finnish healthcare system: SII and pharmacies are not under the jurisdiction of the Ministry, and neither are the municipal healthcare organisations. Administratively, the pilot was a network of voluntary actors with no budget, and there was no clear owner for the pilot.

The pilot was begun as a technical pilot, whereas organisational and user issues were largely neglected. To this end, judging the rationale behind the implementation decision is exceedingly difficult, and it remains to be seen whether the EPS will answer organisational and user needs, or will descend into mere technological innovation with little practical use.

It is generally assumed that organisational change will occur with the implementation of new technology. However, in some instances change in tasks or processes is required to precede the technology implementation. At least it should be settled in advance how the processes and tasks *should be* administered, otherwise implementing organisations will end up turning the old manual processes into electronic ones, without considering the new possibilities provided by the technology. In the case of EPS, this can be seen as leading to user frustration, and doctors have so far found little benefit in creating prescriptions electronically compared to the traditional manual process.

By autumn 2005, the development process and management-level recommendations of the evaluation had been implemented so, that a consultative company had been hired for the pilot to create a project plan, cost-benefit calculations and creation of a dissemination plan. The organisational aspect to the evaluation will be continued in the second phase to evaluate these and their impact.

4.2.4 Normative aspects of the system's evaluation

The pilot project was regulated by the Decree of the Ministry for Social Affairs and Health on Experiments with Electronic Prescription (771/2003). It entered into force on 1 September 2003. The interpretation and analysis of the legal aspects have been characterised by the lack of tradition in evaluating the functionality of the regulation in practice and the relationship between the Decree to other laws and orders. The research tradition pertaining to legal science is not involved in everyday practices and seldom contains empirical elements. Studies on the profitability and effectiveness of the law in this field are rare. There are no models, traditions, methods and references. The study of the relevant law is therefore mostly based on the interpretation of regulations.

Various regulations were used as the principal data for the juridical evaluation. The applicable regulations at issue are many in number and scattered throughout the legislation. The essential regulations taken into consideration as evaluation material included the Medicines Act 395/1987, Act on the Status and Rights of Patients 785/1992, Personal Data Act 523/1999, Act on Healthcare Professionals 559/1994, Act on the Social Insurance Institution 731/2001, Act on Electronic Services and Communication in the Public Sector (13/2003), Act on Electronic Signatures 14/2003 and Sickness Insurance Act 1224/2004, while other regulations were also considered in the interpretation. Due to the delay in the pilot project it was not possible to get much empirical data for the juridical evaluation. The documentation generated during the project (consents, information processing, agreements etc.), was not available for analysis as initially planned. For this reason it has not been possible to evaluate how privacy protection has been implemented during the pilot period. One problem concerning regulation is the lack of special statutes regarding eHealth in Finland.

The key elements of the legislation analysed concerned medicines, their prescription and sale, practices and professionals in healthcare, patient privacy and its safeguarding, the national prescription database, and electronic communication. The Social Insurance Institution (Kela) is responsible for the electronic prescription record system as laid out in the Decree. A proportion of the price of drugs is compensated by National Health Insurance and Kela is responsible for health insurance, too. The regulation concerning health insurance and Kela were also relevant to the study.

The questions of a hierarchical level of laws and their applicable provisions were of special significance to the juridical evaluation. Experimental enactments must be applied in the first instance if there are conflicts between their provisions and other enactments. For the pilot project this means the Decree regulating the pilot is applied first in respect of other decrees. If there are conflicts between decrees issued by the Government or Ministries and Acts given by Parliament, the latter takes priority. Most of the regulatory problems and difficulties in interpreting them are connected to these questions. The main aim of the evaluation was to produce information for establishing permanent regulation and activities. One result of juridical study that should be taken into consideration if permanent legislation is provided, is that e-prescription regulation should be applied at the level of an Act of Parliament.

Another main juridical conclusion involved the question of the data file and its Controller. According to the experimental Decree the national prescription database is maintained by Kela, which manages it by agreement with healthcare units and pharmacies on their behalf. (note: in Finland healthcare service providers have the responsibility to maintain patient records including medication data and they are also registrars. The Ministry of Social Affairs and Health was not ready to make any changes to this during e-prescription pilot time.)

Processing the electronic prescription requires the informed consent of patients. As a permanent arrangement, the management of the e-prescription system between 600 pharmacies and Kela will be quite burdensome. The same conclusion applies to the management of consents as well. Depending on the processes and the regulation level there are different interpretations as to whether the electronic prescription database has to be considered as a personal data file as such, or as separate files of healthcare units and pharmacies. These interpretations are reflected in the question of the Controller of the system. The conclusions for the permanent solution are firstly that it cannot be based on contracts. Secondly the controller should be defined by the Act. The other data protection conclusions will be drawn as a part of the later phase of the evaluation.

The whole prescribing infrastructure covering legacy systems, a national prescription database and communication networks must be defined and implemented in such a way that prescriptions cannot be disclosed to any unauthorised persons or entities. The integrity of all ePrescriptions must also be secure during the transmission of the data and for the 20 months' preservation time. ePrescription security solutions consist of PKI services, smart-card-based identification, qualified signatures for data integrity, SSL-based mutual authentication of IT-systems and SOAP envelopes, which must all meet the necessary security requirements. One unsolved security problem is that there is no patient-doctor relationship check. All doctors and pharmacists participating in the pilot can technically access any e-prescriptions stored in the national database. To solve this problem, access to the national prescription database and the presence of the patient-doctor/patient-pharmacy relationship at the end user level need to be monitored simultaneously.

4.2.5 *Summary of the main findings*

The main obstacles identified by the evaluation group were:

- Technical difficulties in writing the e-prescription and sending it to the national database (the existing old hardware and software did not necessarily support rapid processing of data, there were differences in medication databases, and problems in authentication and firewall).
- Difficulties in the medication delivery process (pharmacies selected by the Association of Finnish Pharmacies for the pilot were not suitable for most clients: they were too far away from the doctor's office and patients were not able to go to pharmacies which they regularly visited. Since the integrated systems were still under construction, pharmacies also had to use an unreliable and time-consuming stand-alone delivery system).
- The above mentioned problems caused clients to hesitate in giving their consent to participate in the pilot.

The main recommendations presented to the pilot project on the basis of the constructive evaluation phase were:

- The pilot needed to be reorganised administratively so that it had sufficient resources, a concrete plan, working groups and a clear division of labour required in a major technology project.
- The implementation frame needed to be simplified so that experiences could be collected more comprehensively from one or two regions.
- The work in the pilot needed to concentrate on producing a detailed description of the prescription process, actors, their roles and technologies used in information processing.
- Technical and functional requirements of the system need to be documented, as well as a common testing system with documented results for others to learn from.
- Emphasis needed to be shifted from technical piloting to usability and user acceptance.

5 Challenges, possibilities and limitations of the multidisciplinary evaluation

In conclusion, what was the value of the study? It can be discussed from the point of view of the evaluation as a scientific exercise of testing the theoretical framework, as well as from the viewpoint of the results it produced for the Ministry.

It can clearly be seen from the results, that the multidisciplinary evaluation has not been easy, and we have just begun to understand each other a bit better. Each of us has had our own approach and concepts rooted in the disciplines we represent. The evaluation of the whole system has traditionally been conducted by computer science specialists, economics or organisation scientists, with help of the tools offered by their own disciplines. It has been surprisingly difficult to express the core expertise and viewpoint

of each of these disciplines and how they add up to an analysis of the whole system. To put it in activity-theoretical terms, we have had a challenge of the division of work. This is perhaps the key challenge on which we still need to work.

Another challenge has been that of integrating the 'tools' used by researchers from different disciplines and creating understanding about the theoretical framework and its concepts in respect of conceptual frameworks used in different disciplines. These questions have risen in collection of data and the formation of evaluation criteria. To share a lot of the data, and look at it from different angles: as a technical, functional, juridical or economic question, has required us to explore the core concepts of each discipline and ways to bring them as a part of the overall analysis. All of us have also collected a set of our own data. The future challenge is to continue conceptual integration and improve the joint data collection so, that the core concepts can be operationalised into questions, which allow us to collect as much joint data as possible.

In spite of the challenges, the multidisciplinary approach has been rewarding. It helped us uphold the voices of many stakeholder groups, which appears to have helped them get their voice heard, and improve co-operation in the second phase of the pilot, with the 'multi-voiced', co-construction of the service and IT systems.

It has also helped us navigate in the jungle of different interests. The pilot was a policy-initiated development, and the evaluation was research to order. In this type of evaluation the buyer often attaches conditions to the research which aim to serve the buyer's interests. The subject of our evaluation - an e-prescription system - is a politically sensitive subject, because it presents one concrete application of the Ministry's social welfare and healthcare technological benefit strategy. Thus, the expectations for success at a political level are high. We, as evaluators, were placed in a hot spot, balancing between the sometimes conflicting interests and presumptions of the stakeholders participating in the design of the system, end users and political decision-makers. The framework helped us to produce a realistic evaluation from different perspectives to inform decision makers about the continuation of the pilot. The ministry representative's analysis of the work done was: 'The outcome is more than expected.' It seems that this type of multidisciplinary evaluation is new to the government programmes, and it has produced more results than the Ministry had anticipated.

Scientifically, combining our expertise has helped us produce a study which none of us could have achieved on our own, and we are enthusiastic in continuing the work.

It is too early to critically analyse the actual impacts of our evaluation from the different stakeholders' points of view. The objective to inform the Ministry about the basis for permanent legislation has been partly met, but will require additional data collection from the established use phase. The second part of the evaluation will elaborate on the question of the normative framework required. The objective of providing practical information on the development process of the e-prescription system in order to guide the process was obviously met, since the recommendations provided have been taken seriously.

In conclusion, the general theoretical framework for evaluating co-development of e-prescription service and technology has proved as a promising tool for integrating multidisciplinary evaluations into a comprehensive evaluation study. We will continue to work with the framework to further answer the challenges we met, and to test the framework in different contexts. It remains to be seen how useful it will prove to be as an inspiration for the rest of the scientific community.

References

- Aerschot, P. (2000) *Van: Legal Security, New Activation Policies and the Privatization of Social Services*, Retfaerd 88. Nordisk juridisk tidskrift. 23. årgang 2000 Nr. 1, pp. 3–19 (legal security specielt pp.3–6).
- Ammenwerth, E., Gräber, S., Herrmann, G., Bürkle, T. and König, J. (2003) 'Evaluation of health information systems – problems and challenges', *International Journal of Medical Informatics*, No. 71.
- Bannon, L.J. (1990) 'From human factors to human actors: the role of psychology and human computer interaction studies in system design', *Design at Work: Cooperative Design of Computer Systems*, Greenbaun, J. and Kyng, M. (eds) Hillsdale: Lawrence Erlbaum Associates, pp.25–41
- Bastholm Rahmner, P., Andersen-Karlsson, E., Arnhjort, T., Eliasson, M., Gustafsson, L-L., Jacobsson, L., Ovesjö, M-L., Rosenqvist, U., Sjövikar, S., Tomson, G. and Holmström, I. (2004) 'Physicians' perceptions of possibilities and obstacles prior to implementing a computerised drug prescribing support system', *International Journal of Healthcare Quality Assurance*, Vol. 17, No. 4, pp.173–179.
- Bauersfeld, K. and Halgren, S. (1996) '“You've got three days!” Case studies in field techniques for the time-challenged', *Field Methods Casebook for Software Design*, New York: John Wiley & Sons, Inc.
- Bell, D.S., et al. (2004) 'Recommendations for comparing electronic prescribing systems: results of an expert consensus process', *Health Affairs*, (25 May 2004).
- Bijker, W.E., Hughes T.P. and Pinch T.J. (eds) (1987) 'The social construction of technological systems', *New Directions in the Sociology and History of Technology*, Cambridge, MA: The MIT Press, pp.17–50.
- Boonstra, A. (2003) 'Interpretive perspectives on the acceptance of an electronic prescription system', *Journal of Information Technology Cases and Applications*, Vol. 5, No. 2, pp.27–49.
- Brender, J. (1999) 'Methodology for constructive assessment of IT-based systems in an organisational context', *International Journal of Medical Informatics*, No. 56, pp.67–86.
- Callon, M., Law, J. and Rip, A. (eds) (1986) *Mapping the Dynamics of Science and Technology. Sociology of Science in the Real World*, London: The MacMillan Press.
- Cole, M. (1996) *Cultural Psychology: A Once and Future Discipline*, Cambridge, MA: Belknap Press of Harvard University Press.
- Daamsgaard, J. and Lyytinen, K. (1998) 'Contours of diffusion of electronic data interchange in Finland – overcoming technological barriers and collaborating to make it happen', *Journal of Strategic Information Systems*, Vol. 7, pp.275–297.
- Engström, Y. (1985) 'Kehittävä työntutkimus. Perusteita, tuloksia ja haasteita', Helsinki, Painatuskeskus.
- Engström, Y. (1987) *Learning by Expanding: an Activity-Theoretical Approach to Developmental Research*, Orienta-konsultit, Helsinki.
- European Union (2005) http://europa.eu.int/information_society/qualif/health/index_en.htm 6.10.05.
- Finland in Figures (2005) Statistics Finland, Helsinki.
- Gregory, J. (2000) 'Sorcerer's apprentice: creating the electronic health record, re-inventing medical records and patient care', PhD Dissertation, Department of Communication, University of California, San Diego, La Jolla, CA, 2000 [online] http://heim.ifi.uio.no/~judithg/phd_mstrx.pdf.

- Hasu, M. (2001) 'Critical transition from developers to users. Activity-theoretical studies of interaction and learning in the innovation process', Academic dissertation. Department of Education, Centre of Activity Theory and Developmental Work Research, University of Helsinki, Otamedia Oy, Espoo.
- Hyppönen, H. (2004) Tekniikka kehittyä, kehittyvätö palvelut? (Technology develops, what about services. A case study of development of home care services in a technology project), Academic dissertation, University of Helsinki, Department of Education. Research reports 134, National Research and Development Centre for Welfare and Health (STAKES), Helsinki.
- Hyppönen, H., Nykänen, P., Salmivalli, L., Pajukoski, M., Ruotsalainen, P. and Vuorela, S. (2005b) 'Conducting interdisciplinary research: evaluation of the ePrescription pilot scheme in Finland', in Dan Remenyi (ed) *Proceedings of the 12th European Conference on Information Technology Evaluation*, Turku, Finland 29–30.9.2005, Academic Conferences Ltd, Reading, UK., pp.245–254.
- Hyppönen, H., Salmivalli, L. and Suomi, R. (2005a) 'Organizing for a national infrastructure project: the case of the Finnish electronic prescription', in *Hawaii International Conference on System Sciences*, Hilton Waikoloa Village, Big Island, Hawaii.
- Hyysalo, S. (2004) *Uses of Innovation. Wristcare in the Practices of Engineers and Elderly*, Helsinki: University of Helsinki, Department of Education.
- Johnston, D. (2004) 'Healthcare in OECD countries: can we do better without increasing cost pressure?', in *Policy & Research*, AARP, Editor. AARP.
- Kiviahho, K., Winblad, I. and Reponen, J. (2004). Terveysthuollon toimintaprosesseja ja asiointia tukevat atk-sovellukset Suomessa – Karttoitus ja käyttöanalyysi. FinnTelemedicum. Osaavien keskusten verkoston julkaisuja 8/2004, STAKES, Helsinki.
- Kwak, N.K. and Lee, C.W. (2002) 'Business process reengineering for health-care system using multicriteria mathematical programming', *European Journal of Operational Research*, Vol. 140, No. 2, pp.447–458.
- Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers Through Society*, Milton Keynes: Open University Press.
- Lehenkari, J. (2000) 'Studying innovation trajectories and networks: the case of Benecol Margarine', *Science Studies*, Vol. 13, No.1, pp.50–67.
- Leontjev, A.N. (1978). *Activity, Consciousness and Personality*, Moscow: Progress.
- Miettinen, R. (1999) 'The riddle of things: activity theory and actor-network theory as approaches to studying innovations', *Mind, Culture, and Activity*, Vol. 6, No. 3, pp.170–195.
- Mundy, D.P. (2003) *Providing a Secure Solution for the Integration of Electronic Prescription Transfer Within the United Kingdom Health Service*, UKAIS PhD Consortium.
- Nardi, B. (ed) (1996) *Context and Consciousness. Activity Theory and Human-Computer Interaction*, Cambridge, MA: The MIT Press.
- National Agency for Medicines (2005) Suomen lääketilasto 2003 – Finnish Statistics on Medicines, 2004.
- Orlikowski, W.J. (1992) 'The duality of technology: rethinking the concept of technology in organizations', *Organisation Science*, Vol. 3, No. 3, pp.398–427
- Pather, S. and Remenyi, D. (2004) 'Some of the philosophical issues underpinning research in information systems: from positivism to critical realism', Proceedings of the 2004 annual research conference of the South African institute of computer scientists and information technologists on IT research in developing countries SAICSIT '04. Stellenbosch, Western Cape, South Africa, pp.141–146.
- Raghupathi, W. and Tan, J. (2000) 'Strategic IT applications in healthcare', *Communications of the ACM*, Vol. 45, No. 12, pp.56–61.
- Rip, A., Misa, T.J. and Schot, J. (1995) *Managing Technology in Society. The Approach of Constructive Technology Assessment*, London: Pinter.

- Stakes (2004) Facts about Finnish Social Welfare and Healthcare 2003. Stakes, National Research and Development Centre for Welfare and Health: Helsinki.
- The Social Insurance Institution of Finland (2001) *Sähköistä Reseptiä Koskeva Esiselvitys*. Helsinki: The Social Insurance Institution of Finland (Kela), National Agency for Medicines (Lääkelaitos).
- Vygotsky, L. (1978) *Mind in Society. The Development of Higher Social Processes*, Cambridge: Harvard University Press.
- Westbrook, J.I. and Gosling, A.S. (2002) 'The impact of point of care clinical systems on health care: a review of the evidence and a framework for evaluation', *The Centre for Health Informatics*, Sydney: University of New South Wales.
- Wyssusek, B., Schwartz, M. and Kremberg, B. (2002) 'Targeting the social: a sociopragmatic approach towards design and use of information systems', in M. Khosrowpour (ed) *Proceedings of the Information Resources Management Association International Conference (IRMA 2002)*, Seattle, WA, pp.832–835.

PAPER 2: ORGANIZING FOR A NATIONAL INFRASTRUCTURE PROJECT: THE CASE OF THE FINNISH ELECTRONIC PRESCRIPTION

Hyppönen, Hannele– Salmivalli, Lauri – Suomi, Reima (2005) *“Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription”* Reprinted from *Proceedings of the 38th Hawaii International Conference on System Sciences* January 3-6, 2005, Hilton Waikoloa Village, Big Island, Hawaii. Copyright 2005 IEEE

Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription

Hannele Hyppönen
*The Finnish National Research
 Development Centre for Welfare
 and Health (STAKES)*
hannele.hypponen@stakes.fi

Lauri Salmivalli
Turku School of Economics
lauri.salmivalli@tukkk.fi

Reima Suomi
Turku School of Economics
reima.suomi@tukkk.fi

Abstract

Electronic prescriptions should be a central part of a working health care and national e-government infrastructure. In Finland the pursuit to establish such a system has been up few times, and the most recent, nation-wide initiative to set up a central electronic prescription system was set up in 2001. Our article here describes the starting points of the Finnish initiative to set up the system for electronic prescriptions, and presents the organizational structure and main tasks that are set up to build the system. Our theoretical discussion focuses on the concept of national IT infrastructures, and analyses the Finnish electronic prescription system against the ramifications given for a national infrastructure. The authors of the article are members of a group assigned to evaluate the national project. It is worth noting that both the system and the evaluation tasks are at the very early stages of work.

1. Introduction

Electronic prescriptions will most likely be a central part of a working health care and national e-government infrastructure in the near future. Already the huge amount of transactions calls for benefits through automation. Because of the “medicalization” of the society, the amount of medical prescriptions has risen steadily in most countries. For example, in Finland, year 2000 there were 37 million prescriptions for a population of 5 million [1-3]

Yet few countries have succeeded in establishing such systems because of the huge volume of medicine prescribing (see e.g.[4]). This sounds odd, considering, for example, how effective systems we have for financial transactions in the world. Their scope and complexity is much higher than is the case in electronic prescriptions,

and yet the systems are operating very well. Possible explanations for the obsolescence of electronic prescription systems might be that the application area is not high on the society agenda, or that there must be something inherently complicated and difficult in this area. We feel that both opinions are true.

In Finland local pursuits to establish an electronic prescription system have been up few times. The most recent, nation-wide initiative to establish a centralized Electronic Prescription System, EPS, (also the term Electronic Transmission of Prescriptions, ETP, is commonly used [5, 6]) was set up in 2001. Earlier attempts were of more local and marginal style [7]. This time work proceeds at a very high profile led by the Finnish Ministry of Health and Social affairs.

Pure academic research on electronic prescriptions is still quite scarce ([4, 5, 8-10]. However, the topic is already richly reported in different practitioner reports and public national plans for electronic prescriptions [2, 3, 11]. One of our tasks in this article is to locate the Finnish approach for the electronic prescription among other national projects.

Mundy and Chadwick (2002) define Electronic Prescription Processing (EPP) as: *The electronic transmission and processing of medical information contained within medicinal prescriptions through all components of the prescription system, from the initial prescribing of the drugs, through dispensation to the patient, to the eventual close of transaction at some prescription-processing agent.*” [5] Prescription processing agent in Finland is The Social Insurance Institution of Finland (KELA)

Our article describes the starting points of the Finnish initiative to set up a national system for electronic prescriptions, and presents the organizational structure

and main tasks that are set up to build the system. It is worth noting that both the system and the evaluation tasks are at the very early stages of work.

Methodologically the evaluation approach is closer to process than product evaluation, since the use of the system will still be in its infancy during the time of data collection.

A three-phase evaluation model was adopted in order to study pre-implementation situation containing construction of the system, implementation-phase and effects of the implementation. Pre-implementation evaluation have consisted of 3 parts: (1) describing the organisational, technical, professional and legal contexts, where the new system will be implemented and requirements they set, (2) evaluating organisation of the project and construction work of the new technical and social system (3) and collecting benchmarking data for eventual evaluation of feasibility of the system against international developments.

This study concentrates on some sections of pre-implementation evaluation parts 2 and 3. Within part 2 we have concentrated on organisation of the project work from the point of view of transparency and democracy of the system under construction. For this, we used the concept of infrastructure. Within domain 3 we have described some international developments for baseline information.

Our research questions are as follows:

- What is meant with infrastructures in general and in information technology in particular?
- Can the Finnish electronic prescription system be seen as a national infrastructure project and if, what are the implications of this?
- How is the Finnish electronic prescription system related to developments in other countries?

Our article unfolds as follows. In section 2, we discuss what we mean by infrastructure in general and by a national IT infrastructure in particular. Section 3 shortly describes the organization of the prescription project, the current stage of development and plans of the Finnish electronic prescription from the point of view of infrastructure implications set in section 2. Sections 2 and 3 answer the first and second research question. In section 4 we report some preliminary findings on how work is proceeding in other countries. In section 5 we briefly relate the Finnish electronic prescription infrastructure to international experiences, in order to answer the fourth question. Finally, in section 6 we summarize the findings of the study.

2. Developing IT as a national infrastructure

We speak of the Finnish Electronic Prescription System as a national infrastructure. What do we mean by infrastructure, and what are the implications?

Infrastructure is a word not specific to information technology. At the city planning level infrastructure is probably most visible: we can see streets and other structures for transportation and logistics [12, 13], public buildings such as schools, museums and libraries [14, 15] sewerage and clean water systems, electronic and telecommunication networks, etc. However it would be false to derive from this that infrastructure would mean just something visible and technical. Infrastructure can too be seen in abstract things such as legislation, education system, public health care system, different markets and governance structures... you name it.

However, the word infrastructure is widely used in the area of information technology too [16, 17]. According to Mitchell and Zmud (1999) IT infrastructure offers an organization the ability to effectively leverage IT resources. Generally speaking, IT infrastructure refers to enabling technologies, outsourcing arrangements, and policies [18].

The super infrastructure of IT is the Internet [19]. However, IT infrastructure can refer to smaller entities, such as telecommunication [20], electronic commerce [21], or information as such [22], just to give a few examples. We, focus in this study on the infrastructure aspects of electronic prescription, because we believe that electronic prescription system can be a major national IT infrastructure in the future.

Some relationships between terms need explanation too. *Architecture* is the long-term logical plan for something. It might be there without any concrete embodiment. *Infrastructure* – on the other end – must be something concrete that brings added value to its users. Every infrastructure has some architecture – implicit or explicit – that gives structure to it.

We define infrastructure to have the following characteristics:

- It is directly or indirectly controlled by public organizations and political decision making
- It is available for anyone willing to pay the usage fees and obeying the rules set for its users
- It is not primarily there in order to bring profit for its owner
- Many structures base themselves on infrastructure
- The society as a whole is very dependent on the infrastructure [23]

- Information on infrastructure is mainly open for anyone.

Is the Finnish Electronic Prescription System also a national infrastructure? Even though still in a pilot phase, there are strong indications, that it will become an integral part of a national health care infrastructure.

First, the project is both directly and indirectly strongly controlled by public organizations and decision making. It was set up and is led by the Finnish Ministry of Health and Social Affairs as a national pilot. The centralized electronic prescription database is required to be in strict control of public authorities. At present it is technically hosted by National Insurance Institution. Both the medicine prescription process as well as the process to build an information system to support it is heavily framed through regulation. However, we have not yet seen any definition who is going to be the owner of the new system.

The use of the database will be available for any authorized public or private medical practitioner and pharmacy within limits of data protection legislation.

The primary users of the new system are restricted to certain parties that are involved in the medicine prescription process by law.—The system would be even more a national infrastructure, if the final medicine users, also citizens, would have access through the system to their own medical history. This has been in the visions, but will not yet be made reality in the first version.

It is not there to bring profit for its owner. In fact, there is no one owner defined, nor is there a clear business-model to exploit the system. This too speaks for the fact that there is no party that would develop the system just to bring in economic benefit measured in plain business profit. As in the case of any infrastructure, the system is anyhow expected to bring a lot of benefits – both economic and other – to the nation as a whole.

The electronic prescription system will have interfaces to information systems in health care organizations such as hospitals and health care centers, and in pharmacies. Many new value added activities in these organizations are expected through the electronic prescription system. One important part of the total picture is the rich statistical data that will come into existence because of the new system.

The society is very dependent on a system for prescribing, dispensing and processing medical prescriptions. Medicine prescribing is not a new function in the society. We already have a manual infrastructure for that. The new electronic prescription system will affect some parts of that infrastructure. Since no modern

society could exist without regulated medicine prescription processes, we can clearly speak of an infrastructure.

One could see electronic prescription system as a system keeping track of the *rights* different people have in regard to medication, or keeping track of the medicines each individual is entitled to. In this sense we see similarity to many other systems that are designed to keep track of citizens' rights. Take for example the systems for keeping track of driving licenses, systems that cover bank accounts, or systems in universities etc. that register the accomplishments in studying. In the big picture the electronic prescription system should not differ too much from these national infrastructures. One big national information infrastructure is that of tax administration in every nation [24].

Finally, infrastructure is something of which most information is free. For example, the specifications of the electronic prescription system must be open to software houses so that they can build interfaces to the system. However, for security reasons (even because of national critical security), some information on infrastructure may have to be for restricted use only [25].

If the Finnish Electronic Prescription System is part of a National Health Care Infrastructure, what are the main implications of this? In our mind, the following issues gain in importance:

- Common citizens should find interest in it
- It should be regulated by national government
- Discussion on the infrastructure should be found in public media
- Developments and plans of the infrastructure should be published
- The infrastructure should be subjected to rigorous cost-benefit analysis.

How are these issues then forming themselves in the case of the Finnish Electronic Prescription System? In the following chapter we describe development of the national e-prescription system and evaluate how these implications materialize in the system under construction.

3. The organization of the Finnish electronic prescription project

Background

The old manual system for medicine prescription is working well in Finland. Patient receives a printed (either hand-written or electronically created) prescription form for medication from the doctor containing identification of patient and the doctor. There is room for two drugs and place for dispensing and renewal information. The patient brings the forms to a pharmacy, where a pharmacist feeds

in the data from the prescription to a pharmacy programme for dispensing the medication. The programme calculates the price for the drugs deducting the amount of national insurance if the client has the national insurance card with him. The programme prints bar code slips with the price which the pharmacist attaches to the drugs. The pharmacist marks on the form the amount of medication which is dispensed and returns the form to the client with the medication. The second page is left at the pharmacy for invoicing the national insurance office of the insurance part of the price of the medication.

The entire adult population has some experience and knowledge related to it, though just few citizens might know in detail how the system works. For most common citizens, the electronic system for this process is not high in their interest list. However, the topic has gained some reasonable publicity in the Finnish Media up to the prime-time television news. Infrastructure is typically something that you do not explicitly think of unless it stops from working, and this might be the relationship between medicine prescribing and the big audience in Finland.

Need for a national pilot

Thus, the first implication has not been entirely fulfilled: citizens have not expressed clear interests to change the existing prescription system. Same cannot be said about system designers. Ever since late 1980s there have been some local pilots in Finland trying to develop a system for mediating medical prescriptions electronically from doctor's offices to pharmacists. Different technologies were tested, e.g. smart cards and e-mails mediating prescriptions through local servers [1]. Most of these early projects were initiated by technology providers, serving foremost their interests [1].

The problems experienced e.g. by pharmacies in ensuring authenticity of these prescriptions especially led the National Pharmacists Association to become active in demanding a more coherent national approach. Demands for electronic signature, ensuring abiding to legislation, program compatibility, electronic prescription data transfer security and storage as well as defining rights to access the stored data were raised. The early experiences also called for a common procedure for integrating needs of all relevant actors (e.g. patients' rights) into the system. Patients' equal rights and safety as well as pharmacists information to assess authenticity of prescriptions were given as examples for these varying needs.[26] Similar questions had been reported in many other countries as well [5, 11, 27-29].

Clarifying objectives for a national system

In 2001 Ministry of Health and Social Services initiated a study which aimed at clarifying the structure and

objectives for a system for electronic prescriptions in Finland. [1]

The study described the processes of creating prescriptions and delivering the medication in pharmacists, and problems with paper-based prescriptions as basis for the development of the system. As requirements for the system, the study listed legislation and decrees related to creating and handling prescriptions, contents of prescriptions and principles for social insurance compensation. As users of the system, the study listed doctors, dentists and veterinarians, who could store prescriptions into a database to be delivered by pharmacists, together with the patients, whose rights and level of service was emphasized. The objective was to create a unified, clear national system, which would be efficient, safe and flexible. The usage of standardized CDA-format for prescription contents and a common, up-to-date medication database were defined to ensure error-free contents of prescriptions. It was regarded important, that the prescription data stored could be controlled by authorities in order to avoid commercial exploitation of the data. [1, 26]

The study presented alternatives for realization of electronic prescription, concluding with a recommendation for a model based on centralized prescription database, hosted by Social Insurance Institution (KELA).

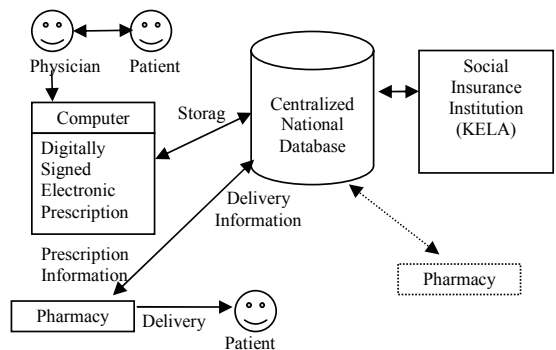


Figure 1. Centralized database solution for the Finnish Medicine Prescription System [1]

The selected model is based on electronic storage, and the retrieval of prescriptions, which require patient's informed, written consent. The doctor creates an electronic prescription with either a stand-alone electronic prescription program or program integrated to electronic patient records systems. The prescription is signed with doctor's secured electronic signature. Instead of printing it, it is transferred from doctors' offices to the national database, where it is technically stored. Patients receive a

printed guide (“comfort slip”) instead of a prescription. When they go to the pharmacy, pharmacists use their electronic identification card together with patient's social security number to retrieve patient's prescriptions with their computers, which are connected to the national database. Transferring of information to and from the database is secured against unauthorized access with Secure Sockets Layer (SSL)-technology, same as web-banks use. [1, 26]

Developing and piloting the described system

In 2002 Ministry of Health and Social Services initiated a project to pilot a system described in the study. Piloting the system was due to be done during 2003-2004. Four different areas in Finland were selected to participate: two specialized hospitals, one health care centre and one occupational health unit. Certain doctors pilot the writing of prescriptions, and a few local pharmacies in each area pilot the delivery of drugs. In the beginning of 2003, the ministry issued a temporary decree, which stated the common terms and restrictions of the pilot. Thus, the second implication is fulfilled: the electronic prescription system is heavily regulated by the government

The electronic prescription function is integrated into three different patient information systems used by pilot sites: *Pegasos*, *Effica* and *Healthnet*. Neither one of the two pharmacy information systems (*Salix* and *Linnea*) used in Finland are expected to host the required features for retrieving the prescriptions during the pilot. Therefore, a systems provider was also selected to develop a stand-alone web-based program for writing prescriptions and delivering medication. This program is in use in one hospital and all pharmacies in the pilot phase.

The concrete work to develop the system took place in 2003 and beginning of 2004. During the preparation of the project and construction of the system it has not been discussed in the mass media in a manner, which would have made it familiar to citizens. Documentation on the Finnish national electronic prescription system can be seen on the Internet- but it is quite scattered there, no main portal or site exists for the electronic prescription system. The actual production of e-prescriptions started on 27.5.2004 with one hospital and two pharmacies.

These findings speak partly against fulfillment of the 3rd and 4th implication. Low coverage in mass media and limited publication of project documents may be due to the fact, that medicine prescribing is a infrastructure that is not very visible and easy to see. It is a part of a wider health care infrastructure in any nation. As the infrastructure is abstract, it does not wake up so much interest than say road building. So the building plans are not so much in publicity than, say, those of a new main

motorway between Turku and Helsinki, a Finnish national infrastructure project that is currently under construction.

The fifth implication has also not been so obvious in the project. It seems that even if several goals for the project area were stated, they have been very poorly operationalized. There is e.g. no detailed cost-benefit analysis behind the work, nor are there specific technical or functional requirements described from different actors. Instead, there are visions and expectations, which are only loosely related to everyday practices and requirements of different technologies, professionals and user organisations. The project seems to have run further by a kind of “must” and “can-not-do-without” -thinking, that is very usual in the case of infrastructure investments. (see also [30-33])

Part of the reason for this can be found in the fact, that the project was organised as a loose network of different stakeholders with no budget apart from a part-time project manager. The four local pilot areas have integrated e-prescription in their own IT-development projects. The integration of the work of these projects with goals of the national e-prescription pilot has required negotiation between different interests, coordinated construction of technical and social systems, coherent testing, training and technology integration activities. This has not been entirely unproblematic.

4. International experiences from Electronic Prescriptions

Electronic prescription is not just a Finnish phenomenon. Quite a few countries are currently in the process of establishing an electronic prescription system, or they already have a viable electronic transmission of prescriptions. We will next introduce briefly some foreign projects concerning electronic prescribing.

This part of the study is largely a desktop-study focusing on the different national electronic prescription systems. Documentation was collected via internet with Google –search engine. Documentation was searched from all registered domains with English, French, German, Norwegian Portuguese, Spanish, Dutch, and Swedish – keywords with over 8000 hits. We are aware of the linguistic and technical limitations of this kind of research.

United States

Electronic prescribing systems have existed in some states in the USA for some years, but the users are have been small cluster groups of selected physicians and pharmacies who have all been signed up to the same

system provider.[5] Half of the 55,000 pharmacies were due to be connected in the nationwide SureScripts' network by the end of the year 2003[30]. Several technology providers offer handheld PDA devices for physicians. [30, 31] In some systems prescriptions are sent by fax or e-mail, and do not fulfill the definition of electronic prescription that we use. [5, 32, 33]

Canada

There have been various provincial health care information systems projects in Canada. *PharmaNet* system was introduced in 1995 in the British Columbia in order to e.g. provide pharmacists province-wide patient medication history, comprehensive drug information and automatic checks for e.g. drug interactions. Similar projects have been established in example to Alberta (*WellNet*) and Ontario (*Smart Systems for Health, ePhysician*) [29] Canadian pharmacy regulatory authorities and certain pharmacists associations published in May 2003 a report called: *Recommendations for Implementing Electronic Prescriptions in Canada* aiming to foster the implementation of national electronic prescription system [11].

The United Kingdom

The United Kingdom government is determinedly reforming the National Health Service (NHS). As part of the plan a system for electronic prescribing of drugs should be available by the end of 2004. Legislation allowing the Electronic Transmission of Prescriptions (ETP) was approved in September 2001 and after that the Department of Health has commissioned three pilot programs testing different technical approaches. Prescription Pricing Authority (PPA) received the first electronic prescription on March 28th 2002. Pilots officially ended on the 30th June 2003. Unlike in Finland, the database is distributed between regions, since a centralized directory would be required to handle over 500,000,000 prescriptions per year. [5, 6, 32, 34-36]

The Netherlands

The Netherlands commissioned a project on Electronic Prescription Support System (EPSS) in 1999. Primary goal of the project was to improve the quality of prescribing in general practice, and secondary goal was to establish a reduction in the costs involved with general practice prescriptions [4, 37]. Common use of the system should lead to more consistency and cost effectiveness, because the system suggests the most cost effective therapies[4]. Boonstra (2003) has aimed some criticism towards the system. According to him, the system was a relative failure, because it was not widely accepted by its users, GPs [4].

Denmark

Denmark has had since 1995 an operating EDIFACT-based electronic prescription system (MEDPRE) [38]. Approximately 35 percent of prescriptions are currently sent electronically [5]. The system is basically point-to-point based and does not provide similar value added features as proposed systems in e.g. Finland or the UK.

Sweden

In Sweden the county councils bear the responsibility of financing and operation of most health care facilities. Also electronic prescribing projects are on the responsibility of regional authorities. In our study we focused on the Swedish capital – Stockholm – areas prescription system. Currently approximately 20 percent of prescriptions are sent electronically, also some 76 000 e-prescriptions per month. Technical implementation is very similar to Finnish with centralized (though on county level) database and open interfaces to other health care information systems. [39-41]

5. Preliminary Experiences from the Finnish system compared with other countries' systems

Motivation for implementing EPS

Generally speaking, Finland together with all the other countries in our study shared very similar motivations and reasons for the implementation of electronic prescription systems.

Orr et al. (2001) state that the potential benefits that IT can provide for the health care are similar to other businesses: competitive advantage through quality of information processing, process efficiencies, improved productivity and performance, superior quality of service, greater responsiveness to customer needs and greater organizational flexibility. [42]

Motivation to implement electronic prescription system or other health care information systems (HICS) falls into three broad categories [28]:

- **Improved patient safety:** e.g. through reduced medication errors and adverse events, improved medication and test ordering
- **Improved quality of care:** e.g. by increasing physicians' time for direct patient care, increased application of clinical pathways and guidelines, facilitating the use of up-to-date medical evidence, improved documentation and patient satisfaction.
- **Improved efficiency in health care delivery:** e.g. by reducing costs through faster order processing, reductions in test duplication, decreased adverse events, and changed patterns of

drug prescribing favoring cheaper generic products.

Reduction of medication errors is emphasized in Finland and elsewhere when discussing about the benefits of electronic prescriptions. (e.g. [9, 10, 28, 43]) and during the last few years, medical adverse effects have received ever-increasing attention. Studies estimate that approximately 7,300 Americans die annually because of medication errors alone. Another study estimates a rate of 6,5 adverse drug events per 100 admission, of which 28% were preventable, mainly being due to illegible writing.[2, 3]

Other frequently accentuated aspects favoring the use of electronic prescriptions are: Reduction of prescription fraud [5, 10, 35], speeding up the prescription ordering process [10, 44, 45], and Data integrity [5, 10, 11]. For example, Mundy and Chadwick (2002) refer to a study according which 40 percent of all prescriptions in the USA require rework, with 5 percent of these requiring a phone call to physician. [5] Also the chances to have better statistical data for research purposes is an important value adding aspect when considering patient safety and quality of care – issues.

Objectives of EPS projects

According to our study, Finland as well as many other countries have made significant preliminary research in order to motivate the implementation of an EPS. However, in our opinion, turning the motives into strategic objectives seemed to be in many cases rather vaguely expressed. Furthermore, reporting the fulfillment of objectives and the evaluation of projects has varied highly between different national projects.

The evaluation of goal achievement can be immensely challenging task. Whitten and Rowe-Adjibogoun (2003) have studied the evaluation of health care information systems. They state that the evaluation task is enormously demanding since projects are unable to reach the stage of evaluation due to an inability to get even a telehealth (i.e. health care information system) service launched. Furthermore, they state that in order to succeed any telemedicine initiative must not compete with existing organizational goals and corresponding resources. [46]

Orr et al. (2001) discovered in their research that most IT project goals were achieved only partially, this seems to be firstly due to lack of communication regarding the outcome of projects, and secondly due to lack of common agreement of acceptable IT project goals.[42] Lack of common agreement of operationalized project goals seems to be a problem in the Finnish case.

Defining objectives in health care information systems project is a tough task with several dimensions including people from different organizational levels with different professional backgrounds. Nevertheless, setting clear objectives is essential because they describe exactly what the project is aiming to achieve and they allow evaluating whether or not each objective has been established [47, 48]. Martin recommends using the SMART-rule when setting up project objectives [32]:

- **Specific:** Clearly defined with completion criteria
- **Measurable:** One knows when the objectives have been achieved
- **Achievable:** Within the current environment and with the skills that are available
- **Realistic:** Not trying to achieve the impossible
- **Timebound:** Limited by a completion date

The Swedish and Dutch projects are exemplary with the objective setting and evaluation. Dutch authorities expected annual savings of 150 m€ with set objectives of approximately 90 percent usage among GPs. Realization of objectives were significantly below intended. Notably, Dutch authorities did not admit the relative failure of system, but they referred to intangible quality improvements and changes of attitudes towards IT [4].

The Swedish e-recept Stockholm is providing continuous up-to-date information via internet site (<http://www.ereceptstockholm.se/>) with statistical data and reports. The fulfillment of objectives can also be easily followed from the site. Currently the project has reached the objective of 20 percent electronically transmitted prescriptions from all prescriptions.

Obstacles for the implementation of EPS

The projects have identified several possible obstacles for the implementation of an electronic prescription system. We divided the obstacles into three groups:

- Technological issues
- Organizational issues
- User perception issues.

Technological issues are related to the design of the system. Especially challenging task seems to be the integration of electronic prescription system into other health care information systems such as electronic medical record (EMR or electronic patient record EPR). Integration of different existing patient record and pharmacy information systems seems to be challenging also in Finland. Problems have been experienced e.g. with integration of medication databases included in different systems. The integration is sometimes hindered by the slow adoption of standards (e.g. HL-7) and profusion of stand-alone systems, lacking open interfaces, though adoption of HL-7 and XML-standards should prevent this from happening in Finland.

Organizational issues include questions like the coordination of projects between different actors in the field. Lacking project plans, objectives and financial estimates seem to be part of many EPS projects, and the Finnish case is no exception. Also the management of projects within each organization could be improved, especially communication and user empowerment.

Finally, an important possible obstacle experienced both in Finland and abroad is the user resistance: physicians do not necessarily see the short term benefits of the system, but rather see the profit of other stakeholders like the pharmacies or prescription processing agents. Furthermore, the social attitude of users can have great impact on the resistance of change. Some users need bigger push to accept the system than others. The costs savings may not be enough for some users to see the need of change. (See e.g. [49])

6. Summary

As we can see from the history of other infrastructures, they need time to mature. Information systems with strategic importance need time to mature. Earlier failures and less than perfect pilots are needed before the really operative system can be born. The Finnish project has invested a lot on the specification of the technical environment. We believe that the designed central solution will be very effective at the end both in technical as well as in economical terms. However, the goals of the infrastructure have not been stipulated very exactly. This might be an outcome of two things: 1) simply taking the EPS as must that you can not question or of 2) the realistic vision that such projects take unmanageable ways of development, and the final outcome of the project is always partly surprise

Although a lot of material on the Finnish pilot is on the web, there is no central point of access to it, which is a clear shortcoming. The Finnish population is still quite unaware of the current developments in the EPS field, and especially they might have difficulties in understanding how far the pilot in practice is, and when it is going to affect their lives. No detailed data about the enthusiasm doctors and other medical staff members have towards the system is available. In general studies about the reception of modern information systems into hospitals we have seen that the expectations are positive, but that many see a lot of unneeded hassle around the new systems [50]

We have reported in this article the basis on which Finnish system for electronic prescriptions will be laid in the future, and we have presented the Finnish EPS as a national infrastructure, which means that it can not be

viewed and assessed as a normal information system within one organization.

In the infrastructure approach, the investment cycle must be very long, and concrete benefits can be expected first after a long time and after a lot of application work in individual organizations. We see that the coming system will be a very advanced one with its state-of-art infrastructure and we see significant potential that the system can provide for national health care.

References

1. The Social Insurance Institution of Finland, *Sähköistä reseptiä koskeva esiselvitys*. 2001, The Social Insurance Institution of Finland (Kela), National Agency for Medicines (Lääkelaitos): Helsinki.
2. Gagnon, J.P., et al., *Physician Connectivity: Electronic Prescribing*, in *Issue Brief No. 752*, T.G.W. University, Editor. 2000, National Health Policy Forum: Washington, DC.
3. KPMG'S Technology Insiders Focus, *E-Prescriptions Promise Patient Safety, Higher Drug Sales*. 2004.
4. Boonstra, A., *Interpretive Perspectives on the Acceptance of an Electronic Prescription System*. *Journal of Information Technology Cases and Applications*, 2003. **5**(2): p. 27-49.
5. Mundy, D.P. and D.W. Chadwick. *A System For Secure Electronic Prescription Handling*. in *Proc. of the 2nd International Conference on the Management of Healthcare and Medical Technology*. 2002. Chicago, Illinois, USA.
6. Sugden, B. and R.W. Wilson. *Electronic Transmission of Prescriptions and Integrated Care Records - Experience of the Evaluation of ETP Pilots*. in *Integrated Care Records: Problems and Solutions Workshop*. 2003. Edinburgh, 11th-12th December 2003.
7. Suomi, R. and L. Salmivalli. *Electronic Prescriptions - Developments in Finland*. in *Towards the knowledge society - eCommerce, eBusiness and eGovernment. The second IFIP conference on E-commerce, E-business, E-government (I3E 2002)*. 2002. Lisbon, Portugal.
8. Niinimäki, J. and J. Forsström, *Approaches for certification of electronic prescription software*. *International journal of Medical Informatics*, 1997(47): p. 175-182.
9. Schiff, G.D. and T.D. Rucker, *Computerized Prescribing Building the Electronic Infrastructure for Better Medication Usage*. *The Journal of the American Medical Association*, 1998. **279**(13).
10. Middleton, H., *Electronically transmitted prescriptions - a good idea?* *The Pharmaceutical Journal*, 2000. **265**(7107): p. 172-176.
11. Canadian Association of Chain Drug Stores, et al., *Recommendations for Implementing Electronic Prescriptions in Canada*. 2003.
12. Gray, P., *Converging infrastructures: Intelligent transportation and the national information infrastructure*. *Information Society*, 1998. **14**(3): p. 247-248.
13. Suomi, R. *Building the Internet - lessons from Railways*. in *The 6th International Scientific Conference WWDU 2002 World Wide Work*. 2002. Bertelsgadon, Germany.
14. Coult, G., *The museum as corporate memory*. *Managing Information*, 2001. **8**(3): p. 44-47.
15. Hopkins, D., *The museum as corporate memory and learning resource*. *Managing Information*, 2001. **8**(3): p. 44-47.
16. Broadbent, M., P. Weill, and D. St Clair, *The implications of information technology infrastructure for business process redesign*. *MIS Quarterly*, 1999. **23**(2): p. 159-182.
17. Broadbent, M., P. Weill, and B.S. Neo, *Strategic context and patterns of IT infrastructure capability*. *Journal of Strategic Information Systems*, 1999. **8**(2): p. 157-187.
18. Mitchell, V.L. and R.W. Zmud, *The effects of coupling IT and work process strategies in redesign projects*. *Organization Science*, 1999. **10**(4): p. 424-438.
19. Gray, P., *The Global Information Infrastructure*. *Information Systems Management*, 1996. **13**(3 (Summer)): p. 7-14.
20. Dutta, A., *Telecommunications infrastructure in developing nations: Rural coverage*. *International Information Systems*, 1992. **1**(3): p. 31-54.
21. Damsgaard, J. and A.F. Farhoomand. *Building Electronic Commerce Infrastructure: Hong Kong Consumer Goods Distribution*. in *Proceedings of the Seventh European Conference on Information Systems*. 1999. Copenhagen: Copenhagen Business School.
22. van den Berg, R., et al. *Information infrastructure as a basis for business process redesign: Results of a case study*. in *Proceedings of the Second European Conference on Information Systems*. 1994. Nijenrode University, The Netherlands: Nijenrode University Press.
23. Vise, D.A., *FBI warns infrastructure vulnerable to cyber-attacks*. *The Washington Post*, 2000.
24. Hüsing, S. *Effects of Internet Facilities on Tax Businesses - Potential Advantages and Vocational Restrictions*. in *Proceedings of the Seventh European Conference on Information Systems*. 1999. Copenhagen: Copenhagen Business School.
25. United States. Congress. Senate. Committee on the Judiciary., *The National Information Infrastructure Protection Act of 1995 : report (to accompany S. 982)*. Report / 104th Congress, 2d session, Senate ; 104-357, ed. S. United, Congress, and Senate. 1996, [Washington, D.C.? : U.S. G.P.O. 21.
26. Finnish Electronic Prescription Steering Group, *Unpublished internal documentation*. 2004.
27. National Association of Pharmacy Regulatory Authorities (NAPRA), *A Proposal for Electronic Prescription Security Standards*. May 10, 2001.
28. Westbrook, J.I. and A.S. Gosling, *The Impact of Point of Care Clinical Systems on Health Care: A Review of the Evidence and A Framework for Evaluation*. 2002, The Centre for Health Informatics, University of New South Wales: Sydney.
29. Cornwall, A., *Connecting health: A review of electronic health record projects in Australia, Europe and Canada*. 2002, Public Interest Advocacy Centre: Sydney.
30. Brewin, B., *Drugstores embrace E-prescription system*, in *Computerworld*. 2003. p. 7.
31. Anonymous, *A4 to offer electronic prescriptions*, in *Health Data Management*; 2003. p. 22.

32. Mundy, D.P., D.W. Chadwick, and E. Ball. *An Application Programming INterface for the Electronic Transmission of Prescriptions*. in *IFIP*. 2003. Ilmenau.
33. James M. Hisle, *Throw Away the Prescription Pad? Debate over Electronic Prescription and Fulfillment*, in *Medical Crossfire*. 2001. p. 47-56.
34. Mundy, D.P. *Providing a Secure Solution For The Integration Of Electronic Prescription Transfer Within The United Kingdom National Health Service*. in *UKAIS PhD Consortium*. 2003.
35. Kossendey, G., *Electronic Transmission of Prescriptions (ETP): UK Case Study*. 2002, Bidart Consultants: Munich.
36. Sugden, B., *Electronic Transmission of Prescriptions - Evaluation of Pilots: Summary Report*. 2003, Sowerby Centre for Health Informatics at Newcastle.
37. Wolters, I., H.v.d. Hoogen, and D.d. Bakker, *Evaluatie invoering Elektronisch Voorschrift Systeem - Monitoringfase: de situatie in 2000*. 2001, Nivel - Nederlands instituut voor onderzoek van de gezondheidszorg.
38. Theilgaard, J., *MESSAGE IMPLEMENTATION GUIDE for PRESCRIPTION*. 1997, The CoCo Project.
39. Gustafsson, L.L., et al. *JANUS – a computerized system for rational drug treatment and drug research. in the Nordic Conference on Electronic Drug Prescribing*. 2001. Stockholm.
40. County Council Public Health Board (HSN) - Division of Drug Management and Informatics, *Official Approval: Organization of a common standard for IT structure for electronic prescribing support and electronic prescriptions*. 2001: Stockholm.
41. Apoteket AB and Stockholms Läns Landsting, *e-recept Stockholm*. 2004.
42. Orr, S., et al., *The impact of information technology on a section of the Australian health care industry*. *Benchmarking: An International Journal*, 2001. **8**(2): p. 108.
43. Bell, D.S., et al., *Recommendations For Comparing Electronic Prescribing Systems: Results of An Expert Consensus Process*, in *Health Affairs*. 2004.
44. Hisle, J.M., *Throw Away the Prescription Pad? Debate over Electronic Prescription and Fulfillment*, in *Medical Crossfire*. 2001. p. 47-56.
45. Mellin, A., *E-prescribing: An Opportunity for Process Re-engineering*. *Health Management Technology*, 2002.
46. Whitten, P. and J. Rowe-Adjibogoun, *Researching Health Communication Technology Intervention Projects: The Challenge of Achieving Utilization Levels Sufficient for Evaluation*. *Journal of Technology in Human Services*, 2003. **22**(3).
47. Martin, V., *Managing Projects in Health and Social Care*. 2002, London: Routledge.
48. Martin, V. and E. Henderson, *Managing in Health and Social Care*. 2001, London: Routledge.
49. Legendijk, P.J.B., R.W. Schuring, and T.A.M. Spil, *Telecommunications as a Medicine for General Practitioners*, in *Strategies for Healthcare Information Systems*, R. Stegwee and T.A.M. Spil, Editors. 2001, Idea Group Publishing: Hershey. p. 114-125.
50. Raitoharju, R., *Tietotekniikka sosiaali- ja terveydenhuollossa -Työterveyslaitoksen tutkimuksen tuloksia*. 2003, Turku School of Economics and Business Administration: Turku.

PAPER 3: BUSINESS PLURALISM OF ELECTRONIC PRESCRIPTIONS: STATE OF DEVELOPMENT IN EUROPE AND THE USA

Salmivalli, Lauri – Hilmola, Olli-Pekka “*Business Pluralism of electronic prescriptions – State of development in Europe and the USA*” *Int. J. Electronic Healthcare*, Vol. 2, No. 2, 2006

Business pluralism of electronic prescriptions: state of development in Europe and the USA

Lauri Salmivalli*

Information Systems Science,
Turku School of Economics and Business Administration,
Rehtorinpellonkatu 3, Turku FIN-20500, Finland
Fax: +358-2-4814-280 E-mail: lauri.salmivalli@tukkk.fi
*Corresponding author

Olli-Pekka Hilmola

Department of Marketing,
Turku School of Economics and Business Administration,
Rehtorinpellonkatu 3, Turku FIN-20500, Finland
Fax: +358-2-4814-280 E-mail: olli-pekka.hilmola@tukkk.fi

Abstract: In this paper, we analyse the current state of the development of electronic prescriptions in Europe and the USA. These two places have different approaches to the healthcare sector, since in the former one national social insurance usually provides treatment for all of the people (most often only with friction from total costs), but in the latter one the healthcare sector is under free market forces. As our analysis shows in this paper, electronic prescriptions in both of the places have developed in recent years quite favourably, but this development has not produced consistent results, whether electronic prescriptions should be provided by for-profit companies or should they be under strict control of governmental authorities. We base this finding in two empirical observations: (1) in Europe saving potential from electronic prescriptions is estimated to be high, and contains many abstract national economy accounts and (2) leading US companies (providing electronic prescription services) have went been able to increase their revenues significantly, but still their profitability is questionable. We argue that the situation of electronic prescriptions is similar with airline or credit card industry. Both of these are vital for international and local economies, but the business models have developed well after the initial idea.

Keywords: electronic prescriptions; business models; health informatics; Europe; the USA.

Reference to this paper should be made as follows: Salmivalli, L. and Hilmola, O-P. (2006) 'Business pluralism of electronic prescriptions: state of development in Europe and the USA', *Int. J. Electronic Healthcare*, Vol. 2, No. 2, pp.132-148.

Biographical notes: Lauri Salmivalli (MSc) is currently finishing his PhD at the Turku School of Economics and Business Administration (TSEBA) in Turku, Finland. His research is on Healthcare Information Systems (HCIS), especially in the implementation and use of electronic prescription. He has published some number of international conference papers, and has been involved in governmental and corporate level e-prescription projects.

Olli-Pekka Hilmola (PhD) is a Research Fellow of Logistics at TSEBA in Turku, Finland. Before joining TSEBA, he received his MSc and PhD from the University of Vaasa, Finland. Currently, he is also working as a Supply Chain Manager for electrical motor manufacturer Rotatek, Finland. His research interests include supply chain management, theory of constraints, system dynamics and total productivity management. He has published around 40 international conference papers, over 30 journal articles and a number of book chapters. He is also a Member of the Editorial Board of Industrial Management and Data Systems as well as the International Journal of Integrated Supply Management.

1 Introduction

As the population of the Western world ages and patient's time spent in hospitals and other healthcare facilities shorten, healthcare organisations are facing increasing pressures to adopt information technology in order to promote safety, quality and speed in patient care (Chen et al., 2004; Gersch, 2004; Le Duff et al., 2004; Mundy and Chadwick, 2004).

This new development has already changed information systems requirements inside hospitals, and currently there is great emphasis on paperless transactions in operations, as well as in administrative processes (Mieczkowska et al., 2004). Business process reengineering takes its first steps in hospital environment, but the expected changes in performance should be equally revolutionary as they have been in industrial companies during the 1990s (Hammer and Champy, 1993; Mellin, 2002; Olmsted Teisberg et al., 1994).

However, changes are not happening inside the service units, also the distribution of pharmaceuticals is under change: electronic prescriptions give visibility for doctors to give the right drugs for patients (e.g. in the case of multidrug treatment) as well as control the amount of times the patient has been treated with a particular drug (e.g. rather important in the case of antibiotics, as resistant bacteria have got more common) (Smith and Flanegin, 2004). Among these quality improvements, electronic prescriptions will also increase the efficiency and inventory levels of pharmaceutical distribution.

Yet, measuring the benefits of Healthcare Information Systems (HCIS) and especially electronic prescription is exceedingly a difficult task: gains may appear on one level and not on the other, depending on whether the gains are funnelled to individual organisations or whether the gains appear only on the national level. Benefits should be carefully estimated before deciding whether the investments are made on an organisational level or aggregate/national level (see also Dedrick et al., 2003).

At the moment there exists a great diversity of competing technological solutions for electronic prescriptions (e.g. each citizen has a memory card or electronic transmission of prescriptions via the internet or EDI) and different forms in physical distribution (directly to their home or picked up from pharmacy).

As healthcare systems in developed nations are typically a combination of governmental sector actors, regulated for-profit actors and purely for-profit companies, the interests of stakeholders are myriad and resistance for change is high. Therefore, in many cases we are still in the start-up phase with electronic prescriptions.

The purpose of this paper is to examine the current state of the use of electronic prescriptions in selected countries in Europe, and compare this development to three for-profit companies located in the USA. According to our analysis results, the use of electronic prescriptions in Europe is still in its early stages, but in the USA the market economy has driven a merger wave among transactions providers, and in the end increased the size and influence of main players in the field. Thus, in Europe and the USA, the electronic prescription business is barely profitable and we see this as a major main threat for the enlargement of these advanced forms of services in the future. Therefore, we have included discussion and initial proposals concerning possible business models of e-prescription transaction providers.

This paper is structured as follows. Firstly, we will introduce the literature and previous research findings from HCIS and electronic prescriptions. After the literature review, the research environment in Europe is briefly described, as well as some main findings arising from country-specific development is being summarised. Thereafter, we will discuss about business models, and analyse sales as well as profitability development of three US for-profit providers operating in this field. In the final section, we will summarise research findings and propose new avenues for further research.

2 Health informatics and HCIS

The academic research field of HCIS (i.e. health informatics or medical informatics) is very convoluted. Health or medical informatics represent (according to Greenes and Shortliffe, 1990):

“The field that concerns itself with the cognitive, information processing, and communication tasks of medical practice, education, and research, including the information science and the technology to support these tasks”.

The aims of the discipline are by one definition (Haux, 1997):

- to provide solutions for problems related to data, information and knowledge processing
- to study general principles of processing data, information and knowledge in medicine and healthcare.

Terms ‘health informatics’ and ‘medical informatics’ can be used as synonyms (e.g. Friedman and Abbas, 2003; Moehr, 2002). Yet, some researchers point out that terms ‘medical informatics’ and ‘health informatics’ may have various meanings in different countries due to national traditions or languages (see e.g. Hasman et al., 1996). Also the question whether health/medical informatics can be regarded as a scientific discipline has been raised several times in the past (see e.g. Protti et al., 1994).

The terminology overall within healthcare field is rather disorganised; terms such as health information systems (HIS), e-Health, telecare and telemedicine are widely used. Each term has slightly different emphasis depending on the domain and emphasis of the research (see e.g. Eysenbach, 2000; Mieczkowska et al., 2004; Nenonen and Nylander, 2001). In this paper, the term health informatics is used in scientific domain and the term HCIS when we are discoursing about the concrete systems. Further conceptual analysis is beyond the scope of this paper.

The healthcare industry is fundamentally knowledge-based. Knowledge work, i.e. healthcare, also involves ‘making sense’, that is to say, turning information into

knowledge through the interpretation of received highly non-standardised information for the purposes of problem solving and decision making (Armoni, 2000; Grütter and Steurer, 2000; Hall and Andriani, 2002; Rohm and Rohm Jr., 2004; Wickramasinghe and Lamb, 2002).

One of the core objectives of HCIS is to offer the user the ability of transforming the data into information. The quality and efficiency of this action depends on the ability to firstly, manage internally created knowledge, for example, about healing practices; and secondly, to enrich and integrate the knowledge with relevant external knowledge created worldwide by researchers, other health organisations and so forth (Armoni, 2002; Grütter and Steurer, 2000; Lin and Umoh, 2002; Tuomi, 1999; Wickramasinghe and Lamb, 2002).

Furthermore, the nature of the data in HCIS differs to some extent from 'regular business' (see e.g. Doktor et al., 2005). Privacy, medico-legal- and ethical issues are emphasised in all health related matters – especially in the cases of storage or transmission of patient information (Armoni, 2002; Grütter and Steurer, 2000).

According to Nykänen (2000), the healthcare environment imposes special requirements for information technology applications in the light of special conditions in decision-making situations and high security, validity and quality demands for data and information (see also Ptochos et al., 2004).

Many countries have created their own HCIS during the two last decades (Nenonen and Nylander, 2001). HCIS are often implemented in order to (Ammenwerth et al., 2003):

- 1 reduce clinical errors (e.g. medication errors and diagnostic errors)
- 2 to support healthcare professionals (e.g. availability of timely and up-to-date patient information)
- 3 to increase the efficiency of care (e.g. less waiting times for patients)
- 4 to improve the quality of patient care.

Yet, Orr et al. (Dedrick et al., 2003; Orr et al., 2001) state that the potential benefits, which IT can provide for healthcare, are similar to other businesses: competitive advantage through quality of information processing, process efficiencies, improved productivity and performance, superior quality of service, greater responsiveness to customer needs and greater organisational flexibility (Dedrick et al., 2003; Orr et al., 2001).

Hitherto, the field of HCIS is immensely fragmented. HCIS consist of numerous different systems and subsystems. Most significant deficiencies seem to be the lack of full integration of systems and their poor interoperability. Moreover, HCIS often pass institutional and organisational boundaries making management and liability issues enormously challenging (Bakker, 2002; Fehse and Krabbendam, 2004; Itkonen, 1999; Nykänen, 2000).

3 Electronic prescription

Pure academic research on electronic prescriptions is still quite scarce (Bell et al., 2004; Boonstra, 2003; Keet, 1999; Middleton, 2000; Mundy, 2003; Mundy and Chadwick., 2002; Mundy and Chadwick, 2004; Niinimäki and Forsström, 1997; Schiff and Rucker, 1998). However, the topic is already richly reported in different

practitioner reports and public national plans for electronic prescriptions (Anonymous, 2004; Canadian Association of Chain Drug Stores et al., 2003; Gagnon et al., 2000; KPMG'S Technology Insiders Focus, 2004). One of our tasks in this paper is to position different national approaches for the electronic prescribing. A basic problem is that different countries possess diverse healthcare systems and the objectives and reasons to implement the system are distinct.

Generally speaking, all the countries in our study shared several similar motivations and reasons for the implementation of electronic prescription systems (EPSs). Reduction of medication errors is often emphasised when discussing about the benefits of electronic prescriptions (see e.g. Marken et al., 2004; Middleton, 2000; Schiff and Rucker, 1998; Westbrook and Gosling, 2002) and during the last few years, medical adverse effects have received ever-increasing attention. As indicated by the Institute of Medicine (IOM) an estimated 44,000–98,000 US citizens die annually as a result of preventable medical errors. Another study estimates a rate of 6.5 adverse drug events per 100 admissions, of which 28% were preventable, mainly being due to illegible writing (Institute of Medicine, 1999; Gagnon et al., 2000; KPMG'S Technology Insiders Focus, 2004; Le Duff et al., 2004).

Other frequently accentuated aspects favouring the use of electronic prescriptions are: reduction of prescription fraud (Kossendey, 2002; Middleton, 2000; Mundy and Chadwick, 2002), speeding up the prescription ordering process (Hisle, 2001; Mellin, 2002; Middleton, 2000) and data integrity (Canadian Association of Chain Drug Stores et al., 2003; Mundy and Chadwick, 2002; Middleton, 2000). For example, Mundy and Chadwick (2002) refer to a study according to which 40% of all prescriptions in the USA require rework, with 5% of these requiring a phone call to physician. Also the changes to have better statistical data for research purposes is an important value-added aspect when considering patient safety and quality of care – type of issues (see also Bell et al., 2004).

Estimates concerning financial savings have also been made, mainly in the national level. For example, in Germany it is estimated that electronic prescription can lead to annual savings of over €1 billion (Dietzel and Riepe, 2004). Le Duff et al. (2004) refer to the study made by IOM and represent that medical errors only cost the US health system between \$37.6 and \$50 billion annually (Le Duff et al., 2004).

Next we describe briefly selected prescription systems from Denmark, Finland, The Netherlands, Sweden, UK and the USA (see the Appendix for descriptive statistics of these countries).

3.1 Denmark

Denmark has had since 1995 an operating EDIFACT-based EPS (MEDPRE SST012) (Theilgaard, 1997). Approximately 80% of prescriptions are currently sent electronically (Mundy and Chadwick., 2002). The current system is a point-to-point-based EDI system, which has been utilised widely among practitioners. However, Denmark has commenced the development of new system providing more value-added services for patients and physicians.

3.2 Finland

In Finland, local pursuits to establish an EPS have been up a few times. The most recent, nationwide initiative to establish a centralised EPS was set up in 2001. The selected

model is based on electronic storage, and the retrieval of prescriptions, which require patient's informed, written consent (Hyppönen et al., 2005). Piloting began in May 2004 in particular units in selected areas, but so far the amount of electronic prescriptions has been moderate.

3.3 The Netherlands

The Netherlands commissioned a project on Electronic Prescription Support System (EPSS) in 1999. The primary goal of the project is to improve the quality of prescribing in general practice, and the secondary goal is to establish a reduction in the costs involved with general practice prescriptions (Boonstra, 2003; Wolters et al., 2001). Common use of the system should have led to more consistency and cost effectiveness, because the system suggests the most cost-effective therapies. Boonstra (2003) has aimed some criticism towards the system. According to him, the system is a relative failure because it is not widely accepted by its users, general practitioners (Boonstra, 2003).

3.4 Sweden

In Sweden, the county councils bear the responsibility of financing and operation of most healthcare facilities. Also electronic prescribing projects are on the responsibility of regional authorities. In our study, we focused on the Swedish capital, Stockholm's, prescription system. Currently, approximately 40–50% of prescriptions are sent electronically (see also <http://www.ereceptstockholm.se/>) (Apoteket and Landsting, 2004; County Council Public Health Board (HSN) – Division of Drug Management and Informatics, 2001; Gustafsson et al., 2001).

3.5 UK

The UK Government is determined in reforming the National Health Service (NHS) program. Part of the plan system for electronic prescribing of drugs should be available by the end of 2004. Legislation allowing the Electronic Transmission of Prescriptions (ETP) was approved on September 2001 and after that the Department of Health has commissioned three pilot programmes testing different technical approaches. The Prescription Pricing Authority (PPA) received the first electronic prescription on 28 March 2002. Pilots officially ended on 30 June 2003 (Kossendey, 2002; Mundy, 2003; Mundy and Chadwick., 2002; Mundy et al., 2003; Sugden and Wilson, 2003; Sugden, 2003).

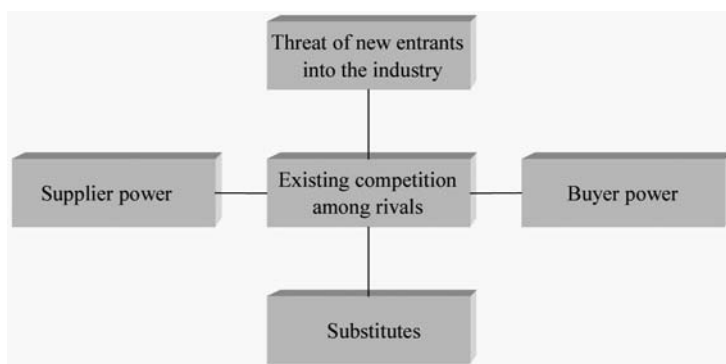
3.6 The USA

Electronic prescribing systems have existed in some states in the USA for a number of years, but the users have been small cluster groups of selected physicians and pharmacies who all have been signed up to the same system provider (Mundy and Chadwick, 2002). Half of the 55,000 pharmacies are due to be connected in the nationwide SureScripts' network by the end of the year 2003 (Brewin, 2003). Several technology providers also offer handheld PDA devices for electronic prescribing (Anonymous, 2003; Brewin, 2003; Hisle, 2001).

4 Business models for electronic prescription

In this section, we briefly discuss what kind of competitive environment the healthcare sector is for electronic prescription providers. As an aid for analysis we use the traditional model of competitive forces by Porter (1980) (see also Teisberg et al., 1994) as depicted in Figure 1.

Figure 1 The competitive forces (adapted from Porter, 1980)



Business models are a way of improving doing business under uncertainty (Osterwalder and Pigneur, 2002). Models can be seen in a certain sense as managerial equivalent of the scientific method – start with a hypothesis, which is then tested in action and revised if necessary (Magretta, 2002).

Furthermore, Magretta (2002) argues that when business models are used correctly they actually drive managers to think thoroughly about their business. Business models' vigour as a planning tool is that they focus attention on how all the elements of the system fit into a functioning entity. Business models fail to work if they fail either the narrative test (i.e. models are built on unsound assumptions about customer behaviour) or the numbers test (the business model is financially untenable) (Magretta, 2002).

There seems to be much apprehension about the suitability of various business models for particular organisations and industrial sectors (Hayes and Finnegan, 2005). The healthcare industry is fragmented in almost any country, and almost regardless of the study sector within the industry. Missing dominant and powerful players provides the industry-specific ramifications, as does its strongly regulated nature (Nissilä et al., 2004).

Timmers (1998) defines a business model as (Timmers, 1998):

- an architecture for the product, service and information flows, including a description of the various business actors and their roles
- a description of the potential benefits for the various business actors
- a description of the sources of revenues.

Porter has a point when arguing that a business model in itself does not yet provide understanding of how it will contribute to realise the business mission, but one has to know the marketing strategy of the company in order to assess the commercial viability and to answer questions like: how is competitive advantage being built?; what is the positioning?; what is the marketing mix?; which product-market strategy is followed?.

It is worth mentioning that different strategic approaches demand differently focused business models. A business model for stable markets that reflects positioning is different from a model that reflects simple rules for turbulent markets (see e.g. Eisenhardt and Sull, 2001).

As electronic prescriptions may sound feasible, solution to almost any developed nation's healthcare system, the non-dynamic and locally competed system emphasising cost reduction could represent major constraint for the implementation and use of these systems. If the general development in healthcare systems is, like Porter and Teisberg (2004) have proposed, towards higher quality emphasis, instead of short-term cost-saving potential, then electronic prescriptions have a flourishing future ahead (Porter and Teisberg, 2004).

However, we argue that this breakthrough also requires understanding, about what stakeholders and customers value. For example, American Express (a credit card company) was forced to link its business model towards higher customer satisfaction in the late 1970s (e.g. by linking travelling expenses into invoices and giving a 90-day guarantee for all purchases), when Visa and MasterCard rapidly took their market share (Harvard Business Review, 2001).

As Porter (2001) has argued that all of the e-innovations will result in lower barriers of entry and higher power for suppliers (manufacturers), we hypothesise that this will force other parties to link their total service and information databases to electronic prescriptions and eventually capture old power away from manufacturers of pharmaceuticals (Porter, 2001).

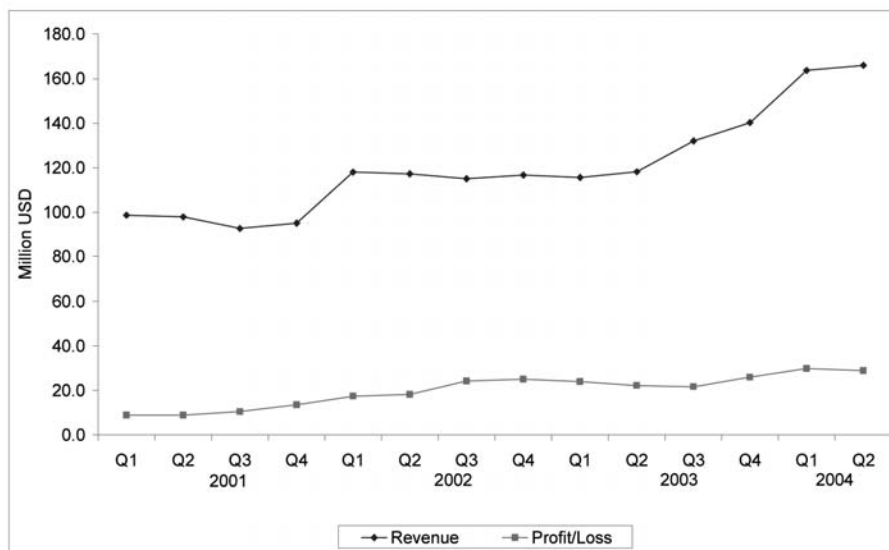
5 Three for-profit company examples from the USA

In the following section we analyse three for-profit e-prescription providers, which are all located in the USA. According to our knowledge, the US market has so far been the only place that has really enabled companies to position themselves for a healthcare value chain and hopefully in the future make profits through their operations. Thus, as the following analysis shows, all three actors in the field are at the moment barely profitable, but on the other hand their revenues have increased quite significantly.

WebMD Envoy, which is a part of the WebMD corporation, has its roots in a large-scale merger that took place in 1999 between four different companies, namely Healthon, WebMD, MEDE America and Medcast. After this merger the corporation was known as Healthon-WebMD, but the first part from the name was removed only one year after the merger was effective.

Thereafter, WebMD has continued to strengthen their transaction service business development with aggressive use of mergers. In 2001, four other organisations are scaled up to this company; Envoy as the most important, but also consisting of companies such as CareInsite, OnHealth and Medical Manager.

The effect of these mergers could be noticed from the development of transaction business revenues, since the increase from 2001 to 2002 remained more like a growth step rather than organic increase. However, after these four mergers, the revenue development levelled off for five consecutive quarters and interestingly, in 2003, transaction service business was strengthened with a new merger, when Advanced Business Fulfilment was integrated to WebMD Envoy (Figure 2).

Figure 2 Development of revenue and profit in WebMD Envoy in the past 14 quarters

Transaction business seems to produce steady increasing revenues and profits, but it should be remembered that the whole corporation is barely profitable. However, in terms of revenues and profits (before taken into account costs of the corporation), transaction business is the most important for this company, since over 50% of revenues and nearly 60% from profits are produced in this business unit. Another important source of revenue and profits in this corporation are physician services, which produced one-third from revenues and above 10% from profits. Two remaining business units, portal services and plastic technologies have a minor role in total revenues, but in accounting year 2003 they produced nice proportional profits.

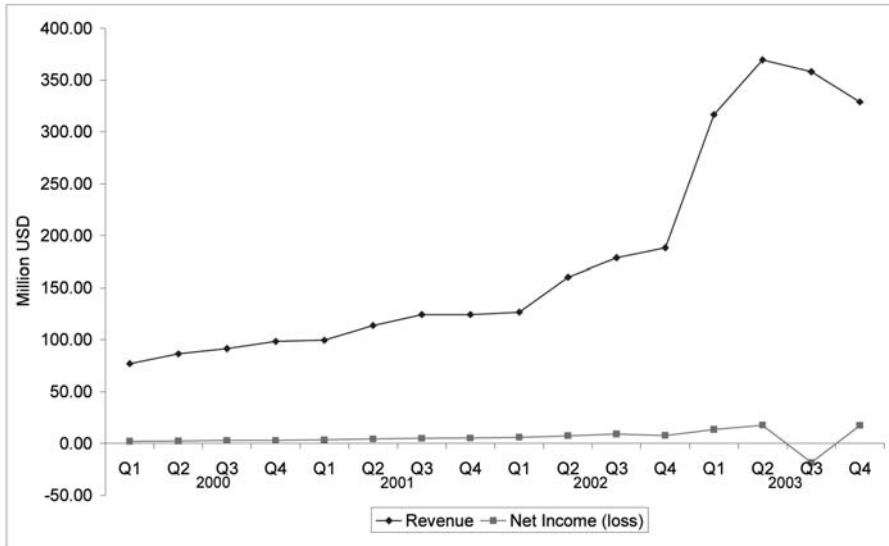
Like WebMD Envoy, Accredo has also grown rapidly through mergers. In 1999 Accredo's public offering began and the stock commenced to be publicly traded. In 2001 Accredo acquired Pharmicare Resources, Inc. and BioPartners In Care, Inc., which specialised in haemophilia and intravenous immunoglobulin (IVIG).

In June 2002, Accredo acquired the Specialty Pharmaceutical Services (SPS) and Clinical Business Solutions divisions of Gentiva Health Services, Inc. and gained new products. Accredo changed the name of one of the acquired Gentiva companies to develop a new division, Accredo Therapeutics, Inc. (ATI).

In 2004, Medco Health Solutions and Accredo Health announced strategic alliance for specialty pharmacy care and management. Medco Health Solutions is an independently operated subsidiary of Merck & Co., which in turn is the leading pharmacy benefit manager (PBM) in the USA, providing pharmaceutical care for about 64 million people on the mandate of more than 1650 health plan sponsors throughout the USA.

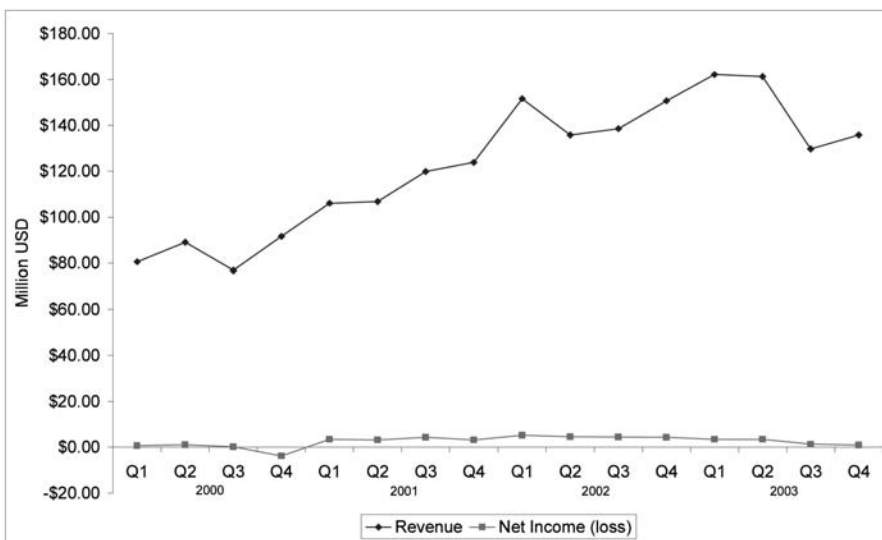
As we can see from Figure 3 the revenues of Accredo have risen rapidly through the mergers, but the company is scarcely profitable. According to financial statements the revenues have increased strongly, but at the same time costs have risen at the same pace. Furthermore, Accredo incurred additional debt to acquire the SPS business of Gentiva Health Services, which in turn encumbers the profitability.

Figure 3 Development of revenue and profit in Accredo in the past 16 quarters



The revenues of MIM Corporation show a similar pattern with two previous ones, but more precariously. The first setback in revenue and income was in 2000 when MIM made an acquisition on American Disease Management Associates, LLC (ADIMA) in August. Secondly, zero-growth phase was in 2001 when MIM rebranded its operations and created a new subsidiary, ScripSolutions. It was noticeable that the profitability of MIM was quite poor, and similarities with Accredo could be made as profits declined during 2003 (Figure 4).

Figure 4 Development of revenue and profit in MIM Corporation in the past 16 quarters



6 Discussion

As is shown in the empirical examples, e-prescriptions have been implemented in both Europe and the USA quite widely and currently, it is only a matter of time when their use will spread to larger audiences.

However, we are concerned about the profitability of these implementations. In Europe, information systems are being developed quite often by software companies on the basis of hourly rates and all of the possible financial benefits are given for other stakeholders of this system.

We argue that this will eventually create inefficient systems, since current supply structures are not going to be greatly challenged. However, the situation in the USA does not give positive indication either. It seems to be the case that this new industrial area needs its 'Southwest Airlines' or 'Dell' to revolutionise current business models (Hax and Wilde II, 1999). Thus, this will take quite long time to be realised; the healthcare sector is still low-volume industry, only under local competition.

One possible business model development for electronic prescription providers is the route of Intel and Microsoft. There is clearly an opportunity for an entrant being able to create de facto standard in prescriptions and capture high market shares from global markets, while neglecting other product performance and customer satisfaction attributes. However, even if the market forces would merge all of the US providers together, their revenues from transaction business are approximately 1 billion US dollars. We argue that the European government-managed structures should be open for competition and also that this possible de facto standard could appear.

7 Conclusions

This paper has attempted to demonstrate that electronic prescribing systems have been implemented widely both in the USA and Europe. However, the 'business logic' of electronic prescriptions is still quite immature. Electronic prescription can clearly provide benefits for users and on the national level, but turning the benefits into profitable business seems to be a hard task.

What the future will hold for electronic prescription business are open markets, however, these are highly required and could create developments either in the direction of structural changes or de facto standards. The question is quite similar to what the situation previously was with credit card business, which appeared in the 1970s. Firstly, American Express dominated markets by providing luxurious benefit packages for card users, whilst charging high rates from product sellers. This de facto standard did not last forever, since Visa and MasterCard were able to introduce a wider global use network by neglecting high transaction rates from the product sellers' side. Even though American Express's de facto model still exists today (although in reshaped form), users have benefited greatly from the use of credit cards. Could anyone imagine a business trip without one? We would like to see similar development in e-prescription transaction business.

References

- Ammenwerth, E., Gräber, S., Herrmann, G., Bürkle, T. and König, J. (2003) 'Evaluation of health information systems-problems and challenges', *International Journal of Medical Informatics*, Vol. 71, Nos. 2/3, pp.125–135.
- Apoteket AB and Stockholms Läns Landsting (2004) *e-recept Stockholm*.
- Armoni, A. (2000, Edition) *Healthcare Information Systems: Challenges of the New Millennium*, Hersey: Idea Group Publishing.
- Armoni, A. (2002, Edition) *Effective Healthcare Information Systems*, Hershey, PA, USA: Idea Group Publishing.
- Bakker, A.R. (2002) 'Health care and ICT, partnership is a must', *International Journal of Medical Informatics*, Vol. 66, Nos. 1/2/3, pp.51–57.
- Bell, D.S., Marken, R.S., Meili, R.C., Wang, C.J., Rosen, M., Brook, R.H. and RAND Electronic Prescribing Expert Advisory Panel (2004) 'Recommendations for comparing electronic prescribing systems: results of an expert consensus process', *Health Affairs*, Vol. 25, pp.305–317.
- Boonstra, A. (2003) 'Interpretive perspectives on the acceptance of an electronic prescription system', *Journal of Information Technology Cases and Applications*, Vol. 5, No. 2, pp.27–49.
- Brewin, B. (2003) 'Drugstores embrace E-prescription system', in *Computerworld*, p.7.
- Canadian Association of Chain Drug Stores et al. (2003) *Recommendations for Implementing Electronic Prescriptions in Canada*.
- Chen, J.C.H., Dolan, M. and Lin, B. (2004) 'Improve processes on healthcare: current issues and future trends', *International Journal of Electronic Healthcare*, Vol. 1, No. 2, pp.149–164.
- County Council Public Health Board (HSN) – Division of Drug Management and Informatics (2001) *Official Approval: Organization of a Common Standard for IT Structure for Electronic Prescribing Support and Electronic Prescriptions*, Stockholm.
- Dedrick, J., Gurbaxani, V. and Kraemer, K. (2003) 'Information technology and economic performance: a critical review of the empirical evidence', *ACM Computing Surveys*, Vol. 35, No. 1, pp.1–28.
- Dietzel, G.T.W. and Riepe, C. (2004) 'Modernizing healthcare in Germany by introducing the eHealthcard', *Swiss Medical Informatics*, No. 52.
- Doktor, R., Bangert, D. and Valdez, M. (2005) *Organizational Learning and Culture in the Managerial Implementation of Clinical E-Health Systems: An International Perspective*, HICSS-38, Hawaii.
- Eisenhardt, K.M. and Sull, D.N. (2001) 'Strategy as simple rules', *Harvard Business Review*, Vol. 79, No. 1, pp.107–116.
- Eysenbach, G. (2000) 'Recent advances: consumer health informatics', *BMJ*, Vol. 320, pp.1713–1716.
- Fehse, K. and Krabbendam, K. (2004) 'How organisational politics explain IS implementation outcomes in hospitals', *International Journal of Electronic Healthcare*, Vol. 1, No. 2, pp.139–148.

144 *L. Salmivalli and O-P. Hilmola*

- Friedman, C.P. and Abbas, U.L. (2003) 'Is medical informatics a mature science? A review of measurement practice in outcome studies of clinical systems', *International Journal of Medical Informatics*, Vol. 69, Nos. 2/3, pp.261–272.
- Gagnon, J.P. et al. (2000) *Physician Connectivity: Electronic Prescribing*, Issue Brief No. 752, T.G.W. University, Editor. National Health Policy Forum: Washington, DC.
- Gersch, M. (2004) 'Business evolution or revolution? Mail-order pharmacies in Germany', *International Journal of Electronic Healthcare*, Vol. 1, No. 1, pp.17–32.
- Greenes, R.A. and Shortliffe, E.H. (1990) 'Medical informatics: an emerging academic discipline and institutional priority', *Journal of American Medical Association*, Vol. 263, No. 8, pp.1114–1120.
- Grütter, R. and Steurer, J. (2000) 'Towards a web-based medical information service for general practice – the EVIMED project', *Proceedings of the Eighth European Conference on Information Systems*, Vienna.
- Gustafsson, L.L. et al. (2001) 'JANUS – a computerized system for rational drug treatment and drug research', *The Nordic Conference on Electronic Drug Prescribing*, Stockholm.
- Hall, R. and Andriani, P. (2002) 'Managing knowledge for innovation', *Long Range Planning*, Vol. 35, No. 1, pp.29–48.
- Hammer, M. and Champy, J. (1993) *Reengineering the Corporation: A Manifesto for Business Revolution*, New York: Harper Business.
- Harvard Business Review (2001) 'Setting a direction: Lou Gerstner at American Express', *Harvard Business Review*, Vol. 79, No. 11, p.8.
- Hasman, A., Haux, R. and Albert, A. (1996) 'A systematic view on medical informatics', *Computer Methods and Programs in Biomedicine*, Vol. 51, No. 3, pp.131–139.
- Haux, R. (1997) 'Aims and tasks of medical informatics', *International Journal of Medical Informatics*, Vol. 44, No. 1, pp.9–20.
- Hax, A.C. and Wilde II, D.L. (1999) 'The delta model: adaptive management for a changing world', *Sloan Management Review*, Vol. 40, No. 2, pp.11–28.
- Hayes, J. and Finnegan, P. (2005) 'Assessing the potential of e-business models: towards a framework for assisting decision-makers', *European Journal of Operational Research*, Vol. 160, No. 2, pp.365–379.
- Health Data Management (2003) 'A4 to offer electronic prescriptions', *Health Data Management*, p.22.
- Hisle, J.M. (2001) 'Throw away the prescription pad? debate over electronic prescription and fulfillment', *Medical Crossfire*, pp.47–56.
- Hyppönen, H., Salmivalli, L. and Suomi, R. (2005) 'Organizing for a national infrastructure project: the case of the Finnish electronic prescription', *Hawaii International Conference on System Sciences*, Big Island, Hawaii: Hilton Waikoloa Village.
- Institute of Medicine (1999) *To Err Is Human: Building a Safer Health System*, Institute of Medicine.
- Itkonen, P. (1999) 'Information technology as tool for change', *International Journal of Medical Informatics*, Vol. 56, Nos. 1/2/3, pp.135–139.

- Keet, R. (1999) 'Essential characteristics of an electronic prescription writer', *Journal of Healthcare Information Management*, Vol. 13, No. 3.
- Kossendey, G. (2002) *Electronic Transmission of Prescriptions (ETP): UK Case Study*, Bidart Consultants: Munich.
- KPMG'S Technology Insiders Focus (2004) *E-Prescriptions Promise Patient Safety, Higher Drug Sales*.
- Le Duff, F., Daniel, S., Kamendjé, B., Le Beux, P. and Duvauferrier, R. (2004) 'Monitoring incident report in the healthcare process to improve quality in hospitals', *International Journal of Medical Informatics*, Vol. 74, Nos. 2/3/4, pp.111–117.
- Lin, B. and Umoh, D. (2002) 'E-healthcare: a vehicle of change', *American Business Review*, Vol. 20, No. 2, pp.27.
- Magretta, J. (2002) 'Why business models matter', *Harvard Business Review*, Vol. 80, No. 5, pp.86–92.
- Marken, R.S., Meili, R.C., Wang, C.J., Rosen, M., Brook, R.H. and RAND Electronic Prescribing Expert Advisory Panel (2004) 'Recommendations for comparing electronic prescribing systems: results of an expert consensus process', *Health Affairs*, pp.305–317.
- Mellin, A. (2002) 'E-prescribing: an opportunity for process re-engineering', *Health Management Technology*, Vol. 23, No. 1, pp.42–44.
- Middleton, H. (2000) 'Electronically transmitted prescriptions – a good idea?', *The Pharmaceutical Journal*, Vol. 265, No. 7107, pp.172–176.
- Mieczkowska, S., Hinton, M. and Barnes, D. (2004) 'Barriers to e-health business processes', *International Journal of Electronic Healthcare*, Vol. 1, No. 1, pp.47–59.
- Moehr, J.R. (2002) 'Evaluation: salvation or nemesis of medical informatics?', *Computers in Biology and Medicine*, Vol. 32, No. 3, pp.113–125.
- Mundy, D. and Chadwick, D.W. (2004) 'Electronic transmission of prescriptions: towards realising the dream', *International Journal of Electronic Healthcare*, Vol. 1, No. 1, pp.112–125.
- Mundy, D.P. (2003) 'Providing a secure solution for the integration of electronic prescription transfer within the United Kingdom National Health Service', in UKAIS PhD Consortium.
- Mundy, D.P. and Chadwick, D.W. (2002) 'A system for secure electronic prescription handling', *Proceedings of the Second International Conference on the Management of Healthcare and Medical Technology*, Chicago, IL, USA.
- Mundy, D.P., Chadwick, D.W. and Ball, E. (2003) 'An application programming interface for the electronic transmission of prescriptions', *IFIP*, Ilmenau.
- Nenonen, M. and Nylander, O. (2001) *A Theoretical Framework for Health Information Systems, in Themes 3/2001*, National Research and Development Centre for Welfare and Health (Stakes): Helsinki.
- Niinimäki, J. and Forsström, J. (1997) 'Approaches for certification of electronic prescription software', *International Journal of Medical Informatics*, Vol. 47, No. 3, pp.175–182.
- Nissilä, J. et al. (2004) 'The house that jack built: eBusiness models for SMEs', *In 17th Bled eCommerce Conference, eGlobal*, Bled, Slovenia, 21–23 June.

146 *L. Salmivalli and O-P. Hilmola*

- Nykänen, P. (2000) 'Decision support systems from health informatics perspective', Department of Computer and Information Sciences, No. 105, University of Tampere, Tampere, Finland.
- Orr, S. et al. (2001) 'The impact of information technology on a section of the Australian health care industry', *Benchmarking: An International Journal*, Vol. 8, No. 2, p.108.
- Osterwalder, A. and Pigneur, Y. (2002) 'An eBusiness model ontology for modeling eBusiness', *The 15th Bled Electronic Commerce Conference*, Bled, Slovenia.
- Planungsauftrag eRezept, eArztbrief, ePatientenakte und Telematikinfrastruktur (2004) IBM Deutschland GmbH, ORGA Kartensysteme GmbH.
- Porter, M. (1980) *Competitive Strategy: Techniques for Analysing Industries and Competitors*, New York: The Free Press.
- Porter, M.E. (2001) 'Strategy and the internet', *Harvard Business Review*, Vol. 79, No. 3, pp.62–78.
- Porter, M.E. and Teisberg, E.O. (2004) 'Redefining competition in health care', *Harvard Business Review*, Vol. 82, No. 6, pp.64–76.
- Protti, D.J. et al. (1994) 'Can health/medical informatics be regarded as a separate discipline?', *Methods of Information in Medicine*, Vol. 33, pp.318–326.
- Ptochos, D., Panopoulos, D., Metaxiotis, K., Askounis, D. and Psarras, J. (2004) 'Using internet GIS technology for early warning, response and controlling the quality of the public health sector', *International Journal of Electronic Healthcare*, Vol. 1, No. 1, pp.78–102.
- Rohm, B.W.T. and Rohm, Jr., C.E.T. (2004) 'Evolving medical informatics: from diagnosis to prognosis', *International Journal of Electronic Healthcare*, Vol. 1, No. 1, pp.103–111.
- Schiff, G.D. and Rucker, T.D. (1998) 'Computerized prescribing building the electronic infrastructure for better medication usage', *The Journal of the American Medical Association*, Vol. 279, No. 13.
- Smith, A.D. and Flanegin, F.R. (2004) 'E-procurement and automatic identification: enhancing supply chain management in the healthcare industry', *International Journal of Electronic Healthcare*, Vol. 1, No. 2, pp.176–198.
- Sugden, B. (2003) *Electronic Transmission of Prescriptions – Evaluation of Pilots: Summary Report*, Sowerby Centre for Health Informatics at Newcastle.
- Sugden, B. and Wilson, R.W. (2003) 'Electronic transmission of prescriptions and integrated care records – experience of the evaluation of ETP pilots', *Integrated Care Records: Problems and Solutions Workshop*, Edinburgh, 11–12 December.
- Teisberg, E.O., Porter, M.E. and Brown, G.B. (1994) 'Making competition in health care work', *Harvard Business Review*, Vol. 72, No. 4, pp.131–141.
- Theilgaard, J. (1997) *Message Implementation Guide for Prescription*, The CoCo Project.
- Timmers, P. (1998) 'Business models for electronic markets', *EM-International Journal of Electronic Markets*, Vol. 8, No. 2, pp.3–8.
- Tuomi, I. (1999) 'Data is more than knowledge: implications of the reversed knowledge hierarchy for knowledge management and organizational memory', *Journal of Management Information Systems*, Vol. 16, No. 3, p.103.

- Westbrook, J.I. and Gosling, A.S. (2002) 'The impact of point of care clinical systems on health care: a review of the evidence and a framework for evaluation', The Centre for Health Informatics, University of New South Wales, Sydney.
- Wickramasinghe, N. and Lamb, R. (2002) 'Managing managed care: the enabling role of IS/IT', *Journal of Health Organization and Management*, Vol. 16, Nos. 2/3, pp.238–250.
- Wolters, I., Hoogen, H.V.D. and Bakker, D.D. (2001) *Evaluatie invoering Elektronisch Voorschrift Systeem – Monitoringfase: de situatie in 2000*, Nivel – Nederlands instituut voor onderzoek van de gezondheidszorg.

Appendix*Demographical factors of some countries that have adopted EPS*

Country	Denmark	UK	Finland	The Netherlands	Sweden	The USA
Population	5,376,000	59,234,000	5,201,000	16,149,000	8,925,000	284,797,000
Population prognosis 2010	5,425,000	60,392,000	5,258,000	16,583,000	8,940,000	314,921,000
Annual change of pop.	0.4%	0.4%	0.3%	0.6%	0.1%	0.9%
Age structure						
<15 yrs. old	18.8%	18.9%	17.8%	18.6%	18.0%	21.5%
15–29	17.8%	19.1%	18.6%	18.3%	18.1%	20.6%
30–44	22.3%	23.0%	20.6%	24.1%	20.8%	23.9%
45–64	26.2%	23.4%	27.6%	25.3%	25.9%	21.2%
>64	14.8%	15.6%	15.3%	13.7%	17.2%	12.7%
Share of social security in GDP	30.0%	26.8%	27.2%	28.5%	33.3%	N/A%
Female life expectancy	79.9 yrs.	80.7 yrs.	81.7 yrs.	81.8 yrs.	82.8 yrs.	80.1 yrs.
Male life expectancy	74.5 yrs.	75.7 yrs.	74.3 yrs.	75.9 yrs.	77.3 yrs.	74.4 yrs.
Physician	3.4/1000 persons	2.0/1000 persons	3.1/1000 persons	3.3/1000 persons	3.0/1000 persons	2.7/1000 persons
Hospital beds	4.5/1000 persons	4.1/1000 persons	7.5/1000 persons	10.8/1000 persons	3.6/1000 persons	3.6/1000 persons

PAPER 4: BUILDING INTER-ORGANIZATIONAL COOPERATIVE NETWORK FOR IT COLLABORATION

Salmivalli, Lauri – Salmela, Hannu – Kestilä, Timo (2008) “***Building Inter-organizational Cooperative Network for IT Collaboration***” Reprinted from *proceedings of the 41st Hawaii International Conference on System Sciences* January 7-10, 2008, Hilton Waikoloa Village, Big Island, Hawaii, Copyright 2005 IEEE

Building Inter-organizational Cooperative Network for IT Collaboration

Lauri A.T. Salmivalli,
Welfare Economics
Turku School of Economics,
Pori Unit
lauri.salmivalli@tse.fi

Hannu Salmela,
Information Systems Science
Turku School of Economics
hannu.salmela@tse.fi

Timo Kestilä
Information Systems Science
Turku School of Economics
timo.kestila@tse.fi

Abstract

Information technology has been a central enabler in the process toward network society. Despite the critical role of computers in inter-organizational arrangements, coordination of IT decisions within these networks is a fairly unexplored area, both in research and in practice. The processes through which the orchestration of IT in networks takes place are largely hidden. In this paper we investigate the processes through which three public sector networks tried to reach collaborative agreements in the use and management of IT. We present some preliminary findings in the areas of management, vision, mission, and shared goals in the context of networks' IT governance.

1. Introduction

Information technology (IT) has been a central enabler in the process toward network society. The complexity of the alliances, of subcontracting agreements, and of decentralized decision-making would have been simply impossible to manage without the development of computer networks [1]. Despite of the critical role of computers in inter-organizational arrangements, coordination of IT decisions within these networks is a fairly unexplored area, both in research and in practice. The processes through which the orchestration of IT in networks takes place are largely hidden.

Ability to create information partnerships has led to several success stories [1, 2]. Such stories provide evidence of the potential that IT has – if the managers in partner organizations are able to use it.

However, many initiatives to coordinate IT decisions fail within networks. These failures are not necessarily very visible and thus get very little attention. The idea of increasing coordination in processes, information, systems and infrastructure is quietly terminated. The negotiations go on endlessly but no commitment is achieved, the project is scaled down to a “pilot” that is never even intended to be implemented further. The

project may also eventually be started - but fails because of lack of initial commitment. The core group, managers working together, simply have not been able to find a way to get the institutional support for their innovative ideas.

This research investigates the processes through which networks can reach agreements on the use of IT. The research problem is formulated as follows: *How to build and maintain inter-organizational cooperative network for IT collaboration?*

The practical objective is to provide methods for the managerial group, who is seeking commitment of different partners to foster a specific IT related collaborative idea. It is suggested, however, that networks differ in terms of dominant coordination mechanisms. Hence, the group should employ methods that fit with the general coordination style of the network.

The scientific purpose of this paper is to explain the outcomes of early negotiations, i.e. why the process succeeds or fails. The importance of aggregate network level analysis has been rising lately. In a recent literature review on network research, Provan et al. conclude that more research is needed on network level governance, as opposed to dyadic or single organization perspectives [3]. We acknowledge the dynamic nature of networks: the explanations for outcomes are process theories, rather than variance theories [4]. Preconditions and situational variables are not, as such, sufficient to explain outcomes. The outcomes result from the interplay between initial conditions, contextual changes, and process events [5].

The empirical data of the study is gathered from three networks. One has fared well, the second one was intermediate success and the third one failed.

2. Theoretical Background

Theoretical approach of this paper originates from the research tradition of inter-organizational relationships. An inter-organizational relationship (IOR) can be defined as “a social action system on the premise that it exhibits the basic elements of any

organized form of collective behavior” [6]. These IORs include strategic alliances, partnerships, coalitions, joint ventures, franchises, research consortia and various forms of network organizations [7].

Within information systems science, the research draws from the research tradition of inter-organizational systems (IOS). In the initial phases of network, nurturing championship is critical for the success of eventual IOS project. Champions are needed to inspire stakeholders in different organizations through transformational leadership behaviour [8]. In similar vein, Kumar and Crook state the importance of collaboration between members at different organizational levels.

Research on strategic IS planning (SISP), and more recently that of IT governance, will also be used as a theoretical background. While most of the studies in this area address IS management and governance mainly as taking place within a single firm, some researchers have already identified the need to incorporate network level considerations. For instance, Finnegan et al. argue that there is growing need for inter-organizational SISP research [9]. This argument is further developed by Salmela and Spil [10]. The planning in IOS context needs to involve stakeholders in different organizational levels and is often based on agreements [11].

The research does, however, also draw from the more general network research tradition that has evolved in different disciplines. Perhaps the most fundamental difference between a network and an organization is lack of a single authority to ensure coordination of actions. Absence of a single authority has led networks to employ a wide array of mechanisms to be used for building and maintaining commitment to joint efforts. These mechanisms have intrigued researchers in many fields, such as economics [12], strategic management [13], organization science [14], marketing [15], sociology [16], public administration [17] information systems [18, 19] and strategic information systems planning [2].

Finally, because public service networks involve both public and private players, literature on public administration will be used to add insights to the theoretical background. Provan and Milward have argued that the effectiveness of public networks should be assessed in terms of different stakeholders and at different levels. The key stakeholders are: principals, agents and clients. Levels of network analysis are community, network and organization/ participants [17]. Allison [20] has classified the differences between public and private sector management into three groups:

- Differences in environmental characteristics

- Differences in the relationship between environment and organization
- Differences in organizational factors

Governance in networks requires distinctive management practices from traditional public sector management: Government is not the single dominant actor that can unilaterally impose its will: hierarchical, central top-down steering does not work in networks that have no ‘top’. All in all, a network manager often operates from a comparatively powerless position with little hierarchical means at disposal, yet there are several different strategies that network managers can utilize. [21]

3. Methodology

Cunningham categorizes different types of case research into *intensive case*, *comparative case* and *action research (AR)*. This study is based on mixture of comparative case and action research approach.[22]

In the comparative case approach, the researcher generates an explanation for one case and then replicates it with similar cases. This in turn helps to understand why certain conditions did or didn’t occur and then offers interpretations.[22]

Rapoport [23] has defined action research as follows: “*Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework.*” This twofold view of the objectives of action research - to solve a problem for a client and to advance science - is, perhaps, the most fundamental feature of action research [24, 25].

Action research is a clinical method that places the researcher in a helping role within real organization. In all three cases of this paper the researchers were invited to help organization with their IOR related problems. Action research is often viewed comprising two stages. In the first diagnostic stage an analysis of the social situation is made in collaboration with organization’s personnel. The second therapeutic stage involves collaborative change [26].

The cases of this study were chosen from the Finnish well-being services industry, consisting of mainly public sector organizations. In all three cases, the network structure was in its early stages. Longitudinal data describing the early phases of network building was collected from documents, interviews and participatory observation (including researcher diaries and group discussions). The results presented in this paper are based on the comparison of experiences in the three cases [22].

The first case, Centre of Expertise on Social Welfare (Vasso), was conducted during the years 2002-2007.

The aim was to create information systems' governance structure for the social service sector in the area of South-West Finland. The second case was conducted in a network of four municipalities in South-West Finland. The objective was to increase collaboration in planning the use of IT to support early childhood education (ECE) in 2004-2007. The case describes the creation of network that focused on initiating collaboration in the use of IT in ECE services. The third case reports findings from the Finnish Electronic Prescription System (EPS) pilot in 2000-2006.

The degree of intervention varied in the cases. In the cases of early education and social welfare the researchers were strongly involved as plenipotentiary actors in building and reinforcing networks. In these two cases, the researchers were also part of the core management group who actively tried to promote increased collaboration within the network. In the third case, the role was more a consultative one.

4. Cases

In the first case, the aim was to create information systems' governance structure for social welfare service sector in one regional area. In Finland, municipalities have the primary responsibility for organizing welfare services to their inhabitants. The social services sector is quite heterogeneous as it includes e.g. day care services for children, services for handicapped, social work, elderly care, and substance abuse treatment and prevention. Individual customers may have several social problems at the same time and thus need multidisciplinary care [27]. Hence, social services are produced by a network of professional services in each municipality.

The area of South-West Finland consists of 53 municipalities with populations ranging from 245 to 175.000 inhabitants. Knowledge of IT and its governance varies a lot between municipalities. Larger cities have dedicated personnel for IS governance e.g. CIO and IT-managers, whereas small municipalities have only a part time IS support person. The cooperation between municipalities in IT related issues was minor.

Vasso is owned by local municipalities. The objective of Vasso is to create knowledge to the social sector in a co-operative manner. It provides interpersonal and –organizational networking and is the network coordinator of the region in matters related to social services. It can be called with term network administrative organization (NAO) [17].

The objectives of Vasso are not directly related to promoting the use of IT. Majority of initiated projects are related to the substance of social services. The new

managing director of Vasso was, however, aware of the need for inter-municipality collaboration to promote increased adoption of IT. His background as a director of social services of mid-sized municipality had shown him both the significance of IT and the difficulty of implementing it in small and even mid-sized municipalities.

Shortly after the foundation of Vasso in 2002, the new managing director of Vasso contacted the IS research group in the local business school. The initial group who started discussing about first actions comprised also a teacher from local school of social welfare and a development director from university hospital. This core group acted as champion and was critical resource for organizing process. The aim was set to produce an inter-organizational strategic information systems plan for the social welfare sector in the South-West Finland. The idea was that all municipalities and third sector service providers in South-West Finland would develop a joint strategic IS plan. The formulation of a joint plan was seen as a first step for committing municipalities to collaboration in the development and implementation of IS in the social services.

Because Vasso couldn't finance the project, arranging funding for SISP was the first task. The municipalities themselves weren't interested in funding the project. After one year of investigating potential sources of funding and clarifying the arguments for the project, the core group succeeded in arranging funding from the regional council of Southwest Finland. With this funding, the interview based analysis was made about the current state of IT in social services. The interviews took place in winter 2004.

Majority of the interviewees were directors of social welfare in different municipalities. The contacts proved to be useful later when members were persuaded to join the IT council. The interviewees assessed that strong commitment to the provincial level information system plan would be difficult to reach. Most municipalities lacked financial resources and personnel for developing their information systems. Also, the traditions for inter-municipality collaboration were limited.

The results of the first round of interviews were, however, positive enough to justify further planning efforts. In fact, a few interviewees had suggested that an area level strategic information systems plan for the social sector might be useful. It was also strongly recommended that there would be one full-time IT coordinator who would coordinate the projects and an area level IT council that would initiate, and supervise the projects.

IT coordinator was hired in fall 2004 and IT council started to work after few months. IT council's first task

was to develop strategic information system plan. During the planning process it shrank to development plan divided to two parts. Informative part explained how IT enables new practices and models in producing social services. The implementation part suggested actions for developing area level practices that would support inter-municipality collaboration in the joint development of social service processes and supporting systems

One reason why IT council didn't succeed to make strategic information systems plan, was the different views of strategic thinking between the core group and the council. Most members of the core group were used to design school strategy process and followed a fairly linear strategy formation process. The members in the IT governance council preferred a more emergent approach to strategic planning. One explanation for that could be that the council members and their organizations didn't want to commit to any detailed strategy. In addition to that, emergent approach allowed them opportunist behaviour, i.e. to choose the option which is best for them.

Perhaps the main effect of the strategy planning process was that a council was founded with an idea that it would act as informative forum, where municipalities and other actors could share their experience about IT issues. The membership in the council is voluntary and members don't have any official status from their own organizations.

The council is still active and has sessions twice a year. The members of the council see it as a forum for changing experiences and sharing thoughts. Although the organization is much weaker than what was suggested in the original plan, it can be seen as some form of governance structure. The council has proved to be a good place for promoting new inter-organizational IT projects. The meetings of the council have been critical for getting two IOR related IT governance projects to start. In fact, the second case of this paper (ECE case) was presented as a proposal in the council and this presentation had a significant effect on committing some key persons in the four municipalities to the project.

It is obvious, however, that the networking efforts were only partly successful. They strengthened ties in terms of IT utilization in social sector. Vasso's role as network administration organization in IT governance was accepted. However, neither the municipalities nor the sponsors were interested to fund the network. The amount of genuinely active participants in the council has remained small. For the participating organizations the immediate benefits remained moderate: organizations received knowledge on how to utilize IT, but more concrete forms of collaboration were not

achieved. The possibility to negotiate IOR cooperation can, however, bring them better service in future.

All in all, this case can be evaluated as partly successful. It didn't exceed original objectives but still succeeded in initiating some forms of inter-organizational IT governance collaboration in South-West Finland.

The second case describes the creation of IT utilization oriented network in the context of early childhood education (ECE). In Finland every child has a statutory subjective right to receive public day care and the municipalities are responsible for organizing day care to every child according to demand [28].

The creation of IT utilization oriented network began in 2004. In the first phase (2004–2005) the core group formulated first drafts of the possibilities of using IT in ECE. Arguments were developed for inter-municipal collaboration as a means to better realize these possibilities. The possible actors in the network were also outlined. In this case, the initial core group included two IS researchers and one ECE researcher from local university. The IS researchers had worked in Vasso case and utilized their contacts in different municipalities to promote this project. The contacts were mainly directors in social sector and had rather powerful position in municipality's hierarchy. The directors in turn encouraged their own municipalities' ECE managers to participate in project.

The participation of the ECE researcher was important for the project's success. She had worked as researcher in many ECE development projects and was therefore familiar with most of the ECE managers. The presence of the ECE researcher invoked confidence among the ECE participants. She interpreted IS researchers' IT based concepts and terms to the ECE professionals.

In the fall of 2005 the foundation of the network was established. The core group organized seminars and made several informal discussions, where a preliminary proposal was presented and ECE managers were asked whether they were personally committed to participation and how likely it would be that their municipality would be interested.

In the early 2006 four municipalities made an agreement about a common development project and filled in a funding application for a one year long developing project to the Finnish Ministry of Social Affairs and Health. The funding application form has to include things like project plan, governance model, budget etc. The application form serves as a legal agreement between the participating municipalities. While the Ministry provides most of the funding for the project, the municipalities are expected to provide some own funding. Although this amount per

municipality was only few thousand euros, this was still one of the major obstacles for other municipalities to participate.

After the positive funding decision was received, the actual inter-organizational cooperation commenced quickly. A steering group with chairman was established with representatives from the four municipalities and two universities. The initial development plan was further specified and the agreements on fiscal matters between participating organizations were signed. The members of the steering group had worked with the initial application together and had therefore created a common value space for this project.

The actual work in the project started in fall 2006 with orientation lecture. A total of 50 ECE professionals with different professional backgrounds varying from the director of ECE to day care teachers and administrative officers participated in the developing process. Altogether over 150 people were involved in the network during the years 2004–2007.

The aim of this network was to increase day care's capability to utilize IT at the operative and management level. Three workshops were organized to assess the usefulness of potential IT applications in childhood education processes. In summer 2007 a one-day seminar was held to spread projects results. Altogether 50 ECE professionals and managers from different parts of Finland participated in the seminar. This was the first time when a meeting was organized that focused solely on IT issues in ECE in Finland.

The end of 2006, the negotiations for a new development project began. Members of the steering group and working groups were asked which of the development proposals should be implemented and how. Based on the answers, the foundation for further development project was formulated. Three municipalities showed their interest to continue IOR cooperation. Funding application was delivered to Ministry of Health and Social Affairs. After positive decision a two year long development project started.

At the community level the network was a success. Ministry admitted funding twice and ongoing development project was lifted as one of most important e-Government projects in the municipal sector in Finland. At the network level the project also succeeded well, even if one of the four municipalities didn't continue to the second phase. The three other decided to invest in two years long development project. Same wide network about IT in ECE was established. On the participants and organization level ECE staff and their master organizations gained a lot of knowledge and capabilities to utilize IT in future. This in turn can produce better service for ECE's clients - children and parents. The case didn't succeed to create

clear network administrative organization. The principal researcher from a local university created the network and in the long run it remains to be seen whether the collaboration will continue. Despite the weaknesses of the ECE case it can be evaluated as successful in initiating an inter-organizational IT governance collaboration network.

Third case: Implementation of Electronic Prescription System (EPS) The last case reports findings from the Finnish Electronic Prescription System (EPS) pilot.

In Finland, medicines may be sold to the public only by pharmacies and subsidiary pharmacies, except in sparsely populated areas, where non-prescription products may be sold by medicine dispensaries owned by pharmacies. An order by doctor, dentist, or veterinary surgeon is needed for the purchase of prescription medicines from a pharmacy. [29]

All in all, the current Finnish manual system for medicine prescription is relatively sound. Patient receives a printed (either filled in hand writing or computer made) prescription form for medication from the doctor containing identification data of patient and physician. There is a place for two drugs and area for dispensing and renewal information. The patient brings the forms to a pharmacy, where pharmacist feeds in the data from the prescription to a pharmacy program for dispensing the medication. The program calculates the price for the drugs deducting the amount of national insurance if the client has the social insurance card with her. The program prints bar code slips with the price which the pharmacist attaches to the drugs. The pharmacist marks on the form the amount of medication which is dispensed and returns the form to the client with the medication. The second page of prescription is left at the pharmacy for invoicing the national insurance office of the insurance part of the price of the medication. [30]

The prescription ordering process consists of public and private actors and could be defined as a public – private network. [17]

In the year 2000, the Ministry of Social Affairs and Health set up a project to suggest a national concept for ePrescribing. The preliminary report about electronic prescription in Finland was published in 2001. In 2002, the Finnish Ministry of Social Affairs and Health started implementing the national concept suggested in the report. It selected units from health care organizations and a couple of nearby pharmacies in four different regions to pilot the national concept described in the report. The implementation approach was very similar to intra-organizational implementation processes, and the benefits of different stakeholders were not exhaustively evaluated.

Furthermore, the whole process was technology led instead of being user or organization centric. The project didn't systematically deploy champions. Instead, the promotion of the system relied on individual enthusiastic users.

A national steering group coordinated the locally organized pilots with a small budget. An experimental decree on ePrescribing was issued in 2003. It laid down provisions among other things on preparing, signing, technical content, altering and delivery of electronic prescriptions.

The steering mechanism relied mainly on the imperative nature of the experimental decree and the participating organizations didn't have agreements on inter-organizational intercourses. As the representatives of the participating organizations were involved in the project among their other tasks it remains somewhat questionable how deeply committed they were to the pilot project.

The construction of the system took 2 years, and the first clinical pilot started in 2004. By the end of 2004, two out of the four piloting health care units had integrated the EPS into their Electronic Patient Record (EPR). The pilot pharmacies still used a stand-alone system, which was not integrated into pharmacy systems and thus created extra work at the pharmacies. In June 2005, the third integrated EPS and the first integrated pharmacy system were implemented. Furthermore, in the spring 2005 the organization of the national e-prescription pilot was changed thoroughly; the part time project manager of the pilot was changed to a major consultancy company, which re-organized the administration of the pilot entirely.

The amount of produced e-prescriptions remained still very small and at the end of 2005 only approximately 800 electronic prescriptions had been dispensed (there are approximately 40 million dispensed prescriptions in Finland annually). In June 2006 the ePrescription pilot was ended, because it had "reached the objectives set to it".

The implementation pilot was coordinated at first hand by a part-time project manager designated by the Ministry of Health. Yet the project manager had little means to influence the network. He had neither rewards for good performance, nor penalties for under performance.

There was a broad conception among interviewees that the organization and governance of the pilot had been a failure. Time scale of the project had been drawn out constantly, the pilot was under-resourced both in terms of money and personnel, and responsibilities were not clear.

Several interviewees reported that steering group was too large, and decision-making was difficult. Decision-making was further aggravated because there

were no prepared drafts to be used as a basis of decision making. Finally, when it became evident that pilot would not succeed with present resources a major consultancy company was hired to take responsibility for project management.

The pilot was a peculiar combination of different governance methods. The actual 'management' was conducted through steering group which had little normative rules to affect to the pilot. Some of the interviewees referred to it as a debating club.

As the objectives and benefits to be attained were expressed loosely there was no clear common objective for all the organizations to pursue. In order to overcome the obscurity of the pilot, it would have needed hierarchy.

Organization of health care in general is still very hierarchical and some of the actors were expecting firmer steering for the pilot. However as the pilot network consisted of actors with different backgrounds (e.g. public sector, private sector, "third sector") the hierarchical steering failed to work due to vagueness of "chain of command". In addition, the pilot suffered from incompleteness of legislation which in turn hindered the pilot.

Yet the situation would have been eased if actors had have contracts among each other defining the rights and responsibilities in the pilot. As the contractual jurisprudence was lacking, the project lost its final coordination mechanism.

To summarize, EPS implementation pilot can be considered as a relative failure. On the community level, the pilot didn't bring much value added. The pilot was set up to improve the prevailing prescribing process, but the visible results were insignificant measured by the volume of electronic prescriptions compared to paper-based prescriptions. The proportion of electronic prescriptions remained strikingly low throughout the whole project.

On the network level the project failed too. The inter-organizational collaboration failed to deliver expected benefits and individual organizations perceived no benefit from EPSs. As the amount of electronic prescriptions was low and the organizations needed to support two different systems at the time, the result was adverse. However, as the objectives of the pilot were expressed vaguely in the first place it is difficult to compare achievements to practically non-existent objectives. Low amount of prescriptions makes it also difficult to provide any estimates about potential benefits to patients.

As the project was later cancelled it can be claimed that the pilot project was a failure also on the organization and participant level. Furthermore, theme interviews revealed the dissatisfaction of majority of actors. Probably the biggest benefits were gained by

participants and their master organization in terms of experiencing the challenges of an inter-organizational IS implementation, which can help the organization of future IOS implementation ventures.

5. Discussion

Based on the experiences gained in the three cases it appears that active participation of network level organization is important in IOS governance. Vasso and the Ministry of Social Affairs and Health were widely recognized as network orchestrators which in turn institutionalized network structure. In the early stages of network building, the core group at the network level should design the initial proposal for the content and governance of network collaboration. Both in the Vasso case and in the electronic prescription system case, this design work was not completed, either because of lack of vision, resources and/or attention.

The managers and IS designers in the public sector appear to be familiar with traditional design oriented top-down approaches (e.g. waterfall model). Based on three cases it appears that planning in networks should be adaptive and explicitly address the different stakeholders' interests. Furthermore, there should be a backward loop in the planning process. The process should be open to emergence of totally new things. An important feature is a continuous planning process which identifies important stakeholder groups and keeps them committed to the network.

In all three cases, the initial development idea was invented outside of the actual service network. Furthermore, the initial idea was suggested by IT oriented people, rather than by welfare service professionals. Hence, when the formation of Vasso and ECE networks was initiated, the presence of ECE and social sector professionals was extremely important. The IS researchers' values and concepts are based on their prior experiences in the business and information systems contexts. They are totally different from those that professional in welfare services have. The participation of ECE and social service professionals in the initial group was very critical for creating trust among network participants.

In all three networks, the early stages of network formation appears to have similarities with the process framework presented by Ring and van de Ven [7]. Formal, legal and psychological contracts were important for gaining organizational and personal level commitment in network related IT governance. Furthermore, in the more successful cases the individual level psychological contracts were achieved first. After that the network formation proceeded to financial contracts and finally to the definition of

formal network structure and authority. Perhaps the most promising avenue for future research is to investigate the applicability of Ring and van de Ven framework to the analysis of early phases in the efforts to build ICT governance in networks.

Hence, our research also supports the findings of Wassenaar and Gregor [11] about SISP process in an inter-organizational context. Organizational level commitment to planning requires personal commitments. A single committed person may not, however, be sufficient to ensure organisational commitment. There is a need for several persons who sell the idea of network collaboration inside their own organization.

In Vasso and ECE case it was the expected future benefits that were the most important theme in the early phases of network building. The early discussions and group work focused on the benefits of IT. This in turn improved the arguments about the benefits that each participating organization will gain. An obvious reason for the failure of electronic prescription pilot was that the participants' missed common conception of future IOS benefits.

6. Summary and future research

Adding IT decisions to the sphere of network level coordination is far from easy. Both IT and business managers are often accustomed to viewing IT decisions primarily against internal needs within their own organisations. This paper invites them to carefully weight the gains that can be achieved with network level harmonization and orchestration of IT decisions. If they find areas where they should seek collaboration with their partners, this article provides them with observations about challenges in initiating such cooperation as well as some preliminary findings about how to manage them.

References

- [1] Porter, M.E. and Millar, V.E., How information gives you competitive advantage. *Harvard Business Review*, 1985. 64(4): p. 149-160.
- [2] Johnston, H.R. and Vitale, M.R., Creating competitive advantage with interorganizational information systems. *MIS Quarterly*, 1998. 12(2): p. 153-165.
- [3] Provan, K.G., Fish, A., and Sydow, J., Interorganizational Networks at the Network Level: A Review of the Empirical Literature on Whole Networks†. *Journal of Management*, 2007. 33.

- [4] Markus, M. and Robey, D., Information Technology and Organizational Change: Causal Structure in Theory and Research. *Management Science*, 1988. 34(5): p. 583-598.
- [5] Pettigrew, A.M., *The Awakening Giant: Continuity and Change in Imperial Chemical Industries*. 1985: Blackwell Publishers.
- [6] Van de Ven, A.H., On the Nature, Formation, and Maintenance of Relations Among Organizations. *Academy of Management Review*, 1976. 1(4): p. 24-36.
- [7] Ring, P.S. and Van de Ven, A., Developmental Processes of Cooperative Interorganizational Relationships. *The Academy of Management Review*, 1994. 19(1): p. 90-118.
- [8] Kumar, R.L. and Crook, C.W., A multi-disciplinary framework of the management of interorganizational systems. *The Data Base for Advances of Information Systems*, 1999. 30(1): p. 22-37.
- [9] Finnegan, P., Galliers, R.D., and Powell, P., Applying triple loop learning to planning electronic trading systems. *Information Technology & People*, 2003. 16(4): p. 461.
- [10] Salmela, H. and Spil, T. Strategic Information Systems Planning in Inter-Organizational Networks: Adapting SISF Approaches to Network Context. in 2nd European Conference on IS Management, Leadership and Governance. 2006. Paris.
- [11] Wassenaar, A. and Gregor, S., E-business strategy formulating and forming: New wine in old bottles? in Global Co-Operation in the New Millennium, The 9th European Conference on Information Systems. Bled, Slovenia, June 27-29, 2001. 2001.
- [12] Williamson, O.E., *The Economic Institutions of Capitalism. Firms, Markets, Relational Constructing*. 1985: The Free Press.
- [13] Thorelli, H.B., Networks: Between Markets and Hierarchies. *Strategic Management Journal*, 1986. 7(1): p. 37-52.
- [14] Ouchi, W.G., A Conceptual Framework for the Design of Organizational Control Mechanism. *Management Science*, 1979. 25(9): p. 833- 847.
- [15] Wilkinson, L., A History of Network and Channels Thinking in Marketing in the 20th Century. *Australasian Marketing Journal*, 2001. 9(2): p. 23-52.
- [16] Leblebic, H., Salancik, G.R., Copay, A., and King, T., Institutional Change and the Transformation of Interorganizational Fields: An Organizational History of the U.S. Radio Broadcasting Industry. *Administrative Science Quarterly*, 1991. 36(3): p. 333-363.
- [17] Provan, K.G. and Milward, H.B., Do Networks Really Work? A Framework for Evaluating Public-Sector Organizational Networks. *Public Administration Review*, 2001. 61(4): p. 414-423.
- [18] Malone, T.W., Yates, J., and Benjamin, R.I., Electronic Markets and Electronic Hierarchies: Effects of Information Technology on Market Structure and Corporate Strategies. *Communications of the ACM*, 1987. 30(6): p. 484-497.
- [19] Choudhury, V., Strategic choices in the development of interorganizational information systems. *Information Systems Research*, 1997. 8(1): p. 1-24.
- [20] Allison, G.T., Public and Private Management: Are They Alike in All the Unimportant Respects?, in *Readings in Public Administration*, T., C.R. and Gibson, F., Editors. 1980, Houghton Mifflin: Boston.
- [21] Kickert, W.J.M., E.-H, K., and M., K.j.F., Management Perspective on Policy Networks, in *Managing Complex Networks: - Strategies for the Public Sector*, Kickert, W.J.M., E.-H, K., and M., K.j.F., Editors. 1997, Sage: London.
- [22] Cunningham, J.B., Case study principles for different types of cases. *Quality and Quantity*, 1997. 31(4): p. 401-423.
- [23] Rapoport, R.N., Three Dilemmas of Action Research. *Human Relations*, 1970. 23: p. 499-513.
- [24] Baskerville, R.L. and Wood-Harper, T., Diversity in information systems action research methods. *European Journal of Information Systems*, 1998. 7(2): p. 90-107.
- [25] Susman, G.I. and Evered, R.D., An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly*, 1978. 23(4): p. 582-603.
- [26] Baskerville, R. and Myers, M.D., Special Issue on Action Research in Information Systems: Making IS Research Relevant to Practice - Foreword. *MIS Quarterly*, 2004. 28(3): p. 329.
- [27] Blackburn, N., Building bridges: towards integrated library and information services for mental health and social care. *Health Information and Libraries Journal*, 2001. 18(4): p. 203-212.
- [28] Järveläinen, J., Koskivaara, E., Pihlaja, P., Salmela, H., et al., Value-Creating E-Government Business Models for Early Education Childhood Education in Finland. *International Journal of Electronic Government Research*, 2007. 3.
- [29] National Agency on Medicines, Suomen lääketilasto 2003 - Finnish Statistics on Medicines. 2004.
- [30] Hyppönen, H., Salmivalli, L., and Suomi, R. Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription. in *Hawaii International Conference on System Sciences*. 2005. Hilton Waikoloa Village, Big Island, Hawaii.

**PAPER 5: GOVERNING THE IMPLEMENTATION OF
A COMPLEX INFORMATION SYSTEMS NETWORK: -
THE CASE OF FINNISH ELECTRONIC
PRESCRIPTION**

Salmivalli, Lauri (2006) *“Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription”*
Reprinted from proceedings of the ACIS 2006, the 17th Australasian Conference on Information Systems

Governing the Implementation of a Complex Information Systems Network: - The Case of Finnish Electronic Prescription

Lauri A.T. Salmivalli
Turku Centre for Computer Science/
Information Systems Science
Turku School of Economics, Finland
lauri.salmivalli@tse.fi

Abstract

This paper reports briefly preliminary experiences from implementation case of a complex health care information system, namely Electronic Prescription System (EPS). Theoretical approach of the study is built on inter-organizational networks and their governance. The author claims that the Finnish implementation pilot was a relative failure from network management perspective. Statement is supported by semi-structured interviews collected during the evaluation process.

Keywords

Electronic Prescription Systems, health care, implementation, network,

INTRODUCTION

Health Care Information Systems (HCIS) and their research have been of increasing interest during the couple past decades as health care organizations have been seeking for quantitative and qualitative benefits in their operation and health care information systems have been seen as one remedy for rationalization of health care. (Raghupathi 1997; Thornett 2001; Wang et al. 2003)

Health care IS research has so far mainly concentrated on intra-organizational research whereas inter-organizational relationships have been of lesser importance. This is natural as focus of HCIS development has been until recently in intra-organizational systems; whereas inter-organizational IS networks are still relatively new phenomena in health care. (Johns 1997; Grimson et al. 2000; Raghupathi and Tan 2002; Gagnon et al. 2005)

Today, health care organizations are facing new operational environment as previously isolated organizations are networking to other health care actors. The trend seems to be towards development of large-scale, integrated organizations that offer the benefits of coordinated care and more effective monitoring and enhancement of clinical practices; processes in which information systems are expected to play a crucial role. (Robinson and Casalino 1996; Gray Southon et al. 1997; Mercer 2001)

Furthermore, health care generally speaking, has been late adopter of information and communication technology (ICT) and similar inter-organizational connections that have existed several years in e.g. banking are only now emerging in health care field. Reasons for this, among other things, are underinvestment in IT, lack of political will, fragmented markets with inadequate revenue streams to support development of new systems, lack of standards or slow adoption of them. (Grimson et al. 2000; Khoumbati et al. 2006)

Yet, researchers agree that new technologies have potential to improve the functioning of health care; the difficult part is that that potential can only be achieved if healthcare information systems can be successfully developed and implemented. (Johns 1997; Armoni 2000; Heeks et al. 2000; Armoni 2002; Raghupathi and Tan 2002)

The purpose of this paper is to introduce briefly preliminary experiences from implementation case of a complex health care information system, namely Electronic Prescription System (EPS). Electronic prescription systems are one example of the use of inter-organizational information technology in health care, and these types of systems have been or are being implemented in several European countries and the USA during the past years (see e.g. Salmivalli & Hilmola 2006) According to Vrakking (1995) the main question in implementation is: How can we create, with minimum effort and cost, the best possible chance that implementation of intended and approved complex innovations will actually take place?

Theoretical perspective of the paper focuses on the governance of networks and the research questions are:

1. What is the intrinsic rationale to implement electronic prescription system?
2. How is the implementation of EPS network governed?

NETWORKS AND GOVERNANCE

The basis of theoretical framework in this study is built on inter-organizational networks and their governance. Networks and their governance have been researched for decades from several different disciplinary and theoretical approaches (On networks see e.g. (Benson 1975; Cook and Emerson 1978; Ouchi 1979); In governance: Coase's (1937) governance forms, Transaction Cost Economics by Williamson (1979), Jones et al. (1997) etc.).

This paper studies network governance especially from policy network perspective accommodating the special features of health care and inter-organizational information systems (IOIS) implementation domain. Research in this domain is still relatively juvenile, but there is apparent need for research in the field as the health care is moving from single patient-doctor relationship towards seamless care (Grimson et al. 2000).

The term *network* illustrates the several interdependent actors involved in delivering services. The *networks* consist of organizations which need to exchange resources (information, money, expertise etc.) to attain their objectives, to maximize their influence over outcomes, and to avoid becoming dependent on other players in the game. (adopted from R.A.W Rhodes, foreword of (Kickert et al. 1997b)).

Governance is described on general level as 'directed influence of social processes', covering all sorts of guidance mechanisms which are connected with public policy processes. The forms of guidance are not restricted to conscious or deliberate forms of guidance. Nor is governance limited to public actors (adopted from (Kickert et al. 1997a) see also e.g. (Jones et al. 1997) for definitions of network governance).

Network management then is an example of governance and public management in situations of interdependencies. It is aimed at coordinating strategies of actors with different goals and preferences with regard to a certain problem or policy measure within an existing network of inter-organizational relations. (Kickert et al. 1997a)

The differences between public and private sector management have been discussed widely in management and organization sciences. Allison (1980) has classified the differences into three groups:

1. **Differences in environmental characteristics:** market exposure, legal, formal constraints, and political influence
2. **Differences in the relationship between environment and organization:** coerciveness, scope of impact, public scrutiny and expectations
3. **Differences in organizational factors:** goal complexity, authority relations, performance, incentive structures and personal characteristics (from (Kickert and Koppenjan 1997))

Furthermore, traditionally the operating environments of organizations have been divided into *Markets* and *Hierarchies* (Williamson 1975) and later Ouchi (1979) added *Clans* (Community) into classification, and their control mechanisms are respectively *Price*, *Authority*, and *Trust*. (Adler 2001)

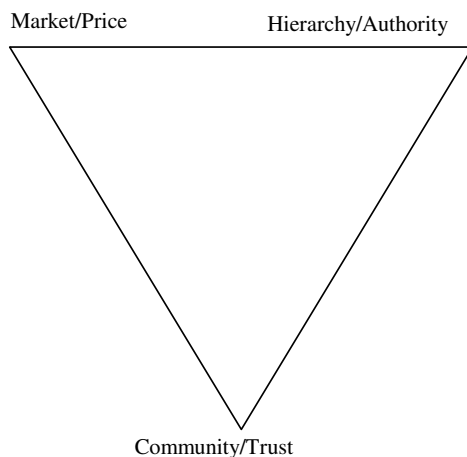


Figure 1. Organizational models and their coordination mechanisms (Adopted from (Adler 2001))

Hierarchies and markets have been revealed to illustrate poorly health care field (Glouberman and Mintzberg 2001). Hierarchies do not solve the problems of cost control or coordination. On the other hand, markets separate sellers of like products from each other by the order of competition so that each actor is encouraged to work independently, which usually is not the case in health care field.

Trust (Community) as a control mechanism seems to fit quite well in the health care field (Gilson 2003), but cannot be the sole building brick as, at least in Finland, health care has elements of hierarchy deeply rooted in the system (e.g. strong Ministry/legislative steering) and there are also elements of market orientation (e.g. private pharmacies and private sector health care providers). Therefore, it seems that we cannot solely rely on any single control mechanism of Authority, Price, or Trust.

Governance in complex networks requires distinctive management practices from traditional public sector management: Government is not the single dominant actor that can unilaterally impose its will, hierarchical, central top-down steering does not work in networks that have no 'top'. (Kickert and Koppenjan 1997) All in all, network manager operates from a comparatively powerless position with little hierarchical means at its disposal, yet there are several different strategies that network manager can utilize. (Kickert et al. 1997c)

Kickert et al. (1997) propose three different perspectives or 'ideal types' of network management:

1. **Instrumental perspective:** is refinement of classical rational 'steering' approach. Main argument is that regulatory instruments do not apply in a network situation because they are uniform and one-sided. In network situation more refined instruments, like incentives, communicative instruments or covenants should be employed.
2. **Interactive perspective:** stresses the multitude of actors, and especially their interactions. Network management is about contributing to and providing conditions for the process of finding a common purpose more than attaining governmental goals.
3. **Institutional perspective:** emphasizes the role of institutions which shape the strategies and intentions of actors. Network management has to build upon these institutions.

Table 1. summarizes the main features of these three perspectives Adapted from (Kickert et al. 1997c).

	<i>Instrumental perspective</i>	<i>Interactive perspective</i>	<i>Institutional perspective</i>
Research focus	Improving steering conditions	Cooperation	Network arrangements and their impacts
Level of analysis	'Focal organization'	Interaction	Network
View of policy networks	Closed and pluriform object of steering	Horizontal interaction situation	Product and context of interaction and governance
Characterization of network management	Strategic use of steering strategies and treatment of dependency relations	Furtherance of co-operation and prevention and removal of blockages	Incremental adaptation of incentive structure and rules of structure and culture of policy networks
Criteria for evaluation and prescription	Effectiveness; Problem solving	Satisfying policy; consensus and openness	Openness, robustness, facilitating interaction
Strong points	Applicability; Consistent with steering ambitions of government	Realization of cooperation in pluralistic situations	Interest in role of institutions and institutionalization; Cautions against easy structural solutions
Weak Points	Limits to steering in connection with goal orientedness; danger of instrumentalism	Too little attention to institutional aspects; Danger of particularism	Limited manipulability of variables

Table 1. Three perspectives on network management (Kickert et al. 1997c)

In the general strategy literature, strategic actions are usually characterized as efforts by actors to manipulate (change or preserve) their position(s) in network. The three above presented perspectives possess diverse strategies to achieve desired outcome. In brief, instrumental perspectives strategies are aimed at the realization of fixed goals or the solution of a well-defined problem. From an interactive perspective strategies are aimed at influencing ideas and perceptions of actors to improve the opportunities for common action (e.g. attempts to collectively adjust strategies and goals). The institutional perspective focuses on the long term impact of game strategies on the network as a whole, and is not so committed to particular goals or policies. (Kickert et al. 1997c) see also (Agranoff and McGuire 2001; Agranoff and McGuire 2003)

Implementation situation (e.g. implementing inter-organizational information systems) in networks has some special features compared to more 'static' network environment. One of the major differences is the need to attend to the developing, maintaining and utilizing of common purpose within and across functionally specific clusters of interrelated actors. Usually the tasks to be performed in implementation phase are more concrete and narrow as well. O'Toole et al. (1997) list three strategies fitted especially for implementation phase: *Bargaining and Compromising*; *Changing Perspectives*; and *Managing the Context*. (O'Toole et al. 1997)

RESEARCH METHODS

The work presented in this paper is part of a larger study in which the implementation of Finnish EPS is studied. The author has been participant in inter-disciplinary team evaluating the Finnish ePrescribing pilot. Research approach has been throughout the study action research, in which researchers are in a 'helping role' within the organizations that are being studied (for action research see e.g. (Rapoport 1970; Baskerville and Wood-Harper 1996; Grant and Ngunenyama 2003)).

This paper follows interpretivistic paradigm (see e.g. (Chen and Hirschheim 2004)) and empirical part of this paper reports findings from fifteen semi-structured interviews made to main actors in the Finnish ePrescription pilot. Interviewees were on the management level in their organizations. Patient perspective is demarcated outside the scope of this study. There were ten themes with sub-questions; this paper reports the responses from *entry and expectations*; and *organization of the project and rules of game* –themes. The interviews were recorded, transcribed to text document and analyzed with qualitative analysis software (NUDIST Vivo).

The paper at hand focuses especially on the implementation of Finnish electronic prescription system from network perspective. Previously Finnish EPS has been reported from e.g. infrastructure perspective (Hyppönen et al 2005), business model perspective (Salmivalli & Hilmola 2006), interdisciplinary evaluation perspective (Hyppönen et al 2007), and from the comparison of different national implementation strategies perspective (Hyppönen et al 2006).

ELECTRONIC PRESCRIPTION SYSTEMS (EPS)

Electronic prescription systems are expected to solve several challenges in health care: rationalizing medication practices of physicians, providing up-to-date information on the cheapest medication available, reducing overlapping medication, reducing medication errors and adverse drug interactions, decreasing prescription handling costs, and increasing efficiency in several organizations. Furthermore, electronic prescriptions are expected to provide more accurate and up-to-date statistical information about medication practices in relation to these issues and hence increase the efficiency of pharmaceutical distribution and improve the planning of national health policy in the long run. (Niinimäki and Forsström 1997; Mundy and Chadwick 2002; Schuring and Spil 2002; Boonstra 2003; Mundy 2003; Schuring and Spil 2003; Bastholm Rahmner et al. 2004; Boonstra et al. 2004; Spil et al. 2004)

Different Electronic Prescription Systems have been implemented, or are being implemented in several European countries and America. Among implementing countries are at least Canada (Taylor and Tamblyn 2004); Denmark (Demkjaer et al. 1999); Germany (Brill et al. 2005); the Netherlands (Schuring and Spil 2002; Boonstra 2003; Spil et al. 2004); Portugal (Freire 2006); Spain (Pina Vera 2006) Sweden (Bastholm Rahmner et al. 2004); The UK (Mundy 2003; Mundy and Chadwick 2004); and the US (Teich et al. 2005).

However, the starting points and context, implementation process and technical solutions for EPS differ from one country to another. Merely, the concept of electronic prescription differs from electronically created and printed prescriptions to electronically transmitted and processed prescriptions. In this paper we use the terms ePrescribing and Electronic Prescription System (EPS) to denote the entire system with different actors and subsystems.

There is still very little research made on the comparison of EPS in different countries (Hyppönen et al 2006) but it seems that the most important common denominators for EPS projects are that: A) There is vigorous motive on national levels to implement EPS in order to e.g. resist rising medication costs (Taylor and Tamblyn 2004) and B) EPS-projects are always inter-organizational in nature, systems are implemented in several different

organizations at the same time, organizations are usually heterogeneous in size, operate in different areas of health care field (e.g. pharmacies, hospitals, imbursement authorities), and they possess different legacy information systems.

THE CASE: IMPLEMENTING EPS IN FINLAND

Overview

Electronic prescription in Finland dates back into 1990's, when alternative technologies were piloted locally, including the point-to-point email solution, card-based systems with a national medication record and prescription database trials. Analogous problems were encountered in all of the local pilots: inadequate attention to the entire process of prescription data processing, lack of attention to patients' rights, data security and technological interoperability, lacking agreement about financing the system and rights to access the data as well as lack of national regulation. (Hyppönen ed. 2005, 2006)

In 2000 the Ministry of Social Affairs and Health set a project to draw conclusions on experiences of the local trials and to suggest a national concept for ePrescribing in order to harmonise the development. In 2001 was published a preliminary disquisition about electronic prescription in Finland. The report concluded recommending a national database-system with access to doctors, pharmacies, Social Insurance Institution and later also patients. (Social Insurance Institution 2001) In 2002, the Finnish Ministry of Social Affairs and Health started implementing the national concept suggested in the report by selecting units from health care organizations and a couple of nearby pharmacies in four different regions to pilot the national concept described in the report. A national steering group coordinated the locally organized pilots with a small budget. An experimental decree on ePrescribing was issued in 2003. It laid down provisions among other things on preparing, signing, technical content, altering and delivery of electronic prescriptions.

The construction of the system took 2 years, and the first clinical pilot started in 2004. By the end of 2004 two out of the four piloting health care units had implemented the EPS integrated into electronic patient record (EPR), pilot pharmacies still used a stand-alone system, which was not integrated into pharmacy systems and created extra work at the pharmacies. In June 2005, the third integrated EPS and the first integrated pharmacy system were implemented.

Furthermore, in the spring 2005 the organization of the national e-prescription pilot was changed thoroughly; the part time project manager of the pilot was changed to a major consultancy company, which re-organized the administration of pilot entirely. The amount of produced e-prescriptions remained still very small and at the end of 2005 only approximately 800 electronic prescriptions had been dispensed (there are approximately 40 million dispensed prescriptions in Finland annually). In June 2006 the ePrescription pilot was ended, because it had "reached the objectives set to it". Interviews used in this paper were collected before the pilot administration was re-organized.

Figure 2. describes the network organization of the national e-prescription pilot, actors included in the figure were mentioned in the preliminary disquisition (2001) as stakeholder organizations for e-prescription pilot. Solid line presents actual information system connections to the EPS and dash line portrays formal or informal influence on the EPS system. Stakeholders are arranged in a such way that authorities are in the upper part of the figure, associations and trusteeship organizations on the left side and software providers and other commercial actors are at the bottom of the figure.

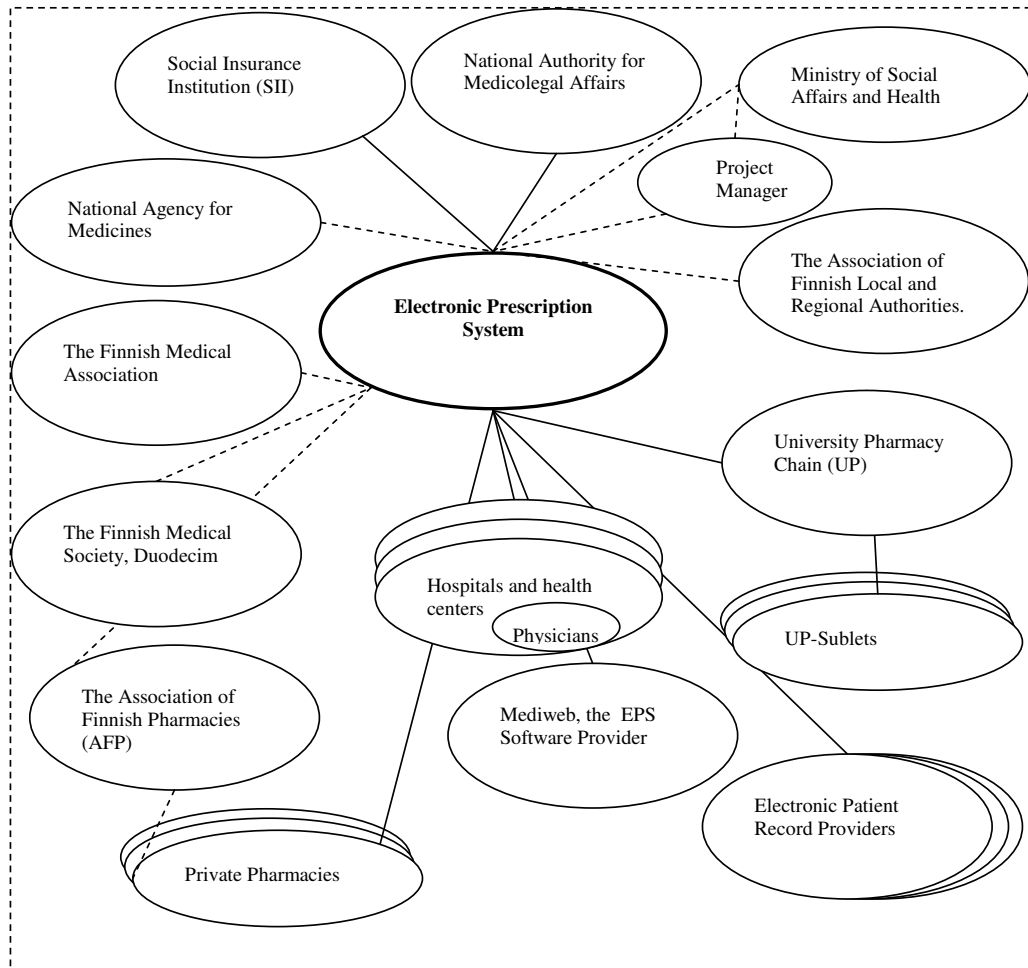


Figure 2. The network structure of Finnish EPS

Motives to implement EPS

Prerequisite for successful IS network implementation is the motivation of actors for cooperation in project. An IS network project has little odds to prosper if all the actors perceive project goals completely differently. Respectively, one of the main missions for project management is to mesh together different interests to reach a common objective.

In our research the author identified three levels of goals or objectives: *National level motive to implement EPS*; *Organizational level motive*; and *User level motive* (users are physicians and pharmacy personnel). Interviewees were asked their own motives and objectives on the pilot (i.e. reasons to participate the implementation pilot), what they presumed was the national reason to launch the pilot, and if there were any conflicts of interests between actors or individual actors and national objectives.

Based on the interviews, we can say that there is exceptionally wide understanding that there is clear *raison d'être* on the national level for ePrescription system. All interviewees shared mutual understanding that EPS pilot is needed and that it could generate benefits on the national level. Expected benefits mentioned related to rationalization of medication and medication costs, bringing health care up to date and increasing the productivity of health care generally, and improving the quality of care (e.g. less errors in prescriptions). However, respondents criticized that the Ministry of Health had not expressed the national objectives clearly. There was no unambiguous vision of EPS, nor was there any exact milestones or clearly expressed objectives to be reached in set time.

All organizations claimed that they are committed to national implementation project, and generally respondents didn't see that there were any major conflicts of interest, only that different actors emphasise different issues which has slowed down decision making, e.g. differing opinions about data security level was mentioned most often. Yet, five respondents reported that a certain trusteeship organization is having its own agenda, and is hindering the work of steering group.

Organizations participating in the pilot did not receive any financial incentives for participation, but instead they were expected to allocate resources for the pilot. Hence, all of the individuals participated the project among their other tasks. Part-time project manager was only person receiving salary from the project, software vendors naturally billed for the development work which was funded by the Ministry.

Interviewees did not expect financial savings from the system; on the contrary, organizations expected EPS to create more costs in terms of IT-personnel and upgrading of existing systems. Main benefits expected were related to time saving and quality improvements in care. Based on interviews it seems that costs and benefits appear on different levels. Costs seem to be concentrating on individual organizations shoulders whereas benefits generate on national level, and are often difficult to calculate (e.g. how to calculate improvements in life quality due to more rational medication of patient).

Organizations involved in the pilot were surprisingly committed considering the fact that generation of actual benefits is somewhat tentative, and would anyways require that significant proportion of all prescriptions would be electronic. As long as there are two systems: one for the paper prescriptions and one for electronic prescriptions, the benefits are not generated – at least in full scale – but instead costs of both systems are running. Pioneer spirit and possibility to have an influence were mentioned several times as motive to take part in the pilot.

User level motivation was the third identified dimension affecting the implementation project. User level motivation is twofold: primary users are doctors and pharmacy personnel. Based on interviews, it seems that critical success factor is user acceptance of physicians. Pharmacy personnel have lesser choices, as they have to dispense prescriptions regardless their format: paper or electronic. Physicians, on the other hand, can choose between paper and electronic prescription and threshold to use ePrescription may be considerable high if they don't perceive advantage from using EPS. Interviewees stated that user feedback from the system was that it was slow to use and physicians had to explain patients the data security issues related to system and ask their written consent, which in turn created extra work and loss of time for physicians.

The governance of EPS implementation network

The governance structure of Finnish EPS pilot is exceedingly complex network with several different dimensions. Firstly, there are several authorities involved in the network; one governance challenge is that there are two powerful players: Ministry of Health and Social Insurance Institution (SII). SII is under parliament control and Ministry does not possess formal power on SII. Secondly, local health care actors have wide-ranging self-government and possibilities to affect local decision making are limited. Third issue are the private actors, e.g. private pharmacies and software vendors acting on commercial basis, and a major question is how their actions can be steered. Fourth institutional field consists of different trusteeship organizations acting in the interest of their principals.

There was a wide understanding among interviewees that organization of the project has been a failure. Time scale of the project had been drawn out constantly, the pilot was under-resourced both in terms of money and personnel, and responsibilities were not clear. Several interviewees reported that steering group was too large, and decision-making was difficult. Decision-making was aggravated further because there was no prepared drafts on basis of decision making.

Part-time project manager had little means to influence the network. There were no rewards to be offered for good performance, nor penalties for under performance. Hence, main tools to be used were based on actors voluntary cooperation. Furthermore, project manager did not have whole-hearted trust of all actors, which in turn was seen to complicate management.

Based on interviews, the managerial perspective falls into *interactive perspective* discussed above. Despite of the strong commitment of participating actors the Finnish EPS pilot was not a success story. The amount of electronic prescriptions remained insignificant compared to aggregate volume of prescriptions, or even phone prescriptions (the physician calls to a pharmacy to order medication for the patient).

CONCLUSIONS AND SUMMARY

Provan & Milward (1995) claim that in the public sector, where a strong public interest is involved, network outcomes are particularly significant, and the motivation for organizations cooperating to accomplish system

goals rather than organizational ends is often stronger than in the private sector, even when specific incentives to integrate and cooperate are weak. (Provan and Milward 1995)

For one, our research would indicate quite the opposite. Networked organizations can have strong commitment in a project, but network governance can still fail. Firstly, the rationale to implement EPS remains still problematic issue. EPS is first of all national level mission, and in its current form it provides little incentives of use for individual organizations and users. Yet, even at the national level goals and objectives were vaguely expressed from the beginning of pilot.

One of the main objectives of network management according to interactive perspective is to find common objective for the network. Based on our research it remains uncertain whether common objective benefiting all participants was really found. Positively, all organizations claimed to be very committed to the pilot and its objectives.

As the expense of entry was comparatively low and expected benefits for participants relatively precarious organizations may have joined the pilot "just in case". Second possible explanation is opportunism and wielding of power. Studies argue that introduction of telemedicine (e.g. EPS or other health care IS) increases bilateral dependence (lock-in) between health care actors. Approving this line of thought, it is essential for the relationship to be continuous if the benefits of the IS investment are to be realised, but such continuity exposes the relationship to opportunistic behaviour, as assets cannot be easily re-deployed. (Pelletier-Fleury and Fargeon 1997)

Based on this study It seems evident, that A) network perspective of complex health care IS project needs further study and critical evaluation (see e.g. (Hardy and Phillips 1998) for excellent presentation of inter-organizational collaboration), and B) such complex network settings need more effective steering methods to be successful (e.g. focusing strategies based on Ouchi's triangle presented on figure 1.). There is still very little research on private-public networks and health care governance forms in complex network settings. It seems evident that further research and critical evaluation about objectives, rationale, and management of HCIS is needed.

The evaluation team provided national steering group continuous feed-back and produced two bigger reports (Hyppönen ed. 2005, 2006). National pilot changed its direction during the evaluation process: pilot steering group was re-organized, and a question of *National Actor* was raised. National Actor would be the "owner" of the system, and hence clarify management issues. Many of the troubles were solved during the first pilot phase, but usage rates remained disturbingly low.

REFERENCES

- Adler, P. S. (2001). "Market, Hierarchy, and Trust: The Knowledge Economy and the Future of Capitalism." *Organization Science* 12(2): 215-234.
- Agranoff, R. and M. McGuire (2001). "Big Questions in Public Network Management Research." *Journal of Public Administration Research & Theory* (Transaction) 11(3): 295.
- Agranoff, R. and M. McGuire (2003). "Inside the Matrix: Integrating the Paradigms of Intergovernmental and Network Management." *International Journal of Public Administration* 26(12): 1401.
- Armoni, A., Ed. (2000). *Healthcare Information Systems: Challenges of the New Millennium*. Hersey, Idea Group Publishing.
- Armoni, A., Ed. (2002). *Effective Healthcare Information Systems*. Hershey, PA, USA, Idea Group Publishing.
- Baskerville, R. L. and A. T. Wood-Harper (1996). "A critical perspective on action research as a method for information systems research." *Journal of Information Technology* 11: 235-246.
- Bastholm Rahmner, P., E. Andersén-Karlsson, et al. (2004). "Physicians' perceptions of possibilities and obstacles prior to implementing a computerised drug prescribing support system." *International Journal of Health Care Quality Assurance* 17(4): 173-179.
- Benson, J. K. (1975). "The Interorganizational Network as a Polical Economy." *Administrative Science Quarterly* 20(2): 229-249.
- Berg, M. (2001). *Implementing Information Systems in Health Care Organizations: Myths and Challenges*, Erasmus University, Rotterdam, NL: Institute of Health Policy and Management.
- Boonstra, A. (2003). "Interpretive Perspectives on the Acceptance of an Electronic Prescription System." *journal of Information Technology Cases and Applications* 5(2): 27-49.

17th Australasian Conference on Information Systems Governing the implementation of health care IS
6-8 Dec 2006, Adelaide Salmivalli

- Boonstra, A., D. Boddy, et al. (2004). "The limited acceptance of an electronic prescription system by general practitioners: reasons and practical implications." *New Technology, Work and Employment* 19(2): 128-144.
- Brill, C. W., K. Forster, et al. (2005). "Patients' mailbox and electronic prescription." *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz*. 48(7): 732-5.
- Chen, W. and R. Hirschheim (2004). "A paradigmatic and methodological examination of information systems research from 1991 to 2001." *Info Systems J* 14: 197-235.
- Cook, K. S. and R. M. Emerson (1978). "Power, Equity and Commitment in Exchange Networks." *American Sociological Review* 43(5): 721-739.
- Demkjaer, K., I. Johansen, et al. (1999). "Third generation electronic pharmacy communications. Recommendations based on ten years' experience." *Studies in health technology and informatics* 68: 278-82.
- Freire, F. C. (2006). Electronic Prescribing in Portugal. ePrescribing & Medication Management, EHTEL International Conference, Ljubljana, Slovenia, 19-20 June.
- Gagnon, M.-P., L. Lamothe, et al. (2005). "Telehealth adoption in hospitals: an organisational perspective." *Journal of Health Organization and Management* 19(1): 32-56.
- Gilson, L. (2003). "Trust and the development of health care as a social institution." *Social Science & Medicine* 56(7): 1453-68.
- Glouberman, S. and H. Mintzberg (2001). "Managing the care of health and the cure of disease--Part II: Integration." *Health Care Management Review* 26(1): 70-84.
- Grant, D. and O. Ngwenyama (2003). "A report on the use of action research to evaluate a manufacturing information systems development methodology in a company." *Info Systems J* 13: 21-35.
- Gray Southon, F. C., C. Sauer, et al. (1997). "Information Technology in Complex Health Services: Organizational Impediments to Successful Technology Transfer and Diffusion." *J Am Med Inform Assoc* 4(2).
- Grimson, J., W. Grimson, et al. (2000). "The SI Challenge in Health Care." *Communications of the ACM* 43(6): 48.
- Hardy, C. and N. Phillips (1998). "Strategies of engagement: Lessons from the critical examination of collaboration and conflict in an interorganizational domain." *Organization Science* 9(2): 217-230.
- Heeks, R., D. Mundy, et al. (2000). *Understanding Success and Failure of Health Care Information Systems. Healthcare Information Systems: Challenges of the New Millennium*. A. Armoni, Idea Group Publishing.
- Hyppönen, H., Salmivalli, L., – Suomi, R., (2005) "Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription" The 38th Hawaii International Conference on System Sciences January 3-6, 2005, Hilton Waikoloa Village, Big Island, Hawaii
- Hyppönen, H., Salmivalli, L., Nykänen, P., Ruotsalainen, P. and Pajukoski, M. (2007), 'Testing a theoretical framework for interdisciplinary IT evaluation: the case of the Finnish Electronic Prescription', *Int. J. Healthcare Technology and Management*, Vol. 8, Nos. 1/2, pp.42–65.
- Hyppönen, H., Salmivalli, L., – Tellingier, K., (2006) "Implementing electronic prescription systems – A comparison between two approaches" in the 6th Nordic Conference on eHealth and Telemedicine, NCeHT2006, Helsinki
- Johns, P. M. (1997). "Integrating information systems and health care." *Logistics Information Management* 10(4): 140-145.
- Jones, C., W. S. Hesterly, et al. (1997). "A General theory of network governance: Exchange conditions and social mechanisms." *Academy of Management Review* 22(4): 911-945.
- Khoubati, K., M. Themistocleous, et al. (2006). "Evaluating the Adoption of Enterprise Application Integration in Health-Care Organizations." *Journal of Management Information Systems* 22(4): 69-108.
- Kickert, W. J. M., E.-H. Klijn, et al. (1997a). Introduction: A Management Perspective on Policy Networks. *Managing Complex Networks: -Strategies for the Public Sector*. W. J. M. Kickert, E.-H. Klijn and J. F. M. Koppenjan. London, Sage.

17th Australasian Conference on Information Systems Governing the implementation of health care IS
6-8 Dec 2006, Adelaide Salmivalli

- Kickert, W. J. M., E.-H. Klijn, et al., Eds. (1997b). *Managing Complex Networks: - Strategies for the Public Sector*. London, Sage.
- Kickert, W. J. M., E.-H. Klijn, et al. (1997c). *Managing Networks in the Public Sector: Findings and Reflections. Managing Complex Networks: Strategies for the Public Sector*. W. J. M. Kickert, E.-H. Klijn and J. F. M. Koppenjan. London, Sage.
- Kickert, W. J. M. and J. F. M. Koppenjan (1997). *Public Management and Network Management: An Overview. Managing Complex Networks: Strategies for the Public Sector*. W. J. M. Kickert, E.-H. Klijn and J. F. M. Koppenjan. London, Sage.
- Mercer, K. (2001). "Examining the impact of health information networks on health system integration in Canada." *Leadership in health services* 3(14): i-xxx.
- Mundy, D. and D. W. Chadwick (2004). "Electronic transmission of prescriptions: towards realising the dream." *Int. J. Electronic Healthcare* 1(1): 112-125.
- Mundy, D. P. (2003). *Providing a Secure Solution For The Integration Of Electronic Prescription Transfer Within The United Kingdom National Health Service*. UKAIS PhD Consortium.
- Mundy, D. P. and D. W. Chadwick (2002). *A System For Secure Electronic Prescription Handling*. Proc. of the 2nd International Conference on the Management of Healthcare and Medical Technology, Chicago, Illinois, USA.
- Niinimäki, J. and J. Forsström (1997). "Approaches for certification of electronic prescription software." *International Journal of Medical Informatics*(47): 175–182.
- O'Toole, L. J., K. I. Hanf, et al. (1997). *Managing Implementation Processes in Networks. Managing Complex Networks: Strategies for the Public Sector*. W. J. M. Kickert, E.-H. Klijn and J. F. M. Koppenjan. London, Sage.
- Ouchi, W. G. (1979). "A Conceptual framework for the design of organizational control mechanisms." *Management Science* 25(9): 833-848.
- Pelletier-Fleury, N. and V. Fargeon (1997). "Transaction cost economics as a conceptual framework for the analysis of barriers to the diffusion of telemedicine." *Health Policy* 42(1): 1-14.
- Pina Vera, M. J. (2006). *Electronic Prescribing in the Region of Andalucia, Spain: Prescription XXI. ePrescribing & Medication Management*, EHTEL International Conference, Ljubljana, Slovenia 19-20 June.
- Provan, K. G. and H. B. Milward (1995). "A Preliminary Theory of Interorganizational Network Effectiveness: A Comparative Study of Community Mental Health Systems." *Administrative Science Quarterly* 40(1): 1-33.
- Raghupathi, W. (1997). "Health Care Information Systems." *Communications of the ACM*(40(8)).
- Raghupathi, W. and J. Tan (2002). "Strategic IT Applications in Health Care." *Communications of the ACM* 45(12).
- Rapoport, R. N. (1970). "Three Dilemmas of Action Research." *Human Relations* 23: 499-513.
- Robinson, J. C. and L. P. Casalino (1996). "Vertical Integration and Organizational Networks in Healthcare." *Health Affairs* 15(1).
- Salmivalli, L., Hilmola, O-P. (2006) "Business Pluralism of E-prescriptions State of development in Europe and US" *Int. J. Electronic Healthcare*, Vol. 2, No. 2, 2006
- Salmivalli, L., in Hyppönen, H., ed. (2005) "Sähköisen reseptin pilotoinnin arviointi vaihe I: Loppuraportti" *Osaavien keskusten verkoston julkaisuja* 1/2005, Stakes, Helsinki
- Salmivalli, L., in Hyppönen, H., ed. "Sähköisen reseptin pilotin arviointi II (2005-2006)" in *Osaavien keskusten verkoston julkaisuja*, Stakes, Helsinki
- Schuring, R. W. and T. A. M. Spil (2002). "Explaining plateaued diffusion by combining the user-IT-success factors (USIT) and adopter categories: The case of electronic prescription systems for general practitioners." *International Journal of Healthcare Technology & Management* 4(3): 303.
- Schuring, R. W. and T. A. M. Spil (2003). *Relevance and Micro-Relevance for the Professional as Determinants of IT-Diffusion and IT-Use in Healthcare. ERP & Data Warehousing in Organizations: Issues and Challenges*. G. Grant. Hershey, Idea Group Publishing: 218-231.

17th Australasian Conference on Information Systems Governing the implementation of health care IS
6-8 Dec 2006, Adelaide Salmivalli

- Spil, T. A. M., R. W. Schuring, et al. (2004). "Electronic prescription system: do the professionals use it?" *International Journal of Healthcare Technology and Management* 6(1): 32 - 55.
- Taylor, L. and R. Tamblin (2004). *Reasons for Physician Non-Adherence to Electronic Drug Alerts*. Medinfo 2004. M. Fieschi, IOS Press: 1101-1105.
- Teich, J. M., J. A. Osheroff, et al. (2005). "Clinical Decision Support in Electronic Prescribing: Recommendations and an Action Plan." *Journal of the American Medical Informatics Association* 12(4): 365-376.
- Thornett, A. M. (2001). "Computer decision support systems in general practice." *International Journal of Information Management* 21: 39-47.
- The Social Insurance Institution of Finland (2001) *Sähköistä reseptiä koskeva esiselvitys* (in Finnish only), Helsinki
- Vracking, W. J. (1995) *The implementation game* *Journal of Organizational Change Management*, Vol. 8 No. 3, 1995, pp. 31-46.
- Wang, S. J., B. Middleton, et al. (2003). "A Cost-Benefit Analysis of Electronic Medical Records." *The American Journal of Medicine* 1(14): 397-403.

ACKNOWLEDGEMENTS

The author wishes to thank Prof. Hannu Salmela, Mr. Timo Kestilä, and Prof. Reima Suomi for their valuable comments. The financial assistance of the Finnish Foundation for Economic Education and the Hans Bang Foundation for the publication of this paper is gratefully acknowledged.

COPYRIGHT

Lauri A.T. Salmivalli © 2006. The authors assign to ACIS and educational and non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to ACIS to publish this document in full in the Conference Papers and Proceedings. Those documents may be published on the World Wide Web, CD-ROM, in printed form, and on mirror sites on the World Wide Web. Any other usage is prohibited without the express permission of the authors.

**TURUN KAUPPAKORKEAKOULUN JULKAISUSARJASSA A OVAT
VUODESTA 2007 LÄHTIEN ILMESTYNEET SEURAAVAT JULKAISUT**

- A-1:2007 Jarmo Tähkäpää
Managing the Information Systems Resource in Health Care.
Findings from two IS Projects
- A-2:2007 Elina Jaakkola
Problem Solving within Professional Services. A Study of
Physicians' Prescribing Decisions
- A-3:2007 Dimitrios Vafidis
Approaches for Knowledge and Application Creation in Logistics.
An Empirical Analysis Based on Finnish and Swedish Doctoral
Dissertations Published Between 1994 and 2003
- A-4:2007 Reetta Raitoharju
Information Technology Acceptance in the Finnish Social and
Healthcare Sector. Exploring the Effects of Cultural Factors
- A-5:2007 Veikko Kärnä
A Return to the Past? An Institutional Analysis of Transitional
Development in the Russian Mining Industry
- A-6:2007 Teemu Haukioja
Sustainable Development and Economic Growth in the Market
Economy
- A-7:2007 Leena Haanpää
The Colour Green – A Structural Approach to the Environment-
Consumption Nexus
- A-8:2007 Jukka Lempa
Essays on Optimal Stopping and Control of Markov Processes
- A-9:2007 Elias Oikarinen
Studies on Housing Price Dynamics
- A-10:2007 Katja Mäki
Yhteistyön rooli uuden liiketoiminnan käynnistämisessä.
Yhteistyön luonne ja yhteistyösuhteiden lähteet suomalaisissa
teknologiaautomoyrityksissä
- A-11:2007 Taru Virtanen
Across and Beyond the Bounds of Taste. On Cultural
Consumption Patterns in the European Union
- A-12:2007 Harri Nieminen
Developing competences through inter-organizational knowledge
acquisition
- A-1:2008 Maria Alaranta

”This has been quite some chaos.” Integrating information systems after a merger – a case study

A-2:2008 Maija Vähämäki

Dialogi organisaation oppimisessa. Itseohjautuvan muutoksen mahdollisuus tuotantotyössä

A-3:2008 Lauri Salmivalli

Governing the Implementation of a Complex Inter-Organizational Information System Network - The Case of Finnish Prescription

Kaikkia edellä mainittuja sekä muita Turun kauppakorkeakoulun julkaisusarjoissa ilmestyneitä julkaisuja voi tilata osoitteella:

KY-Dealing Oy

Rehtorinpellonkatu 3

20500 Turku

Puh. (02) 481 4422, fax (02) 481 4433

E-mail: ky-dealing@tse.fi

All the publications can be ordered from

KY-Dealing Oy

Rehtorinpellonkatu 3

20500 Turku, Finland

Phone +358-2-481 4422, fax +358-2-481 4433

E-mail: ky-dealing@tse.fi