Evolving Structure in the Implementation of Healthcare Information Systems: An Actor-Network Analysis

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Abstract: Public sector ICT use is now moving towards integration of services and processes across departments, for instance in the healthcare sector. This is a challenging issue as it involves distributed decision making, often across both public and private organizations, which implies a multitude of issues. Enterprise Architectures (EA) aim at providing a common framework that includes data, resources and processes, through which all aspects of the enterprise can be directed towards a common goal in an efficient manner. It as been argued that architectures should be perceived as evolving (rather then as carefully planned roadmaps), although more research on how EA evolves is needed. This paper addresses the general question of, *how does an EA evolve during implementation?* A case study is used to illustrate how an EA evolves throughout the process of implementation. The case is the implementation of a national patient record system in the decentralized Swedish healthcare system. The project is part of a larger effort to implement an EA in the healthcare sector aimed at further integrating the whole sector. Data is collected by means of observations, interviews and document analysis. Using an Actor-Network Theory perspective, this paper presents four episodes during which an EA evolves through interactions. In this way the paper contributes with a deepened understanding of how EA evolves by arguing that EA programs should be seen as something that needs to be planned with regard to that it will, and should, evolve in order to respond to needs discovered in the process. The contribution is a deepened understanding of how sub-projects co-evolve with a national EA project, thus mutually affecting each other. This should not be perceived as something unequivocally negative as this might also be strategic, and leads to evolution of other parts of the EA to suit each other.

Keywords: actor-network theory, eGovernment, eHealth, enterprise architecture, evolving structure, implementation

1. Introduction

Public sector ICT use has moved from web presence to electronic services and is now moving towards whole-of-government integration (de Brí 2009). Such a change is taking place in many government sectors and can be seen to have a number of causes. Cross-department integration of services is aimed at making services easier for citizens to use; for instance, through the use of portal-solutions (Faruk et al. 2009). It also allows for more automation, such as checks of user input against the Tax Authority records (CSN 2006). The healthcare sector is also moving towards international integration of Information Systems (IS). One reason is the increased mobility which leads people to demand healthcare in countries other than that of their citizenship, as is the case in the EU. Another reason, and indeed one that is particularly important in Sweden, is the EU requirement for cross-border competition. Such a requirement means that goods and services produced in any EU country have to be available to citizens in other EU countries. The reasons for this are both commercial (no trade barriers within the common market) and democratic (free mobility and availability of services in all countries) (European Commission 2009). A central project concerning the development of interoperability of eHealth in Europe is epSOS (European Patients Smart Open Services). The project is a step towards meeting the patient mobility directive, which aims to enhance the opportunity for individuals of EU member states to receive healthcare in another country inside the union. The two major parts of the project involve making ePrescriptions and patient summaries (an overview of the state of a patient's health and medical history) available over country borders throughout the EU. Many of the member states have implemented or started to implement these kinds of solutions, such as the national patient summary in Sweden, although communications between states have not yet been achieved (epSOS 2009).

Enterprise Architectures (EAs) are increasingly applied in public settings, and aim at providing a common framework that includes data, resources and processes (Guijarro 2009). Through such a framework, these components can be directed towards a common goal in an efficient manner (The Chief Information Officers Council 1999). When implementing large-scale information systems (such as EAs) there is obviously a need to balance the needs and abilities of different actors, such as local and central government agencies (Boddy et al. 2009), in order to acknowledge both coherence and local independence (Humes and Reinhard 2009). Implementation of government information systems is difficult, as many failure stories bear witness (Lapsley 2009), in particular for integration projects,

which involve aligning the work of a large number of autonomous organizations (Bruun-Rasmussen et al. 2008). Projects often tend to be overambitious and fail to recognize that implementation of IS only is part of a larger agenda of changing government operations (BCS 2004). A central question relates to the way in which large-scale IT projects (such as EAs) are implemented and how this leads to failure or success. In order to understand the complexity of IS there is a need to take multiple aspects into consideration, such as relations between "technical-social, local-global, and system-infrastructure" (Jacucci et al. 2006). In order to approach this it has been proposed that information infrastructure projects should be perceived as evolving and that further research into how they evolve is needed (Cordella 2010). The need for more research into the social aspects of implementation within the specific setting of eGovernment has also been highlighted (Grundén 2009).

This paper analyzes the implementation of a national patient record system in the decentralized Swedish health care system, in which 20 county councils and 290 municipalities are owners and main care providers. The project is part of a larger program to implement an entire EA in the healthcare sector so as to make the whole sector increasingly integrated. This paper addresses the general question: *how does an EA evolve during implementation?* It uses a particular case study to illustrate and analyze how the structure of an EA evolves throughout implementation.

Section 2 of this paper presents EAs and an overview of literature on implementation of large scale IT projects. Section 3 describes the Actor-network Theory and motivates its use in this context. Section 4 describes the method used for the case study and analysis. Section 5 gives a brief background to the Swedish healthcare EA of which the national patient record system implementation is a case example. Section 6 presents the findings. Section 7 analyzes the findings in relation to EA. Section 8 summarizes the conclusions and highlights where research efforts should be directed in the future.

2. Implementation and Enterprise Architecture

In large-scale IT projects in the public sector, several issues can be identified. Goals may be vague or unrealistic (Lilmatainen et al. 2008), resulting in slow progress or no progress at all (Chowdhury et al. 2007). Aubert et al. (2008) argue that implementation should be carried out in accordance with careful planning and that monitoring of the work and results is necessary to avoid potentially harmful behaviour from different actors. Enterprise Architectures, such as the Federal Enterprise Architecture (FEA) have been proposed as a solution to this, clearly stating the intended outcomes and then building an architecture to support these outcomes (The Chief Information Officers Council 1999). Some authors argue that one major barrier to eGovernment initiatives is the lack of proper architectures in general (Venkatraman et al. 2008), or EAs specifically (Ebrahim and Irani 2005). On the other hand it has been questioned whether EAs are suitable for public organizations as they might be too rigorous and demand too much coherence, which would not be suitable within the complex context of eGovernment as it includes processes of information exchange between autonomous organizations and departments (Weerakkody et al. 2007). EA implementation projects require carefully considered timeframes and planning that is neither too rigid nor too relaxed with regard to when certain things should be in place (Aubert et al. 2008; Chowdhury et al. 2007). Others have also argued that architectures should be perceived as emergent and improvised rather than as clearly planned roadmaps (Smolander et al. 2008). The degree of strictness in planning is thus a contested issue, one which is proposed as a focus for future research (Hussain and Cornelius 2009).

A large-scale project implies that a number of actors (organizations, projects, technologies, etc.) need to work together, creating a situation which is often problematic. Possible issues include how to coordinate the work between departments and organizations, how to communicate across organizational boundaries, and how to create a shared vision of the future (Ebrahim and Irani 2005; Weerakkody et al. 2007), or indeed a more systematic vision of the organization as a whole (Chowdhury et al. 2007). Some studies argue that different actors' preconceptions about technology might influence the implementation (Hussain and Taylor 2007), since different groups have their own perceptions and experiences of what the technology is or should be (Sefyrin and Mörtberg 2009; Smolander et al. 2008). Central issues are how to align the interests of separate groups or how to align perceptions of the work that is actually going on, so as to avoid problems caused by differences in understanding of purpose, goals or progress.

In studies of mega-projects (not specifically related to IT) it has also been argued that goals of a project can evolve, as they are part of multi-project networks (Aramo-Immonen 2009), and that it is vital to ensure flexibility in projects in order to be able to cope with a complex social and technological

environment (Priemus 2010). Clearly, implementations of large scale projects involving IT are not either as easy as following a blueprint, which a multitude of issues concerning coordination, communication and strictness of planning shows. In order to better understand this complexity, large scale IT projects can also be perceived as evolving (Sahay et al. 2009). Some argue that eGovernment projects might have too much interpretative flexibility which can cause them to drift away from the intended goals and thus weaken the planned functionalities (Chen et al. 2009). On the other hand it has been argued that such projects could use flexibility as a strategy, allowing information infrastructures to evolve in order to strive for integration. How they evolve is, however, poorly understood in research (Sahay et al. 2009). In order to highlight how an EA is implemented with regard to initial plans and how the EA changes, or resists change in relation to this plan, the Federal Enterprise Architecture (FEA) business reference model is used as a frame of reference. The model is divided into (1) *outcomes*, such as the strategic or intended outcomes of an EA, and *business results*; and (2) *outputs*, such as processes and activities practised on a daily basis, and (3) *inputs* in the form of human capital, technology, and other fixed assets, such as finances. The initial planning of an EA starts with strategic outcomes and aims to align other aspects in order to support those outcomes (The Chief Information Officers Council 1999). This paper examines one case, with the aim to highlight how an EA program and projects related to it evolves dynamically throughout the process of implementation. Actor-network Theory (ANT) is used as the theoretical basis for this, as proposed by Cordella (2010).

3. Actor-Network Theory

To answer to the need to take relations between technical-social as well as local-global into consideration (Jacucci et al. 2006), the theoretical framework of ANT is suitable. As the purpose of this paper is to understand the evolving interactions in EA implementation in the public sector, it deals with different departments, projects and organizations. ANT is used to emphasize the interactions between these various actors and takes into account how these affect implementation. ANT also offers a theoretical basis to analyze relations between the actors as processes of interactive effects (Law 1992). Thus the analysis is not a static description but one which analyzes EA as an evolving process. This is suitable since EA implementation is perceived as being influenced by social as well as technological issues. A number of central concepts are summarized in table 1.

Table 1: ANT-related concepts used in the paper

Concept	Definition
Actor	Actors are not only human as there are also non-human actors. Humans and other actors are socially connected in networks and dependent upon one and other. (Walsham 1997)
Enrolment and translation	Enrolment is the process of creating a body of allies thorough the translation of the actors' interests to be aligned with the rest of the network. (Walsham 1997)
Actor network	A heterogeneous network of actors with aligned interests. An actor is also always perceived as a network. (Walsham 1997)
Inscription	An embodiment of translated interests, which provide direction of how other actors should act. (Hanseth and Monteiro 1997)
Obligatory point of passage	A defined border which actors need to pass in order to be able to go on with the process. (Callon 1986)
Black box	When a network is defined as a single actor, as it acts as a unit, it is black-boxed. This is, however, just a relative stability. (Hanseth and Monteiro 1997)
Episode	An episode is when the stability of a process is challenged, either by the enrolment of new actors or when an event that might trigger change occurs. (Cho et al. 2008)

In ANT there is no *a priori* distinction between different kinds of actors, whether they are humans, organizations or technologies: all are part of, and make up, overlapping heterogeneous networks. A network is held together by the alignment of actors' interests. This does not mean, however, that there is a high degree of consensus within the networks (Law 1992). The enrolment of actors leads to reconfiguration of the networks. In other words, the networks change when more actors are enrolled and their interests are translated to suit a wider body of actors. Thus, actors take part in a series of negotiations, at the same time defining the identity of the Actor-network, the inscriptions, as they try to align the other actors' interests to suit their own interests (Hanseth and Monteiro 1997). Some actors are enrolled into the network while others are left out as their interests could not be aligned with the other actors (Callon 1986). A network gains stability as the values inscribed are interpreted in a similar way by the actors, and might over time be black-boxed, although the box might still be opened if challenged (Walsham 1997). The focus in this paper is on the translations and inscriptions in the

different actor-networks (such as projects, technologies and humans) involved in the implementation of an EA. The focus herein is on events which are perceived as central by the actors, which are referred to as episodes (Cho et al. 2008).

4. Method

A qualitative interpretative case study approach is used as the purpose is to gain an in-depth understanding of the issues that affect the process of implementation in public organizations (Walsham 1995). The case study used is part of the implementation of the national patient summary, a project which formed part of the National strategy for eHealth in Sweden. The case was selected as it is a part of an EA, and includes organizations on both a national and local level.

The primary method for data collection involved carrying out semi-structured interviews (Myers and Newman 2007), performed between June and September 2009. An interview guide was used, with a set of themes to guide the interview, although allowing for follow-up questions and improvisation. The themes treated the actor's perception of the project (such as purpose and development over time), her/his role, identification of the central events and actors, and perceptions of issues in the process. (A full interview guide is available from the author on request.) The informants were primarily based at a local level as the project was a first step in the implementation process. The selection of informants was initially carried out through the identification of actors in central roles in the local project, by participating in the project meetings. The first interviews were with the project coordinator and the communications manager. Others were selected by snowball sampling, although efforts were made to interview actors based at various levels of the actor networks (Myers and Newman 2007). The actors came from several fields of practice, such as the IT department, project management and healthcare practice. A total of 12 interviews were conducted, of which 11 were at a local level and one was with a national actor; the latter was chosen because several local actors saw this actor as playing a central role.

The sampling method and the semi-structured interviews were motivated by the use of ANT, as it allowed the actors to participate in setting the focus of the research (Law and Singleton 2000). The interviews were recorded and transcribed and then analyzed continuously throughout the process. The author also sat in on meetings with a local project group for the implementation of the national patient summary. During a total of 12 meetings (held between August 2008 and December 2009), the author took notes relating to what was discussed, but did not participate in any discussions. The notes taken during observations were not structured in any particular way, although they were guided from an ANT perspective, with specific regard to critical events that challenged and/or redefined the process of implementation. The central material analyzed herein comprises transcripts of the interviews, although statements have been cross-checked with documentation (such as public reports, web pages and internal documents made available by the informants) and observation notes.

Analysis was carried out by grouping the informants' statements into themes categorized according to which subject they concerned; these were then related to each other. As themes were connected to other themes, inscriptions and translations were clarified and the descriptions of connected processes took form. The central processes (themes, with actors and events) are the episodes presented in the findings. The episodes comprise the parallel processes, which are the result of analysis of those processes perceived by the informants to be central, the actors and networks that took part in these, and the outcomes. The paper was presented to a stakeholder panel, which gave feedback on the analysis. In addition, the entire paper was read by a national-level actor, which led to minor corrections concerning formulations, although the paper was considered to provide a fair picture of the case. All quotations were read by the quoted actors to ensure a fair interpretation.

5. The Swedish national strategy for eHealth

Healthcare in Sweden is decentralized. The system is maintained by 20 county councils, which are responsible for hospitals and primary care, and by 290 municipalities, which are responsible for home care of the elderly and disabled. At the time of the case study, the use of IT in healthcare was widespread, although lacking in coordination and interoperability as most care providers used different systems for electronic patient records. When a patient required healthcare in another part of the country the record was not available, thus requiring the care provider to create a new record. This was perceived as inefficient and potentially hazardous as records could be inconsistent, outdated or double-stored.

In 2004, a report was released by the Swedish healthcare authorities and Carelink, a private organization set up to establish a common picture of the use of IT in healthcare. This put in place the groundwork for engaging relevant stakeholders in discussion on requirements and legal preconditions for interoperable ICTs in the healthcare sector. In 2005, Carelink initiated a project aimed at defining rules for electronic information exchange. The project was split up into sub-projects that dealt with such issues as laws, information architecture and the National Patient Summary (NPS). The NPS was defined as an application to allow all connected care providers to take part of a summary of information in patient records from other care providers (thus summarizing the most recent information). A central aspect of the NPS was that it only allowed users to read a summary of patient records and not to edit the information. The motivation for the NPS was the increasing mobility of patients, requirements for efficiency in healthcare and growing demands for patient participation. An early version of the NPS was piloted by four county councils during 2005 and 2006. Lessons learnt from the pilot were summarized in a report, which stated that a central strategy should be to prioritize time over functionality, in order not to let the development of specific parts of the system stand in the way of the progress of the entire project. A need for changes in privacy legislation and for standardization concerning semantic and technical interoperability was perceived. A second central notion was that priority should be given to the coordination of work with security solutions. It should be noted that the focus of the NPS had shifted towards information exchange between municipalities and county councils (on a local level); previously, the primary focus was on information exchange on a national level (primarily between county councils), although it was now perceived that a greater flow of patients (and information) was on a local level. NPS was considered to be a first step towards interoperability in eHealth, furthering the development of related architectural work and integration of IS for all care providers.

Following the work carried out by Carelink, the national strategy for eHealth (henceforth referred to as 'the strategy') was released in March 2006. The initiators of the strategy were Carelink, together with the Swedish healthcare authorities. The purpose of the strategy was to improve the quality, availability and safety of healthcare through the use of ICTs. By aligning laws with extended use of ICT, a common infrastructure would be created, with information made accessible to citizens and across organizational borders. The strategy outlined several sub-projects, of which the NPS was one. Two related projects were the basic services for information maintenance and architectural security (BIF) and the formulation of a new patient data act. Thus, NPS was now put in the context of a larger EA for healthcare. Several aspects were not clearly defined in the strategy but were developed incrementally and, as highlighted below, in an evolving manner.

6. Findings

This section presents four episodes. An episode is a process in which the stability of the implementation is challenged, either as a result of the enrolment of new actors or by an event that might trigger change (Cho et al. 2008). The first episode starts off at the national level. Two local episodes follow, before returning to the national level in the fourth episode.

6.1 Episode 1: Reorganization for enrolment

The first episode took place at a national level, and evolved from that Carelink acted both as client and contractor in the NPS project. In October 2006, Carelink initiated the first stage of procurement for the NPS software and service provision. At this stage of the procurement process, service providers were invited to bid. However, the interests of all county councils were not aligned in support of Carelink's decision to start procurement. Consequently, the county councils initiated negotiations. The local project owner states:

> "[W]hat was perhaps the biggest delay in this was BIF, the security solution […] They had procured an application for the NPS but had not simultaneously procured BIF, which is a prerequisite for being able to enter and work in the NPS. But it happened in another process..."

The obligatory point of passage for moving the project forward was the enrolment of all county councils. It was necessary to have their support in the procurement process because Carelink, as a private organization, was not actually allowed to initiate procurement. In interviews with both local and national informants, it became clear that the lack of support from several of the county councils focused on the issue that the BIF project, seen as a foundation for NPS, did not have a clearly set timeline. The procurement of NPS had been initiated before BIF, which was perceived as a problem

by some of the county councils, as they argued that it went against the national strategy. BIF was regarded as an important element in the architecture and a prerequisite for the NPS. Thus, BIF needed to be enrolled into the network before the procurement could get the support of all county councils and, thus, reach the obligatory point of passage.

In January 2007, a commissioning entity was formed by a political organization appointed by the county councils, municipalities and regions. The purpose of setting up the organization was to coordinate the use of ICTs in Swedish healthcare and to anchor the national IT projects among all care providers, thus acting as client for all IT projects in Swedish healthcare. The intended function was to act as an enrolment device for the county councils. All decisions taken by the commissioning entity needed to be supported by the county councils as well as national-level politicians; thus, the interests of the actors in the commissioning entity would be aligned by political means. The commissioning entity was now the initiator of the procurement, with the support of all county councils. However, the obligatory point of passage, which involved the enrolment of BIF, also needed to be passed. Thus, it was stated that BIF would be implemented by all care providers by 2009 and that NPS would be implemented successively parallel to this (as stated in the project directives for the commissioning entity). With BIF seemingly enrolled into the Actor network the process could continue. The interests of the county councils, NPS and BIF had been aligned, a new Actor network (the commissioning entity) was created and, within it, a common plan for implementation was inscribed. The coordination of the two projects resulted in a synchronized procurement of solutions for BIF and NPS, both ending in the first quarter of 2008. Thus far, it seemed that the coordination had been successful.

At the end of 2007, Carelink's role as coordinator for Swedish eHealth was taken over by the commissioning entity. Carelink was merged into SVR (an organization owned by all county councils). SVR now took over Carelink's role, thus replacing this particular actor. Consequently, several of the projects in the national strategy for eHealth were also organized under one contractor (as different projects, with different service providers).

6.2 Episode 2: Aligning the project with the Patient Data Act

In order to understand the second episode, a further explanation of the context is necessary. The NPS project was to be implemented at the beginning of 2009, starting out with a test run in the municipality and county council of a mid-sized Swedish city. The purpose of the test run was to verify the functionality of the NPS and BIF (as part of the architecture) to allow for national implementation. Several national- and local-level actors highlighted the fact that the test run was not another pilot, but the first step of implementation. The local project was directed by the national project, although there was some autonomy in decision making. The local project, responsible for the test run, is referred to as the test run network.

In June 2005, the healthcare authorities worked towards the formulation of a new law, which emerged as the Patient Data Act. This episode, which occurred on a local level, was a consequence of a change that was brought about by this new law. Henceforth, in order for a care provider to be allowed to look into the NPS, they needed the patients' consent. Unlike the previous law, the new law specifically stated that no one except the patient in question could give their approval; thus, a trustee could no longer take this decision on behalf of the patient. This caused a grey area in how to interpret the law with regards to some patients. Since a large number of the patients to be involved in the test run were older or persons with mental disabilities (the primary patients in municipal care), this was perceived as a problem. One of the nurses stated that: "it actually became rather precarious with NPS, since unless we are able to use implicit consent then there wouldn't have been anything to look at, because we could not obtain the consent of these persons". The law was unavoidably inscribed in the network, and the patient group could not be excluded as the test run would then have no patients to look at. Thus, an obligatory point of passage for the test run network was to align the law to the test run. This could be achieved by legitimizing an interpretation that allowed access to patients' records, even if their approval could not be given.

A national project aimed at interpreting the law and providing guidelines for its use was initiated by the national board of health and welfare soon after the law was implemented. The project, referred to as the law network, thus became central to working with the law. The law network also became an actor who could potentially be enrolled into the test run network in order to align the inscription of the law with the inscription of the test run. The law network consisted of practitioners and lawyers from

various county councils, as well as one nurse (from the test run network) who represented the municipalities. The test run network counted on the law network to provide a legitimate interpretation of the law which would align it to the other actor, the patients. At the beginning of 2009, the awaited report was published by the law network. However, it did not contain a solution to the issue concerning approval, and therefore did not help the test run network with aligning the law to the test run. The local chief of the department of social welfare stated that: "we believed that the national board of health and welfare would give us quite clear positions on how to handle the new law, but that wasn't the case". Since the law network had been assigned as a separate project it was not inscribed with the same incentives as the test run network. The issue concerning approval from the types of patients who were to be included in the test run was not a pressing matter for the law network as the test run was not inscribed as its primary focus. As the only representative from both the test run network and the law network, the nurse did not succeed in enrolling other actors to inscribe it as an issue that needed to be dealt with. Thus, inscriptions in the law network did not support the test run network.

The obligatory point of passage for the test run network had not been passed as their voices had not been heard, and the perceived problem had not been inscribed into the law network. Furthermore, the local project now had to take sole responsibility for aligning the law to the project by deciding on their own guidelines for interpretation. This led to extensive discussions over responsibilities for interpretation as well as how to legitimize the decision, which ultimately resulted in the production of local guidelines. As a result of this episode, the obligatory point of passage was passed at a local level. The solution could thus be black-boxed for the test run, although not for the national NPS project.

6.3 Episode 3: Solving goal conflict through priorities

The third episode took place on a local level, following events that occurred in the first episode. Since the creation of the strategy, BIF had been considered to be an obligatory point of passage for the NPS project; it was a vital part of the architecture concerning information security. However, since BIF was run in a separate project from NPS, the projects were hard to coordinate, bringing about this episode. Delays in the development of BIF had resulted in the test run network deciding to postpone the test run on two occasions. When it was announced that BIF would be delayed a third time, with no concrete picture of when it would be ready, it became apparent that there was a conflict between two inscriptions: the inscription of time over functionality and the inscription of BIF as an obligatory point of passage, as the time inscription was now challenged by the delay of BIF. However, BIF had already been considered a major risk factor in the project; thus, the national steering group had elaborated an emergency solution when it looked like BIF would be delayed.

The software that had been procured for NPS had a built-in security solution. This meant that the user had access to basic security, using the same means as BIF. However, as the security solution would only function locally, the architecture could not be verified in the test run. Thus, the architectural aspect which dealt with defining the access and restrictions of a user group in one place (BIF) could not be tested. The alternative would only function locally and with NPS (and not with other applications), as well as that users would have to be given rights and restrictions separately as this could not be changed simultaneously for whole groups of users, as with BIF. The national steering group was clear in that they would rather see time made a priority for the project. At the same time, though, the local project had a mandate in this decision. Negotiations over whether to wait or use the emergency solution were thus initiated in the test run network. The project owner described the process:

> "We were confronted by a choice when it became clear that BIF would not be ready,. Maybe it would be ready in October, but how the heck should we do this then? Then there was another security solution […] and it would work in the NPS, although it did not really have the broad usefulness of BIF, as I have understood it, although I do not know everything now. But [the national project] assured us rather quickly that it would meet demands for security."

The actors in the discussion were the national project, the municipal and county representatives in the local steering group, and one other distinct actor, an IT architect from the county council. The majority of the county council actors argued in favour of prioritizing time. Some did so because they wished to keep in line with the national steering group. Others wanted to prioritize time so as not to lose momentum, which they believed would make it harder to enrol users to participate in the test run as

well as other care providers in an upcoming national implementation of NPS. Their interests were thus already aligned with the national steering group. However, some actors from the municipality, together with a county council IT technician who had taken part in the architectural work, argued against the emergency solution as they thought that security would be lacking. The national steering group made assurances that the same level of security would be achieved, even though the architecture would not be tested (as access would not be controlled centrally through BIF). This argument enrolled the opposing actors (including the IT technician), who accepted the emergency solution in order to move on with the test run. The inscription of time seemingly resulted in the disintegration of BIF as an obligatory point of passage for implementing NPS. The interests of the actors in the test run network were thus aligned as much by a concern to maintain momentum as a belief that security would be *sufficient* for the test run, although not for the entire EA.

6.4 Episode 4: Project alignment under a new actor

The fourth episode was directly linked to that previously outlined, and appeared on a national level. The episode was brought about when the NPS test run network encountered problems with enrolling BIF, as it had not been successfully inscribed with the value of being ready in time for the test run. The problem was perceived by SVR, since NPS and BIF had acted too independently of each other and the two actors' interests had to be aligned before they could be coordinated. The program leader for NPS/BIF coordination states that:

> *"[S]everal concurrent projects that have worked with BIF issues have been run and these must be sewn together, and must move at the same pace. And technically these solutions must work together and they're supposed to be implemented together in [the city] for instance, and then there are projects to synchronize and get a whole."*

The enrolment of BIF had not been made successful simply by forming a commissioning entity. In order to do this, SVR created a new national program in which the NPS and BIF were placed under one program with a program leader, so as to be able to align the interests of the two actors. BIF was delivered by the developer just after the test run of NPS had been initiated. Preparations to integrate NPS and BIF are currently ongoing (which will lead to additional time and costs). The program leader reflects on the process of dividing the work into several projects and the effects of this on the architecture;

> *"[W]e now instead have to work for standardization which costs both time and effort but also money [...] Although we have still been able to run the NPS project as a separate project rather well, if you're talking from a business point of view [...], by contrast it is a bigger problem for the IT architect because they must produce an architecture that knits together the safety and information access aspects of an overall functional architecture, so for them it is a bigger issue."*

7. How does an EA evolve during implementation?

In order to highlight when and how an EA evolves, the four episodes are presented in relation to the inputs, outputs and outcomes of the FEA performance reference model.

Prior to the first episode, the focus of the NPS project was shifted from information exchange on a national level to a local level, partly because there was a need to enrol more organizations (the municipalities), but also because there was a larger information flow on this level. Thus, the planned strategic outcomes (the usefulness of the NPS) evolved, as other business processes were defined as central.

In the first episode, BIF (a technology that was seen to be a major part of the architecture) and the NPS became entwined, with the former formulated as a prerequisite for the latter in order to get the county councils on board. This was due to that pushing the development of BIF was regarded as the strategic outcome of NPS implementation (and indeed as a central aspect of the whole EA). This brought on major changes in the organizational and financial structure of the project as the commissioning entity was created and, later on, Carelink merged with SVR. Thus, the financial assets and human capital that support the EA were rearranged in order to support the strategic outcome.

The second episode was caused by the unexpected need to handle the process of approval for patients who could not give their consent. In the initial project structure the process of interpreting the law was going to be handled on a national level, although this became a problem when the law

network did not provide guidelines on this matter (as they did not share the test run network's incentives). Uncertainties arose regarding which part of the human capital should support this process. In order to move on with the implementation, the process of handling consent needed to be defined locally. Thus, it evolved into a local interpretation that was valid only in the local context, instead of national standardized guidelines for the process.

In episode three, the perception of BIF as a technological prerequisite for NPS clashed with the priority of time over functionality. The strategy for implementation was clear on prioritizing time. However, several actors saw this as being problematic because the project's purpose had partly been to test the architecture. As time was the stronger inscription, the project moved on with a makeshift security solution instead. This temporary change of technology affected the business results as reuse of information was not tested. The purpose of the whole test run thus evolved, leading to a different business output. The main goal had evolved to support the NPS process in order to enrol more people, instead of implementing the intended artefact. Thus, the project evolved away from the intended strategic outcome.

In the fourth episode, the project management wished to re-align the NPS project to support the overall strategic outcome, as the evolution of NPS was not considered to be fully satisfactory from an architectural point of view (although still supporting the overall progress of the EA). This resulted in the creation of a joint program for NPS and BIF, in order to be able to further align the financial assets as well as maintain the EA as a whole. The flexibility shown by adopting an "emergency solution" was not considered a failure, although it was perceived as a step away from the intended outcome, towards which the project still worked. Thus, the project did in a sense drift away from this, although the decision was intentional and strategic for the EA as a whole.

As seen above, one issue relates to that the law network did not support the NPS network, as both projects mainly supported their focused processes instead of the overall strategic outcome of the EA. Planning is, of course, an important issue. However, it does appear that the flexibility of an EA program is also a central aspect since creativity in the implementation of NPS was dependent upon the ability of the national program to respond to needs at a local level, although not fully succeeding with this. In this case, projects do not only evolve independently, but rather due to effects of (re)configurations in a heterogeneous network of actors.

8. Conclusions and further research

In order to implement EAs, it is necessary to get vital actors and vital technologies on board to support the strategic outcomes. However, actors' interpretations of goals, technologies and responsibilities differ. Thus, conflicts that challenge the implementation processes may occur. In turn, this could lead to the evolution of the EA program into something that differs from the initial plan for implementation or even the initial purpose of the EA. However, it is vital to acknowledge that this does not exclude following a plan as it might very well include priorities that allow for flexibility. In this, four aspects are central:

- EA does not change uncontrollably, but responds to parallel projects that evolve in different directions.

- Changes in projects should not be perceived as them drifting away from plans in an EA, but rather as co-evolving with it.

- Thus, projects to implement parts of an EA need to be aware of and act in accordance with incentives of other projects (and not just the EA program itself) in order not to counteract each other.

- The evolution of EA can be both intentional (as the program management might perceive that a program should be allowed to evolve) or unintentional (due to differing interpretations in sub-projects, unexpected events, delays, etc.).

The central notion is that EA should be considered neither as a blueprint nor as something that evolves uncontrollably. Instead, EA programs should be seen as something that needs to be planned with regard to that it will, and should, evolve in order to respond to needs discovered in the process. The contribution is a deepened understanding of how sub-projects co-evolve with a national EA program. Thus, projects might evolve in unintended directions, although this should not be perceived as something unequivocally negative as this might also be strategic, and lead to evolution of other parts of the EA to suit each other. The results provide project management with an in-depth

understanding of the importance of perceiving large-scale IT programs as evolving, as well as allowing them to do so. The results are also relevant to researchers focusing on social aspects of large scale eGovernment programs.

Further research could focus on the evolution of EA projects through longitudinal studies which covers a longer period of time, perhaps in other areas than healthcare. This could provide insights into a longer process of evolution, as the period covered by the case studied here is approximately five years.

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