A framework for analysing interoperability in electronic government

Hans Solli-Sæther

Department of Leadership and Organizational Management,
Norwegian School of Management,
Nydalsveien 17, NO-0442 Oslo, Norway
E-mail: hans.solli-sather@bi.no

Abstract: E-government interoperability has been recognised to have a potentially great impact on productivity and user satisfaction. Based on the stage hypothesis model of growth in e-government interoperability, a framework to analyse and predict interoperability is suggested. Lessons learned from the experiences of the government sector in Norway are useful in analysing the number of stages, dominant problems at each stage, evolutionary path, and the economies of interoperability. Using the organisational, semantic and technical parameters of the framework, benchmarks applicable to each stage are applied to the case studies. Findings indicate that governments face different issues, expectations and benefits, depending on their maturity level.

Keywords: e-government; stages-of-growth model; interoperability; benchmark variables; benefits; e-finance.

Biographical notes: Hans Solli-Sæther is a Postdoctoral Fellow at Norwegian School of Management. He holds a PhD in Leadership and Organisation from Norwegian School of Management. He has served as the Chief Information Officer of Norway Post. His main research interests include management of inter-organisational relationships, knowledge management and project management.

1   Introduction

The term electronic government or e-government appeared about a decade ago, and there is no commonly accepted definition for this terminology (Gottschalk and Solli-Sæther, 2009). This paper uses e-government and digital government synonymously with the use of Information and Communication Technology (ICT) in the public sector (Pardo and Tayi, 2007). To provide citizen-centric, efficient operations and services, governments must challenge the traditional way of cooperation, and improve technical, semantic, as well as organisational interoperability. According to Legner and Lebreton (2007), business interoperability can be defined as the organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value.

This definition can be used as well to describe a government agency cooperating with citizens, business enterprises, or other government agencies.

Very few publications have addressed the impact of interoperability on benefits (Legner and Lebreton, 2007), but these could be identified in terms of the defining purpose of the digital government. Important issues of e-government are usually highly agile, citizen-centric, accountable, transparent and effective, and should provide efficient government operations and services (Scholl and Klischewski, 2007). According to Wilson et al. (2007), national, regional and municipal government agencies struggle with interoperability, standardisation, collaboration and service integration as well as with ICTs.

It is reasonable to expect that the interoperability of systems enables the interoperability of organisations. Systems interoperability is concerned with the ability of two or more systems or components to exchange information that is accessible and useful by the involved systems. Organisational interoperability is concerned with the ability of two or more units to provide services to and accept service from other units, and to use the services so exchanged for effective operation and communication (Legner and Lebreton, 2007).

According to Gottschalk and Solli-Sæther (2008), the level of e-government interoperability has the following four stages: aligning work processes, knowledge sharing, joining value creation and strategic alignment. Collaborating and communicating agencies are assumed to be more cost-effective when work processes are aligned, knowledge is shared, value creation is joined and strategies are aligned. This paper focuses on how to analyse and predict interoperability and discusses the productivity gains that communicating and collaborating agencies could make in using Information Technology (IT) to improve productivity and user satisfaction.

The paper is organised in six sections including this introduction. In Section 2, the methodology is presented. In Section 3, two governmental e-services in Norway are presented. In Section 4, the issues and challenges of stages-of-growth models are discussed. On the basis of the evidence drawn from the literature of stage models, a framework for analysing the growth of e-government interoperability is proposed. In Section 5, the cases studied are used to demonstrate the framework's utility in identifying critical issues that need to be addressed for continuous development of e-government interoperability. Finally, the paper summarises the main results, as well as areas for further research.

2   Methodology

According to Yin (2003), the case study method is preferred in examining contemporary events, especially when the focus is on a contemporary phenomenon within some real-life context. The case study's unique strength is its ability to deal with the full variety of evidence, including documents, artefacts, interviews and observations. For case studies, five components of research design are especially important: the study's questions, its propositions (if any), its unit(s) of analysis, the logic linking the data to the propositions, and the criteria for interpreting the findings (Yin, 2003, p.21). In designing the case study, all of these components have to be dealt with.

This exploratory study had the following guiding research questions: "How does e-government interoperability mature and evolve?" and "What is the potential impact of e-government interoperability?" As such, the unit of analysis was at an organisational relationship level. Since the investigator's goal was to explore organisational, semantic and technical issues rather than analytical generalisations, no propositions were developed before the study, even though the underlying assumption is that the use of internet technologies should improve the ways government serves its citizens and the ways in which these citizens interact with governments. This approach was selected to understand the inherent complexities and the underlying constructs, in addition to debating the economies of e-government interoperability.

Although the global assessment of electronic government is increasing, a United Nations (UN) survey indicates that the aims to which IT is put to use vary (United Nations, 2008). According to the UN survey, e-government solutions are fairly well developed in Europe, particularly in Norway, which ranks third. The selection of cases for the study was from cooperating government organisations in Norway. The cases are of secondary interest; they play a supportive role, facilitating our understanding of something else (Stake, 1994, p.237). The choice of cases was made, however, because the cases were expected to advance our understanding of e-government interoperability. The 'Birth' case was, in its initial phase, trying to establish new government e-services and the 'All In' case was a mature one renewing e-services at a government information portal. The cases provide a broad base of e-government interoperability practices, suggesting that the case in each cooperating constellation would be of interest and value to this research study. Table 1 summarises some characteristics of the cases studied.

Table 1   Two e-government research case studies

Government organisation (*main actors*)	*Origin*	*Focus area*	*Services involved*	*Start of cooperation*	*Users*
The Norwegian Tax Authority, Norwegian Directorate of Health, Norwegian Centre of Informatics in Health and Social Care	Norway	Notification of newborns from hospitals to the National Registry	Birth message, choice of name, personal number	2004, 2008	Hospitals, the National Registry, parents
The Norwegian Tax Authority, The Brønnøysund Register Centre, Statistics Norway	Norway	New information portal	E.g., Tax, VAT, salary and account, annual reports	2002	Unique citizens, companies and enterprises, public agencies

Data collection was accomplished through 12 interviews, with questions addressing government e-services, dominant problems, benchmark variables, description of the evolution and the economies of e-governance interoperability. For each case, six interviewees were selected among the participating government organisations. Interviews consisted of personal meetings with two additional follow-up interviews by phone. The individual cases serve as the evidentiary base for the study. The purpose is not to portray any single one of the relationships, but rather to synthesise the lessons learned, which were dispersed throughout the separate, cross-case issues.

3 Two government e-services in Norway

In this section, a short introduction to the two cases is given. First, the government e-services are presented, followed by its registers and transactions, and finally strategic drivers for change. This is done to set the scene for analysing the level of e-government interoperability.

3.1 Notification of newborns

The Birth case can be divided into two main parts. First, it is the notification of birth, which is an electronic birth message from regional hospitals to the National Registry. Second, it is the orchestration of all relevant government e-services into one main process of services applicable to people preparing for having a child and for the baby's first year of life.

Today, notification of birth is partly conducted manually with several stakeholders involved, e.g., staff at hospitals, staff at the National Registry and staff at the Norwegian Tax Directorate. The work process is supported by different information systems since each regional hospital trust operates its own healthcare information network. The National Registry operates the government database that files personal identifying information about a person. The steps in the notification process are summarised briefly as follows:

- When children are born, hospitals in Norway send a message (usually done by a midwife) on a standardised physical form, in three copies, to the regional office of the National Registry, which is operated by the Norwegian Tax Directorate.

- At the National Registry's regional office, the forms are controlled manually. One form is sent to the National Registry central office for further processing, one form is sent to the Church, and one is archived.

- The National Registry central office controls, registers and assigns a personal number (i.e., social security number) to the newborn.

- The final step is completion of the birth certificate (with the personal number), which is sent as a paper document from the regional office to the newborn's parents. A naming form is also sent, which initiates the naming dialogue.

The national population register, called the National Registry, is a government database of all people with affiliation to Norway. Since 1991, the Norwegian Tax Directorate has kept the register up-to-date. The register is used by the Norwegian government as a means of tracking its citizens, permanent residents and temporary residents for the purposes of work, taxation, government benefits, healthcare and other government-related functions. In Norway, a citizen is issued a personal number at birth. Non-citizens are issued such numbers when they enter the country. Several government registers use the personal number, e.g., property, car, driving licence, company, family doctor. A change of name or address is done in the national population register and transferred to other registers. Bringing the national population register up to date is partly based on messages from other government authorities, e.g., birth messages, death certificates, marital status, and partly by individual messages. All citizens have a duty to report change of residence, both domestic and abroad. The national population registry

also deals with the naming of children and changes of names. Access to the national population register is restricted. Only companies and organisations with reporting responsibility can apply for access.

The Norwegian health and social sector has spent years in strategic IT planning. According to the Office of the Auditor General of Norway (OAG, 2008a), the follow-up of ICT efforts in the health service has been inadequate:

> "Despite the focus on ICT and health during the last ten years, a great deal of the information flow in the health service is still paper-based. So far, electronic medical records in hospitals have only made a limited contribution to improving cooperation and the utilisation of resources. The Ministry of Health and Care Services has failed to fulfil its responsibility for following up the national ICT efforts."

As described, the work process notification of newborns is, to a large extent, paper-based. The first initiatives in electronic birth notification started in 2004 and involved two hospitals and the Norwegian Tax Directorate. The process stopped without being able to implement any electronic services or solutions. The project was re-established in 2008. In addition to services connected to the notification of birth – such as the electronic birth message, naming of newborn and assignment of personal number – a set of new government e-services can be developed. Confirming fatherhood for couples who are not married, applying for birth leave financial support and applying for kindergarten are examples of different relevant e-services to parents of a newborn child. In this way, data or information changes will be always updated as well as providing accurate accessible information, strengthened rights of pregnant women regarding use of the information, and simplified, better services.

3.2   The information portal 'All In'

Each year, Norwegian enterprises complete a series of public reporting forms to satisfy the public need for information. Surveys indicate that Norwegian enterprises spend 4800 full-time equivalent staff years on statutory reporting to state and government agencies (Brønnøysund Register Centre, 2007). As a measure to ease the burden of public reporting, the transition to reliable electronic reporting is of high importance in public trade and IT policies.

In 2002, the Norwegian Tax Administration, Statistics Norway and the Brønnøysund Register Centre joined forces to create a common internet portal for public reporting. The portal was launched in December 2003 under the name 'All In', and has been in full operation since that time. More than 120 different public forms are available and more than 23 million forms have been submitted through All In. The users of All In can either fill in the forms directly at the internet portal or they can use their own IT systems to transfer data, for example, salary and accounting systems or a year-end accounting package. The companies' own IT systems transfer pre-filled forms to the portal through a simple interface where the forms can be subsequently completed and signed in the portal. Efforts have been made to make the forms as easily accessible as possible. All In is a 24/7 solution, which provides high flexibility for the users. It allows users the opportunity to use the solution anywhere and at any time.

The registers contain information and key data about such matters as liabilities and titles in mortgaged moveable property, business enterprises, annual accounts and auditors' reports of limited companies, bankruptcies and compulsory liquidations,

marriage settlements. Other data include a shareholder register list, notification of change of address, monthly reports on biomass and salmon lice, turnover reports, tax returns for wage earners and pensioners, coordinated register notification, tax returns for businesses, operators and companies, term reports, annual accounts (Brønnøysund Register Centre, 2009). The responsibility to administer and develop All In is allocated to the Brønnøysund Register Centre, which is an administrative agency responsible for a number of national control and registration schemes for business and industry. The Registry performs an important task by coordinating the reporting obligations of business and industry. The overall aim is to prevent the superfluous collection and registration of information.

The work on establishing the next-generation solution, All In II, is forging ahead. Before starting All In II, a new mission statement was developed: "All In is the key to world class e-government services". All In will be developed as a cooperative platform for all public authorities, enterprises and local authorities in their dialogues with enterprises in the public and private sector. All electronic services for business enterprises shall be made available at the All In portal. All In can be used for the production of services for private individuals and will also enable interaction across agency boundaries in the public sector. According to the head of the All In control group and Director General of the Brønnøysund Register Centre,

> "All In is a vital common effort to establish electronic administration in Norway. The focus on All In has been strengthened because it is anchored both with the public authorities and on the ministerial level."

It is reasonable to state that All In has contributed to more efficient and better public and private services for citizens and businesses. A specific profit-taking project shows that All In has saved Norwegian businesses 1000 man-years of effort since it was launched in 2003.

4 Framework for e-government interoperability

Maturity levels in terms of stages-of-growth models have been widely used in both organisational research and IT management research. According to King and Teo (1997), these models describe a wide variety of phenomena – the organisational life cycle, product life cycle, biological growth, and so forth. These models assume that predictable patterns (conceptualised in terms of stages) exist in the growth of organisations, the sales levels of products, the diffusion of IT and the growth of living organisms. These stages are sequential in nature, occur as a hierarchical progression that is not easily reversed, and involve a broad range of organisational activities and structures.

Nolan's (1979) stages-of-growth model of the evolution of data processing became a landmark reference. He developed a model with six stages of growth and some workable benchmark variables identifying the stages. Several other researchers, inspired by Nolan's model, have studied areas such as the growth of end-user computing (Huff et al., 1988), evolution of information centres (Magal et al., 1988) and growth patterns of technology-based new ventures (Kazanjian, 1988). King and Teo (1997) suggested a four-stage model for the evolution of information systems planning. The level of integration between business planning and information systems planning has the following four stages: separate planning with administrative

integration, one-way linked planning with sequential integration, two-way linked planning with reciprocal planning and integrated planning with full integration. Earl (2000) suggested a stages-of-growth model for evolving e-business, consisting of the following six stages: external communication, internal communication, e-commerce, e-business, e-enterprise and transformation. Layne and Lee (2001) developed a four-stage model for fully functional e-government as cataloguing, transaction, vertical integration and horizontal integration. Teo and Pain (2004) introduce a model for web adoption and examine the characteristics of different level websites in terms of their features. One of the more recent stages-of-growth models was suggested by Gottschalk and Dean (2009), a stage model for criminal organisations and the costs of crime to society. Klievink and Jannsen (2009) present a five-stage model that describes the progression from stove-piped situations towards a nationwide, customer-oriented, and joined-up government. Each of the models identified certain characteristics that typified firms in different stages of growth.

Four core challenges and topics emerge when theorising stages of growth. The first challenge is to identify and explore the number of stages of growth. Second, a set of dominant problems with primary concerns for each stage needs to be identified. Third, is a need to develop workable benchmark variables identifying the stages, and fourth, is to find a proper description for the evolution in the model.

4.1   Number of stages and evolutionary path

Gottschalk and Solli-Sæther (2008) identify and discuss stages of e-government interoperability. The four stages presented are aligning work process, knowledge sharing, joint value creation and strategic alignment. The stage model was experimental in nature by assigning phenomenon to four stages and by labelling each stage according to a meaningful characteristic.

- *Stage 1: Aligning work process.* Common work processes are clearly defined among cooperating agencies. Some activities are carried out in one agency and other activities in another agency. Efficient operation requires integrated activities, forms and (physical or electronic) data exchange among different information systems. Data definitions must be specified in detail in certain cooperating areas. Interoperability at this level is partly manual work and partly supported by IT.

- *Stage 2: Knowledge sharing.* Agencies demonstrate their ability and determination to share knowledge. Knowledge sharing plays an important role for inter-organisational learning and innovation. Agencies put effort into defining best practices, specification of metadata, methods and technical standards for information infrastructure, systems and data exchange. Bilateral exchange of knowledge requires places to meet and support from knowledge management systems.

- *Stage 3: Joint value creation.* Being able to see common value configuration is fundamental in creating added value from cross-agency services. Common information models and service catalogues are necessary for the joint development of services for common end-users. Agencies are ready to bear the developmental costs even though benefits may be created in another agency.

- *Stage 4: Strategic alignment.* Common strategic positioning requires (political) alignment of mission statements. Joint government financing of projects is necessary to achieve socio-economic benefits. Adaptation of laws and regulations is necessary to achieve strategic alignment.

As an overall impression, the interviewees found these suggested four stages relevant to their particular e-services. According to the respondents in Norwegian public-sector organisations, too few stages will make the partition too large, and too many stages will make the partition too detailed. The respondents recognised conceptual planning, as an important preparation in obtaining e-government interoperability. Sushil (2008) found that in-depth planning and effective implementation strategy are essential factors for the success of any programme including e-governance. According to the interviewees, the evolutionary path seems to be logic, although it cannot be a linear progression only. The average value may have a linear progression, but in certain areas the evolution may have some divergence. They argue it is important that agencies have common goals (or expectations) for interoperability. As a consequence, maturity levels should be transparent for all cooperating parties.

4.2 Dominant problems and benchmark areas

Jayasuriya (1993) discussed the growth of end-user computing, using a framework where structure, technology and people are interrelated with mutually adjusting benchmark areas. In a similar way, this research builds a composite analytical framework where each stage of e-government interoperability is described in three different but related aspects: 1) organisational interoperability, 2) semantic interoperability, and 3) technical interoperability. These are similar to the three aspects of interoperability identified by The European Interoperability Framework (IDABC, 2004).

Interoperability refers to the property of diverse systems and organisations that enables them to work together. Organisational interoperability was defined as the extent to which organisations, using different work practices, are able to communicate. Semantic interoperability was defined as the extent to which information systems, using different terminology, are able to communicate. Lastly, technical interoperability was defined as the extent of systems to communicate, interpret and interchange data in a meaningful way (Archmann and Kudlacek, 2008).

Table 2 was developed during the case studies by asking the interviewees: "What were the dominant problems at each stage?" Respondents identified one or more important characteristics for each stage, which later were grouped into the three different, but related, benchmark areas. Table 2 serves as a framework for analysing stages of growth for e-government interoperability.

Applying dominant problems to stages of growth indicates an existing pattern of primary concerns that firms face for each theorised stage (Kazanjian, 1988). Kazanjian and Drazin (1989) argue that either implicitly or explicitly, all stage-of-growth models share a common underlying logic. Organisations undergo transformations in their design characteristics, which enable them to face the new tasks or problems that growth elicits. The problems, tasks or environments may differ from model to model, but almost all suggest that stages emerge in a well-defined sequence, so that the solution

of one set of problems or tasks leads to the emergence of a new set of problems or tasks that the organisation must address. Benchmark variables are often used to indicate characteristics in each stage of growth and to demonstrate that transitions occur through the stages.

Table 2   Analytical framework for e-government interoperability

Benchmark area / *Stage*	*Aligning work processes*	*Knowledge sharing*	*Joining value creation*	*Aligning strategies*
Organisational Interoperability	Efficient operation requires integration of activities and forms	Best practices	Cross-agency value configuration	Political decision-making
		Real-time knowledge transfer	New services based on business cases	Socio-economic benefits
		Change of organisational culture	Inter-organisational control mechanisms and trust	
Semantic Interoperability	High degree of specificity and common data definitions in certain areas	Metadata specification	Service catalogues	Adaptation of laws and regulations
			Information models	Business models
Technical Interoperability	Physical or electronic data exchange among separate applications	Common architecture	Joint application development	Joint financing
		Technical standards	Common databases	
	Closed systems		Information security	

5   Application of the framework

In this section, the results from the case studies are presented and discussed with respect to the number of stages, dominant problems, benchmark areas, potential benchmark variables and evolutionary path. To illustrate the application of the analytical framework presented in Table 2, the Birth case (B) and the All In case (A) were selected to represent different levels of e-governance interoperability. Here, they are analysed based on the relevant parameters of the framework (organisation, semantic and technical interoperabilities).

Organisational interoperability aims to link processes among different organisations. Thus, it is interesting to look at the inter-organisational architecture where these processes will take place. Conventional, organisational architecture consists of the formal organisation, informal organisation, business processes, strategy and human resources (e.g., Galbraith, 1995; Nadler and Tushman, 1997). These components can be understood as the building blocks that are mandatory for designing an organisational interoperability. To obtain organisational interoperability in e-governance, agencies with different work practices must be able to design a common stage where this work takes place. Galbraith's (1995) star model is a framework for thinking holistically about major components

of organisation design. In Table 3, these major components are seen in an organisational interoperability perspective, where components must be aligned to make the public-sector agencies interoperable.

In the Birth case, work process 'notification of birth' is aligned with some activities carried out at hospitals and some activities carried out within the Norwegian Tax Directorate, the National Registry. The public agencies are focusing on their firm-specific skills and know-how, solving problems related to 'life and death' and "collecting key numbers for tax purposes and a number of other purposes". The agencies have very different value-creation logic, where hospitals are solving unique customer problems and where the National Registry is transforming inputs into outputs. The formal structure is based on a few guidelines and process descriptions to ensure quality in the shared process. Participants facilitate the working relationship by making it as efficient as possible. The business process has some integrative roles where stakeholders perform separate parts of an overall work process. Workers are employed in very different organisations and are motivated by work feedback related to their functional responsibility. This indicates stage 1 of organisational interoperability.

Table 3   Organisational interoperability and stages of growth

Benchmark variable	Aligning work processes	Knowledge sharing	Joining value creation	Aligning strategies
Strategy	Cost minimisation and operational efficiency (B)(A)	Availability of resources	Mutually compatible goals	Socio-economic benefits
Business processes and lateral links	Obligations and service levels (B)	Process productivity and innovation (A)	Configuration of common value creation logic	Overall service quality
Formal structure	Guidelines and process descriptions (B)	Information sharing (A)	Organisational roles (A)	Power and authority
Informal structure	Facilitate working relationships (B)	Trust and reciprocity (A)	Task culture	Values and norms
Human resource management	Integration of firm-specific skills and know-how (B)	Integration and exploitation of strategic resources (A)	Personnel exchange	Resource pool

In the All In case, organisations are sharing knowledge and having strategic discussions on how to leverage distinctive internal or external resources. Being able to integrate and exploit strategic resources, they are trying to establish a strategic direction for the development of All In II. Information flows between participating agencies because they have established coordination committees and councils, hold formal meetings for discussions, etc. In the All In case, clearly defined organisational roles exist for agencies participating in the information portal. The Brønnøysund Register Centre has the responsibility for coordinating industry and businesses while the Agency for Public Management and e-Government has the responsibility for coordinating citizens and between public-sector agencies. Agencies have the responsibility for their own services.

The informal structure is based on trust and reciprocity. Individuals are learning from each other as well as from external sources. The formal and informal networks have created a culture for knowledge sharing, indicating stage 2 of organisational interoperability.

Semantic interoperability is part of the interoperability challenge for networked organisations. According to Papazoglou and Ribbers (2006), semantic issues at the data level are concerned with the actual meaning of data found in one system, and how it relates to data found in each and every one of the other partner's systems. Addressing these semantic concerns involves discovering how information is used differently by each of the cooperating organisations, and how that information maps to the normative alliance view. Semantic issues at the work process level are concerned with mutual agreement about how work processes are defined and managed, e.g., common metadata specifications.

The two cases studied showed different levels of maturity as shown in Table 4. The Birth case has developed a requirement specification (stage 1), where common data is thoroughly specified, and this document is distributed to all stakeholders involved in the birth message. In the All In case, metadata is specified in a semantic register for electronic interoperability (stage 2).

Table 4   Semantic interoperability and stages of growth

Benchmark variable	*Stage*			
	Aligning work processes	*Knowledge sharing*	*Joining value creation*	*Aligning strategies*
Meaning of data	Common data is specified (B)	Metadata specified in common databases (A)	Common information models	Common business models established

Technical interoperability can be viewed as a starting point for achieving e-governance interoperability. Archmann and Kudlacek (2008) found that key success factors for technical interoperability include the application of already existing technologies, common understanding and use of data. Data schemes, common syntax, accessibility, security and privacy are important issues when working on technical interoperability.

In the Birth case, the work process is supported by a separate information infrastructure consisting of systems and databases with physical forms for data exchange (i.e., a form is printed and sent by mail in a batch). Although physical data is exchanged between hospitals and the National Registry, requirement specifications are agreed upon so that the institutions are able to collect, register, store and retrieve information about newborns.

The All In case has established a common infrastructure with a common application architecture, tools and guidelines for service development, but little joint application development and no common databases. To a large extent, agencies have their own professional applications made available for end-users through a common information portal. Joint application development is planned for in All In II. There is a high degree of specificity and there are common data definitions in forms used by several agencies. Activities are to a certain degree aligned. Although some services are agency specific,

there are examples of joint services developed for two or more agencies. The differences between the Birth case and the All In case are shown in Table 5.

Overall, the All In case is at the knowledge-sharing stage of e-government interoperability (stage 2) and is trying to reach the next stage of maturity by joining value creation. The Birth case is at the work process stage of e-government interoperability (stage 1). Although the Ministry of Health and Social Care has indicated a need for clear strategic control and management of ICT in the health sector (press release 14/01/2009), there is still a long way to go. Today, responsibilities are fragmented and shared among several stakeholders, e.g., regional hospitals are allowed to decide on their own information infrastructure and systems.

Table 5   Technical interoperability and stages of growth

Stage *Benchmark variable*	*Aligning work processes*	*Knowledge sharing*	*Joining value creation*	*Aligning strategies*
Role of infrastructure	Separate infrastructures (B)	Integrated architecture (A)	Joint infrastructure investments	Common infrastructure
Role of information systems	Separate applications (B)(A)	Integrated application architecture (A)	Joint application investments (A)	Common applications
Data	Separate databases (B)(A)	Protocols for sharing (A)	Common databases	Accessibility
Data exchange	Forms for physical or electronic transfer (B)	Standardised data exchange formats (A)	Data stored in common databases	Data available for other purposes
Information security	Separate security services (B)	General security services (A)	Web service security	Protection

5.1   Impact of interoperability

Objectives of e-government are generally to improve efficiency and effectiveness and to save costs, but the driving force can also be public demand for online services and information that increase democratic participation, accountability, transparency, and the quality and speed of services (Yadav and Yadav, 2009). The idea of developing government e-services as described in the two cases has the following objectives. First, an electronic dialogue will provide better services for end-users. Second, a great potential exists for more efficient services within the agencies. Third, by building cross-agency value-added services for its citizens and businesses, public-sector agencies will appear to be unified. In addition, synergies between interoperating organisations may appear. As such, systematically developing interoperability in e-government may cause long-term benefits for a community, as suggested in Table 6. According to the Office of the Auditor General of Norway (OAG, 2008b), there is poor utilisation of the potential for the electronic exchange of information in the government administration:

> "Many public sector agencies possess information that is useful to other public agencies", says Auditor General [...]. "Better utilisation of this information could contribute to more secure, speedier and more efficient services for citizens and businesses."

According to IDABC (2008), benefits can be classified by the interoperability level which provides them, the type of benefit obtained (cost, time, etc.) and by the beneficiary (agencies, businesses and citizens). At the technical level, interoperability amounts to a dramatic savings in time and cost deriving from the avoidance of *ad-hoc* or point-to-point solutions. Furthermore, the resulting exchanges are more likely to be more reliable and require less maintenance. Interoperability at the semantic level may benefit from fewer labour-intensive and time-intensive actions needed to process data for reuse at the receiving end. Interoperability at the organisational level may produce benefits by enabling certain processes and activities to take place, and certain objectives to be met that normally would not be possible. Benefits to public agencies would include: facilitation of better and more efficient services, reuse of data and functionality, improvement of management decision, a speeding up of development, better coordination and reduced ICT costs. Benefits for industry and businesses would include: reduction in the reporting burden, service aggregation and better coordination, and increased and fairer competition. Finally, benefits to citizens would include: reduction in the reporting burden, accurate and complete information in their dealing with governments, and finally, that the agencies/government provides citizen-centric services.

Table 6   Stages of e-government interoperability and potential benefits

Stage		Benefits
1	Aligning work processes	Integration and efficiency in work processes
2	Knowledge sharing	Effectiveness and learning in inter-organisational relationships
3	Joining value creation	Added value from interoperability
4	Strategic alignment	Synergies among interoperating organisations

The cumulative effect of higher stages of interoperability is shown in Table 6, indicating relationships between maturity level and potential benefits. An organisation's performance can be measured in terms of differentiation, cost reduction, innovation, growth and alliance (e.g., Lederer et al., 1997; Teo and Pian, 2004). At a single organisation level, these measures may fit, but they are challenging when trying to measure benefits of e-government interoperability. In the example of All In, the reduction of reporting burden was measured in terms of reducing man-years for businesses. In this case, the beneficiary is not the same as the organisation that makes the investment. This may cause problems when calculating return on investments or financial assets. In a study of internet banking, Laukkanen (2006) found that different electronic services created value for individuals in their service consumption. Government services, as described in this paper, include an option for multiple service transactions *via* the internet. Although it is difficult to measure return on investment when the beneficiaries are individual citizens, such service may create great value for citizens. Another example is the All In II project where investments in one agency create benefits in another agency in terms of a reduced workforce and travel costs, as well as reduced costs for information distribution and communication. Since these organisations are government agencies,

socio-economic benefits must be taken into account when discussing potential benefits of e-government interoperability. Traditional performance measures such as return on investment, return on assets and increased annual revenue may not be appropriate, and future success may be found in achieving customer satisfaction through proper customer relations-management techniques (Smith, 2006). Similar to the findings of Chircu (2009), e-government interoperability projects studied in Norway are characterised by many stakeholders with multiple value dimensions that include financial, social and political.

According to Hansen (2009), working across organisational boundaries can create or destroy tremendous value. Collaboration can result in innovative cross-unit product development, increased sales through cross selling and transfer of best practices that reduce costs. But, he also warns that the conventional wisdom rests on the false assumption that the more employees collaborate, the better off the company will be. A collaborative return is the difference between the projected financial return on a project and two often overlooked factors – opportunity and collaboration costs (Hansen, 2009). A senior manager within the health sector also raised a similar warning: "*higher organisational interoperability may increase transaction costs*". The manager was concerned with control and management costs related to the definition of data, services and business processes. As such, the challenge is to determine when it makes sense to collaborate and when it does not. The analytical framework can help management identify where major transition points occur and also the change factors that need to be managed if staged growth is to be accomplished effectively. E-government needs to be planned by a holistic view to reduce the associated risks and prevent increased wastage of time and money (Ghapanchi et al., 2008).

6   Conclusion

In this research, the suggested stages-of-growth model for e-government interoperability suggested by Gottschalk and Solli-Sæther (2008) was found relevant in two governmental e-services in Norway. The study suggests a multidimensional analytical framework incorporating organisational, semantic and technical interoperability, investigating maturity in e-government interoperability. Application of the framework in analysing cross-agency e-services in Norway indicates:

- governments face different issues and challenges based on their stages of growth

- cooperating and communicating governments have different expectations and goals based on their stages of growth

- benefits from e-government interoperability vary depending on maturity level.

Interoperability results in benefits when work processes are aligned, knowledge is shared, value creation is common, and strategies are aligned. Investments in e-government interoperability improve value for government agencies, businesses and citizens, but traditional performance measures are found difficult to use in measuring the success of e-government interoperability, since stakeholders with different value dimensions are involved.

For e-government managers, the stages-of-growth model represents a picture of evolution where the current stage can be understood in terms of history and future. Organisations can use the analytical framework to identify which stage they are in,

particularly when using the characteristics of each stage. Having positioned their organisation, the model potentially helps e-government managers in identifying upcoming issues and thus provides a framework for planning and orchestrating the evolutionary journey, as well as improving stakeholder value. Using the benchmark variables suggested for e-government interoperability provides managers with a set of considerations that may deserve special attention.

For researchers, the stages-of-growth models have the potential for creating new knowledge and insights into organisational phenomena. Such models represent theory-building tools that conceptualise evolution over time in a variety of areas. The conceptual stages of growth for e-government interoperability represents a theory to be explored and empirically validated. Further research should carry out empirical testing of the framework and its benchmark variables. This can be done as a survey, where stages, evolution and benchmark values are empirically tested. On the basis of the survey research, the analytical framework for e-government interoperability should be revised. It would also be interesting to investigate further the effect of increased interoperability on benefits, in the directions of increased efficiency, effectiveness and user satisfaction. This study is limited to a subset of objectives of interoperability. In this exploratory part, the study has, to a large extent, neglected legal interoperability and political context, and it disregards potential drawbacks, barriers and disadvantages of interoperability – all of which should be considered in future research.

Acknowledgement

References

Archmann, S. and Kudlacek, I. (2008) 'Interoperability and the exchange of good practice cases', *European Journal of ePractice*, Vol. 2, pp.3–12.

Brønnøysund Register Centre (2007) *Annual Report 2007*, Online, The Brønnøysund Register Centre, Available: www.brreg.no, Accessed 15 May 2009.

Brønnøysund Register Centre (2009) *The Central Source of Information in Norway*, Online, Brønnøysund Register Centre, Available: http://www.brreg.no/english/, Accessed 15 May 2009.

Chircu, A.M. (2009) 'E-government evaluation: towards a multidimensional framework', *Electronic Government, An International Journal*, Vol. 5, pp.345–363.

Earl, M.J. (2000) 'Evolving the e-business', *Business Strategy Review*, Vol. 11, pp.33–38.

Galbraith, J. (1995) '*Designing Organizations: An Executive Briefing on Strategy, Structure, and Process*, Jossey-Bass Publishers, San Francisco, CA.

Ghapanchi, A., Albadvi, A. and Zarei, B. (2008) 'A framework for e-government planning and implementation', *Electronic Government, An International Journal*, Vol. 5, pp.71–90.

Gottschalk, P. and Dean, G. (2009) 'A review of organized crime in electronic finance', *International Journal of Electronic Finance*, Vol. 3, pp.46–63.

Gottschalk, P. and Solli-Sæther, H. (2008) 'Stages of e-government interoperability', *Electronic Government, an International Journal*, Vol. 5, pp.310–320.

Gottschalk, P. and Solli-Sæther, H. (2009) '*E-Government Interoperability and Information Resource Integration: Frameworks for Aligned Development*, IGI Global, Hershey, PA.

Hansen, M.T. (2009) 'When internal collaboration is bad for your company', *Harvard Business Review*, Vol. 87, pp.82–87.

Huff, S.L., Munro, M.C., Martin, B.H. and Sibley, E.H. (1988) 'Growth stages of end user computing', *Communications of the ACM*, Vol. 31, pp.542–550.

IDABC (2004) *European Interoperability Framework for Pan-European eGovernment Services V1.0*, European Commission.

IDABC (2008) *European Interoperability Framework for Pan-European eGovernment Services V2.0 (Draft for Public Comments 15/07/2008)*, European Commission.

Jayasuriya, R. (1993) 'Stages of growth in end-user computing: applications in the health sector of developing countries in Asia-Pacific', *Journal of Information Technology*, Vol. 8, pp.151–159.

Kazanjian, R.K. (1988) 'Relation of dominant problems to stages of growth in technology-based new ventures', *Academy of Management Journal*, Vol. 31, pp.257–279.

Kazanjian, R.K. and Drazin, R. (1989) 'An empirical test of a stage of growth progression model', *Management Science*, Vol. 35, pp.1489–1503.

King, W.R. and Teo, T.S.H. (1997) 'Integration between business planning and information systems planning: validating a stage hypothesis', *Decision Science*, Vol. 28, pp.279–308.

Klievink, B. and Janssen, M. (2009) 'Realizing joined-up government – dynamic capabilities and stage models for transformation', *Government Information Quarterly*, Vol. 26, pp.275–284.

Laukkanen, T. (2006) 'Customer-perceived value of e-financial services: a means-end approach', *International Journal of Electronic Finance*, Vol. 1, pp.5–17.

Layne, K. and Lee, J. (2001) 'Developing fully functional e-government: a four stage model', *Government Information Quarterly*, Vol. 18, pp.122–136.

Lederer, A.L., Mirchandani, D.A. and Sims, K. (1997) 'The link between information strategy and electronic commerce', *Journal of Organizational Computing and Electronic Commerce*, Vol. 7, pp.17–34.

Legner, C. and Lebreton, B. (2007) 'Business interoperability research: present achievements and upcoming challenges', *Electronic Markets*, Vol. 17, pp.176–186.

Magal, S.R., Carr, H.H. and Watson, H.J. (1988) 'Critical success factors for information center managers', *MIS Quarterly*, Vol. 22, pp.413–425.

Nadler, D.A. and Tushman, M.L. (1997) *Competing by Design. The Power of Organizational Architecture*, Oxford University Press, New York.

Nolan, R.L. (1979) 'Managing the crisis in data processing', *Harvard Business Review*, Vol. 57, pp.115–126.

OAG (2008a) *The Office of the Auditor General's Investigation into ICT in Hospitals and Electronic Cooperation in the Health Service*, Office of the Auditor General of Norway.

OAG (2008b) *The Office of the Auditor General's Investigation into the Electronic Exchange of Information and the Development of Services in the Public Sector*, Office of the Auditor General of Norway.

Papazoglou, T.A. and Ribbers, P.M.A. (2006) *E-Business: Organizational and Technical Foundations*, John Wiley & Sons, West Sussex, UK.

Pardo, T.A. and Tayi, G.K. (2007) 'Interorganizational information integration: a key enabler for digital government', *Government Information Quarterly*, Vol. 24, pp.691–715.

Scholl, H.J. and Klischewski, R. (2007) 'E-government integration and interoperability: framing the research agenda', *International Journal of Public Administration*, Vol. 30, pp.889–920.

Smith, A.D. (2006) 'Exploring security and comfort issues associated with online banking', *International Journal of Electronic Finance*, Vol. 1, pp.18–48.

Stake, R.E. (1994) 'Case studies', in Denzin, N.K. and Lincoln, Y.S. (Eds.): *Handbook of Qualitative Research*, Sage Publications, Thousand Oaks, CA, p.237.

Sushil, P.K.S. (2008) 'Towards a strategy for implementing e-governance applications: a case study of integrated fertilisers management information systems based on SAP-LAP framework', *Electronic Government, An International Journal*, Vol. 5, pp.420–444.

Teo, T.S.H. and Pian, Y. (2004) 'A model for web adoption', *Information & Management*, Vol. 41, pp.457–468.

United Nations (2008) *United Nations e-Government Survey 2008*, From e-Government to Connected Governance, Department of Economics and Social Affairs, Divison for Public Administration and Development Management, New York.

Wilson, F., van Engers, T. and Peters, R. (2007) 'Training e-government actors: experience and future needs', *European Journal of ePractice*, Vol. 1, pp.36–47.

Yadav, N. and Yadav, H. (2009) 'An electronic government model based on a case study approach', *Electronic Government, An International Journal*, Vol. 6, pp.421–432.

Yin, R.K. (2003) *Case Study Research: Design and Methods*, Sage Publications, Inc., Thousand Oaks, CA.