How to Develop an Open and Flexible Information Infrastructure for the Public Sector?

Erik Hornnes[1], Arild Jansen[2], Øivind Langeland[1],
[1]Agency for Public Management and eGovernment Post Box 8115 Dep, 0032 Oslo, Norway
[2] Section for eGovernment, Department for Private Law, University of Oslo, Norway

Abstract

In line with a number of other countries, Norway has decided to base their ICT solutions in the public sector on a common ICT architecture. This article discusses some challenges related to this work. The theoretical basis for the discussions is our understanding of information infrastructures, which we claim offers a fruitful perspective to the building of ICT architectures. Of particular relevance is its installed base: the history of technical and non-technical components that determines its further development. We argue that an ICT architecture for the public sector should be seen as an important element of a government information infrastructure. However, it has to be adapted to other principles and fulfil a wider range of needs than traditional types of infrastructures, including the specific political, regulatory and organizational context that it targets

Keywords: ICT architecture, information infrastructure, installed base, IT governance

1 Introduction

The Norwegian government, like governments in many other countries, is facing great challenges in their efforts to improve service provision to the citizens and the private sector at large. One important challenge is to overcome the obstacles created by the highly fragmented public sector, and as the result, a silo-organization of its information systems. Modern eGovernment services require IT-solutions whereby information can be easily accessed and transferred between agencies and across sector-based boundaries. As a response, many countries have defined more coherent strategies for developing their ICT-solutions designed to simplify information exchange and interaction between public agencies in order to provide better services to citizens and businesses in a coordinated and user friendly manner. One common component in many of these strategies is to build a common ICT-architecture as a framework for their eGovernment solutions (see e.g. Janssen and Hjort-Madsen 2007, Liimatainen 2008). However, such efforts imply technical, as well as organizational and, not least, legal challenges. It also includes measures that have been proposed in the past, however without having succeeded (e.g. Heeks 2006). We do believe that the chances for success are greater now than in the past, since there is a much stronger understanding on the political level, which manifests itself, for example, through the strong focus among the EU members[1]. However, we argue that a major challenge is to build an adequate information infrastructure that can constitute an open and flexible foundation for new eGovernment services, and that the design and implementation of a government ICT-architecture must be an integral part of that work.

Thus, from both a theoretical and a practical point of view, we need a better understanding of the type of "artefact" this government ICT-architecture should be. Still, eGovernment as a research field is in its early stage (see e.g. Grønlund 2005,

[1]See the Fifth ministerial eGovernment conference 19 - 20 November in Malmö, http://ec.europa.eu/information_society/activities/egovernment/conferences/past/malmo_2009/index_en

Grønlund & Andersson 2006, Heeks & Bailur 2007, Scholl 2009), and the broader IS research field is able to capture the variety and complexity in the public sector only to a limited extent. This implies that we lack an adequate conceptual framework that can describe the different types of systems and solutions we find in the public sector, not least ICT-architectures. A traditional perspective has been to see ICT as a toolbox, implying that the user can select the appropriate tool for a specific task and use it, having full control. This is in contrast to the machine perspective, characterized by "something" determining how a production process unfolds and requiring the operator to carry out specific operations as mandated by the machine. It seems rather evident that none of these perspectives are fruitful as analytical tools for understanding ICT-architectures. No single entity can control an ICT-architecture, nor does an architecture imply a determining machine.

In their seminal paper "*Desperately Seeking the 'IT' in IT Research—A Call to Theorizing the IT Artifact*" Orlikowski and Iacono (2001) argue that we need a better conceptualization of the information technology (IT) artefact. Based on a review of a number of published articles, they discuss different categories of IT, where their "ensemble view" seems to be a valuable contribution to understanding the nature of an ICT-architecture. But it does not capture all its dimensions, neither its socio-technical character nor its installed base; that is, the history of technical and non-technical components that determines its further development. We do not claim that an ICT-architecture on its own will constitute an information infrastructure. We will, however argue that an information infrastructure perspective can be fruitful when analysing the different properties of an ICT-architecture. This will also make visible some of the barriers that are linked to the implementation of an ICT-architecture in the government. The article will discuss the following research questions:

1. In what manner is the perspective of information infrastructures relevant for the building of an ICT-architecture in the public sector?
2. How do we conceptualize the installed base of an ICT architecture?
3. What specific characteristics are important for such information infrastructures?

1.1 Our research approach

This study is based on an inductive approach where the aim is to contribute to an increased theoretical understanding of the kind of infrastructure needed to support the provision of electronic services to citizens. Our theoretical point of departure is from information infrastructures (Weill and Broadbent 1988, Shapiro and Varian 1999, Hanseth and Lyytinen 2004) and from management control and technological drift (Ciborra 2000, 2002). Our main empirical base is the ongoing work to realize an ICT-architecture in Norway, which we believe is representative of similar efforts in many other countries. Our data collection and analysis comprises analysis of documents, including descriptions of planned and finished eGovernment projects. The proposal for a Norwegian Common ICT architecture, along with all remarks to that report, as well as the budget documents and "assignment letters" etc. have been particularly relevant. Furthermore, we have participated in open hearings and meetings that have been organized in relation to this work in Norway.

The next chapter will briefly present the basic ideas of ICT-architecture, illustrated by current work in the Norwegian government. Chapter 3 provides the theoretical framework, followed by our analysis, findings and our conclusions with suggestions for further research.

2 What is an ICT architecture for the public sector?

As part of public modernization plans in many countries, governments seek to offer citizens and businesses seamless online services by improving horizontal and vertical relationships and linking independently developed processes and information systems. Current efforts are focused on coordinating the projects and providing a framework that will function as an umbrella for explaining the relationships among the projects. These kinds of frameworks are often denoted as *national enterprise architecture* (NEA); see, for example, Janssen and Madsen (2007). The Norwegian government has also defined a common ICT-architecture (Report to the Storting no.17: 2006-07). Facing the reality that the Norwegian public sector (as many others) is a collection of a large number of independent and heterogeneous organizations, having different business processes and information systems, this architecture aims at ensuring interoperability, avoiding duplication of efforts and enabling reuse of existing ICT-based services and solutions.

Even though the Norwegian architecture has been designed in a national context, its overall principles are based on a service-oriented framework, heavily influenced by the work in Denmark and other countries. Its overall, layered structure is illustrated in figure 1. The business layer at the bottom consists of the different government agencies and their ICT solutions. The middle layer provides shared services that may be relevant to many or all eGovernment services, such as an identification and authentication solution, etc. in order to enable the reuse of ICT-services (DIFI 2009). The presentation layer at the top enables citizens and businesses to interact with the electronic services provided by the different government agencies. This layered structure makes it much more flexible and robust with respect to future changes in the different layers, since a change in one layer will not impact on another layer. This assumes that the layers are loosely coupled and that they make use of open and standardized interfaces, preferably through the use of open standards.

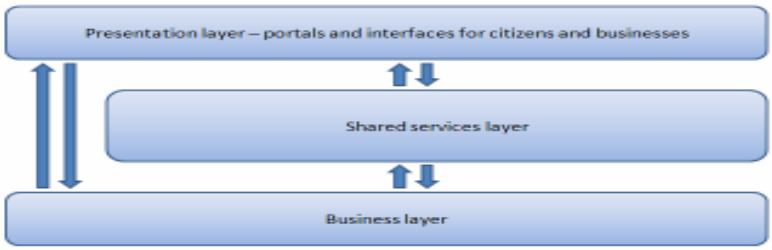

Figure 1: Generic government ICT architecture

The Norwegian government has defined seven architectural principles: service orientation, interoperability, availability, security, openness, flexibility and scalability. Other countries such as Denmark and Sweden operate with similar sets of architectural principles.. Although the principles are somewhat differently described, their goal is also to provide a unified framework for the national ICT architecture in question. Denmark has defined nine architectural principles[2] (IT- og Telestyrelsen 2009). Sweden has defined six architectural principles (Verket för förvaltningsutveckling 2008). In the Netherlands, their architectural program is based on adopting one part of

[2] The Danish principles address topics such as information security, flexibility, user orientation, modularization and loose coupling etc, while the Swedish architecture addresses topics such as information security, clearly defined interfaces, standardization, universal design etc.

the Zachman framework, and includes a large number of principles (Janssen and Hjort-Madsen 2007). In these countries, the use of the national architecture is based on a sort of voluntarism, in the sense that each individual agency may decide not to use the principles if there are good reasons for not doing so. However, there is substantial pressure to accommodate to the national framework.[3] We also find similar approaches in countries like the UK and the US. However, as we argue below, these are minor differences at a detailed level, and the relevance of an information infrastructure perspective is not dependent upon the type of architecture as such. The overall scope and design of the architecture is more important, i.e. that the architecture is open and accessible to all relevant stakeholders and that it is sufficiently flexible to support the diversity of ICT –systems and services that are continuously evolving.

Although these different ICT-architectures do share many characteristics with enterprise architectures (EAs), there are nevertheless many differences. EAs lack a universally accepted definition (Rohloff 2005); a common understanding, however, is that it "identifies the main components of the enterprise, its information systems, the ways in which these components work together in order to achieve defined objectives and the way in which the systems support business processes". Weill (2007) defines an EA as "*the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the firm's operating model*", which implies that it involves redesigning the business. Architectures aim at creating some kind of coherence and structure in a chaotic environment through the use of systematic approaches.

Our argument, in line with Janssen and Hjort-Madsen (op.cit. p 2), is that national (government) ICT-architecture differs from EA in that *"architecting public sector involves designing public administrations to reflect the political and public managers' decisions at a strategic level in operational activities and decisions*". Public administration must be seen as a collection of a large number of heterogeneous organizations having different business processes and information systems which constitute their "installed base" of technical, organizational and legal elements. Ross (2003) criticized enterprise frameworks for taking a technologist view and claimed that such frameworks do not highlight the role of institutions and capabilities critical to enabling the governance, adoption and diffusion of an EA, a viewpoint we fully support. Our point of departure here is that there exist a number of different national EA-like initiatives having different ambitions and scope, but having some common features in that they are designed to support advanced eGovernment services that span different agencies and sectors. In this respect they need a foundation of technical and non-technical elements that correspond to infrastructures, in line with Janssen and Hjort-Madsen (2007, p5-6). Below we will discuss a "generic" government information infrastructure, as a kind of basic kernel for the individual ICT-architectures.

3 ICT-architecture in an information infrastructure perspective

The term information infrastructure was introduced in the early 1990s, usually by reference to Al Gore's political initiative to build a global information network in the US. Important contributors to the development of the information infrastructure the-

[3] There are still differences between the national policies. While the Norwegian approach implies that an agency has to explain why they choose not to apply these principles, the Danish policy is primarily driven by incentives and non-mandatory principles, and the Dutch policy primarily aims at guiding and stimulating the individual agencies to adopt best practice.

ory, among others, have been Hanseth and Monteiro (1996), Weill and Broadbent (1998), Hanseth and Lyytinen (2004). This perspective has proved fruitful in the analysis of a number of cases, including the description of complex technical systems (Ciborra 2000, 2002), with links to standardization processes (Braa et al. 2007).

Hanseth and Lyytinen (2004) define an information infrastructure (II) as: "*a shared, evolving, heterogeneous installed base of IT capabilities among a set of user communities based on open and/or standardized interfaces*". We find many similarities when comparing this definition with the basic principles of an ICT-architecture; it has to be shared by all its users by being accessible and open to a broad community of users and interests; it has to be continuously evolving, flexible and scalable in order to meet new requirements etc.

By the installed base we mean the history of its technical and non-technical components that determines its further development, that is, the interconnected practices and technologies that are institutionalized in the organization (Hanseth, Ciborra and Braa 2001). One thus needs to understand what the installed base in the public sector comprises, and what implications it might have for the development work. One important part is all the legacy systems; which are often based on proprietary technical solutions, old data formats and non-standard databases. Although many of them are technically outdated, they represent a lot of invested "capital" and are linked to work routines and organizational practices. The legal framework itself is another essential part of the installed base, which in many ways implies substantial challenges both in terms of implementation of the technical solutions and its governance and control. First of all, it constitutes the overall (political) setting for the use of ICT in the public sector, that is the overall principles for governance management. Secondly, it amounts to the logic of a number of systems that are being used in decision making. These systems cannot be changed without revising the corresponding regulation. Furthermore, many of the eGovernment solutions are linked to specific regulations that may include legal definitions which are not, however, consistent across government, making interoperability difficult. Furthermore, the public sector is diverse and manifold in many ways; it includes a large number of agencies that are independent each with its own responsibilities and decision-making power. Furthermore, it is continuously being reformed, and new laws and regulations are being implemented consecutively. We thus define the installed base in a specific government as "*the history of technical, organizational and legal components, including work routines, practices and even social and cultural structures that influence how the ICT systems in government are being used"*. This installed base is neither static nor controlled by a single authority, and it will include multiple local architectures and the specific ICT-solutions that are being developed and maintained at various levels in the public sector.

4 What type of infrastructure is needed in the public sector?

Even though it seems evident that modern governmental electronic services need an information infrastructure, the type of infrastructure this may be is not obvious, nor the requirements it should meet. Hanseth and Lyytinen (2004) present a simple taxonomy for IIs. Using the scale and scope of the II as the main classification criterion they distinguish between three types of vertical II's: 1) universal service infrastructure, 2) business sector infrastructure, and 3) corporate information infrastructure. A *universal service infrastructure* is designed for all types of users and applications, based upon a set of international standards. Internet is the most typical

example. Second, a *business sector infrastructure* is designed for specific groups of users, and offers specialized transactions- and data exchange services (e.g. the finance industry, car industry etc). Thirdly, their *corporate infrastructure* offers information- and transaction services for its internal users and its partners, which has a limited focus and may be based on specialized standards and services.

Although information infrastructures for the government share many of the characteristics of these different types of II's, such as being heterogeneous and containing many standards and many service providers, there are also quite a few differences. Although a government II will span a large and heterogeneous group of users, that is, public agencies, citizens, businesses, suppliers etc., it will be more limited than a universal II designed to support potentially any application, service or user. Another important difference is the presence of legal regulations in the installed base of a government II. The principle of legality is an important factor in modern government, implying that legal regulations must always be taken into account.

In the same way it can be argued that an II for the government will resemble some of the properties of a corporate II, e.g. regarding its more limited scope and appliance. It is also possible to determine more specific guidelines and directions related to architecture and technical systems. On the other hand, an II for the government will have greater diversity than a corporate II since it will include a large number of state agencies and municipalities which to a large extent are independent, in that each institution has its own specific responsibility and decision authority. Furthermore, while a private company may define its own standards, the government has to pay attention to precompetitive measures and secure an open and accessible public sector. It could also be argued that a government II bears some resemblance to a business sector II;. However, a business sector infrastructure will be more restricted than the government infrastructure, with regard to purpose, functions and methods of use. The table below summarizes these four categories of II's and their characteristics[4]:

Table 1: Different types of information infrastructures and their characteristics

Types Quality	Universal II	Business sector II	Corporation II	Government II
Shared (by)	Potentially any application, service or user on earth.	Primarily companies within the sector (including their employees), but also customer and suppliers.	Primarily units and employees within the corporation, but also suppliers, customers and partners.	Primarily public agencies along with suppliers to and users of the public services
Evolving	By adding services and computers to the network since the first data network was established	By exchanging new types of information among the users and by involving more organizations.	By integrating more applications with each other, by introducing new applications	By adding new services, exchanging new types of information and integration of new applications
Heterogeneous	Many sub infrastructures, different version of standards, service providers, etc.	Multiplicity of competing and overlapping subinfrastructures, standards, service providers, etc.	Multiplicity of applications and subinfrastructures, users, services etc.	Includes many sector-wise infrastructures, multiplicity of applications and various types of standards
Installed base	The current Internet, applications integrated with it, users and use practices	All current integrated services, their users and developers, and the practices they are supporting and embedding.	All current applications and their users and developers, and the working practices they support and embed	Legal regulations, politics, administrative practices, legacy systems, etc

[4] This table is based on table II in Hanseth and Lyytinen (2004), but expanded with a fourth category:Government II (GII).

We will thus argue that it will be fruitful to introduce this new category: an (e)*Government information infrastructurs,* denoted GII. Our definition of the objective of a GII is that it *"should include the technical, organizational and legal structures that are required to enable and support ICT-solutions in the public administration to operate as intended"*. This approach would correspond to the definition introduced by Tilson and Lyytinen (2009, p2), which states that infrastructures are *"the basic physical and organizational structures needed for the operation of a society or enterprise"*. Our definition is based on normative criteria since it describes what goals must be fulfilled in order to be included in a GII, rather than describing what specific characteristics that must be met. This definition is somewhat "vague", but it reflects the basic nature of infrastructures; they cannot be conceived as static and well-defined., but continuously changing and expanding. Just as we cannot consider the public administration as a single "body", it follows that we cannot perceive a government II as merely a single entity, but rather as several (sub) infrastructures related to the different levels and the different sectors. This implies that a GII must be perceived as a diverse collection of elements that grows through an evolutionary harmonization and coupling of different sub-infrastructures, which implies the coupling of the different installed bases that are already part of the public administration today.

In addition to the characteristics described in the table, there are also other characteristics, as its dynamics, the stakeholders and strategy for governance, that illustrate the differences between them and why it is reasonable to introduce GII as a fourth category.

The dynamics and drivers in a GII will primarily be agency needs and it will thus be shaped by political directions and signals. This is different from the other types of IIs, in view of the fact that a universal II is technology and user driven, while a business sector II is user driven and shaped by the requirements from the civil society, and that a corporation II is driven by business needs of the corporation. A GII will comprise a wide range of stakeholders, including citizens, businesses, agencies, NGO's, suppliers and politicians. This, however, represents a more "focused" group of stakeholders than for a universal II, which comprises all types of users and use patterns. But it is clearly a larger and more heterogeneous group of stakeholders than for both business and corporate IIs, which are typically limited to the stakeholders within the businesses and industries.

Not least, the strategy for governance is different. In the context of a GII strategy will mainly manifest itself through political governance, legal regulations and principles for the public administration, including the perspectives of democracy and rule of law. This is in contrast to e.g. a universal infrastructure, where the emphasis is put on international consensus. We also find that the governance structure and use of policy instruments in the public sector differ from what we find in private corporations as well as in business sectors. In particular, a corporate infrastructure may appear more coherent in that it can apply more powerful means of co-ordination without having to allow for influence from the environment, which the government, on the other hand, is obliged to accommodate. As a contrast, the government acts both as a service provider and as an authority that must exercise control and ensure common values and civil rights, which in turn implies that a government II must also exhibit other characteristics. An important element of a governance strategy for a GII will furthermore be to overcome the barriers represented by the silo organization in the public sector when developing new eGovernment services.

One may ask to what extent it is fruitful to introduce this new type of information. The contrary would be to claim that since its installed base does not fit into existing

categories, one should rather accept that an information infrastructure perspective does not add much insight when it comes to government ICT architecture, and that it may even be counterproductive since it offers misleading associations. Such arguments should be taken seriously, and an II perspective is not the only relevant perspective to be applied in the analysis of government ICT architectures. However, we will argue that an II perspective will help us to identify both similarities and differences, and in this way create a basis for a better understanding of what government ICT architectures should be and should not be. Not least we should carefully examine what lessons can be learned from other II projects when it comes to design and not least management of complex ICT architectures.

Implications of an infrastructure perspective for designing ICT architectures

Previous experiences from building infrastructures clearly reveal that they cannot be constructed in the same way as traditional information systems. Hanseth and Lyytinen (op. cit, p 208) points out that IIs are large and complex, evolving over a heterogeneous set of communities and components; they need to adapt to both functional and technical requirements that are *unknown* at the time of designing, and they are commonly designed as extensions to, or improvements on, the existing installed base with heterogeneous, diverse components that are not under the control of a single authority or designer. The implication of this view on ICT architectures is to admit that the complexity and diversity of the public sector cannot be resolved, but has to be accepted and handled in constructive ways. It thus follows that ICT-architectures cannot be designed and built through a top-down process-reengineering approach. Rather the opposite, whereas they are meant for a variety of users and types of usage implying an abundance of user requirements and external conditions, they have to be adopted and adapted in a step-wise, bottom-up strategy, thus corresponding to the building of infrastructures (see e.g. Ciborra 2000, 2002). For a GII this means that the strategy for development will be driven by the needs of the different public agencies along with requirements from citizens and private sector users. It is therefore particularly important that government ICT-architectures are adapted not only to existing technical components, but also to institutions and capabilities critical to the governance, adoption and diffusion of them (Ross, 2005).

The proposal for the Norwegian ICT-architecture is based on a layered structure, which is in line with central principles of object-oriented system architecture. This also resembles service-oriented architecture. Hanseth and Lyytinen (2004) also demonstrate a similar strategy in the design of infrastructures by decomposing a complex infrastructure into a set of simpler ones which offer only one type of functionality. This type of *horizontal* decomposition is equivalent to the use of abstraction principles applied in software engineering. According to Hanseth and Lyytinen (ibid) an infrastructure may be split into an application infrastructure and an underlying support infrastructure, where the latter is split into a transport- and service infrastructure such as we find in the Internet architecture. A similar approach of layering information infrastructures is applicable for a GII. This means that a government information infrastructure will consist of a basic infrastructure, a service infrastructure and an application infrastructure, cf. figure 2. The basic infrastructure will contain generic shared services, while the application infrastructure will contain specialized shared services based on the generic ones. Examples of such services are shared handling of registries, shared metadata and the generation of electronic forms. This implies that the generic, shared services of the basic infrastructure will offer a minimum of functionality, which most of the stakeholders will find useful and valuable. Additional function-

ality that is not offered by the generic shared services may be implemented by building specialized services in the application infrastructure on top. Both types of services may utilize the shared services in the service infrastructure, for example electronic ID.

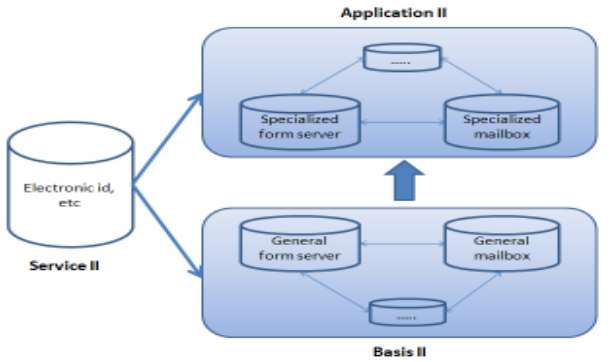

Figure 2 : Layering of infrastructures – the case of Norwegian ICT-architecture

4.1 Legal regulation – also a catalyst for new services in the public sector?

Traditionally, laws and regulations are regarded as barriers against development of eGovernment. Legal regulation, however, may also be seen as a catalyst in the public sector, because new laws and regulations can help facilitate the penetration of new ICT solutions. An example in Norway is the introduction of the eGovernment administrative rule[5], which has accelerated the development and use of secure electronic communication services in the government. The Norwegian Freedom of Information Act is yet another example, prescribing that all Norwegian ministries, directorates and authorities make their mail records publicly accessible on the Internet.

Similarly, new common components may be introduced through a "bootstrapping" strategy, because a legal regulation identifies and creates requirements that must be fulfilled. On the other hand these requirements may be demanding to implement, due to old systems and practices. Bootstrapping means "to promote or develop by initiative and effort with little or no assistance" (Hanseth & Aanestad 2001). Hanseth & Lyytinen (2004) propose some simple design principles: i) design initially a service that takes the desires of chosen user groups into account; ii) draw upon existing installed bases where this is advantageous; iii) expand installed base by persuasive tactics in order to gain sufficient momentum (critical mass of users); iv) make the solution as simple and modular as possible, especially in order to avoid future lock-ins.

We have seen that such a strategy has been successful in a Norwegian context, for example the Norwegian State Educational Loan Fund has succeeded in providing new eGovernment services to a limited user group. The need for financial support in order to pursue studies has motivated their customers to use the electronic services for identification and authentication. Thus, the fact that most of them are young and educated implies that they have the skills to take the authentication service into use (Lånekassen 2008). Although their interests as users were limited, by using a part of the ICT-architecture they will contribute to increasing the value of the entire infrastructure through the mechanism denoted as *positive network externalities* (Weil and Broadbent 1998, Hanseth & Aanestad 2001). A similar mechanism was crucial when the first

[5] The rule, enacted by the Public Administration Act (1967), regulates how electronic communication in government can take place and requires agencies to respond to electronicl enquiries in a similar way.

version of the Norwegian portal *Altinn*[6], a common portal for public reporting in Norway, was introduced and has subsequently proved to be successful.

This illustrates that ICT solutions, when made simple at the outset, can be further developed and adapted in the long run to accommodate continual shifts in requirements and needs. A prerequisite is that ICT solutions are designed with sufficient flexibility so as to handle changes after the solutions have been taken into use. This flexibility is twofold and consists of both *change and use*. The *change* perspective emphasizes that a standard [in the infrastructure] may be replaced by another (more appropriate) standard, without entailing high costs and uncertainty. Examples here are how standards have been replaced on the Internet at various layers. The *use* perspective emphasizes that the infrastructure must allow for usage in different ways and for different purposes. Again, Internet is the best example, but new mobile communication platforms are also used today for many different types of applications. These two perspectives are related in the sense that increased flexibility in usage will entail a lesser need for change flexibility and vice versa. In practical terms it means that a generically designed ICT-architecture will have a lesser need for flexibility to changes than an ICT-architecture that is designed in a more specialized and narrow manner. In this way, an open and flexible infrastructure will help to overcome many of the obstacles caused by the information silos in the public sector.

5 Concluding remarks

We have demonstrated that it can be fruitful to apply an information infrastructure perspective when designing a government ICT-architecture in order to understand its scope, variety and dynamic nature. We have defined a new type of infrastructure, an eGovernment information infrastructure that will include essential components of the ICT-architecture. When comparing the characteristics of an eGovernment ICT-architecture with different types of (conceptual) information infrastructures described in the literature, we find a number of similarities, but also differences, which can help us to identify important factors for the successful planning, implementation and management of an ICT-architecture. In particular, we have illustrated that it can help us to understand the complexity of the installed base, and how to handle it in a constructive way, for example through bootstrapping and cultivation approaches. We emphasize that such work is not primarily a technical design task, but must include ongoing organizational, legal and cultural reform processes on various levels in the government. Thus, our understanding is in line with Bygstad's (2008) conclusion that *"it is fruitful to regard information infrastructure as an ICT-based organizational form",* which represents an important contribution to understanding what kind of role and ICT-architecture may play in the public sector. An important implication of this view is that an ICT-architecture cannot be designed and implemented in a top-down manner, but has to evolve through dynamic, iterative and also, to some extent, experimental development processes. Janssen and Hjort-Madsen, 2007, p 2) claim that ICT-architectures are often initiated at the political levels and diffused using different gov-

[6]Altinn is a common portal for public reporting to the government in Norway. It started out as a project between two ministries and three agencies to help businesses report accounting records to the government, but it is currently used by more the 25 different agencies in their dialogue with a large variety of private businesses and organizations. It has undergone an evolutionary process and has been adopted and adapted throughout the Norwegian Government.

ernance mechanisms. A government ICT-architecture is meaningless if it is not adopted and used by public agencies.

Although some of our discussions have been based on the specific characteristics of the Norwegian public sector and its proposed ICT-architecture, we maintain that our arguments are applicable to a large extent to similar work being done in other national governments. However, it is necessary to understand the significance of the specific political, regulatory and organizational context which is defined by the constitutional framework, the political setting and the current organizational practices in each country.

Our discussions furthermore illustrate that ICT architectures, by definition, are not neutral, universal, or given, but designed according to specific purposes and underlying interests and norms. This is above all related to the overall policies in general and in particular to how one wishes to control the development of eGovernment in the different countries. Thus it has significance for both the use and effects of the ICT-architecture. Furthermore, they are woven into a given socio-technical reality in a political, organizational and institutional context that cannot be overlooked. They are neither static nor closed, but rather, they grow out of organizational practices and a political setting that will change over time in interaction with its environment.

Finally, we do not deny that other conceptualizations of ICT-architectures canbe fruitful, such as, for example, Orlikowski and Iacono's (2000) "ensemble view", but we believe that the addition of an infrastructure perspective is useful. We fully support their concluding statement that *"the lack of theories about IT artefacts, the ways in which they emerge and evolve over time, and how they become interdependent with socio-economic contexts and practices, are key unresolved issues for our field and ones that will become even more problematic in these dynamic and innovative times*". More research on the different types of ICT artefacts in eGovernment solutions is highly needed.

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