Facing the Lernaean Hydra: The nature of large-scale integration projects in healthcare.

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Abstract. Despite initiatives and actions, only minor steps towards better communication systems have been achieved in healthcare. We examine this phenomenon empirically through three Norwegian healthcare projects, all of which started in 2005. The projects were initiated and funded by the Norwegian government and were aimed at establishing inter-organizational integration in healthcare. We examine the nature of these projects, and elaborate on how they tended to escalate and increasingly become enmeshed with each other. The top-down approach, with a high degree of requirement specification up front, creates a large gap between the different stakeholders involved. As an alternative, we propose a more restrained strategy in line with the information infrastructure concept: development in an inter-organizational setting must be carried out in small steps and with substantial influence by users and vendors.

Keywords: National projects, healthcare, coordination, interdependency strategy, integration, information infrastructures, ANT

1 Introduction

A Western health care infrastructure is distributed across several institutional boundaries that typically involve general practitioners, hospitals, nursing homes, and home care services. This presents challenges for healthcare personnel who need a complete picture of the patient's condition. An example is when a patient is transferred from a hospital to the home care service; information about medication and care is essential to provide a quality service. As a result, improved electronic cooperation and integration in the healthcare sector have become an essential part of governmental strategies in Western countries [1-4]. In some instances, the government has even become directly involved in running several large-scale projects, such as the National Programme for IT in England [5] and the ePrescription project in Norway [1].

Despite these initiatives, only minor steps towards the improvement of electronic inter-organizational collaboration have been achieved [1, 6]. In the Netherlands, a number of national projects met pitfalls and challenges [7]. Conclusions from

evaluation and status reports in Norway are similar [8]. As a result, there is a call for even more governmental control and coordination [1, 8, 9].

However, large integration projects run by the Health Directorate seem to present a paradox: while many healthcare stakeholders call for more governance [10], the same stakeholders complain about how these top-down interventions are misplaced or fail to provide working solutions. We examine this phenomenon empirically through three national healthcare projects, which all started in 2005. The projects were initiated and funded by the Norwegian government and were aimed at establishing inter-organizational integration in healthcare.

The study contributes empirical insight into complex large-scale projects with top-down organizing. We elaborate on how these projects tend to escalate and increasingly become enmeshed with each other, thus complicating any governmental action. As an alternative, we propose a more modest strategy in line with the information infrastructure concept. Based on this, we address the following research question: What is the nature of government-initiated inter-organizational integration projects in health care?

Our analysis proceeds along the following three dimensions: Firstly, we elaborate on how the size and scope of national IT projects escalate and how they increasingly become interdependent on each other. Secondly, we explore how the government's top-down pre-specification needs substantial translations among the vendors to make requirement specifications work. And thirdly, given the many stakeholders and the different associated interests, we critically examine how integrations tend to redistribute the costs and the benefits unevenly among participants.

As a theoretical basis, we employ the concept of information infrastructure and supplement it with Actor Network Theory (ANT) to emphasize how infrastructural integration projects are complex, interdependent and unpredictable.

The rest of the paper is organized as follows: The next section describes the theoretical framework and concepts used in this paper. The methods section describes and explains the methods for the research. Next, we present in-depth information about three nationally initiated inter-organizational projects, followed by the discussion and conclusion.

2 Theory

Many of today's healthcare organizations have a large installed base [11] of information systems. General practitioners (GPs) use electronic patient record systems (EPRs) in their practice; hospitals run composite systems containing hospital-based EPRs, laboratory systems, radiology systems, and patient administrative systems. Many nursing homes have also introduced EPRs, and special-purpose systems are used by many emergency care units. While these different systems function effectively within the institution they are supposed to support, integration between them is often lacking or problematic [6, 7].

The lack of integration may have serious consequences. An example is information about medication held in EPRs in GP practices, hospitals and home care services. In most countries, this information is not integrated and must be cut and pasted into

ordinary letters for transmission between the different health care providers. This may cause adverse drug events [12] because physicians may prescribe new medication without being aware of existing medicine regimes. A study from a hospital in Norway found that 20% of the hospitalizations of elderly people were caused by adverse drug events [13].

Accordingly, in many Western countries, national strategy on IT in the healthcare sector emphasizes the importance of achieving a smooth information flow between the systems in the different organizations [1-4]. In many instances, the health authorities even undertake a direct role in coordinating and running IT projects [14]. In this regard, it is assumed that the authorities have the resources and the power to run the projects in a structured and controlled manner, and that they are able to coordinate activities between the different and often autonomous stakeholders in a top-down manner [8, 9, 14].

Unfortunately, experience from many studies of large-scale projects indicates that a top-down approach is risky and often fails. The size and inter-organizational scope of these infrastructures make integration efforts very complex. Typically, many stakeholders, infrastructures and vendors are involved, and a recurrent characteristic is that the projects tend to suffer from insurmountable delays, overrun budgets, as well as escalation of ambitions and scope [15, 16].

In contrast, considering coordination from the perspective of information infrastructure invites a more careful approach. Such an approach recognizes that overall control of systems in the healthcare sector is almost impossible, for the reasons provided above. The question then becomes how we can scale (cf. integrate) information infrastructures in healthcare without at the same time scaling the associated projects. Some clues to an answer may be found in the way that Star and Ruhleder [17] describe how infrastructures are *emergent*. They grow slowly over time, building on the installed base.

What also increases complexity in this domain is that there is not just one project, but several. As a result of their inter-organizational scope, many of the projects have interrelated and partly overlapping aims. Consequently, the government faces challenges related to coordinating and prioritizing *between* them. One complex project may escalate into a bundled collection of complex and mutually interdependent projects. In a sense, integration projects *are* about creating interdependencies between different systems. Data exchange formats have to be agreed on and work processes shaped, etc. However, the danger is that several overlapping projects may be too tightly coupled. From a system perspective, Perrow [18] uses the notion of loose and tight coupling to describe the degree of dependencies between the various components. He warns that tightly coupled systems have very little slack with only limited ways to accomplish a task. In a more process-oriented perspective, these dependencies may be conceptualized through the lenses of Actor Network Theory (ANT), where people and artefacts as actors are linked together in networks [19, 20]. The basis for the actors' participation in the network is that they pursue specific interests and will negotiate with and possibly ally themselves with other actors to try to achieve their goals. The flexibility of ANT enables us to zoom in on several of the characteristics of the projects while at the same time examining their increasing scale, their different strategies and their interdependency.

However, due to the high degree of complexity of national projects, it is not surprising that many demand for even more governmental intervention and top-down control, in accordance with the management literature [21]. This typically includes agreeing on a clear-cut requirement specification up front, followed by a well-defined bid-for-tender, and finalized by acquisition of the new system. However, considering the (coordination) challenge through the lenses of ANT, we are invited to see that it is extremely difficult to have everything settled up front. Firstly, this is not just a relatively standalone design task involving one customer and one vendor. Instead, there is a heterogeneous ensemble of existing systems and organizations that must coordinate their activities. ANT emphasizes how achievements are a result of negotiation of the actors' interests. In such a process, an agreement between two actors may result in a displacement of their original goals, or as Latour notes: "We can portray the relation between two agents as a translation of their goals which results in a composite goal that is different from the two original goals". It follows that top-down requirements from the authorities cannot just be imposed on vendors and user organizations. Rather, there is a great deal of work on the vendors' part in order to translate high-level requirement specifications on integration into the designer's specific needs in the development phase, which revolves around screen layout, specific exchange formats and data structures. In turn, the developed systems and the associated functionality need to be translated to the end-users' practice. Hence, there is a chain of translations and adaptations between the different actors in the network.

One might believe that integration is positive for everybody. However, the distributed, negotiated and partly unpredictable character of networks [19, 20] indicates that the envisioned effect of integration is not given per se. Several studies have also pointed out how integration delimits action [22]. Hence, integration brings not only benefits, but also costs [23]. As many of these projects are run at a national level, these issues have direct implications for the health authorities' strategy on integration: the assumed benefits and costs have to be carefully balanced. To take the argument further, given the many different institutions involved, one may experience that the costs and benefits may be unevenly distributed among the participants [24]. Naturally, this will also be reflected in each stakeholder's willingness to allocate resources as well as to pay for integration projects. From an ANT perspective, the actors involved (vendors, institutions, authorities, etc.) may pursue completely different interests, thus prohibiting potential compromises and making it hard to keep the actors in line.

3 Method

An interpretative approach [25] is used to develop a better understanding of the mechanisms influencing the development of tools for electronic cooperation in the healthcare sector. The empirical material has been gathered through a longitudinal process that started in 2004 and is still ongoing. In this period, the first author has collected empirical data from the following information sources:

- Strategic documents and evaluation reports for ICT in Norwegian health care for the period 1997 onwards.
- Project documentations for each of the three projects
- 25 semi-structured interviews with vendors, policy makers and public authorities. The interviews were conducted by the first author and lasted between approximately 60 and 160 minutes

The first author was formerly a project member in the core EPR project, one of the analysed projects, and has thus worked as an insider [25]. This has given her valuable insight into how these projects have been run and has enabled easier access to key actors in all of these projects, who would otherwise be difficult to make appointments with. Nonetheless, throughout the data collection and analyses process, she had to re-examine her own perceptions of what was going on in these projects. After initially ascribing the problems and delays primarily to the vendors, she increasingly considered the challenges to be much more complex, involving interests, relationships and interdependencies between many actors.

4 Background: Problems due to inadequate cooperation

Norway has a publicly managed healthcare sector divided into the primary health service and the hospitals. An important part of the primary health care is the self-employed GPs, who number almost 3000. Today, almost 100% of the GPs and the hospitals use EPRs. In 1990, the authorities established KITH, a dedicated centre, which prepares national standards for secure electronic cooperation within healthcare. Norway was one of the first countries in Europe to establish an infrastructural network for interaction in the healthcare sector [9]. Currently, more than 80% of the GPs and 100 % of the hospitals are connected to the Norwegian Health Net [1]. During more than 30 years, a vast number of standards for exchanging medical certificates, discharge letters, referrals, laboratory orders and laboratory results have been developed. In spite of this, establishing substantial volume services between different health institutions has taken more time than anyone would have expected when taking into account the first national plan for ICT in Norwegian healthcare from 1997. In 2006, only 8% of referrals to Norwegian hospitals and about 50% of discharge letters were sent electronically [8]. A high number of versions of the messages are making the communication even more challenging. In 2009, only 8% of the messages flowing between the health institutions were approved by the authorities [26]. Electronic medical certificates were required by law from January 2010. At this date, 33% were sent electronically [26]. Thus, a key concern in the current national strategy plan is to revitalize the efforts related to improved workflow and seamlessness [26].

4.1 Three nationally initiated inter-organizational projects

During a few months in 2005, the public administration started several linked projects: ePrescription, Core EPR and ELIN-k. The projects were to be finished within a period of three to four years.

The three projects had a common goal of increasing the degree of regional cooperation, and were thus perfectly aligned with the Norwegian strategy [1].

Table 1. Key information concerning the three projects.

Project	Design strategy	Funding	Period
ePrescription	Database with prescriptions	30 million Euro	2005 ->
Core EPR	Database with medication records	3 million Euro	2005 - 2009
ELIN-k	Messages directly between institutions	2 million Euro	2005 ->

4.2 ePrescription – "a living hell"

In 2004, the Ministry of Health initiated a project called ePrescription, which stood for electronic prescriptions. The most important argument for this was a regulation that instructed the National Insurance Administration to document all prescriptions handled by the pharmacies. However, implementing electronic prescriptions was also expected to provide benefits for pharmacies, which could handle prescriptions faster and with fewer errors. The doctors saw the potential for decision support, improved quality, and less time spent on writing prescriptions. The patients could have their prescription distributed to any pharmacy, and the authorities could distribute changes to regulations more efficiently. The project was to be completed in 2009.

The following actors were included in the project: Norwegian Pharmacist's Union, National Insurance Administration (NIA), Norwegian Medical Association (representing physicians) and Norwegian Medicines Agency (NMA), which concerns all information concerning medicine in Norway. The project was managed by the Directorate of Health.

The ePrescription project was established with funding from the parliament of about 30 million euros. The EPR vendors received funding for parts of their development costs.

First of all, the authorities wanted an electronic prescription system to document the use of medicine and control the public financing aspect of medicine distribution. In the beginning of the project, the management targeted its efforts toward this end. However, the physicians' representative was dissatisfied with the system that had been outlined, as the physicians' perspective was lacking. The system did not allow for some kind of support during the prescription phase, such as interaction control and product information. Neither was it possible to send orders to the pharmacy for those patients who got their medicine packed in separate single-use doses. The physicians

are vital in the prescription process. Without their goodwill, prescriptions would probably still be in a paper-based format, and this would have undermined the concept of substantial electronic cooperation concerning prescriptions. In 2007, a new version of ePrescription was designed, but pilot testing was based on the first version.

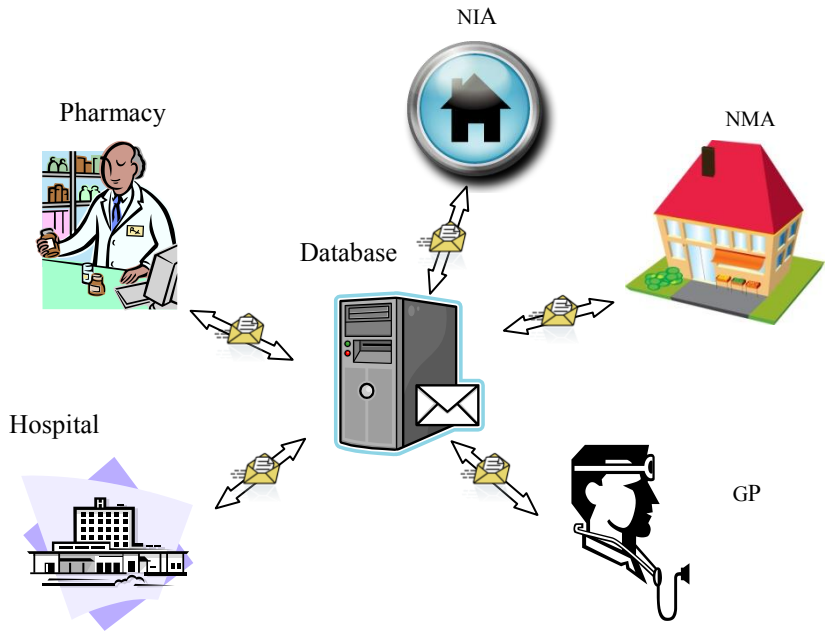

Figure 1. ePrescription concept.

The first version of ePrescription did not provide the functionality that the doctor wanted. We had to tear it apart and build it up completely from the ground. The first version did not have any future perspective and was not possible to develop further into an adequate service. [Project member]

Another problem was that the three vendors of the hospital-based EPRs demanded more specific requirement specifications before they were willing to develop anything. As a result, the project initiated working groups in the hospitals to work out user requirements for hospitals. It was difficult to launch an initiative and recruit volunteers in large institutions like hospitals, and therefore about two years passed before the working group was able to deliver. Only one EPR vendor for GPs developed functionality for the first version of ePrescription. The remaining two were not able to participate because they had recently introduced new EPR systems that needed a great deal of attention.

Much involvement from doctors was in the form of interviews, meetings, and workshops. The EPR vendor participated in much of this work. During this process, the specification changed extensively:

The technical specification of the message we were supposed to get from the Norwegian Medicine Agency was only ten percent OK when we started developing. [..] They had defined classes and stuff that they wanted to use in the message but the

message itself was not defined. And there were a lot of changes in the class structure afterwards. [EPR vendor]

The Norwegian standardization organization, KITH, was included in the project when the testing phase started:

It [the message] was supposed to be finished before we started developing because we needed something to test against. The result was that we had to go several rounds with the Norwegian Medicine Agency to say that the message that had been constructed was in fact not a message, but rather a text string. So we had to go some rounds with KITH where they standardized the message. [..] In the end of the summer [2007] we had a fairly good data model on the message, but still we received a lot of errors in the messages, wrong data type, etc.[..] Several kinds of things like this influence the time of development. [EPR vendor]

Even after KITH had established the structure of these messages, a great deal of testing and error detection was necessary in order to communicate seamlessly between the actors. In the ePrescription project, only one of six vendors participated actively during the first three years. The workload necessary for establishing communication between the EPR and the rest of the actors, for instance the prescription database, was very time-consuming and several times greater than initially expected. This project, with a budget of 30 million euros, offered the vendor 175 000 euros – which is about 0.6% of the total budget.

A pilot test was launched by the Minister of Health in a small municipality in Norway in May 2008. The EPR vendor insisted that it should be postponed for a few months, but this was refused.

Those who manage the [ePrescription] project have obviously decided to keep it on schedule, and this is said in such a way that you understand that there is a lot of prestige in the project – as if there is somebody who will rap them over the knuckles if they don't. [Profiled health actor]

The EPR system that was integrated with ePrescription was a completely new system, but unfortunately the vendor had not had time to test it sufficiently in-house. The ePrescription was installed just a few days after the installation of the new EPR. This caused even more trouble for the pilot users, who received too much experimental software to test in a busy working day. The EPR vendor was mainly delayed because the development tool they had used, Microsoft's FoxPro, was not supported any more. The vendor then had to start its development from scratch, only two years back in time. As a result, the combined functionality offered to users was not good enough and was characterized as a "living hell" in the Norwegian media. The pilot was aborted after only three months. The next pilot test is now scheduled for the beginning of 2010.

4.3 ELIN-k: Communication with the municipal sector – "the best public project in which I have ever participated"

In 2005, the Norwegian Nursing Council initiated the ELIN-k project, which focused on electronic information exchange of health information in the municipalities. More specifically, this concerned the nursing homes, home care service, emergency wards, hospitals and medical offices (GPs).

The goal of ELIN-k was to develop 13 standardized message formats that enabled the different institutions to communicate. ELIN-k was the first project that used standardized electronic messages in the municipal healthcare sector – both internally and to other parts of the health care sector. The messages were logistics, applications, medication and diverse information messages. In a revised project plan from February 2006, the project was scheduled for completion in February 2008.

The Norwegian Nursing Council and the Norwegian Association of Local and Regional Authorities were in charge of the project. The latter was considered to be an important actor because it represented the users and the owners of the ICT solutions in the municipalities. The Nursing Council represented the users on an occupational level. The inclusion of the Norwegian standardization centre, KITH, was considered essential.

The communication flow had to be tightly integrated in the ICT tools that already existed in the health care sector. Therefore, a total of seven vendors, covering all sectors within the healthcare, signed contracts with the project. Six municipalities wanted to run pilots.

The funding of the project was a package deal between the Ministry of Health, Innovation Norway (the Norwegian Association of Local and Regional Authorities) and the Norwegian Nursing Council. The EPR vendors would get about 50% of the stipulated development cost of the project. The package totalled about 1.5 million euros.

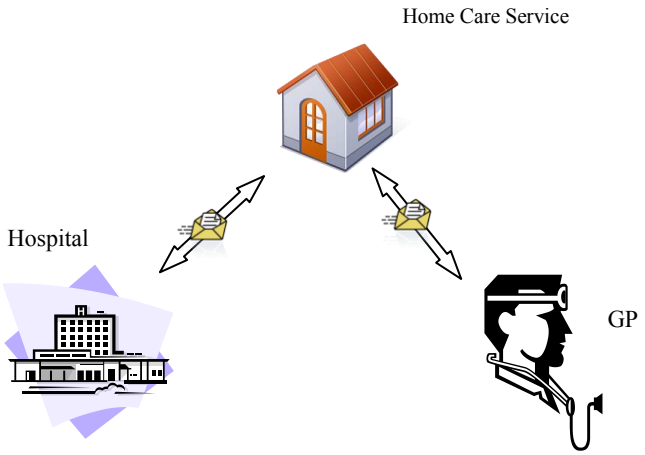

Figure 2. ELIN-k concept.

One of the most essential messages included in the project contained medication information. The prescription is the first step in creating this information. Hence the prescription should also be the basis for information that the home care service or the hospital needed. This caused some trouble for ELIN-k, because medication was the essential part of the ePrescription project, and here a standard was in the process of being developed. A common data model was necessary in the medication module.

The main activities in the project were development, laboratory testing, approval, pilot testing, evaluation, and adjustment of requirements. In the beginning of the project, the specifications had to be worked out more in detail in order to create a description that developers could take further. The project used a working method that involved users in cooperation with vendors to specify the requirements and to adjust them. Several meetings and workshops were arranged and included users from the pilot municipalities and sometimes also EPR vendors. These gatherings were considered useful from the vendors' point of view. The vendors were involved from the very beginning, but were not very active during the first two years. The amount of work with regards to user requirements was more time-consuming than initially expected. Several rounds of description and justification were necessary in order to fit the workflow and standards.

But the function descriptions are very difficult to follow and they have also changed a lot without a good specification. [..] The function descriptions do not always agree with the standardized messages. [EPR vendor]

Considerable delay was also caused by a lack of resources on the vendor's part. The specifications for the first phase in the project, communication between nursing homes and medical centres, were finished in 2006 and the vendors were supposed to deliver in spring 2007. An informant among the vendors explained:

The vendors are heavily tied up in other things too. They have to upgrade their own system and requests from their customers. Then IPLOS [a demand from the authority] has been going on at the same time, we have been forced to prioritize IPLOS over the messages. All these projects that are going on at the same time steal from the same resources and there is very little coordination between them. [..] The Directorate pushes on and does not respect that we are tied up with other things. [EPR vendor]

During the spring of 2009, one of the EPR vendors within medical centres and one within the municipal sector delivered the functionality in the EPR and the first message was sent from one of the pilot sites. This was two years later than first planned. Unfortunately, the project run out of money in 2009 and will not be able to include all the planned messages. In sum, the EPR vendors were positive to the way the project had been organized and several stated that it was the best public project in which they had participated.

4.4 A National Core EPR – "I can't imagine that our doctors will pay for this"

In 2004 Trondheim Municipality applied for project money announced by the Directorate of Health. It received support in December 2005 and named the project: Core EPR. The goal of the project was to develop, implement and test the functionality of a core patient record. This was a database consisting of all the medication information of the patients. The database should be easy to access for those treating the patients. Patients who had their medicine administered by the home care service were the ones who were planned to be included in the pilot. The first pilot installation was planned to take place in late 2006, and the service was to be evaluated and completed by the end of 2008.

The project was run by Trondheim Municipality and included eight EPR vendors (three GP EPRs, three municipal EPRs and two hospital EPRs). KITH was also included because new standards for the cooperating EPR systems had to be developed.

The funding of the project was a package deal between the Ministry of Health, Innovation Norway and Northern Norway Regional Health Authority. The EPR vendors would get about 50% of the stipulated development cost of the project. The package included about 3 million euros.

Some sort of coordination with the ePrescription project was expected, as the electronic prescription was considered the most significant input to the database. The Core EPR was to be used in several different health care institutions: hospitals, home care services, nursing homes, emergency wards and GP practices. This implied that the medication information had to be presented in a proper and adapted way in each institution.

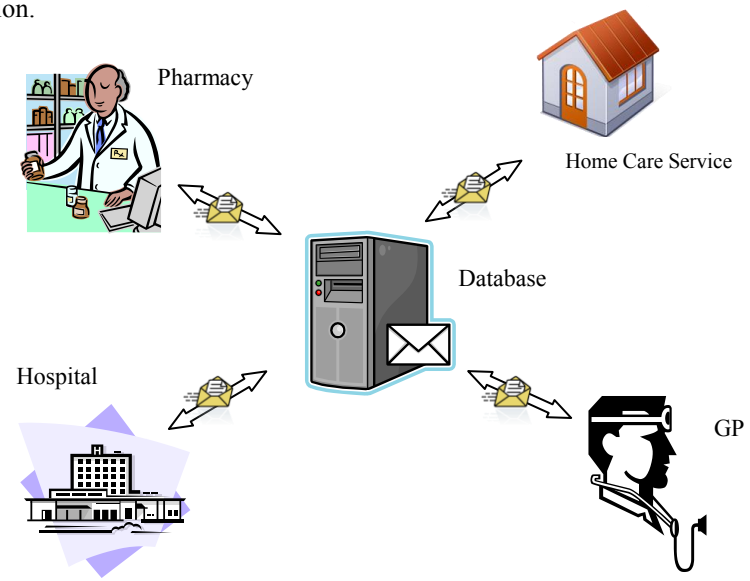

Figure 3. Core EPR concept.

However, the first version of ePrescription did not split up the information elements in such a way that the information could be presented differently to the hospital and to the home care service. As a result, the progress in the Core ERP was slowed down until the ePrescription team drew up new specifications in version two.

The core EPR consisted of two main parts: (1) a database and (2) integrated EPRs that read and write information into the database. A high-level requirement specification was made in the beginning of the project. This was based on user participation and was mainly written by the Norwegian standardization company, KITH. While interested in the project, the vendors had concerns about whether they would be fully funded and whether they had the development resources available

within the specified time limit. As they saw it, there was little potential for making money from the new functionality:

This might be a good service, but I can't imagine that our doctors are willing to pay for this. [EPR vendor]

Due to feedback, the project had to find a source of finance so that the EPR vendors could get payed for their effort. This process lasted for more than a year. Basically, the project team wanted to include as few EPR vendors as possible, but felt forced to include all the vendors and to produce a national solution because funding from Innovation Norway was not available otherwise.

The development of the Core EPR database was assigned to ProfDoc – the largest EPR vendor in the GP market. The contract was signed based on the preliminary specification. By the end of 2006, the project had raised funding for 50% of the development that the EPR vendors needed to do in order to adapt the EPRs to the database. Most of the other vendors also signed a contract. User workshops and technical workshops were arranged and the specifications were further developed. This process was difficult for the EPR vendors.

We give input to the specification all the time, but we don't receive any feedback. We just hear from the project that "yes, we have included it in the specification", but we don't know which part of our input has been taken into account. We have to wait until the next meeting and read the documents that are sent to us in connection with it, and see if our input is taken into account. [EPR vendor1]

It seems like those who work with the specification and the EPR vendors live in two separate worlds [...] when we get an answer to a question, it is often on a level that is useless to us. [EPR vendor2]

None of the EPR vendors started to make adaptations in their systems for the Core EPR. The vendor that developed the database delivered it and installed it in the local area network at the municipality and claimed that it was according to specifications. The municipality claimed that they had not received sufficient documentation together with the database.

If they don't understand it, then it is because they don't understand their own project – and that is a bit curious! [EPR vendor]

The project made no progress and was terminated in 2009 without achieving any kind of testing.

5 Discussion

5.1 Escalation and Interdependencies

In this section, we analyse how national projects coordinated by the authorities tend to escalate, overlap with each other, and increasingly become mutually interdependent [18], which curbs progress and may ultimately cause failure. From an ANT perspective, we consider each of the projects as a growing network due to an increasing number of actors with regard to participants, details on requirement specifications, funding and the like [19, 20].

In its simplest form, the authorities wanted electronic prescription to document use of medicine and to control the public financing aspects of medication distribution. In the first round, this implied giving preference to the requirement specification from the National Insurance Administration and the pharmacies. However, this was not in line with the interests of the physicians' representatives. They argued that the doctors were an essential part of the service and if the functionality for physicians was not included now, it would probably take many years to achieve anything that worked, if this was possible at all. Since the requirement specification was more or less pre-specified, they argued very strongly in favour of having the physicians' functionality added. Otherwise, the risk existed that by the time the project period was complete, nothing would be developed for them and the funding would be spent.

As a result, during the project period the requirements from the hospitals and the GP practices were also included. When the project management re-designed the specifications, all actors had their say, and the project agreed on a solution that worked for everybody. However, keeping everybody satisfied resulted in an enormous escalation of the requirement specification.

In the Core EPR, lack of funding caused the escalation. Initially, the project team wanted to test a simple medication database and integrate a few EPR systems, but the project was forced to include all the EPR vendors to obtain sufficient funding. The authorities had funded only the part of the project that included project costs for the public staff of the project. In turn, much of this funding was used to find funding sources for the EPR vendors. Finally, after nearly a year, funding was granted from Innovation Norway – a governmental funding institute that stimulates nationwide industrial development. In this process, the project grew from a small local project into a project with national dimensions.

Basically we wanted to develop a small Core EPR between only three systems, but due to the pressure we were forced to have a national focus – and then everybody had to be included. [Project manager, Core EPR]

In ELIN-k, they experienced that the specifications needed substantial work in order to fit into the workflow in the three different institutions.

Since the projects concerned medication, there were overlapping functionalities between them. Therefore, the vendors wanted to use the same data model for medication information in all the three projects. While this was an obvious strategy for the vendors, it tightened the dependencies between the projects. Since the ePrescription was to contain all active prescriptions for a limited time span and the Core EPR was to contain the complete medication regime for a limited patient group, this implied that the Core EPR project had to wait until the ePrescription definitions were ready. Unfortunately, the first draft of the electronic prescription was not in a data format that the Core EPR could use, causing a new delay in the Core EPR project. Even in the relatively simple ELIN-k project, the lack of a defined medication message hampered the progress. The participants argued that the project was dependent on the specifications defined in both ePrescription and the Core EPR. The ELIN-k project considered it was best to wait for the definition from the ePrescription rather than defining anything themselves, in turn potentially adding some constraints to the ePrescription project. This situation was enforced because ePrescription was recognized as having more influence and status than the other two projects and was run directly by the Directorate.

Furthermore, since all the projects had signed an agreement with the same EPR vendor, a serious resource dependency emerged. The vendor had signed up with all the projects because it felt the pressure of being the largest vendor in the GP practice market (70–80% of the market), and knowing that progress was dependent on them. However, as the amount of development work was underestimated, the vendor became a bottleneck in the process. Even worse, the ePrescription solution could not be integrated with the vendor's EPR version because of the new data structure. As the vendor was in the middle of redesigning its EPR, it was not willing to adapt the old EPR version to the ePrescription format. Instead, most of the vendor's resources were allocated to the task of redesigning its EPR software, causing even more delays.

5.2 Translating top-down requirements into practical work

Large-scale integration projects in healthcare need coordination between the different stakeholders and their associated information systems. As this is recognized as a complex task, often subject to delays, it is a common perception that the authorities should impose more governance to ensure that the projects are run more predictably [1]. This was also a key theme at the Norwegian national HelsIT conference 2008 [27]. Many representatives from the healthcare institutions called for more interventions from the authorities regarding stricter project plans, well-defined requirement specifications, fixed completion dates and complete standardization formats up front.

In contrast, we believe that more governance and having everything settled up front may be the wrong strategy. Lessons learned from many studies on information infrastructures indicate how these systems emerge gradually and never top-down [17]. Many translations, adaptations, and negotiations need to be done at a practical level where many heterogeneous stakeholders are involved [20 p 36]. Predefined specifications fit poorly with this:

It is not possible to start some kind of development based on the specification [in one of the three projects] - we must rewrite the whole damn thing. It is on such a theoretical level that all of it needs to be explained in a practical frame. [EPR vendor]

We get these projects that are kind of agile processes where we receive a requirement specification that is not finished – then we work with it continuously, but then also the time schedule is shifted all the time because when the requirement specifications are not frozen – you accept modifications and then you must modify the final date. [...] And that is the problem with public projects. They have specified a final date and at the same time put up an agile process that will change on the way. [EPR vendor]

Accordingly, a major problem is that the authorities expect the vendors to sign up on development contracts that have a fixed closing date and a limited budget, but still expect an agile and dynamic development process.

The paradoxical consequence is that the vendors also end up demanding more pre-specifications from the authorities to avoid losing money on emerging demands from

the users and unforeseen circumstances. Consider how the vendors did not want to start developing anything in the ePrescription project until a detailed requirement specification was on the table. Consequently, the stakeholders take part in and contribute to a self-reinforcing process where everybody is demanding more detailed requirement specifications up front, which in turn causes more delays, keeping the spiral going. Ultimately, in the ePrescription project the vendor maintained that it received funding for only 20–25 % of its work.

This unfortunate process is bound to continue when the new system is put into real use. While the vendors deliver in accordance with high-level requirement specifications, the software has not really been tested. So instead of having a stepwise negotiation process [20] for requirements between vendors and users, the system – in accordance with high-level requirements – is pushed onto the users. The probability of failure then increases dramatically, which was eventually the case in the ePrescription project.

5.3 Uneven distribution of costs and benefits

An essential part of ANT is how actors are associated with and manoeuvre in accordance with their interests [19, 20]. In this light, each actor will pay attention to the consequences of the integration effort, and may easily ask: "What is the benefit, and what is the cost for me?" Along these lines, an uneven distribution of the costs and benefits for different user groups may explain failure.

In the ePrescription project, the most obvious benefits were associated with the authorities' need for control over the financial aspects of the medication distribution. In the Core EPR project, the benefits were found in nursing homes and the home care service. Accordingly, the benefits were not found directly among those who generated medication information, namely the physicians. They tended to see the new integrations as a cost. At least, this was not something the GPs would pay for or prioritize compared to other pressing tasks. In comparison, the success in the ELIN-k project may partly be ascribed to the municipality sector's willingness to put some money on the table to achieve integration with EPRs in the GP practice and hospitals.

What is surprising, then, is that many of the large integration projects are promoted as a joint effort among stakeholders who are only moderately interested in the project. Even if the government provides some limited start-up funding, this seems to be asking for trouble:

There is very little willingness in the Norwegian administration […] to finance public joint initiatives via the state budget. We are supposed to follow the line principle, which means that it is those with needs who should take the responsibility. This has been a central principle in Norwegian administration and I believe that this principle has been like a nightmare for the governmental administration – when I look at what other countries have been willing to finance in governmental projects. [Member of the Directorate of Health]

The principle of matching costs to needs entailed identifying those actors who had most to gain from this project. Interestingly, in this case it is basically the Norwegian administration itself that has most to gain. Hence, in accordance with its own

principle of weighing the benefits against the costs [23, 24], it should take on more of the economic burden of the project. If not, the burden of taking on the costs of developing the integrations easily becomes a joint effort that very few actors are interested in. Specifically, in the ePrescription and Core EPR project, the costs spilled over to the EPR vendors in the latter project, the vendor received only 0.6 % of a budget of 30 million euros.

Consequently, since the income is low and the new integrations do not do much for the vendors' market share, they do not see much benefit in the process. Accordingly, when vendors need to prioritize between different development tasks, it should not come as a surprise that they give preference to assignments from their primary customers, which ensure a steady cash flow. This is beneficial for both the customers and the vendors who appear as allies in these matters [20]. However, at the same time this puts the vendors in the unfortunate position of being regarded as the core reason for the major delays in these projects. A member of the Health Directorate expressed deep concern:

All the projects that I am concerned with in any way report delays due to (EPR) vendors, all of them - all of them! [Member of the Directorate of Health]

However, as we have emphasized, the problem is more complicated; the modest interest among end-users and the vendors combined with the government's funding policy may cause the project to drift off course.

6 Conclusions

In this study, we found that it is extremely difficult to manage large-scale projects top-down on a relatively detailed level, exercising a high degree of control. Information and workflow are so enmeshed in each other that it requires much effort and detailed insight to deal with the challenges as they emerge during the project phases. Organizing development within traditional project management - with a high degree of requirement specifications up front with pre-specified completion dates - creates the danger that every stakeholder will demand to have their interests inscribed in the requirement specification from the outset. Based on the study, we draw the following conclusions:

Firstly, we believe that development in inter-organizational settings requires a stepwise approach with substantial influence by (real) users. Early cooperation between developers and users will result in detailed specifications and will make the users able to understand the service that is being developed. A service that is developed in close cooperation with users will encourage the users to adopt the solution if it adds value to their work and is thus a service that the users will be willing to pay for.

Secondly, if the users are not willing to commit in early development phases, a model that is almost fully funded might be necessary to enable significant progress. Basically, this will also reflect the fact that the authorities are the driving force behind the required new functionalities. Alternatively, the authorities could channel funding via the users in order to convince the vendors prior to the authorities' request. The

reason for this is that the vendors are more loyal to their customers than to the authorities because their users give them a stable income.

Thirdly, scientific studies on national inter-organizational services seem to be lacking. The importance of such studies will increase as demands for inter-organizational collaboration increase, in healthcare as well as in other areas. We suggest that new projects focusing on new inter-organizational ICT services should be financed with earmarked research money - focusing on project processes. It is important that these funds are given to research groups that study several projects in order to build up a substantial body of knowledge. The research funding must be grounded among the participants in the projects, in order to achieve access to the various actors.

References

1. Norwegian Ministries of Health Social Affairs: Te@mwork 2007 - Implementation Plan, http://www.helsedirektoratet.no/vp/multimedia/archive/00017/IS-1433E_17193a.pdf. (2006)
2. Swedish Social Departement. National ICT strategy, http://www.regeringen.se/content/1/c6/12/47/97/9af34a6e.pdf. (2009)
3. Danish National Strategy, Digitalisation of the Danish Healthcare Service, http://www.sdsd.dk/~/media/Files/Strategi/Strategy_english.ashx (2007)
4. UK Department of Health. Delivering 21st Century IT Support for the NHS, http://www.connectingforhealth.nhs.uk/resources/policyandguidance/delivery_21_century_IT.pdf. (2001)
5. Parliamentary Office of Science and Technology. New NHS IT, http://www.parliament.uk/documents/upload/POSTpn214.pdf (2004)
6. Ham, C.: Integrating NHS Care: Lessons from the Frontline, http://www.nuffieldtrust.org.uk/ecomm/files/Integrating_NHS_Care.pdf. (2008)
7. Roos, A.d.: Implementing an electronic health record in the Netherlands: pitfalls and challenges, http://albertderoos.nl/pdf/Implementing%20an%20electronic%20health%20record%20in%20NL.pdf (2007)
8. Auditor General Norway. Evaluation on ICT in hospitals and electronic interaction in the health service, http://www.riksrevisjonen.no/SiteCollectionDocuments/Dokumentbasen/Dokument3/2007-2008/Dok_3_7_2007_2008.pdf (2008)
9. Norwegian Health Directhorate. Teamwork 2.0, http://www.helsedirektoratet.no/vp/multimedia/archive/00047/Samspill_2_0_-strate_47719a.pdf (2008)
10. Gaventa, J.: Triumph, deficit or contestation?: deepening the" deepening democracy" debate., Brighton, UK, IDS (2006)
11. Bowker, G., Star, S.L.: Sorting things out: classification and its consequenses. Inside technology. MIT Press (2000)
12. Nebeker, J., Barach, P., Samore, M.: Clarifying adverse drug events: a clinician's guide to terminology, documentation, and reporting. Annals of internal medicine, 140(10), p. 795 (2004)
13. Buajordet, I., Ebbesen, J., Erikssen, J., Brors, O., Hilberg, T,: Fatal adverse drug events: the paradox of drug treatment. Journal of internal medicine, 250(4), pp. 327--341 (2001)
14. Hyppönen, H., Salmivalli, L., Suomi, R.: Organizing for a national infrastructure project: the case of the Finnish electronic prescription (2005)

15. Fleming, N.: Bill for hi-tech NHS soars to £20 billion, http://www.telegraph.co.uk/news/uknews/1473927/Bill-for-hi-tech-NHS-soars-to-20-billion.html (2004)
16. Ellingsen, G., Monteiro E,: Big is beautiful:electronic patient records in Norwegian hospitals 1980-2001. Methods Inf Med, 42, pp. 366--70 (2003)
17. Star, S.L., Ruhleder, K.: Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces. Information Systems Research, 7, pp. 111--133 (1996)
18. Perrow, C.: Complexity, coupling and catastrophe, in Normal accidents, P.U. Press, Editor. pp. 62--100 (1984)
19. Latour, B.: Science in Action. Cambridge, US: Harvard University Press (1987)
20. Latour, B.: Pandora's Hope . Essays on the Reality of Science Studies, Harvard University press (1999)
21. Davenport, T.: Process innovation: reengineering work through information technology. Harvard Business School Pr, USA (1993)
22. Boudreau, M., Robey, D.: Enacting integrated information technology: A human agency perspective. Organization Science, 16(1), pp. 3--18 (2005)
23. Rolland, K., Monteiro, E,: Balancing the Local and the Global in Infrastructural Information Systems. The Information Society, 18, pp. 87--100 (2002)
24. Berg, M., Goorman, E,: The contextual nature of medical information. International Journal of Medical Informatics, 56, pp. 51--60 (1999)
25. Walsham, G.: Interpreting information systems in organizations. John Wiley & Sons, Inc. New York, NY, USA (1993)
26. Health Directorate Norway. Messages Status pr 1. Jan 2010, http://www.helsedirektoratet.no/vp/multimedia/archive/00282/Rapportering_pr__1__28275 9a.pdf (2010)
27. KITH NTNU. HelsIT 2008, http://www.kith.no/templates/kith_WebPage____2164.aspx (2008)