Electronic prescriptions as a part of national ICT-infrastructure for the healthcare industry

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Abstract

In the individual organization level, it is quite usual to distribute information technology into the basic infrastructure and to the applications resting on it. This kind of thinking is not so well developed in the national level, even though we there too clearly identify several kinds of infrastructures, such as those connected with traffic, waste management, education, power and energy supply, health care, and the judiciary, just to name a few. Common for all infrastructures in both cases are that they often do not support themselves financially, and that thus straightforward business thinking does not develop them keen enough. Similarly governance structures tailored for running business do not suit them. As the national infrastructure components too take time to mature, they are often owned and mainly supported by the government. However, the role of governments is changing, and as infrastructures grow more complicated, their development and maintenance usually needs the support of many stakeholders. In our article we discuss which are national ICT infrastructures, and especially which are those in the health care industry. We discuss how their governance structures, development, application and maintenance should differ from those of individual ICT applications. One particular aspect of study is how much should the health care industry infrastructure rely on other national ICT infrastructure components. As a concrete example we take up the case of the Finnish national electronic prescription implementation project. Our discussion focuses on how this important application could be implemented better taking into account its nature a national ICT infrastructure in the health care field.

Keywords: National ICT infrastructure, health care, electronic prescribing

Introduction

In the individual organization level, it is quite usual to distribute information technology into the basic

infrastructure and to the applications resting on it. [1-3].

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identify several kinds of infrastructures, such as those connected with traffic, waste management, education, power and energy supply, health care, and the judiciary, just to name a few. Common for all infrastructures in both cases are that they often do not support themselves financially, and that thus straightforward business thinking does not develop them keen enough.

As the national infrastructures too take time to mature, they are often owned and mainly supported by the government. However, the role of governments is changing, and as infrastructures grow more complicated, their development maintenance usually needs the support of many stakeholders.
Governments turn from suppliers of regulation and resources to participants in networks, as [4] suggest:*"The role of government varies, and at times it reverses from its typical stance in public choice as a supplier of regulation to being a customer of regulation."*

Our research questions are

1 What is a national ICT infrastructure?
2 Which are the ICT infrastructures in health care
3 How much should the health care industry infrastructure rely on other national ICT infrastructure components.
4 What are the implications of seeing electronic prescriptions as a part of national ITC infrastructure for health care?

Methodologically this study is a concept analysis study supported by empirical work on various projects in the health care industry.

National ICT infrastructure – what is it?

Within information and communication technology, the concept of infrastructure is well established. Kumar (2004, 11) defines IT infrastructure as follows: "*An information technology (IT) infrastructure is a collection of technologies, people, and processes that facilitates large-scale connectivity and effective interoperation of an organization's IT applications. The technology component of an effective IT infrastructure includes technologies for effective data storage and retrieval (e.g. storage area networks), system integration (e.g. middleware), connectivity (e.g. networking components), and security technologies (e.g. firewalls). The people component includes infrastructure arhitecht and other employees charged with infrastructure desing and support. The process component includes processes for architecture standardization and infrastructure change reviews.*"

Weill & al (2002) differentiate between physical and management-oriented infrastructure components. In accordance with basic principles of cypernetics, infrastructure also consists of a technical systems and of a system controlling it. Basic physical components of infrastructure according to them are (Weill & al 2002, 60):

- Channel-management services
  - integrating physical outlets, e-mail, www-sites, physical mail, interactive voice response, wireless devices and ATM's to give a single picture of a customer's relationship
- Security and risk-management services
  - Firewalls, policies for remote access encryption, user account management
- Communication services
  - network management
- Data-management services
  - electronic-reporting systems, data warehouses, web services, storage area networks, knowledge management
- Application-infrastructure services
  - ERP / accounting, human resource management, budgeting
- IT-facilies-management services
  - servers, large-scale processing, system development environment.

Similarly, basic management oriented infrastructure components are (Weill & al 2002, 61):

- IT-management services
  - Information systems planning, project management, service-level agreements and negotiations with vendors
- IT-architecture and standard services
  - core policies that govern the use of information technology
- IT-education services
- R&D services .

Infrastructure is a word not specific to information technology. At the city planning level infrastructure maybe most visible: we can see streets and other structures for transportation and logistics [5, 6], public houses such as schools, museums and libraries [7, 8], 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, different markets and governance structures… you name it.

However, the word infrastructure is heavily used in the area of information technology too [1, 2]. The superinfrastructure of IT is that of Internet [9]. However, in IT infrastructure can refer to smaller entities, such as telecommunication [10], electronic commerce [11], or information as such [12], just to give a few examples.

Information and communications infrastructure is most often discussed at an individual organization level. However, we believe that the concept is usable at the national level too. In Table 1 we interpret the concepts defined by Weill & al (2002) at the national level in general and at the national level as it comes to health care.

Table 1- Manifestions of infrastructure as defined by Weill & al at the national level

Areas of infrastructure as defined by (Weill & al 2002)	**Examples of outcomes at the national level**	**Examles of outcomes at the health care sector (national level)**
Channel-management services	National gateways between different types of networks National mail services	Health-care specific networks
Security and risk-management services	Identification services and cards	Identification services for health and social care workers
Communication services	Management of third generation mobile networks, backbone	Electronic prescribing

	networks, broadcasting services	
Data-management services	Libraries, national archieves	National code centres in the area of health care
Application-infrastructure services	National payment and clearing services	Health care insurance systems
IT-facilies-management services	National supercomputing centres	National archieves for health records, medical images
IT-management services	Public sector procurement schemes. Clearing systems and arrangements with international networks.	National standards for clinical equipment
IT-architecture and standard services	Address spaces for different communication networks. National IT-strategies	National and internation al codes for identifying illnesses, health care institutions and cures
IT-education services	IT-education in primary school, universities etc.	Training programs for health care manageme nt
R&D services	Computer science in universities, national research centres on IT	Medical and health informatio n systems research

The relationship between the terms “architecture” and “infrastructure” also need explanation. 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 of 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 satisfying 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 [13]
- Information on infrastructure is mainly open for anyone.

The Finnish Electronic Prescription

The Finnish electronic prescription is currently in the building phase. First implementations should take place in December 2008, and by year 2012 80% percent of all prescriptions should run electronically.

The key feature of the Finnish electronic prescription is, that all prescriptions are sent electronically to a central, nation-wide database. As far as we are aware a similar solution exists nowhere. The central database is operated and owned by the state-agency Social Insurance Institution. For now, the electronic delivery of prescriptions will be just one alternative among others, namely

1 traditional paper-based prescription
2 telephone prescription
3 fax prescription.

However, in the long run, if the benefits of the electronic prescription, such as the elimination of false and counterfeit prescriptions, are to take place, the other methods of medicine delivery should be abandoned.

The principle of the Finnish Electronic Prescription is presented in Figure 1.

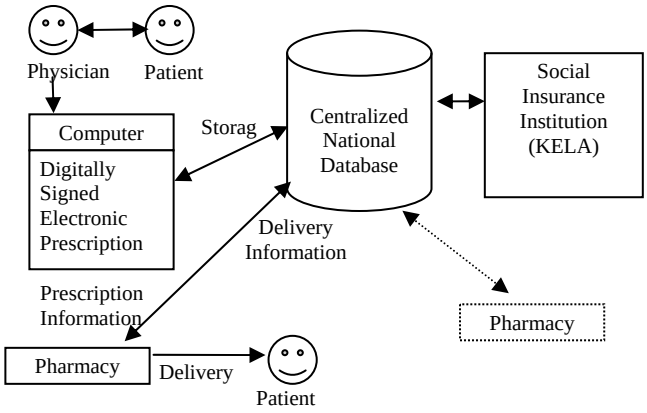

Figure 1 - The centralized database solution for the Finnish Medicine Prescription System

Central principles for the national electronic prescription system are among other the following:

- at least to begin with, the use of electronic prescription is voluntary for the patient
- health care organizations must be able to provide electronic prescriptions by year 2011
- patients are delivered a medicine guidance sheet
- the patient must be able to collect his/her medicines from every pharmacy
- there will be a national portal for citizens (eKatselu = eView) to take a look at their own medicines
- the system must keep track on the logins to the data and provide that data to the citizen
- the prescribing medical doctor, upon agreement of the patient, will have a possibility to take a look at all the prescriptions the patient has
- the system is based on one medicine database, maintained by government authorities.

Implications for electronic prescriptions

Is the Finnish Electronic Prescription System also a national infrastructure? We think yes.

First, the project was set up by the Finnish Ministry of Health and Social Affairs, and both the medicine prescription process as well as the process to build an information system to support it are heavily framed through regulation. However, we have not yet seen any definition who is going to be the owner of the new system.

The primary users of the new system are restricted to certain parties that are involved in the medicine prescription process by law. However, inside that group there should be no discrimination by any plans. 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.

As said, the owner of the electronic prescription system is not clearly defined. This speaks too 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 those are made possible 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.

Medicine prescribing is not a new function in the society. We also already have a manual infrastructure for that. The new electronic prescription system will affect some parts of that infrastructure. However, no modern society could life without regulated medicine prescription processes, so we 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. It should be 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 peoples rights. Take for example the systems for keeping track of driving licences. Or take systems that cover bank accounts. Or systems in universities etc. that register their 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 [14].

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 [15].

Table 2 IT-infrastructure in general and in the case of electronic prescriptions

IT infrastructure characteristics	**IT infrastructure characteristics in the case of electronic prescriptions**

It is not primarily there in order to bring profit for its owner	Electronic prescribing is not for profit to the state
Many structures base themselves on infrastructure	For example, automated drug dispensing solutions base themselves on the electronic prescription
The society as a whole is very dependent on the infrastructure	Prescribing in general is needed in every country – with electronic prescriptions the process will become more efficient and effective
Information on infrastructure is mainly open for anyone.	The documentation on the electronic prescription is available on the net (not all technical solutions, but requirements for the system)
It is directly or indirectly controlled by public organizations and political decision making	The system is run by the Finnish social insurance institution and controlled by the ministry of health and social affairs
It is available for anyone willing to pay the usage fees and satisfying the rules set for its users	Every Finnish health care organization and pharmacy is able (and must) join the system. Every citizen has the right to use the system.

Conclusions

We arrive to several conclusions. First, infrastructure and normal business applications are a different issue. They need different bases and methods for feasibility studies, building and sourcing, operation, management, maintenance and life cycle management. In most cases, infrastructures have an eternal life-cycle (at least with current visible technologies). As a general rule, everything having to do with infrastructure must be more patient than that with applications: changes are and must be slower, things mature over a long time, and there are no possibilities for fast business profits.

The IT research community has focused its interest mainly on IT infrastructures at an organizational, business level. The topic of national infrastructures is less studied, but the study of the Internet in its various forms has a strong grisp on the global communication infrastructure. Yet, many topics and infrastructures are neglected at the national and global level.

Something being an infrastructure does not mean that it would not generate business opportunities. On the contrary, many infrastructures are a constant source of income to their owners, many times even a lucrative one, as in the case of electric distribution. The trap hidden to many is that infrastructures need investment, which can turn the business case upside down. If you want to cash out your infrastructure, you can do it for maybe some decades depending on the type of the infrastructure at hand, but sooner or later a need for massive investment needs is to emerge, and then many cost/benefit calculations and business models need radical change.

Health care is a wide industry penetrating many aspects of human life. It certainly has many infrastructures, and the information and communication infrastructures of the area are growing and expanding fast. As a heavy regulated and conservative industry it has very many very permanent infrastructures. To take an example, the very basic process of prescribing medicines has remained mainly and basically the same for 200 or more years in almost all countries. Widely speaking, medicine has the biggest body of knowledge supporting it among all disciplines and industries, and it is then clear that a huge infrastructure is needed to support the maintaining, management and utilization of this knowledge.

Electronic prescribing is maybe a borderline case between being just a normal information system application or a national infrastructure. Our conclusion and proposal brought forward here is, that seeing the system as a infrastructure rather than a normal application would give us a deeper insight on the system and its various use aspects, and give us richer guidance on its building, management and maintenance. In the case of the Finnish endeavor to build an electronic prescription system, we have seen several project and system failures in a period of over 20 years. First now we can see dyes that the system is maybe built on the premises of being an infrastructure. Time will show us whether this will make the system more successful than its older versions.

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