

Reprint, permitted by the National Institute for Health and Welfare and the author. The original (in Finnish): Sosi-aali- ja terveydenhuollon tietotekniikan ja tiedonhallinnan tutkimuspäivien satoa julkaisusta: Avauksia, 12/2009 (toim. P Ruotsalainen) Terveyden ja hyvinvoinnin laitos, Helsinki 2009.
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ICT Infrastructure and Network Externalities– two forgotten concepts in Finnish discussion on health care information systems

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Abstract

Finland is flooded with ambitious projects to build nationwide health care information system solutions. A key issue to emerge is how to engage potential users, both at individual and organizational levels, to accept these systems and take them into intensive and productive use. Acceptance might be hard to find, as financial calculations showing positive payback on investments to organizations are hard to produce. What should maybe stressed more is that the systems in building phase will bring considerable benefit through infrastructure level services and resulting network externalities to the user community. These two key concepts are shortly discussed in this article, and their application in the health care information systems environment is illustrated.

Keywords: Health care information systems, ICT architecture, network externalities, acceptance of information system investments

Introduction

Introducing new information and communication technology (ICT) to the health care field is a major challenge. Broad finance, even from outside the taxpayers' pockets is needed. For example, the private sector needs new motivation factors and reasons to join the new national systems, such as nationwide health information archive or electronic prescription system. New argumentation concepts are needed. Here we introduce the benefits of infrastructure thinking and network externalities as potential new argumentation devices to support investments into health care information systems. Limitedly, these arguments can be used even in the search for new information technology acceptance from medical professionals, but primarily they should address political decision makers and health care organization management.

Information and communication technology infrastructure

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 [1] [2], public houses such as schools, museums and libraries [3, 4], 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 [5, 6]. The super infrastructure of IT is that of Internet [7]. However, in IT infrastructure can refer to smaller entities, such as telecommunication [8], electronic commerce [9], or information as such [10], just to give a few examples. Some relationships between terms too 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 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 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 [11]
- Information on infrastructure is mainly open for anyone.

In the following table, we illustrate how electronic prescription, as a representative example, could be seen as a national ICT infrastructure.

Table 1. Illustration of interpreting electronic prescription as a national ICT infrastructure

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.

Network externalities

Network externality has been defined as a change in the benefit, or surplus, that an agent derives from a good when the number of other agents consuming the same kind of good changes. [12]. The roots of the network effect research are in the marketing discipline, where it was understood that the success of a product or service is a phenomenon strengthening itself. The phenomenon was called the bandwagon effect by which was meant *“the extent to which the demand for a commodity is increased due to the fact that others are also consuming the same commodity. It represents the desire of people to purchase a commodity in order to get into ‘the swim of things’; in order to conform with the people they wish to be associated with; in order to be fashionable or stylish; or, in order to appear to be ‘one of the boys.’”*[13] Still today, the network effect is often connected the act of buying and selling, and not the act of consuming, as above: *“A positive consumption externality (or network externality) signifies the fact that the value of a unit of the good increases with the number of units sold”* [14]. Another definition stressing buying is that of: *“Network externalities arise when a consumer values compatibility—often stemming from ability to take advantage of the same complements—with other consumers, creating economies of scope between different consumers’ purchases”* [15].

One should make a difference between network effect and network externality. Network externalities should not properly be called network externalities unless the participants in the market fail to internalize these externalities [12]. An **externality** is the effect of a transaction between two parties on a third party who is not involved in the carrying out of that transaction. Internalizing an effect means that it is no more directed towards a third party.

Network externalities can be direct or indirect, and positive or negative.

Direct network externalities exist when an increase in the size of a network increases the number of others with whom one can “communicate” directly. Indirect network externalities exist when an increase in the size of a network expands the range of complementary products available to the members of the network [16].

Network externalities can be positive or negative. A typical negative network effect is a traffic jam. All too often network externalities are understood just as positive. The same phenomenon can be both positive and negative, depending on the role of the observer. To take an example, to a railway operator having a lot of customers is a good thing (more revenue), but for the customer the same situation can mean congestion, also a negative effect.

The enchantment of network externalities is that they often come out as surprise and as a byproduct that was not calculated or foreseen in any way.

In Table 2, we illustrate some network externalities that come out from the use of electronic prescriptions.

Table 2. Network externalities in the case of electronic prescriptions.

		<i>Causality</i>	
		<i>Direct</i>	<i>Indirect</i>
<i>Type of effect</i>	<i>Positive</i>	Increased computer literacy of medical staff Better possibilities to make statistics of medicine use Better preparedness for other areas of computerized order entry	New business for teleoperators Better capabilities of the software companies Environmental benefits from decreased paper use
	<i>Negative</i>	Decreasing value of prescription in the eyes of patients Decreased contacts between patients and medical staff Unemployment risk in pharmacies and the Social Insurance Institution	Less business for paper and printer producers More abstract health care system for citizen New challenges for medical staff education

Discussion

Network externalities and ICT infrastructure are clearly relevant concepts for health care. At the current point of development, the message of these concepts is not yet clear for the developers of health care professionals. Both concepts illustrate the long-term effects of information systems, and the fact that often the total industry or cluster is better off after investments in information systems, even when individual organizations on the short turn seem to have a negative payback for their investments.

This article just shortly summarizes the importance of the concepts discussed, and gives illustrative examples. The issue should be taken into extensive and intensive research agenda.

Summary

Argumenting the benefits of health care information systems to potential user organizations can be challenging. Seeing investments into health care information systems as traditional system investments limits the vision. New concepts and ways of illustrating the benefits are needed. The concepts of ICT infrastructure and network externalities hold considerable promise.

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