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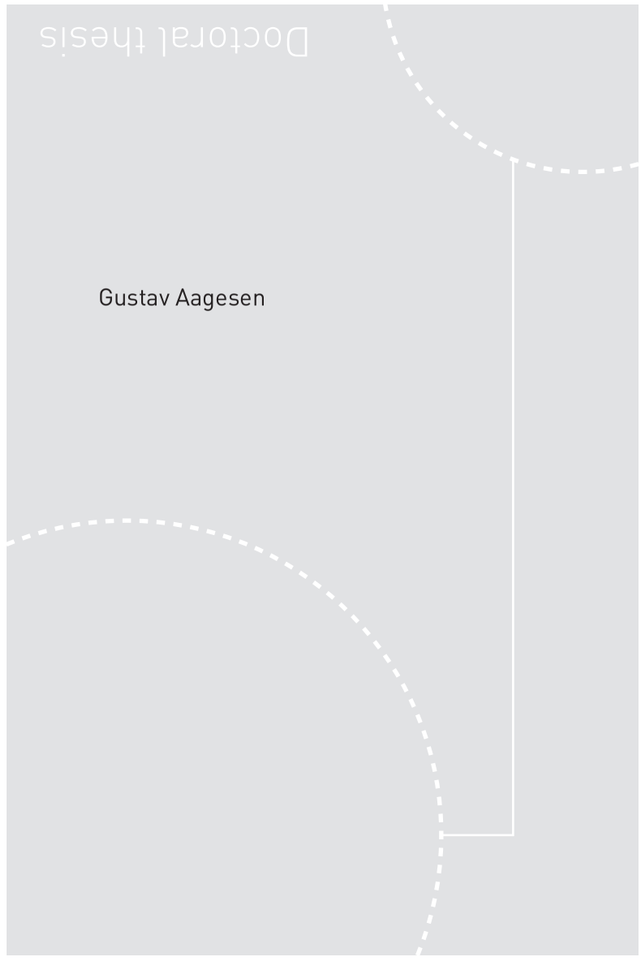
Gustav Aagesen

Multi-channel Provisioning of Public Services

Doctoral thesis



Gustav Aagesen

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Norwegian University of
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Thesis for the degree of
Philosophiae Doctor

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Abstract

Information technology facilitates a continuous change in how public services are organised and provided. Influenced by external and internal requirements, the changes are step-wise and non-linear, each step facilitating the next. Examples of requirements are related to supporting e-services, multi-channel provisioning, transparency, citizen-centricity, mobility, and globalisation. Information infrastructures define the capabilities of a public agency for efficient service delivery, both internally and externally. Historically, information infrastructures have evolved over time and have drifted in use, leaving complex systems and use of systems at a national level. National government e-service infrastructures aim to support cross agency collaboration, provide access to shared components, and the reuse of previously defined functionality. Depending on its construction, an infrastructure as a platform for service provisioning can support or limit the development of an improved provisioning of services. There is a need for systems with mechanisms that support public services that evolve with the changing requirements of the environment.

The objective of this PhD study is to contribute to the delivery of citizen-centric and demand driven services and to the establishment a hypothetical *My Processes* citizen's portal. This portal will provide process-oriented multi-channel personalised interaction for all public services.

Using a design science approach, this study is performed through the analysis of the existing knowledge base, the modelling of design artefacts, and case studies in the problem environment. The contributions of the study are:

C1: A model describing the dynamics of e-government.
C2: Future scenarios for citizen-centric and demand driven public services.
C3: Requirements for an e-service infrastructure for public service provisioning.
C4: A conceptual design for a national e-service infrastructure.
C5: A conceptual e-service governance model.

In addition to a general focus on process-oriented service provisioning throughout the research study, overviews of the current use of process models and the flexibility supported by process-aware information systems are also provided.

The contributions are targeted towards system developers and researchers that are working with governance or development of e-government systems providing public services, and those that are working with holistic aspects of information infrastructure development.

Preface

This thesis is submitted to the Norwegian University of Science and Technology (NTNU) in partial fulfilment of the requirements for the degree of *philosophiae doctor* (*PhD*). The work has been performed at the Department of Computer and Information Science, NTNU, Trondheim, with Professor John Krogstie as the main supervisor and Professor Guttorm Sindre and Associate Professor Øystein Nytrø as co-supervisors.

Acknowledgements

I would like to express my deepest gratitude to Professor John Krogstie for making this PhD study possible, and for his trust and valuable mentoring. Also, I would like to thank Professor Guttorm Sindre for his eager support in the important early phase of my study.

I extend my sincere gratitude to Associate Professor Marijn Janssen and the e-government group at TU Delft, for their hospitality and an unforgettable 6 months in Delft. A special thanks goes to Anne Fleur van Veenstra for, in addition to being a friend, finding time to collaborate, and in that making my studies even more interesting.

The case study work could not have been conducted without the openness of the *National Office of Building Technology and Administration*, *The Brønnøysund Register Centre*, and the *Agency for Public Management and eGovernment.* Hallstein Husand deserves special thanks for letting me bypass the red tape at a hectic time for the Altinn II project.

Even though I have been without a research group or fellow students with shared concerns research-wise, I would like to thank my partner in crime and colleague Geir Solskinnsbak for the time spent trying to locate the true path to a PhD. I would also like to thank Tor-Erik Hagen for reminding me that taking on this study was my own choice, my father for trying to talk me out of it, and my dearest Tonje for her endless support.

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Abbreviations

AJAX	Asynchronous JavaScript and XML
AKM	Active Knowledge Modelling
API	Application Programming Interface
BAM	Business Activity Monitoring
BPA	Business Performance Analysis
BPDM	Business Process Definition Language
BPEL	Business Process Execution Language
BPM	Business Process Management
BPMN	Business Process Management and Notation
BPMS	Business Process Management System
BZK	Ministry of Interior and Kingdom Relations (Dutch)
CCPV	Citizen-Centric Process View
CH	Case Handling
CIM	Computational-Independent Modelling
CRM	Customer Relationship Management
CPI	Continuous Process Improvement
Difi	Agency for Public Management and E-government (Norwegian)
DFD	Data Flow Diagram
DSM	Domain Specific Model
EA	Enterprise Architecture
EEA	European Economic Area
EDI	Electronic Data Interchange
eID	Electronic Identification
EPC	Event Process Chains
EZ	Ministry of Economic Affairs (Dutch)
FAD	Ministry of Government Administration, Reform and Church Affairs (Norwegian)
GII	Government Information Infrastructure
GIS	Geographical Information System
ICT	Information and Communication Technology
II	Information Infrastructure
IF	Interoperability Framework
IS	Information System
IT	Information Technology
KM	Knowledge Management
KS	Association of Local and Regional Authorities (Norwegian)
MDA	Model Driven Architecture
NEA	National Enterprise Architecture
NGI	Next Generation Digital Government Infrastructure
NII	National Information Infrastructure
NORA	Government Reference Architecture (Dutch)
NTNU	Norwegian University of Science and Technology
NUP	National Implementation Plan (Dutch)
OMG	Object Management Group

OTP	Government Transaction Gate (Dutch)
PaaS	Platform as a Service
PIM	Platform-Independent Modelling
PSM	Platform-Specific Modelling
PAIS	Process-Aware Information System
RFID	Radio Frequency Identification
SaaS	Software as a Service
SCA	Service-Component Architecture
SDK	Service Development Kit
SOA	Service Oriented Architecture
STP	Straight Through Processing
UML	Unified Modelling Language
W3C	World Wide Web Consortium
XML	Extensible Markup Language

1 Introduction

Computer says "No"

– Carol Beer (aka David Walliams), Little Britain

1.1 Motivation

With the modernisation of society at large and with the advent of the Internet there has been a change in the provisioning of public services. Policy reforms, and the corresponding changes in the nature and organisation of public services, are shaped by various rationalities. Examples are found in expectations presented by citizens, responses to societal changes, legal claims from external bodies, pursuit of economic prospects, or efforts taken to bypass unforeseen consequences of prior interventions.

ICT-supported service production in Norway can be traced back to the late 1950s (Jansen, 2008). Matched by equivalent efforts abroad, the information society has been locally built in iterations to fit local needs, extended by regional solutions and customised commercial systems, and later supported by systems providing services globally. The current installed base of systems providing public services are comprised of a loosely coupled combination of old and new systems and the corresponding organisations, cultures, and methods that surround them. Such constellations can also be referred to as information infrastructures[1] (Hanseth and Lyytinen, 2004).

The further development of ICT-supported public services depends on administrative, structural, political, and juridical aspects. The administrative aspects are related to the processes that cover the acquisition and realisation of new technology within and across different organisational units within public administration. The structural aspects are identified by the fact that the structure and organisation of governments are constantly changing. The political aspects include the shifting of political priorities and the expected near instant deployment of new services to the public, based on new laws and regulations. Some juridical aspects can be related to the following: The law and execution of the law is in many cases open for interpretation, thus limiting process automation; Privacy issues related to personal information further limit the availability and use of data to the extent that would normally be considered optimal. It is vital that the ICT supporting public service provisioning is capable of handling the unpredictable nature of the domain, and that ICT is not considered as yet another barrier for further development.

[1] See Section 1.3.1 and Section 4.3

In order to face the further development of ICT-supported public service provisioning, there is a need for holistic long-term e-government strategies. Additionally, there is a need to specifically address the e-government domain from an information systems point of view. This involves both the investigation of current and future needs compared to current technologies, and how current technologies can support the long-term strategic vision of e-government.

1.2 E-government – definition and proposed challenge

E-government is, in its simplest form, the study and use of information technology in public sector organisations (Heeks, 2006). However, with the near omnipresent nature of information technology, the e-government domain is about to engulf most aspects of public administration, governance of contemporary democracies and public service provisioning.

There is international understanding that current institutional arrangements are inadequate and do not deliver, and that major reforms are needed (Olsen, 2010). Historically, democratic institutions have come and gone, as citizens and their leaders have developed and redefined, often unattainable, normative doctrines and organisational principles of good government towards which rulers and the ruled are supposed to orient their behaviour (Olsen, 2010). Current principles for good governance (Weiss, 2000) as defined by the European Commission include openness, participation, accountability, effectiveness and coherence (European Commission, 2001). Similar principles can be found in the United Kingdom (Langlands, 2004), and at the different levels of all governments.

E-government came with the growth of the Internet and the World Wide Web, and the government reform effort initiated by the Clinton-Gore administration in 1993 as the National Performance Review (NPR) and in 1998 the undertaking known as the National Partnership for Reinventing Government (Fountain, 2001). In this, the Internet does not only supply new service channels, but also acts as means to change existing institutional arrangements. Through the use of technology and these new service channels, early efforts were made to redesign work processes towards the needs of customers, rather than the needs or structures of institutions. This process gave birth to the term e-government (electronic government) (Dawes, 2008). A unified definition of e-government does however not exist. Senators Lieberman and Thompson made the first definition of e-government as:

> *A way to better use IT advances to achieve greater effectiveness and to provide citizens easy, electronic access to government programs, services and information.*
>
> *Kraemer and King (2003)*

The definition provided by the European Commission increase the scope of e-government and adds the important perspective of organisational change, defining e-government as …

> *... the use of information and communications technologies in public administrations – combined with organisational change and new skills – to improve public services and democratic processes and to strengthen support to public policies.*
>
> *European Commission (2003)*

Other definitions provided by Dawes (2008) include that of the National Science Foundation, OECD, and the World Bank. These are all based on the use of information technology and span between improving policies and government operations, providing timely services, engaging and empowering citizens through access to information, and facilitating of democratic processes in the relationship between citizens, civil society, the private sector and the state, as well as advancing the public reform agenda.

Although the presented definitions for e-government are ambitious and optimistic, they are challenged by a reality that is somewhat different. Administrative reform implies the making of dramatic, fundamental or radical change in form, and not just a change in degree as implied by *continuous improvement* (Kraemer and King, 2003). Organisations further tend to patch information systems onto existing structures in ways that may enhance efficiency and capacity but that otherwise maintain the status quo (Fountain, 2001). Kraemer and King (2003) propose that IT does not cause reform, and cannot encourage it where the political will to pursue the reform does not exist. They also state that IT has brought relatively little change to the structure of organisations and rather seems to reinforce existing structures. Given the political and organisational will, it is however possible that government reforms can be supported through the strategic use of IT and a pro-active reinvention of core processes. It is further possible that the maturity of previous ICT affordances have been limited to that of enforcing existing operations rather than providing the flexibility for process change at an acceptable cost. This challenge can be faced through improved technology affordances and governance.

1.3 Introductory contextualisation of the problem

Being a multi-disciplinary research field, the breadth of concerns and the position from which the e-government domain is investigated is extensive. Multi-disciplinary research is needed both to understand current implementations, the impacts of new developments and the need for further research to guide strategic decisions. According to Wimmer (2007), schools of research contributing to the e-government field include: social and human sciences; political, strategic, democracy, and legal sciences; information and knowledge research sciences, organisational and economic sciences; and computer and information sciences. Scholl (2007) identifies six main independent concepts constituting study areas within the e-government field – information and technology use are contributing variables interacting with subject variables such as public policy, government operations, government services and citizen engagement, resulting in multi-discipline study areas (Figure 1).

The methodological approach of the study is the design science for information systems research (see Chapter 2). The study takes on a holistic treatment of the e-government

domain, suggesting a broad approach not limited to the use of technology in a restricted context. It implies that a suggested solution is not limited to the engineering of a technical artefact, but that the artefact requirements fit the government context and current concerns related to the provisioning of government services. Accordingly, the problem domain is in the intersection of public policy, government operations, government services, citizen engagement, and technology. The technology viewpoint for this research work is information systems.

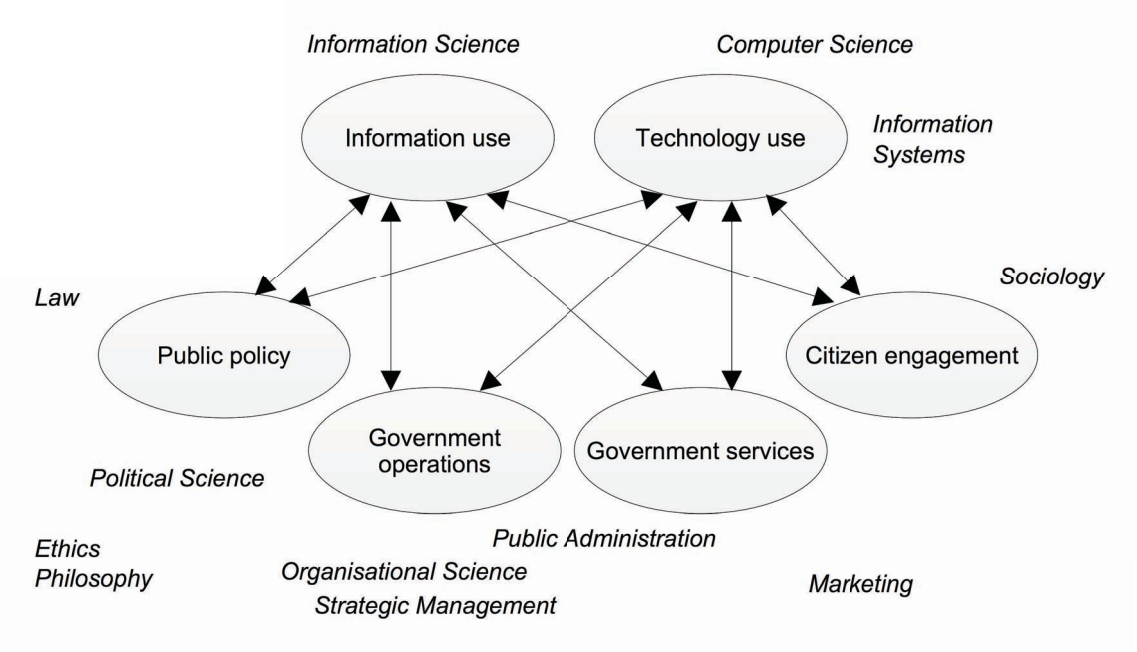

Figure 1 Relationships between key variables in e-government and select disciplinary interests (Scholl, 2007)

A clarification of some terms in the multi-disciplinary context of this study is needed. In the following section, the terms information infrastructure, transformational government, multi-channel provisioning, and e-services are introduced together with the multi-role view of the citizen. This is followed by a discussion of selected constraints related to public service provisioning based on an interpretation of the introduced terms.

1.3.1 Infrastructure

Different coexisting perceptions of infrastructure are used for e-government purposes depending on the perspective, including platform (product), foundation, system, relation, and portfolio (Klischewski, 2011). The understanding of infrastructure used as a basis for the suggestion of the design artefact in this research study is inspired by the information infrastructure concept, complex adaptive systems theory, by cyber infrastructures as envisioned by the *roadmapping eGovernment research* (eGovRTD2020) project (Wimmer et al., 2008), and current development towards a infrastructure of shared services in Norway. Each concept is briefly discussed below.

Information Infrastructure (II) is a central concept in the *US High Performance Computing and Communication Act of 1991* through the definition of National Information Infrastructure (NII). It was used in referring to integrated solutions based on the ongoing fusion of information and communication technologies, and was later

adopted by the European Union through the 1994 Bangemann Report (Hanseth, 2000). Bangemann et al. (1994) suggest that an unlimited potential for acquiring knowledge, innovation, and creativity lies in an information infrastructure comprised by resources that have traditionally have been separate and indeed distant. This refers to finding new use of existing information and combining existing resources across organisations in order to achieve an improved service provisioning. The conceptualisation of II made by Hanseth (2000) is that of II as an evolving, shared, open, and heterogeneous installed base. It can be further understood as a system of socio-technical systems. A socio-technical system implies considering both technical components and human actors. Where the technical components can be technical actors or methods, tools, structures, or other phenomenon constraining or enabling system output. Trist (1981) suggests that socio-technical studies need to be carried out in the interrelated context of primary work systems (activities), whole organisation systems (workplace) and macro-social systems (domains). Socio-technical systems are non-deterministic as system behaviour partially depends on human actors (Sommerville, 2006).

A general definition for a complex adaptive system (CAS) is *a system that emerges over time into a coherent form, and adapts and organises itself without any singular entity deliberately managing or controlling it* (Holland, 1996). Conceptual elements of a complex adaptive system useful when describing public service provisioning and service providing organisations include *co-evolving*, *sub-optimal*, *variety*, and *iterative* (Janssen and Kuk, 2006). *Co-evolving* implies that all systems exist within their own environment, which they also are part of. As their environment changes, they need to change to ensure best fit. But because they are part of their environment, when they change, they change their environment, and so it goes on as a constant process. *Sub-optimal* suggests that a complex adaptive system does not have to be perfect in order for it to thrive within its environment. Once a complex adaptive system reaches the state of being good enough, it will trade off efficiency with greater effectiveness. *Variety* suggests that the greater the variety within the system, the stronger it is. Complex adaptive systems rely on ambiguity, paradox, and contradictions to create new possibilities. *Iterative* suggests that small changes in the initial conditions of the system can have significant impacts after they have passed through the emergence of feedback loops.

Cyber infrastructures refer to infrastructure as a platform and the possibility of constructing public services from the assembly of readily available and reusable components (Codagnone and Wimmer, 2007). The eGovRTD2020 specifically has identified research related to a potential existence of a building-block industry for technology-based infrastructure components for use across the EU. Identified research topic within the project involves the development of business models, success factors, building block repositories, and governance aspects of a public service infrastructure platform comprised by commercially provided building blocks. Reusable components are central also to the implementation of the Norwegian government public service infrastructure platform. The Norwegian ICT architecture is based on a three-layered model where a shared service and presentation layer on top of a business layer comprised by the existing information infrastructures of the various government agencies (FAD, 2007). The shared services are however based on providing access to

information repositories and reuse of centrally defined modules, rather than decomposing the infrastructure as a whole.

1.3.2 Transformational government

Transformational government (t-government) is a label used to describe a specific part or phase of e-government were a transformation of current operations is needed in order to further improve the delivery of public services. It is assumed to enable citizen and business interaction with government, and the provisioning of public services, to act according to what is believed to be optimal. T-government as a term was introduced in the United Kingdom in 2005 through the *Transformational Government Enabled by Technology* programme (Murphy, 2005). It was launched as an attempt to revitalise e-government efforts towards actual service transformation. T-government is defined as a government that…

> *...puts citizens and communities centre stage and envisages a future where citizens are informed and engaged, services are tailored to local needs and organisations are fit for purpose [...with citizens going from...] passive recipients of standard services, to active partners in customised service design and delivery.*
>
> *King and Cotterill (2007).*

Others take on a process view and define t-government as …

> *... a managed process of ICT-enabled change in the public sector, which puts the needs of citizens and businesses at the heart of that process and which achieves significant and transformational impacts on the efficiency and effectiveness of government.*
>
> *Oasis (2012).*

T-government prescribes selected structural changes (cultural, organisational, and political) in order to provide the assumed prerequisites that will enable ICT to deliver improved benefits for the public sector. In this, lies an optimistic view of the role of the individual citizen. Bekkers and Homburg (2007) discuss the myth of a future citizen being informed, engaged or empowered. They point to the Dutch government's future scenario that describes…

> *...citizens which demand a government that is responsive to their needs, and is able to generate an open and horizontal dialogue, and that organises its internal processes in a transparent way.*
>
> *Bekkers and Homburg (2007).*

Janssen and Shu (2008) point to t-government as focusing on governance and changing organisational structures, the redesign of business processes, and the creation of a facilitating infrastructure that is flexible enough to support these changes at a low cost.

This thesis perceives a t-government scenario where the organisation of government and provided services are in a more or less continuous reconfiguration towards what is believed to optimal, and define t-government as …

… a government that is able to holistically provide services that evolve with the changing needs of their stakeholders.

The holism refers to both shared objectives across organisational boundaries of the public sector and a multi-role view on the citizen[2]. Through this view on t-government, the focus of the thesis is the design of long-term information systems, which are able to adapt and evolve with the changing requirements and organisation of government agencies.

1.3.3 Multi-channel provisioning

When it comes to service provisioning, a channel is a means used by an administration for interacting with, and delivering services to, its customers (Estevez et al., 2007). Hence, multi-channel provisioning is …

> *... the use of multiple service channels within one public service delivery process or the use of different channels for different service delivery processes (Pieterson and van Dijk, 2006).*

The term is closely related to that of multi-channel marketing, where different marketing channels are used to reach a customer (Rangaswamy and van Bruggen, 2005). In context of this research, channels are physical service desks, traditional channels like phone, fax and surface mail, and electronic channels provided through end user devices as Word Wide Web access through web browsers, Internet connectivity through various applications, or SMS text messaging. The treatment of these channels in this work is however limited to the understanding that interfaces must be developed so that new channels can be supported, and that the interactions through these channels are coordinated with the service delivery process as a whole.

1.3.4 Public services and e-services

Bovaird and Löfler (2009) give three perspectives on public service, as being services that merit public intervention due to market failure, services that are vitally important for the re-election of politicians or political parties that they are given public subsidies, or services in which Parliament has decreed a need for regulation. In the delivery of public services, it is assumed that ICT will support the service provisioning. An e-service is an interaction between government, citizens, and businesses in the process of applying for, requesting changes to, or reporting on the delivery of a given physical service using an electronic channel.

In the context of ICT support for public service provisioning, services are used as a concept in this thesis both when referring to a physical service provided or to the

[2] See Section 1.3.5

conceptual model of the same service. An e-service denotes that the service has a conceptual representation in an information system, and that the service interactions are supported through electronic channels. Hence, an e-service is defined in this thesis as …

> *…a public service that is provided in such a way that that data that is related to the service can be collected, updated and made available through the use of electronic channels.*

To take into account the complexity of public service provisioning, services that are emphasised in this study are those having multiple contributing actors. These services typically constitute multiple stages between requesting and providing actors. The service processes can further be considered to be knowledge intensive and subject to part automation and part completion with assistance of a human actor. Examples of such services are found within the birth and naming process of a child, building permits and construction of property, and the process related to the passing of a relative.

Services are in this study also considered to be demand-driven. In this, there is an expectation that there are variations between how the service is delivered to the single receiver, and that services and capabilities for service delivery evolve over time.
As an attempt to address the required flexibility of the service environment, the research will utilise the concept of interactive process models (Jørgensen, 2004) as a component in the design process. In this approach, a model representation of a service reflects the actual service, so that changes to the model representation of a service affect how a service is provided. Further, that the user is able to change conditions and rules governing the model representation of a service.

1.3.5 A multi-role view of the citizen

A citizen-centric approach is an approach that set the citizen in the centre of the service provisioning process. In such an approach, the citizen can have various roles in its interactions with its environment and the government. A citizen can act both as a service receiver and a contributor in interest of the public and fellow citizens.

Depending on the service provided, it is sometimes useful to consider the citizen as a service receiver or a customer, while in some service-delivery scenarios the citizen can have other roles, not fit a customer perspective. The scope of this study is however limited to the view of a citizen that is either a receiver of a service as an individual or as part of a group, or as a contributor in the service delivery where an other citizen is the service receiver.

1.3.6 Constraint issues in public service provisioning

As a part of the contextualisation of the problem, the following issues must be taken into account when designing systems for public service provisioning:

- Grant offerings, regulations, and government services are managed politically and are therefore considered dynamic and subject to change.

- Government information systems are of enterprise-scale (large and complex), and the different system clusters require a high level of interoperability.

- Public agencies are autonomous and exercise different levels of freedom.

- The competence and resource availability vary between different public agencies.

- Consequences of weak or failed governance and central support can foster resistance to adhere to what has centrally been defined as best practice.

- Driven by the consumer electronics industry, end user devices (e.g. smartphones) in which users can connect to an e-service infrastructure are updated and replaced continuously. This is both an opportunity and a challenge. The opportunity is that the new capabilities in the end user devices can change what services are provided and how. The challenge is the successful integration of the new channels to the e-service infrastructure.

- From an information systems perspective, the public service environment is dominated by wicked problems (Rittel and Webber, 1973). This is an environment having unstable and unclear work processes and with unstable, unclear and sometimes inconsistent requirements at the user, group, and organisational levels.

1.4 Research environment

The research study is related to the program ICT in Public Sector (e-government), aiming to strengthen existing research and to establish new research and education within ICT in the Public Sector at NTNU. This is achieved by coordinating and stimulating activities, utilising interdisciplinary means, and technology and problem competence within e-government research, both at NTNU and across public and commercial organisations.

Most of the research work has been done within the information systems group of the Department of Computer Science and Information Technology at NTNU. This research, however, has been independent and not within a group of researchers focusing on e-government matters per se. In addition to the work in Trondheim, a 6-month stay abroad has been spent with a group of researchers focusing on e-government related problems at the Faculty for Technology, Policy and Management at the Technical University Delft, Netherlands.

The research study has additionally involved participation at the iGov Research Institute, a 1-week residential program organised by the *Center for Technology in Government* at the University at Albany, State University of New York. The program is supported by a grant from the US National Science Foundation.

1.5 Research context and objectives

The disciplinary context of the study was defined in section 1.3. Concerning interactions between the actors, important issues are the interactions within government agencies on a national and local level, as well as the interactions between the government and its citizens or the government at both local and national levels.

A general objective of the PhD study is to contribute to the transformation of the current Norwegian *My Page* citizen-portal as a public service portal for information directed towards the single citizen into *My Processes*, which is a hypothetical multi-channel service portal for all public services for use both by citizens, businesses, and government agencies.

The specific objective of the PhD study is to contribute towards a national e-service infrastructure. An e-service infrastructure can be understood as a sandbox supporting the development, maintenance, and support for provisioning of public services. It supports cross agency collaboration, provides access to shared components, and the reuse of previously defined functionality

By combining the concept of process work with a framework supporting the flexibility envisioned by a t-government scenario, one would shift from a public online service portal providing static information to *My Processes*, based on a more dynamic, interactive, and customisable approach. This suggests that service interactions are synchronised to the *My Processes* service portal regardless of service channel. Further, that services provided to the individual service receiver can be customised and that the changes in delivery can be accessed by involved actors.

1.6 Research questions

A shift from the *My Page* to the *My Process* service portal will require the development of models, methods, and tools for establishing multi-channel process support for government services.

Based on the objective and methodological approach, 4 research questions were initially defined to guide the research. According to the insights to the problem domain and a better understanding of the research that were attained during the research process, these initial questions were revised to the following five research questions[3].

RQ1 How to define a model that describes the relationship between important concepts influencing service provisioning which can be used as a basis for understanding the e-government domain?

RQ2 What are the requirements to a future process support system for public service provisioning?

[3] The initial research questions can be found in Appendix A.

RQ3 How to apply the description of process work within the context of enterprises as a basis for a design artefact, i.e. a conceptual process work model, which meets the requirements to future infrastructures for public service provisioning?

RQ4 What is the maturity of the available affordances supporting the realisation of the proposed artefact?

RQ5 Assuming the realisation of the proposed artefact, how to conceptualise the needed governance?

The relationships behind the research questions can be considered as sequential. Answering RQ1 is a preparatory task to get an understanding of the problem domain. RQ2 is partially based on RQ1. The domain understanding in RQ1 and the requirements from RQ2 together act as a basis for the construction of the design artefact in RQ3. RQ4 and RQ5 are based on the design artefact proposed by RQ3. While RQ4 investigates the possibility of implementing the design artefact based on available technology affordances, RQ5 addresses aspects related to a successful diffusion of the design artefact, also known as a realisation design.

Initially it was an objective to prototype part of the design artefact. Due to the time available and the need for a broad treatment within the problem domain, it was decided to consider research questions at a conceptual level. Issues related to human computer interaction are also outside the scope of the research study.

The research questions are discussed further in Section 6.1.

1.7 Research publications

The research method of this study is based on the design science for information systems research framework to be discussed further in Chapter 2. Based on the proposed framework of Hevner (2007) (Figure 4), Figure 2 illustrates the work guided by the research questions, resulting in 3 main study areas with their respective research publications.

The design science framework constitutes three main pillars from left to right: The problem environment, design work, and the knowledge base. The problem environment defines the context of the design and the designed artefact. It provides requirements to the design process and enables justification and evaluation of the design, and with that ensures relevance of the design to the problem. The design work is related to artefact design, construction, and evaluation. The knowledge base constitutes existing knowledge in the intersection of the problem domain and the design artefact. It provides rigor and grounding to the design process, and it is further supplemented by the outcomes of the design science research.

The studies and corresponding research publications are briefly presented below.

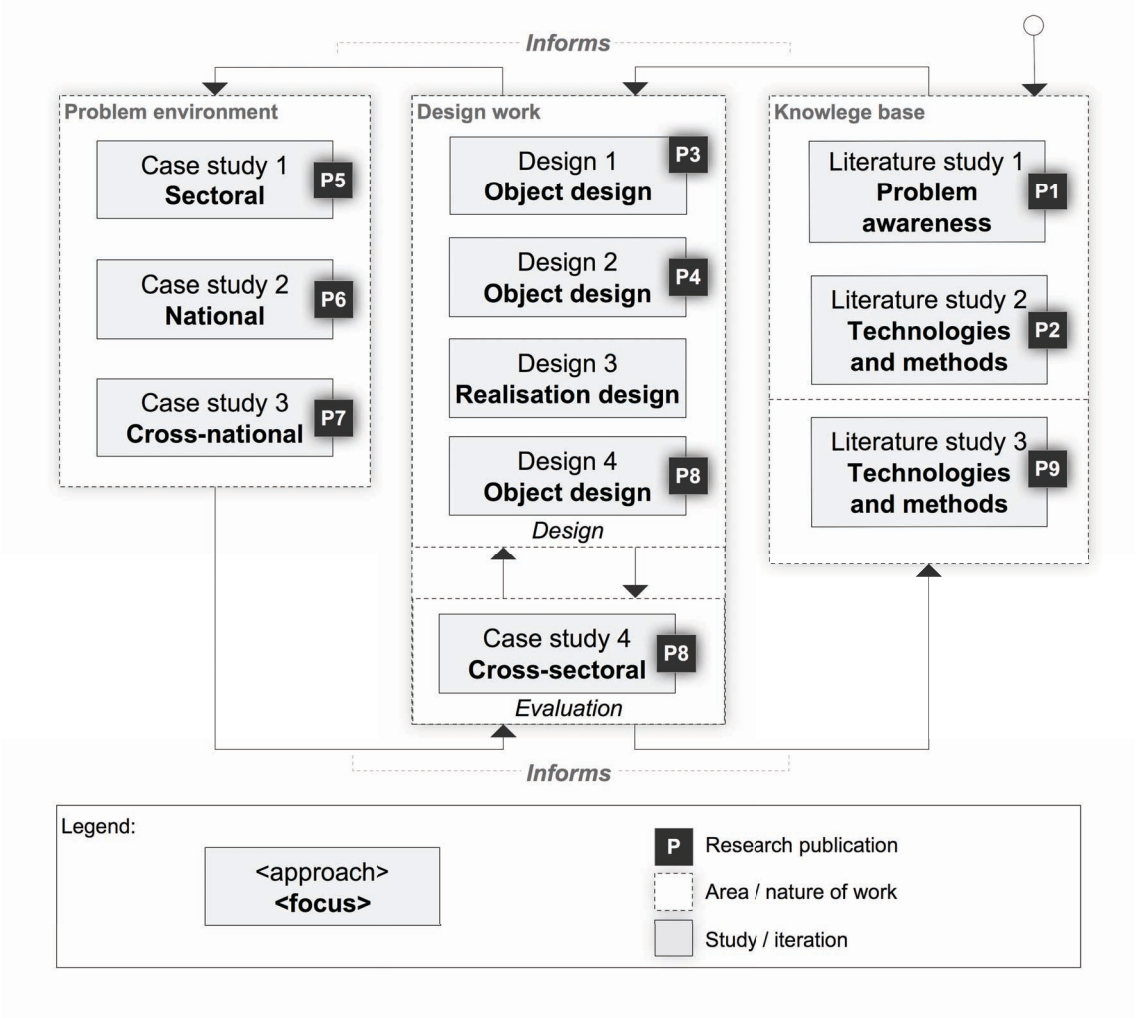

Figure 2: Studies and research publications within the study

Literature studies within the knowledge base

The two first studies within this area represent the early work (2007/2008) related to domain understanding and problem awareness. P1 is based on the e-government knowledge base combined with analytical work leveraging on personal expertise and observations. P2 is based on the information systems knowledge base using existing research and proposed industry standards. The third study within this area, leading to research publication P9, is analytical work based on the information systems knowledge base, reflections from the case studies, as well as experiences from the design work. This work bridges the research domains of the PhD research study. This study was conducted mid 2010.

P1 **Gustav Aagesen** and John Krogstie (2011) Service delivery in transformational government – Model and scenarios, *Electronic Government, and International Journal (EG)*, Special Issue on: E- Government: Past, Present, and Future, 8(2/3), pp. 242-258

P2 **Gustav Aagesen** and John Krogstie (2010) Analysis and design of business processes using BPMN, vom Brocke, J. and Rosemann, M. (eds.), *Handbook on Business Process Management 1, Introduction, Methods and Information Systems*, Series: International Handbooks on Information Systems, ISBN: 978-3-642-00415-5, Springer-Verlag, Berlin/Heidelberg, pp. 213-235

P9 **Gustav Aagesen** and John Krogstie (2010) *Public service provisioning and ICT development. Synchronising the flexibility of organisations and ICT*, Norsk Konferanse for Organisasjoners Bruk av IT, Tapir Forlag

Design work through artefact design and evaluation
The design work passed through several iterations from mid 2008 to late 2010 leading to research publications P3, P4, and P8. P8 is additionally a result of a case study conducted to act as a demonstrator for the design artefact.

P3 **Gustav Aagesen** (2009) *Citizen-centric process views for government service provisioning*, Norsk Konferanse for Organisasjoners Bruk av IT, Tapir Forlag

P4 **Gustav Aagesen** and John Krogstie (2010) Providing adaptive and evolving government e-services through citizen-centric process views, In: Janssen M., Lamersdorf, W., Pries-Heje, H. and Rosemann, M. (eds.), E-Government, E-Services and Global Processes, IFIP AICT 334, 2010, Springer-Verlag, Berlin/Heidelberg, pp. 32-45

P8 **Gustav Aagesen** and John Krogstie (2011) Citizen centric public service provisioning - A conceptual approach for next generation information infrastructures, *5th International Conference on Methodologies, Technologies and Tools enabling e -Government*, 30 June - 1 July 2011, Camerino, Italy

Case studies within the problem environment
Case study work started in late 2009, with two case studies at the sectoral and national level in Norway. This was followed by a case study comparing Norway and the Netherlands at a national level. The case studies provided feedback to the artefact design.

P5 **Gustav Aagesen** and John Krogstie (2010) Investigating requirements for transformational government information infrastructures. The case of the approval process for building applications*, European Conference on e-Government*, National Centre for Taxation Studies, University of Limerick, Ireland

P6 **Gustav Aagesen** and John Krogstie (2010) Service development for national government information infrastructures – The case of Norway, *IFIP E-Government Conference 2010*, Lausanne, Switzerland

P7 **Gustav Aagesen**, Anne Fleur van Veenstra, Marijn Janssen, and John Krogstie (2011) The entanglement of enterprise architecture and IT-governance: The

cases of Norway and the Netherlands, *44th Annual Hawaii International Conference on System Sciences (HICSS'11)*

1.8 Thesis structure

The remaining part of this thesis is structured as follows:

Chapter 2 gives an introduction to the methodological background and the design science research approach from which this study has been guided.

Chapter 3 provides an understanding of the information systems background of the study and through that the technology affordances available for artefact construction.

Chapter 4 considers related e-government background works in the context of providing cross-agency public services. Related works in context of the thesis contribution is considered in Chapter 7.

Chapter 5 gives an introduction to the research publications found in Appendix B.

Chapter 6 presents an overview of the contributions of the study.

Chapter 7 gives a discussion of the research questions and the contributions, and the mapping of these to the research publications. It further provides a discussion on the research process and possible directions for e-government development.

Chapter 8 concludes the thesis and presents proposed directions for further work.

Appendix A presents the initial research questions of the study.

Appendix B contains the research publications that were selected to be included as parts of the thesis.

Appendix C gives references to additional publications written after the work on the thesis was started and that are not included as part of the thesis.

2 Research method

By three methods we may learn wisdom: First, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest.

- Confucius

The goal for this chapter is to provide an elaboration on the selected research method of this study, being based on the design science for information systems research. The patterns and supporting methods that can be applied for design science research are further presented. The design science research approach is not one single method or approach but several conceptions of the design process and its outputs. The methods and the tools used must be selected to fit the particular research work.

2.1 Design science in information systems research

Following Simon (1981), Walls et al. (1992) make one of the first attempts to prescribe the construction of design theory for information systems. Design theories are based on contingent goals and integrate explanatory, predictive, and normative aspects to design paths suggesting more effective design and use. They prescribe both the properties an artefact should have if it is to achieve certain goals, and what methods should be used in the construction of the artefact. Artefact properties should be derived from design theories, and thus the design theories are the foundation for artefact requirements.

Whereas natural science tries to understand reality, design science attempts to create things that serve human purposes. Design science suggests an ideal or improved situation through proposing new or improved artefacts. Design science artefacts, as described by March and Smith (1995), are manifested as constructs, models, methods, or implementations. March and Smith (1995) suggest that design scientists should strive to create models, methods, and implementations that are innovative and valuable, rather than simply posting theories. Rossi and Sein (2003), however, extend the earlier work of Walls et al. (1992) and suggest the creation of testable design product hypotheses, in addition to improved theories, as the design output.

Despite attempts to build reference process models (March and Smith, 1995; Rossi and Sein, 2003) and practice rules (Hevner et al., 2004) for design science research in information systems, design science research is not part of the dominant information systems research culture (Peffers et al., 2007). Even though it can be argued that research aimed at developing IT systems and improving IT practice has been more

successful than traditional scientific attempts to understand it (March and Smith, 1995), it has been employed in just a small minority of journal papers to produce artefacts that are applicable to research or practice (Peffers et al., 2007). However design science is an increasingly popular approach for research with a problem-solving perspective (Piirainen et al., 2010).

What is common for both Walls et al. (1992), March and Smith (1995), and Hevner et al. (2004) is that they are focused on the IT artefact and exclude the non-technological context by removing people and organisations, thus removing what according to Gartner Group ranks as current and future critical (relevant) IS-issues, and those issues that are less easy to solve (Carlsson, 2006). Carlsson (2006) suggests that information systems design science research should produce knowledge that can be used by professionals through product design[4], process design, and realisation design. The latter given an information systems intervention in a socio-technical system. As wicked problems are seminal to the problem domain of design science research in information systems (Hevner and Chatterjee, 2010), IT-artefact design not raising assumptions about external elements such as people or organisations is possibly problematic. The context of operation is further important to artefact design and evaluation, and design science research thinking is oriented towards context-mechanism-outcome pattern (CMO) configurations. CMO configurations are propositions stating which properties of an IS-initiative works for whom under what circumstances (Carlsson, 2006). Verschulen and Hartog (2005) suggest a configuration of assumptions [A] and requirements [R] related to function [A_f, R_f], user [A_u, R_u], and context [A_c, R_c], leading to a specification [S] describing the steps to reach a given goal [G]. All these have to be evaluated separately in stages of plan, process, and product.

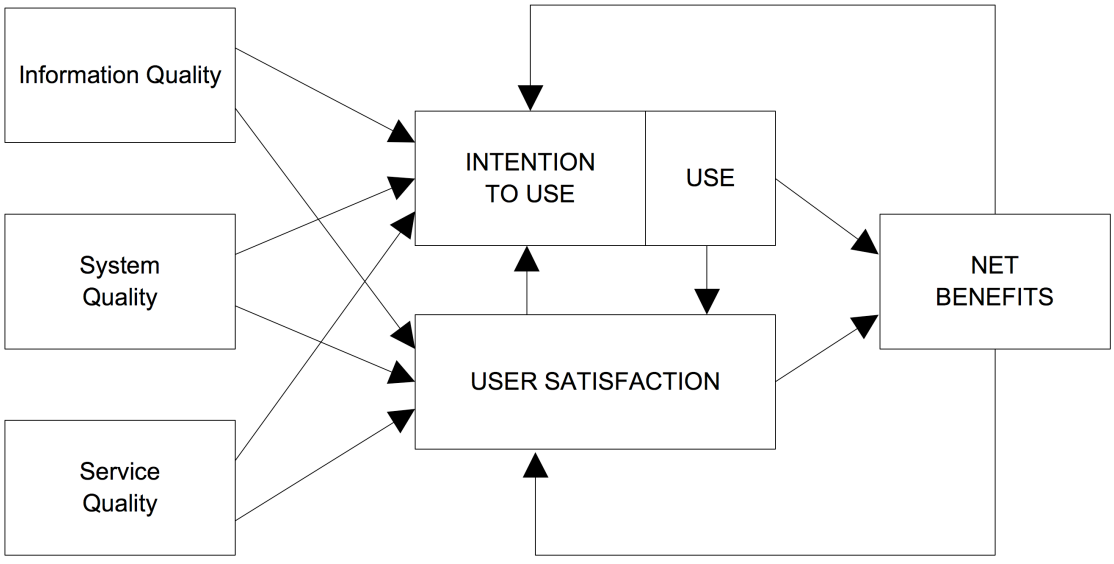

Figure 3 IS success model (DeLone and McLean, 2003)

[4] The use of object design in this study is equivalent to the product design.

Looking at behavioural research in information systems, using natural science approaches to understand and evaluate success or failure of IT artefacts in socio-technical systems, the pick of dependent variables investigated is vast and ever expanding (DeLone and McLean, 1992). A holistic approach to measure information systems success is based on the net benefits of measured qualities of the IT-artefact in its interaction with its stakeholders, as indicated by Figure 3. Significant difficulties in design science results in the fact that artefact performance is related to the environment in which it operates (March and Smith, 1995). Understanding the environment and problem domain in which the artefact operates is crucial.

Wieringa (2009) separates the knowledge produced by design science research to the outcomes of solving practical problems and knowledge problems. Solutions to practical problems satisfy stakeholder goals by changing the world, while solutions to knowledge problems do not change the world, but our knowledge about the world. Practical problems and knowledge problems relate to the relevance and rigor cycles of Hevner (2007) respectively (Figure 4).

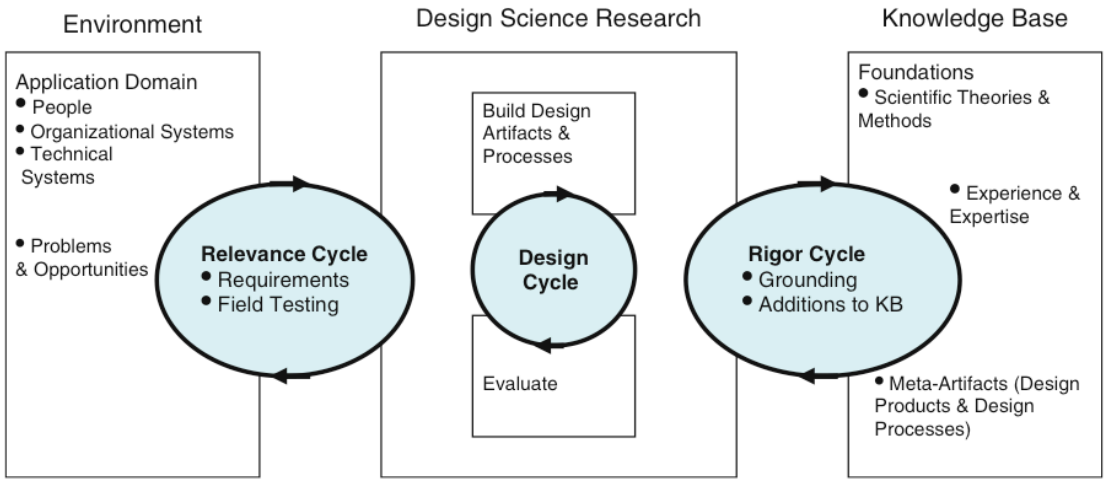

Figure 4 Design science research framework (Hevner, 2007)

In order to support the process and presentation of design science research, Peffers et al. (2006) suggest a design science research process (Figure 5). Through a clear understanding of the different approaches to design science research, it is easier for other researchers to evaluate it. It is further less difficult to mistake design science research for practice activities, such as consulting. This is a problem design science research has in common with action research, with a clear resemblance to the design science research process (Rossi and Sein, 2003).

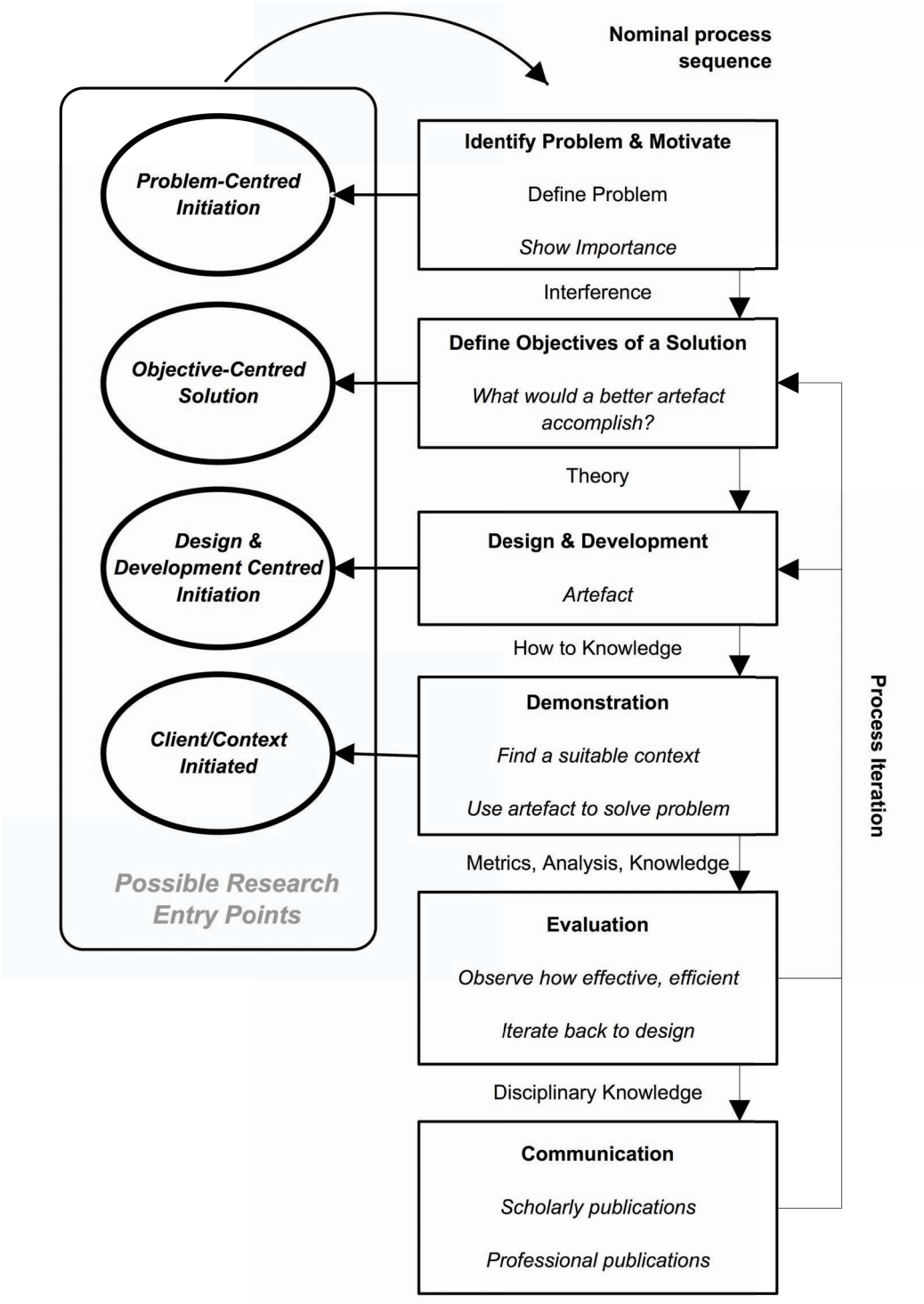

Figure 5 Nominal DSRM process model adapted from Peffers et al. (2006)

The design science research methodology process suggested by Peffers et al. (2006) has four entry points depending on knowledge of the problem, goal, and artefact before the commencement of research. In a problem-centred initiation, the problem is not known, and knowledge about the domain must be accumulated so that the problem and motivation for solving the problem can be established. In an objective-centred solution

the problem is known and articulated, and objectives of a solution must be made clear, and thus suggest goals and requirements for the artefact. In a design and development-centred initiation, the artefact is developed based on already existing goals and requirements. While in a case where research is client or context initiated, the artefact already exists, and the research task is to demonstrate its utility in a given context. When it comes to *design and development*, Vaishnavi and Kuechler (2007) are explicit on the issue that implementation itself does not need to involve novelty beyond the state-of practice for the given artefact, and that novelty is primarily in the design, and not the construction of the artefact.

The design science research approach suggested by Hevner et al. (2004) proposes 7 guidelines related to the research plan, process, and outcome as follows:

Design as an artefact – the research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.

Problem relevance – the research has to develop technology-based solutions to important and relevant business problems.

Design evaluation – the utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.

Research contributions – the research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.

Research rigor – the research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.

Design as a search process – requires utilising available means to reach desired ends while satisfying laws in the problem environment. Design as a search process motivates the use of iteration as a research methodology.

Communication of research – the research must be presented effectively both to technology-oriented as well as management-oriented audiences.

2.2 Methods supporting the design science research approach

Information systems research is supported by a vast selection of methods (e.g. Palvia et al., 2004). When conducting design science research specifically, there exists a selection of alternative methods or variations of the traditional information systems methods that could be utilised. The following groups of patterns for design science research are based on the approaches described by Vaishnavi and Kuechler (2007) and Hevner et al. (2004). For the use of methods in the different phases of this research study, please refer to Sections 7.2 and 7.3.

2.2.1 Creativity

Patterns of creativity include the six stages of the inventive process (interest, preparation, incubation, illumination, verification, and exploitation) where the idea is to focus on the problem over a period of time before taking a break from it so as to leave the solution to the unconscious mind. Alternative approaches involves using wild or unconventional combinations of ideas to solve a problem in order to get out of a traditional or predetermined mindset of possible solutions, and the brainstorming approach where a series of ides are written down before they are evaluated.

2.2.2 Problem selection and development

Patterns related to problem selection and development contributes towards the problem awareness phase of the design science research process. Suggested patterns include deciding the research domain in which the research should contribute and the problem area of focus within that domain. Using previous expertise can also be useful, as insight as a practitioner within the problem area or through relevant past research. A cost-benefit analysis of the research project is suggested, as access to resources can be unrealistic with respect to the outcome of the research or exceed the benefits of the research goal. In acquiring sufficient understanding of the research area, experimentation and exploration through prototype building can be applied. Decomposing the research problem into smaller problems or using abstraction to move the problem away from concrete problem instances to allow a conceptual treatment of the problem are both ways to temporarily reduce the complexity of the problem. Through extrapolating the problem into other research disciplines one can find alternative approaches to a solution, or find a new suitable arena for the problem at hand.

2.2.3 Literature search

Various approaches using literature and existing documents are established outside design science research. Patterns of use suggested by Vaishnavi and Kuechler (2007) are in accordance with Hevner et al. (2004) in using the existing knowledge base as a starting point for design science research. This includes both becoming familiar with the research area and understanding the research community. Framework development through surveying existing literature (Hart, 1999) is a good starting point for both becoming familiar with the research domain and understanding the problems that are of relevance to the community.

2.2.4 Suggestion and development

Suggestion and development are iterative steps that may pass through several iterations within the scope of a given design science research project. Identifying tools and techniques that are appropriate for both the problem at hand and for the given research community is suggested prior to the suggestion and development phase. Novel approaches for problem solving should not be disregarded, albeit being aware of the extra effort in introducing them to the research field. Empirical refinement is one example of an iterative design approach where a conceptual framework and architecture is designed and developed and observed in use under realistic conditions as an input to

subsequent iterations. Attempting to solve the problem through an easy solution is a good start for learning about the problem before possibly going on towards a generic design limited to the functional requirements of the solution, or suggesting a general design based on a problem abstraction or a class of similar problems. Dividing the solution into modules or sub-systems might reduce the complexity of the problem and allow for a partial solution that can later be combined. Taking on the most immediate identified tasks towards a solution is also a possible approach promoting partial solutions given that a means-end analysis does not provide all tasks required for a solution. Modelling existing solutions to similar problems can suggest or disqualify partial approaches for the solution. It is also possible to investigate whether reusing existing solutions from other disciplines are appropriate as a solution entirely.

2.2.5 Evaluation and validation

The appropriate approach for evaluation and validation of the design artefact depends on the nature of the problem and the suggested solution. A demonstration of the artefact involves showing that the solution is realisable and valid in predefined situations. While Vaishnavi and Kuechler (2007) suggest that this involves the construction of a solution or a solution prototype, for some artefacts this construction is not feasible. Hevner et al. (2004) suggest that a descriptive evaluation can build a convincing argument for the artefact's utility through building scenarios or through building an informed argument based on the existing knowledge base. This approach is similar to that which Vaishnavi and Kuechler (2007) call logical reasoning.

Experimentation approaches to artefact validation can be hypothetical/deductive, based on prototyping, case-based or historical. The hypothetical experiment builds a prototype using past experiments and the available knowledge base. Validation is carried out based on the experimental data from the various environments. A prototyping approach utilises inductive reasoning, and the evaluation of the prototype determines the outcome of the experiment. Case-based experimentation is an iterative process where a prototype is developed and evaluated continuously, while historical experimentation is solely based on observations from previously developed systems. Simulation is also an experimental method where artificial data is used for running the artefact directly or through constructing conceptual representation of the artefact. Validation through using existing metrics or benchmarking approaches is appropriate in cases where the goal of the artefact is related to improved performance, as is the case for mathematical proofs.

Hevner et al. (2004) suggests additional methods to those suggested by Vaishnavi and Kuechler (2007), including observational, analytical, experimental, and testing. Observational methods involve case and field studies where the artefact is tested and monitored in a business environment or over multiple projects. Analytical approaches include static analysis, where the structure of the artefact is analysed; architecture analysis, where the appropriateness of the artefact is studied in light of an existing information system architecture; optimization, where the optimal properties of the artefact is demonstrated; or dynamic analysis, where dynamic properties such as performance of the artefact is studied. Testing includes black or white box testing of the artefact where the interfaces or inner workings of the artefact are tested.

Other works discussing design science research evaluation includes Pries-Heje et al. (2008) and Cleven et al. (2009). The main contribution of Pries-Heje et al. (2008) is on the discussion and differentiation between the ex post and ex ante and the naturalistic and artificial evaluation of design science research, and provides a framework for separating these dimensions. Cleven et al. (2009) suggests a more extensive framework[5] for evaluation by proposing 12 initial variables and their respective values in a morphological field to describe the selection of approaches available.

2.2.6 Future studies and scenario-planning

Methods found within future research and scenario-planning can also be used to guide artefact design. The principal objectives of futures research is to help inform perceptions, alternatives, and choices about the future by laying out paths of possibilities (the art of the 'possible'); examining in detail particular paths and the likelihood of their occurring (the science of the 'probable'); or expressing preferences for, and implementing, particular paths (the politics of the 'preferable') (Amara, 1991). Example approaches for laying out probable visions for the future include Delphi studies or trend impact analysis (Glenn and Gordon, 2009). Through studying current events and trends, megatrends can be identified and studied for future societal impact. A megatrend is…

> *… a significant movement, tendency or force that is commencing or occurring in one (regional) or more (global) parts of the world, and that is expected to continue well into the foreseeable future. Moreover, a megatrend has a profound effect on nearly every aspect of a society, affecting individuals and businesses.*
>
> *Sultan et al. (2008)*

Scenarios can be constructed based on an analysis of trends or a given possible forecast. A scenario is not a forecast itself, but one possible future outcome (Porter, 1985). Scenarios are stories, based on an included or presupposed setting, about people and their activities. Scenarios can also include agents or actors, typically having separate goals or objectives, making possible multiple views of the same scenario. Scenarios have a plot, and include sequences of actions and events, things that actors do, and things that happen to them (Carroll, 2000). Compared to a use-case, scenarios correspond to use-case instances, and while a use-case expresses all the possible paths of events, a scenario can describe part of the possible path. In addition, a use-case seeks a formal treatment defining a model while a scenario seeks an informal treatment (Go and Carroll, 2004).

Constructing scenarios inescapably evokes refection in the context of design. *Scenario planning…*

> *… is a process of positing several informed, plausible and imagined alternative future environments in which decisions about the future may be played out, for the purpose of changing current thinking, improving decision making, enhancing human and organization learning and improving performance.*

[5] See Table 5 Section 7.2

Chermack (2005)

In the technology roadmapping approach, major technological elements of product design and manufacturing are projected as milestones into the future, and strategies for efficiently reaching those milestones are built (Coates et al., 2001). Like the backcasting approach (Quist and Vergragt, 2006), where the steps from the future scenario to the current state are retraced, technology roadmapping is equivalent or similar to that of the realisation design for a socio-technical design science artefact. Examples of roadmapping approaches for e-government include Codagnone and Wimmer (2007), Bittinger and Di Maio (2010) and Misuraca et al. (2010).

3 Business modelling and process support

I know you believe you understand what you think I said, but I am not sure you realize that what you heard is not what I meant.

- Alan Greenspan

This chapter considers how various views on enterprises and process work are given a model representation, and the various use of the models from organisational reasoning to process automation. It further provides a background on concepts that are useful in the treatment of the design artefact.

The proposed design artefact of this research study relies heavily on the underlying concepts of process-aware information systems (PAIS). In this, models can be used at various levels when supporting users in completing prescribed tasks in the provisioning of a given service, as well as providing an interface between system users, and the e-service and the real world. Section 3.1 introduces conceptual modelling and different modelling perspectives for supporting various aspects of the enterprise. Section 3.2 has focus on aspects related to workflow, business process management, and PAIS. Section 3.3 considers approaches for implementing an ICT support system for public service provisioning using a Business Process Management (BPM) approach. The thread from this chapter is continued in Section 4.6 as part of the discussion of issues of design and implementation of e-government.

3.1 Conceptual modelling of the enterprise

Models can be used as tools for representing and supporting various aspects of work depending on what they express, and for whom it is expressed. This section provides an introduction to conceptual modelling and the use of models in the interface between human actors, and between groups consisting of both human and computer actors. We see that the usefulness of an information system based on the use and modification of models depends on how fit the models are to the specific work context. In concluding this section, a scenario is made possible where stakeholders involved in the provisioning of services can interactively change the conditions of the service directly through representations and concepts fit the context of the service provided.

Bubenko (1992) defines modelling as a *means essentially to describe a set of abstract or concrete phenomena in a structured and, eventually, in a formal way.* It is an activity, often collaborative, leading to a model of a perceived phenomenon based on a

certain perspective. The possible expressiveness and formality of the model is determined by a meta-model of the language in which the model is constructed. The meta-model determines the syntax and semantics of a modelling perspective through determination of which phenomenon can be expressed through the language, and the ambiguity of the description of that phenomenon. Conceptual modelling languages can be classified as semi-formal (having a formal syntax, but no formal semantics) or formal, having a logical and/or executional semantics. The logical semantics used can vary (e.g. first-order logic, description logic, modal logic). Executional or operational semantics indicate that a model in the language can be executed on a computer if the model is complete.

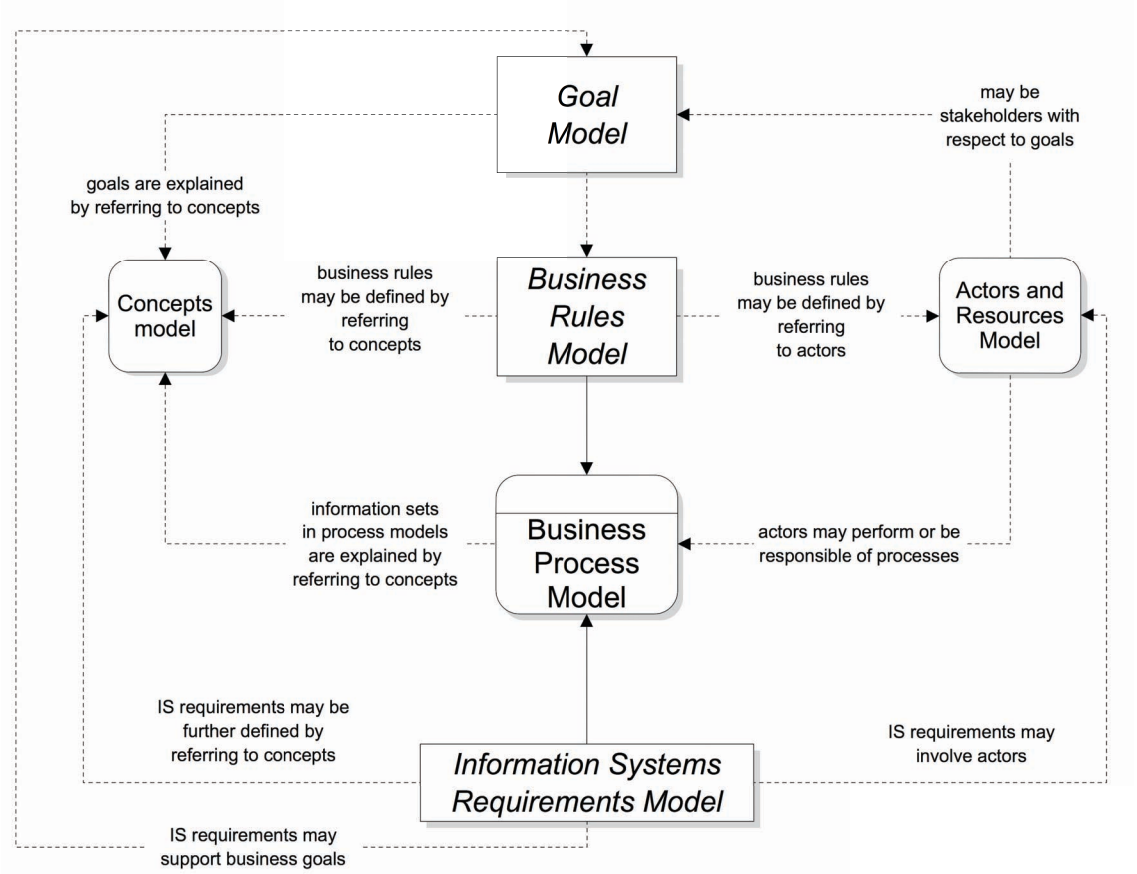

Figure 6 Overview of the EKD multi-model approach (Bubenko, 2007)

An enterprise model is the result of an attempt to create an integrated and negotiated description of the enterprise from various perspectives through a multi-model approach. Figure 6 gives an overview of the perspectives provided by an enterprise model through the top-level Enterprise Knowledge Development (EKD) model (Bubenko, 2007). The interlinked sub-models each provide a different perspective on the enterprise, leading up to the documentation of the enterprise and a set of possible requirements for a supporting information system. Goals, actors, business rules, business processes, and conceptual structures are described, each mapped to related aggregation principles as object, process, actor, and goal orientations. Objects are the things subject to processing, processes are the actions performed, and the actors perform the actions defined with the intention of satisfying the goals. The focus of the work presented in this thesis is within

the perspectives of business processes, actors, and resources. An extended treatment of the design artefact would however involve considering other perspectives as well.

Composing a model of the enterprise based on different perspectives might be problematic as the perspective of the model explicitly promotes certain concepts, while other concepts are caught between model presentations. A possible consequence is that some aspects of the modelled environment are weakly reflected in the model and possibly also in the implemented systems (Opdahl and Sindre, 1997). Based on the modelling approach, selected aspects of work can be emphasised, while others are weakly represented or omitted. New perspectives and modelling notations have however been established in order to address emerging concerns both in the real and modelled world.

Conceptual models, including enterprise process and goal models, may be usefully be utilised in the following areas (Krogstie, 2008):

1. *Human sense-making and communication*: The main purpose of modelling is to make sense of aspects of an enterprise and to communicate with other people.

2. *Computer-assisted analysis*: The main purpose of modelling is to gain knowledge about the enterprise through simulation or deduction.

3. *Model deployment and activation*: The main purpose of modelling is to integrate the model in an information system and thereby have the model actively take part in the work performed by the organisation.

4. The model is a basis and provides the context for a traditional system development project, without being implemented directly.

5. *Business Process Management* in the meaning of maintaining a corporate memory, e.g. as part of the quality system of the enterprise.

The main use of conceptual models in the proposed design artefact is related to model deployment and activation, where the model is an integrated part of the information system. A model is active if it influences the reality it reflects and if changes to the representation also change the way some actors perceive reality. Model activation is the process by which a model affects reality. Activation involves actors by interpreting the model and adjusting their behaviour to it. The process can be automated, where a software component executes the model; manual, where the model guides the actions of human actor; or interactive, where prescribed aspects of the model are automatically interpreted and ambiguous parts are left for the user to resolve, with tool support. Fully automated activation implies that the model must be formal and complete, while manual and interactive activation can also handle informal or emergent process descriptions. A model is defined as interactive if it is interactively activated (Jørgensen, 2004).

A distinction is normally made between *normative* and *descriptive* models. While a descriptive model would model work as performed, a normative model would describe work as planned. If the process is not explicitly modelled, normative descriptions may be found in procedures, spread across various documents as job-descriptions, etc. (Carlsen, 1997).

Quality aspects of models can include domain, knowledge, semantic (descriptive and prescriptive), and pragmatic quality (Krogstie et al., 2006). As modelling as a collaborative exercise can involve stakeholders with different backgrounds and concerns, it is of importance that the modelling method and final model is understandable, and that the concepts used are not too abstract or complex. Pragmatic quality is perceived to be more important than semantic quality, as it refers to the appropriateness of use of the model by the various stakeholders. In a scenario where the model is an integrated part of the information system, an interactive modelling approach can compensate for weak semantic quality.

In order to reduce model complexity, and to keep the modelling and models on a suitable level for the modeller and the modelled domain, it is possible to establish Domain Specific Models (DSM) (Becker et al., 2007). This can be done through extending the language meta-model, and thereby aggregating existing concepts to a level of complexity fit the modeller. The models can later be transformed to different views with the sufficient level of detail. PICTURE is an example of a building-block language providing DSM for the e-government domain (Heitkoetter, 2011). The UEML language (Opdahl and Sindre, 2007) supports the transformation of modelled concepts between different languages, providing a certain degree of freedom in selecting the appropriate modelling approach.

An example of the use of conceptual modelling in system development projects is the Model Driven Architecture (MDA) framework. MDA makes a fundamental distinction between computational-independent modelling (CIM), platform-independent modelling (PIM), and platform-specific modelling (PSM) (Wagner, 2005). These levels of abstractions go from modelling the characteristics of a phenomenon that are universal and not technology specific (CIM), through involving technical aspects though not at the detail level of an implementation (PIM), and to the level where implementation-specific technology aspects are part of the model (PSM). MDA provides facilities for automated code generation, code refactoring, model transformation, and model execution techniques to achieve a faster turnaround for propagating changes in the design into changes in the implementation (Dumas et al., 2005).

The two dominant approaches for business process modelling are models based on graphs and models based on business rule specifications (Lu and Sadiq, 2007). Most graph-based models take a transformational (input-process-output) approach. Processes are divided into activities, which may be divided into further sub-activities. Each activity takes inputs, which it transforms to outputs. Input and output relations define the sequence of work. This perspective is chosen for the standards of the Workflow Management Coalition (WfMC), the Internet Engineering Task Force (IETF), and the Object Management Group (OMG) as well as for most commercial systems (Jørgensen,

2004). Alternatives to the activity centred classification includes process centred, where the processes present the state changes of the process object; and resource centred where the process is represented as a network of processing stations that interact with each other (zur Muehlen and Indulska, 2010). Examples of process languages include $ADEPT_{flex}$, BPMN, and EPC (graph-based); and YAWL, Petri-nets, and flow nets (net-based) (zur Muehlen and Indulska, 2010).

3.2 Service and process-oriented operations support

The previous section established an understanding of the use of conceptual models both as a representation of different aspects of work and in the possible automation of work activities. This section considers the historical element of workflow systems and up to current approaches to PAIS.

Workflow and workflow management systems are a terms mainly belonging to the 1990s, which later have evolved into the BPM domain. The WfMC defined workflow as:

> *The automation of a business process, in whole or part during which documents, information or tasks are passed from one participant to another for actions, according to a set of procedural rules.*
>
> *Lawrence (1997)*

A workflow management system (WFMS) is defined as:

> *A system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications.*
>
> *Lawrence (1997)*

Figure 7 shows relationship among important concepts defined by the WfMC. It shows that the workflow management system is case-driven, handling separate process instances based on a process definition comprised by manual and automatic activities, which have equivalent activity instances within the process instance. Manual activities are performed by human actors, while automatic activities are executed through invoking software compoments within the information infrastructure.

In extending the workflow concept towards BPM and current approaches, the weakness of the WFMS approach is a missing support for overall business process control and monitoring. As long as this support is not provided, the automation of specific functions of enterprises will not provide productivity gains (Lu and Sadiq, 2007). BPM attempts to address this, and provides a structured, coherent, and consistent way of understanding, documenting, modelling, analysing, simulating, executing, and continuously changing end-to-end business processes and all resources involved in light of their contribution to business performance (Recker et al., 2006). BPM can be defined as …

... an approach supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents, and other sources of information.

van der Aalst et al. (2003)

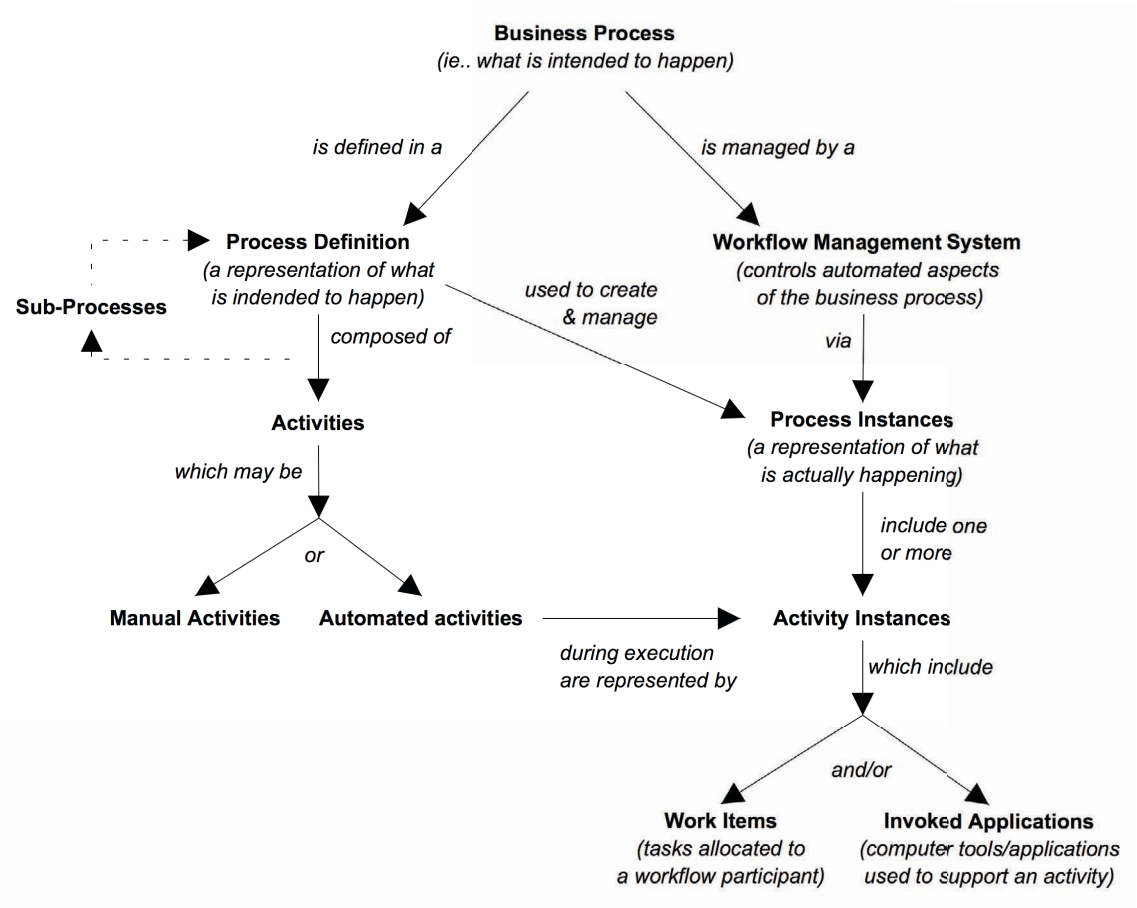

Figure 7 Relationship between WfMC terms (Carlsen, 1997)

In this sense, BPM extends the traditional Workflow Management approach with support for the diagnosis phase, and allows for new ways to support operational processes (van der Aalst et al., 2003). The diagnosis phase can be illustrated through the Continuous Process Improvement (CPI) cycle as shown in Figure 8. The goal of the CPI is to adapt business processes to new market requirements (Lillehagen and Krogstie, 2008). The CPI constitutes the Business Performance Analysis (BPA) followed by change management and a process of (re-) implementation. The BPA is conducted through diagnostics and simulation partly supported by Business Activity Monitoring (BAM) on operational data that is logged by the information system. BAM tools can also provide business process mining to synthesise process models from process instance logs (van der Aalst, 2010).

New approaches for supporting operational processes include Case Handling (CH) and Straight Through Processing (STP) (van der Aalst et al., 2003). STP aims, at an early stage, to separate out process instances that can be processed straight through without intervention from the human actor, thus achieving efficient operations and improved response times. CH implies that cases are unfit to model in a process definition (possibly caused by ambiguity, complexity, or diversity of cases and decision points). A central motivation for the CH paradigm is rooted in the *blind surgeon metaphor* (van der Aalst et al., 2005), where context information is limited to the task at hand, and further prevents the holistic treatment of a single case controlled by the prescribed chain of activities and corresponding accepted inputs.

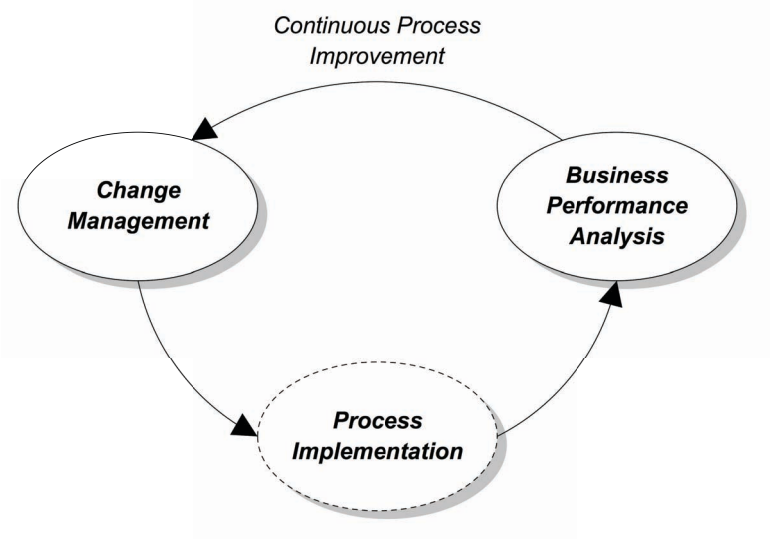

Figure 8 CPI cycle adapted from Lillehagen and Krogstie (2008)

In considering a national e-service infrastructure as process-aware support system for public services, Houy et al. (2010) points to some trends relevant for a large-scale BPM service environment:

1. Processes are increasingly interconnected and it makes limited sense to look at a single process in isolation,

2. The number of processes an organisation has to cope with is rapidly increasing (large organisations have hundreds of processes which need to be managed),

3. Modern technology is generating unprecedented streams of event data representing the states of different processes (sensor data, RFID data, remote logging, remote services etc.) and,

4. Different devices are used to access the information system in different situations necessitating a flexible multi-channel support influencing which parts of the workflow are available in which manner depending on the context of use.

3.3 BPM tool and language support

This section considers implementation issues of PAIS within a single agency or across an enterprise. It involves the discussion of process languages, production rule systems and concepts related to establishing a service-oriented architecture. The approaches presented represent a current set of technology affordances for the implementation of an e-service infrastructure as proposed by the design artefact.

A Business Process Management System (BPMS) can be defined as *a generic software system that is driven by explicit process designs to enact and manage operational business processes* (van der Aalst et al., 2003). The system should be process-aware and generic in the sense that it is possible to modify the processes it supports. The process designs are often graphical and the focus is on structured processes that need to handle many cases. The process model can provide support and guide the user in the right direction based on the current process state and data. Depending on the executional or operational semantics of the model, and the formality of the process that the model represents, the model can be made executable and the process can be partly or completely automated. Example BPMS implementations include Intalio, ARIS (IDS-Scheer), and Oracle (Scheithauer and Wirtz, 2008); Workflow management systems include Staffware, MQSeries Workflow, and COSA; Case handling systems such as FLOWer; While workflow and case handling modules are also common in ERP systems such as SAP, PeopleSoft, JD Edwards, and Baan (van der Aalst et al., 2003; van der Aalst et al., 2005).

A business rule is a statement that aims to influence or guide behaviour and information within an organisation (Steinke and Nikolette, 2003). Production rule platforms are the rule technology that is most widely used in the business rules industry. Examples of production rule systems are JESS, Fair Isaac/Blaze Advisor, iLOG Rules/JRules, CA Aion, ART*Enterprise, Haley, and ESI Logist (Wagner, 2005). Examples of rule-based modelling approaches include PLM_{flow}, ADEPT, AgentWork, and AgFlow (Lu and Sadiq, 2007). The rule-based modelling language is based on formal logic, and logical rules can be used to represent structural data and/or resource dependencies between tasks executions in business processes.

Separating the process flow from the execution of the rules is the most important aspect of a business rules approach because of the processing and maintenance of the system (Corradini et al., 2009). The model-driven or rule-driven approaches are however not mutually exclusive and can effectively be used in combination or support different aspects of a service process.

Flexibility in the design of an information system can be achieved through modularity on several levels. Service-oriented architecture (SOA) is based on the conceptualisation of service modules and distributed service design allowing for the reuse of commonly used resources. Principles characterising SOA include loose coupling, location transparency, separation of concerns, encapsulation, protocol independence, and single implementations. A SOA service is a function that is well defined, self-contained, and does not depend on the context or state of other services. SOA is a collection of services

that communicate with each other (e.g. simple data passing or two or more services coordinating an activity) (Barry, 2003). SOA is comprised of several viewpoints, including an overall system architecture viewpoint, a system management and maintenance viewpoint, an enterprise application integration viewpoint, and an electronic data interchange viewpoint (Draheim, 2010). SOA as a term is mostly associated with the use of web-service technology, and as to preserve the original conceptual intent, Service-Component Architecture (SCA) has emerged to cover the broader aspects of SOA. SCA addresses heterogeneous distributed computing and accounts for both several different implementation technologies and several different service binding technologies. Supported implementation technologies encompass languages of different styles like C, C++, Java, PHP, COBOL, BPEL, XSLT, XQuery, and SQL. Supported service binding technologies are, e.g., Web Services, Java Messaging Service (JMS), and CORBA IIOP (Draheim, 2010).

4 Issues of design and implementation of e-government

If you wish to make an apple pie from scratch, you must first invent the universe.
- Carl Sagan

This chapter is divided into five parts providing a background and also an extended contextualisation of the problem. Together with Chapter 3, this chapter presents what is perceived to be appropriate with regards to e-government maturity and the use and organisation of technology in order to support the desired degree of sophistication of services. The material presented additionally contributes to an informed argument related to the design artefact.

In Section 4.1, integration and interoperability is discussed together with factors constraining integration and interoperability. In Section 4.2, an introduction to e-government maturity models is provided. The purpose is to provide an overview of how various services are type-wise classified, and to illustrate the required technology-support for the various maturity levels. As the design artefact aims to support services with a high level of sophistication, an understanding of how maturity of e-government services is perceived is accordingly needed. Section 4.3 considers public agencies with respect to the current installed base. This is both from the general viewpoint as a socio-technical system, and through a consideration of systems supporting specialised tasks within the various public agencies. Section 4.4 considers selected collaboration arrangements between service-providing organisations, along with current governance approaches and a suggested need for integrating system capabilities. Architecture frameworks as a basis for interoperability are introduced in Section 4.5. Section 4.6 concludes the chapter with a discussion of current trends in information systems development. The discussed trends are based on the idea of an open global environment for service collaboration.

4.1 Conceptualisation of integration and interoperability

This section provides a conceptualisation of public agency integration and interoperability. This is followed by a presentation of constraints that both apply as general constraints and constraining factors for e-government integration and interoperability.

Layne and Lee (2001) propose vertical and horizontal integration as the two final stages of their e-government maturity model. Vertical integration suggests a connection

between the hierarchical layers of the typical organisational "silos" of government, while horizontal integration suggests a connection between organisational "silos" facilitating the creation of compound services, involving multiple service providers from different parts of government. E-government integration is defined as…

> *the forming of a larger unit of government entities, temporary or permanent, for the purpose of merging processes and/or sharing information.*
>
> *Scholl and Klischewski (2007).*

Information integration or process integration are approaches for integration that can be taken depending on the strategic goals and contextual need for cross-organisational collaboration (Klischewski, 2004):

- ***Information integration*** aims at facilitating information flow, i.e. providing access to structured informational resources across technical and organisational borders in order to enable new services based on a virtually shared information environment.

- ***Process integration*** centres around interrelating steps and stages of process performance across technical and organisational borders in order to enable new services based on an overarching monitoring and control of process flow.

While process integration based on a stable group of partnering agencies provides a rewarding setting for the integration of core cross-agency processes, process integration based on global partnerships usually does not pay off. In a global setting it is advised to approach process integration through establishing open process interfaces and applying global standards for process descriptions (Klischewski, 2004).

Interoperability, being a broader term, reflects the ability of a system to operate with parts of another system. It is common to distinguish between three main types of interoperability with scopes related to the organisation, semantics, and technical issues, and alternative classifications are normally found within these. IDABC (2004) describes the types as:

- ***Organisational interoperability*** is concerned with aligned strategic goals – defining business goals, modelling business processes, and bringing about the collaboration of administrations that wish to exchange information and may have different internal structures and processes.

- ***Semantic interoperability*** is concerned with a shared understanding of concepts – ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. Semantic interoperability enables systems to aggregate and reuse information in a meaningful manner.

- ***Technical interoperability*** covers the technical issues of linking computer systems and services. It includes key aspects such as open interfaces, electronic intermediaries, data integration, accessibility, and shared services.

Gottschalk (2009) relates levels of interoperability to successive levels of maturity from computer, process, knowledge, value, and goal interoperability. In this, interoperability can be achieved for all relevant perspectives of the enterprise where collaboration or conflict related to collaboration can occur. Scholl and Klischewski (2007) identify nine influencing factors constraining government integration and interoperability as:

- ***Constitutional/legal constraints –*** Integration and interoperation may be outright unconstitutional because the democratic constitution requires powers to be divided into separate levels and branches of government. Total integration and interoperability between and among branches and levels would virtually offset that constitutional imperative of checks and balances.

- ***Jurisdictional constraints –*** Since under the constitution, governmental and non-governmental constituencies operate independently from each other, they own their information and business processes. Due to this, their collaboration, integration and efforts towards achieving various levels of interoperability are voluntary.

- ***Collaborative constraints*** – Organisations are distinct in terms of their disposition and readiness for collaboration and interoperation with others. Past experience, socio-political organisation, and leadership style influence the degree of proneness and adeptness of potential interoperation.

- ***Organisational constraints*** – Organisational processes and resources may differ between organisations to such an extent that integration and interoperation might prove exceedingly difficult to achieve without standardising processes, systems, and policies.

- ***Informational constraints*** – While transactional information might be more readily shared, strategic and organisational information might not. In addition, information quality issues arise when integrating information sources across various domains of control and quality standards.

- ***Managerial constraints*** – Interoperation becomes inherently more complex as more parties with incongruent interests and needs become involved. As a result, the demands of the respective management task might exceed the management capacity of interoperating partners.

- ***Cost constraints*** – Integration and interoperation between diverse constituencies might be limited to the lowest common denominator in terms of availability of funds. Also, unexpected budget constraints might pose serious challenges to long-term interoperation projects.

- ***Technological constraints*** – The heterogeneity of e-government information system platform and networking capabilities might limit the interoperation of systems to relatively low standards.

- ***Performance constraints*** – As performance tests suggest, the higher the number of interoperating partners the lower the overall system performance in terms of response time. Yet, the focus on prioritised needs might enable fewer but more effective interoperations.

4.2 E-government maturity

This section considers the relation between technology and maturity of government services. The classification of the various levels of maturity both gives an understanding of how current e-government services are provided, and of aspects related to future service provisioning. First, maturity models are generally considered. Then, a presentation of the rather extensive use of maturity models within e-government research is given. The section is concluded with a five-stage example model. This model can be used to understand the level of sophistication of various provided services as a backdrop for the design artefact.

Maturity models (or stage-models) are used to describe the level of maturity of a certain development process, and prescribe succeeding maturity levels based on expected growth. The origin of the models can be traced back the Nolan model of computing evolution in organisations developed between 1969 and 1979 (King and Kraemer, 1984). A number of academic disciplines use the term maturity, and develop maturity models as classification schemes (Andersen and Henriksen, 2006). There is however some discussion of the empirical validity of the Nolan model (Prananto et al., 2003).

The maturity model can act as a simple classification scheme for academics and practitioners, and provide a lightweight framework for the assessment of a given case. Maturity models are prescriptive, but do not say anything about the development of a specific case. The identified level of maturity can further be limited to a given part of an organisation or for a selection of services, which means that the maturity is not organisation-wide. The danger with any maturity model is that it implies that each stage is somehow better than the previous one (King and Cotterill, 2007). A maturity model seldom provides a good understanding of what a given stage entails or the capabilities or incitement for progressing to the next level of maturity. The leap from one step to another is not continuous and does not come from model inertia. Furthermore, the implicit technologies supporting each stage will not likely act as a catalyst for further growth. This points in the direction of external organisational capabilities in order to move the organisation from a given level of maturity to another.

Maturity models have been embraced within e-government, and numerous models have been defined by scholars and governments, including the models of the Gartner Group (Baum and Di Maio, 2000), Layne and Lee (2001), Landsbergen and Wolken (2001), Moon (2002), Murphy (2005), Janssen and van Veenstra (2005), Siau and Long (2005), Andersen and Henriksen (2006), and Iribarren et al. (2008). Common for these models is that they move from offline operations to providing information through electronic channels, and later are able to support single interactions and semi-automated transactions. Common for the peak stage is an integrated service delivery through a single point of access, transformed value chain, and transparency of operations. In line

with this evolutionary development is an increasing degree of connections of semantic information and complexity due to the vertical and horizontal integration of government agencies. Work related to specific aspects of e-government change through the use of maturity models include, among others, the CRM maturity model for transformational government of King and Cotterill (2007), the maturity model for digital government interoperability by Gottschalk (2009), and Klievink and Janssen's (2009) dynamic capabilities model. The latter focusing on the required capabilities and readiness related to moving between the different maturity levels. The *next generation of government*, defined as the 4th wave of government in the maturity model proposed by Murphy (2005), suggests that government at that point is so saturated with information technology that defining e-government as a separate entity ceases to be helpful. Reorganisation is extensive across organisational boundaries and into service partnerships across the public, private, and voluntary sector (Murphy, 2005).

Figure 9 shows an example of a maturity model used for e-government. It has 5 stages going from information, one-way interaction, two-way interaction, transaction, and targetisation. Although the technology use for each stage is not made explicit, each successive stage suggests increased e-government maturity and an increased use of technology in the provisioning of services that are increasingly complex.

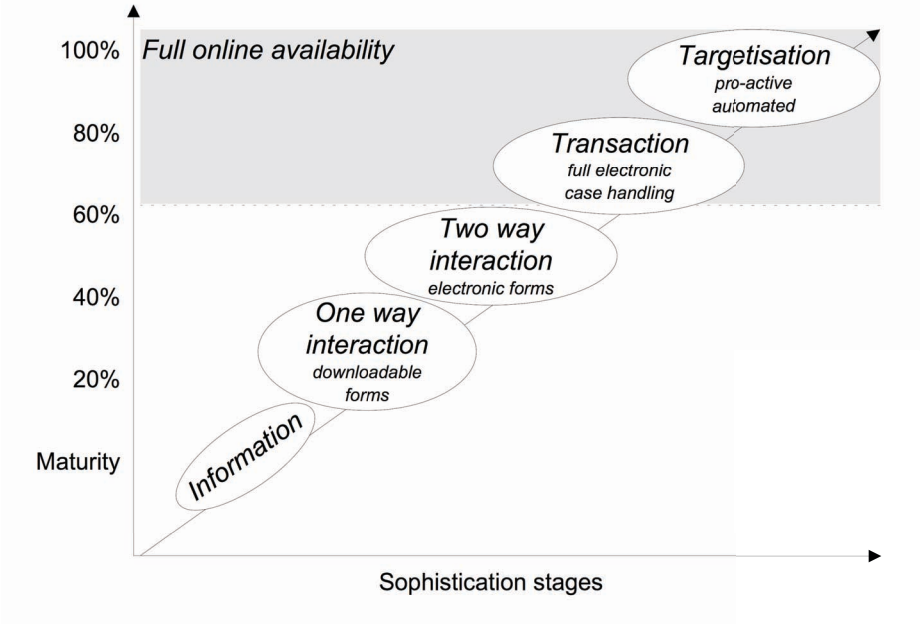

Figure 9 Five-stage model for e-government maturity (European Commission, 2010)

The three first stages (information, one-way, and two-way interaction) are centred on availability, taking new channels into use, and automating existing processes using available technology. Levels four and five suggest full online availability and imply a transformation from existing processes towards full electronic case handling and pro-active service delivery to the individual. The technological capabilities required for the realisation of stage four and five do however go far beyond that of full online availability. New back-office systems and capabilities for cross agency collaboration are required in order to organise e-government service provisioning at this level of maturity.

4.3 Public agencies and services

The *My Processes* portal suggests that information about the provisioning of all public services is available to the citizen. The actual value creation in public services is however to a large degree made by human actors only partially supported by information systems. This implies that the actual work conducted in service provisioning should be reflected by the model representation of the e-service. Further, the e-service infrastructure should sink into the existing information infrastructures in order to allow the combination of new and existing resources and services. The potential value of a connected national information infrastructure refers to a distributed resource environment, and the ability to form constellations around service delivery to a citizen that previously was not feasible.

Hornnes et al. (2010) propose a conceptualisation of a government information infrastructure (GII) having an installed base comprised by legal regulations, politics, administrative practices, legacy systems, etc. Taking this to the local level of public agencies within municipalities, Figure 10 provides an illustration of existing tasks and shared and supporting ICT systems. Specialised systems are found within each sector in supporting the various tasks of the single agency. The information infrastructure is heterogeneous as there are separate regulations and politics for each sector represented, and further variations in organisational culture and administrative practices for each agency or service location.

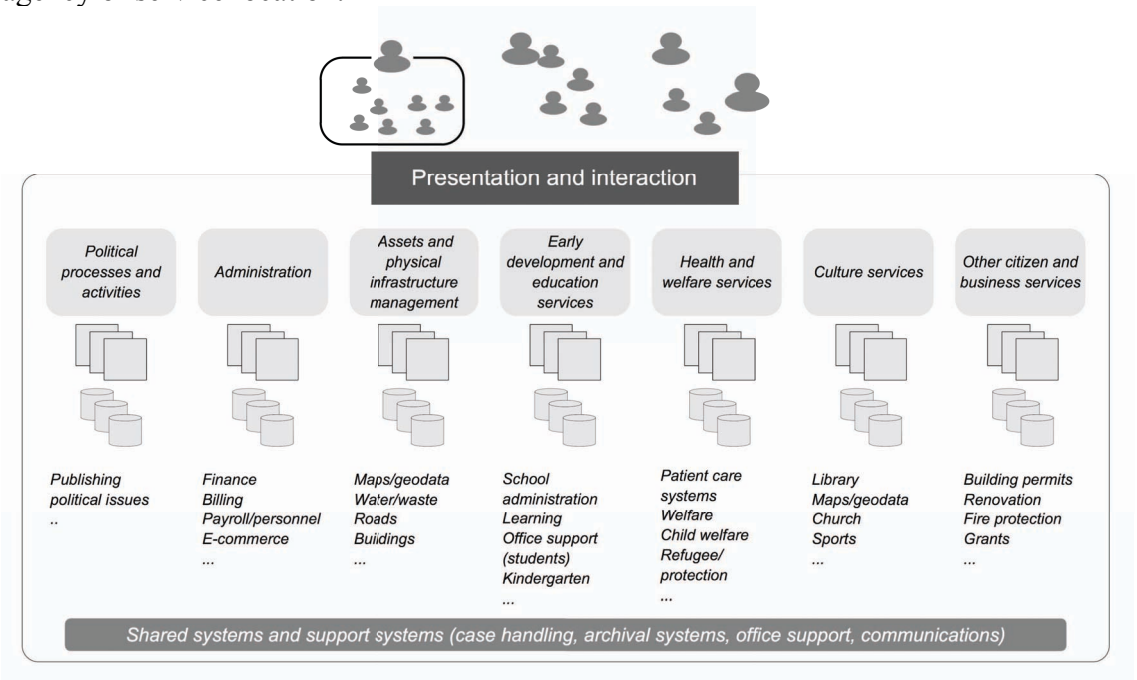

Figure 10 Sector-wise view of municipal tasks and ICT systems (FAD, 2011)

In addition to the services provided at the local level, national agencies provide services at a national level through register services, universities, health, and transportation, to name a few. All of these having an equivalent range of specialised systems, shared, and support systems.

4.4 Arrangements for cross-agency service provisioning

This section provides an overview of arrangements for service provisioning based on the contributions from multiple agencies. The goal is to provide a basis for understanding the need for supporting technology and governance.

Introduced in the 1990s, the *governance paradigm* suggests a shift from government to governance, implying a government as defined by Bekkers and Homburg (2005), as:

- not an entity, but a conglomerate of actors
- not the only actor who tries to influence societal development
- where interventions are interventions in policy networks.

Bekkers (2006) explains this further, and uses policy chains and policy networks to describe public service provisioning. A policy chain is a multi agency service process having a sequential dependency between the actors, while in a policy network the dependencies between the actors have a reciprocal nature (Thompson, 1967). They act as semi-permanent collaboration arrangements between organisations (public, private, and semi-public) in order to provide a given service or outcome. The collaboration arrangements are based on political and administrative agreements, technological agreements, economic agreements, and legal arrangements.

The term virtual state is used by Fountain (2001) for a government that is organised increasingly in terms of virtual agencies in public-private networks, and whose structure and capacity depends on the Internet. A virtual agency is a temporary or semi-permanent arrangement of resources selected independently of the normal organisational boundaries in order to solve a given task or tasks. A virtual organisation of resources can be used to bring individuals from different agencies together and a given individual can be member of several virtual agencies at any given time. Based on the research objective of establishing a *My Processes* service portal, virtual agencies is a possible approach to establishing a public service portal as a virtual one-stop shop.

A one-stop shop is a single point of contact where arrangements for most public services can be made. It is a service where the citizen can ask questions and be guided for applicable services based on given needs. Another kind of arrangement providing convenience to the citizen is related to interoperability and back-office integration. A possible outcome of such an arrangement is that the citizen would not have to resubmit information that previously has been provided to another public agency.

Physical reorganisation towards a one-stop shop at a local level includes a consolidation of service organisations into shared service centres (Janssen and Wagenaar, 2004). In a shared service centre, different branches of government are available to the public at the same physical location. A shared facility does however not necessarily mean having an integrated back-office. An alternative arrangement to the shared service centre of a decentralised character is a shared service network. Shared service networks (Becker et al., 2009) are primarily a result of inter-municipal collaboration motivated by cost

reduction and physical resource availability where the responsibility of providing selected services are divided between adjacent geographical policy domains.

	Back-office integrated	Back-office separated
Co-located	*i*	*ii*
Not co-located	*iii*	*iv*

Table 1 Collaboration arrangements as basis for service integration

Table 1 illustrates collaboration alternatives as a basis for service integration. Having an arrangement where the providers are co-located (*i*-*ii*) will provide the convenience of a shared service centre and a one-stop shop for the citizen. Having an integrated back-office (*i*) will additionally provide the functionality of a virtual organisation to the convenience of both the citizen and the service providing actors, although a co-location might suggest that virtual organisations can be established even without back-office integration (*ii*). A situation where there is no co-location but with an integrated back-office (*iii*), the establishing of a virtual organisation is possible. The case of not being co-located and with a back-office that is separated (*iv*) is the least sophisticated arrangement.

However, in the case of an integrated back-office (*i*, *iii*) where the citizen itself can participate in the virtual organisation, co-location is no longer important from a citizen's perspective. The ability to participate in a virtual organisation, or any other collaboration towards shared service provisioning is however affected by the choice of technology and the installed base of the single organisation (Dawes and Préfontaine, 2003). Here, the governance aspects become important. Fountain (2001) points to three relevant governance approaches, namely mutual adjustment, supervision, and standardisation. While mutual adjustment suggests an arrangement where organisations coordinate and fit technologies on an individual basis, supervision may be problematic for autonomous organisations due to accountability. The case studies in this research study show that municipal consortiums may act as both regulating authorities and have supervising responsibilities, as well as acting as a standards body.

Fountain (2001) suggests that even though standardisation may lead to a reduced variance of inputs, outputs, activities, and behaviours, a goal of standardisation should be to standardise interactions rather than reducing local sovereignty, and through that reduce the ability to provide individually configured services. In this, a challenge identified by Ciborra (2002) is to establish global standards while supporting local solutions and practices.

When it comes to service provisioning organised around the citizen, citizen-centric and life-event types of service have been provided and studied for some years. But studies show that prospects for the integration from which these services are based are very limited, unless the different providers contributing to the overall performance are able to

achieve a higher level of integration than is currently available (Klischewski, 2004). This is possibly a consequence of the fact that the integrations are established in order to support a predefined set of services and interactions specific to those services. However, if more complex initiatives are being realised, they will be rather vulnerable if their design is not flexible (Zouridis and Thaens, 2005). Considering the design artefact, there are challenges related to the provisioning of a flexible and evolving service environment that can provide integrations not limited by predefined services.

4.5 Architectural planning

This section deal with the governance aspects of interoperability, and frameworks for architectural planning that enable e-government interoperability. Historically, important interoperability efforts can be credited as key enablers of e-government. Particularly significant are efforts made in the 1980s through the establishment of the OSI reference model and TCP/IP for Internet traffic, and the formation of the W3C in 1994. The 1996 Information Technology Management Reform (Clinger-Cohen Act) is considered as a governance measure towards increased interoperability through introducing the need for federal agencies to establish architecture programs (Guijarro, 2007).

While enterprise architecture (EA) takes a holistic approach to principles, methods, and models contributing to the structure, business process, information systems, and infrastructure (Lankhorst, 2009), interoperability frameworks (IF) are a possible subset of EA, specifically focusing on standards, formats, and technologies. ISO 15704 considers two types of architecture that deal with enterprise integration: system architectures and enterprise-reference projects. System architectures deal with the design of systems and are also known as conceptual architectures. Enterprise-reference projects, deal with the organisation of enterprise development projects (Lillehagen and Krogstie, 2008). Being of the latter kind, the Zachman framework for enterprise modelling (Zachman, 1987) highlights the intersection between the roles in the design process (owner, designer, and builder), and the *what* (material), *how* (process), and *where* (geometry) the components are relative to one another.

Examples of IF and EA initiatives include the e-GIF (United Kingdom), ADAE (France), SAGA (Germany), DIF (Denmark), and EU Commission programs IDA II (Interchange of Data between Administrations), and IDABC (Interoperable Delivery of pan-European eGovernment Services to public Administrations, Businesses and Citizens). The European IDABC was succeeded by the IDABC EIF (European Interoperability Framework) and the IDABC AG (Architecture Guidelines), which are currently brought further into the ISA (Interoperability Solutions for European Public Administrations) program running from 2010 to 2015 (European Commission, 2009). ISA is further currently to become published as a W3C standard. In the United States, matching efforts include the EAG (Enterprise Architecture Guidelines), the FEAF (Federal Enterprise Architecture Framework) and the succeeding FEA (Federal Enterprise Architecture). Research-based IF frameworks include the ATHENA IF (Berre et al., 2007), while general EA frameworks include the Zachman (Zachman, 1987) and the TOGAF framework (Josey et al., 2009). Various other frameworks exist for different purposes and for specific domains (Lillehagen and Krogstie, 2008).

The need for standards and architecture principles depends on the nature of the integration. Variations in the communications of the government frameworks are mostly related to their differences in approach towards the layered model approach or the organisation around services (Guijarro, 2007). Common to the frameworks is the emphasis on the use of open standards. A clear motive towards preventing vendor lock-in is also apparent.

4.6 Service provisioning in an open environment

This section considers current issues of large-scale information systems development relevant to the process-aware viewpoint and design principles taken on by this research study.

The SOA/SCA approach for information systems development is very much built on the concepts of open standards and allowing different vendors participate to the construction of systems. Dumas et al. (2005) point out several trends leading to the current state of play in information systems development. The first two are the shifts from application programming to application integration and the shift from data orientation to process orientation. The third is a shift from carefully planned designs to redesign and organic growth. These are all consequences of a broad adoption of standards supported by operating systems and existing components, data readily available in legacy systems, and the efficiency achieved through moving from data-centric to more process-driven approaches. Software engineering approaches aimed at adapting existing software in response to changes in requirements call for componentisation and reuse.

Observations of Kutvonen (2010) are in line with what we can see from previous sections, the present trend in enterprise computing is towards networked business. Based on this, the demand for a new global infrastructure-layer facilitating inter-enterprise collaboration and interoperability is apparent. In developing services in an open environment (having components that cross organisational boundaries) it is necessary to account for autonomy, heterogeneity, and dynamism. Autonomy implies that the components in an environment function solely under their own control, and that updates occur locally. Heterogeneity implies that the components of a system are different in their design and construction, and evolve differently. Dynamism is a consequence of this, resulting in the system having to be designed to accommodate the arrival, departure, temporary absence, modification, and substitution of components (Singh and Huhns, 2005).

Lillehagen and Krogstie (2008) identifies collaborative business process networks as a kind of super-enterprise equivalent to the scenario of a collaborative open service environment for public service provisioning as implied in this chapter. In this super-enterprise, concerns for concurrency and for the core enterprise logic, knowledge, and competence of each partaking agency will require model-driven solutions and systems engineering. In order to better support performance analysis and monitoring, modelling and execution platforms must be integrated, so that models can import and base the

model-supported analysis on operations and data that are as close to real-time as possible (Lillehagen and Krogstie, 2008). Although it is not yet realistic to provide end-to-end model-driven and process-aware services as an integrated part of an information infrastructure, the concept can be applied as part of the proposed design artefact.

5 Research publications

Research is to see what everybody else has seen, and to think what nobody else has thought.

- Albert Szent-Györgi

This chapter presents the research publications of the study from P1 to P9. It is divided into groups according to Figure 2 in section 1.7:

- Literature studies within the knowledge base
- Design work through artefact suggestion and evaluation
- Case studies within the problem environment.

Each publication is presented based on the published title, authors, and abstract followed by a brief description of the paper, the author's contribution to the paper and the publication details.

5.1 Literature studies within the knowledge base

P1: Service delivery in transformational government: model and scenarios

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
By formalising the processes related to government service provisioning, it is possible to identify best practice, room for improvement and potential for added service value. Work supported by ICT has the potential of increased efficiency and control, but there is also danger of locking down to a sub-optimal service delivery with low flexibility. Through experimental methods and supported by case studies, we have established a model to aid the conceptual understanding of the dynamics of modern government service delivery. In light of this model, scenarios for service-centric and citizen-centric delivery of government services are presented. The paper describes areas crucial to government service delivery and its supporting tools, methods, and infrastructure for process work in the transformational government scenario.

Description:
P1 is based on an initial literature study followed by meta-synthesis (Sandelowski et al., 1997) and the development of a conceptual model (C1**)** using experimental and

analytical techniques supported by scenario testing. Ideal scenarios are built using association techniques and by bringing in solutions from other contexts into the problem domain.

P1 was written as an externalisation of knowledge accumulated as part of the problem awareness and search process. An established understanding of several concepts is made as a foundation for further research. This includes a t-government and problem understanding in which t-government is not only technology induced government transformation, but a continuous change process where there is a need for supporting technology infrastructure capable of adapting to those changes.

The scope of government services is defined in order to involve all aspects of government service provisioning, and in order to support a holistic and multi-channel service delivery. A model for the dynamics of e-government service provisioning is suggested to support this understanding.

P1 further suggests two views of a scenario for service and citizen-centric service provision (C2), where the key stakeholders are the public servants and citizens respectively.

Author contributions:
The entire paper is written by Gustav Aagesen. John Krogstie has contributed with comments and suggestions throughout the writing process.

Publication details and reference:
Featured in *Electronic Government, an International Journal*, special Issue on e-Government: Past, Present, and Future. Guest Editors: Vikas Jain, Yogesh K. Dwivedi, Shirish C. Srivastava and Mohini Singh.

Gustav Aagesen and John Krogstie (2011) *Service delivery in transformational government - Model and Scenarios*, Electronic Government, an International Journal (EG), Special Issue on: E-Government: Past, Present, and Future, 8(2/3), pp. 242-258

P2: Analysis and design of business processes using BPMN

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
In 2004, the Business Process Modelling Notation (BPMN) was presented as a standard business process modelling language. Its development was considered to be an important step in reducing the fragmentation that was witnessed between the existing process modelling tools and notations. Since then, BPMN has been evaluated in different ways by the academic community and has become widely supported by the industry. After completing the first major revisions of BPMN, the Object Management Group (OMG) is working toward a new BPMN standard, BPMN 2.0. This chapter summarises some of the evaluations of BPMN and presents these together with reported

experiences as well as some examples of proposed extensions and future expectations based on these.

Description:
P2 contributes to the underlying BPM focus of the study through a survey of existing literature and experience from evaluating the BPMN modelling language. This is additionally supported by document studies of draft technical specifications to provide an overview of proposed extensions of BPMN. It represents a partial state of the art on process modelling and modelling capabilities relevant to the understanding of the problem domain and the research objective. Compared to **P9**, this paper look at the modelling capabilities of a specific language and look at these in the context of use both from an academic and practitioner point of view. A takeaway from this study is that BPMN is flexible enough to establish dialects within a group of users, which can be problematic when introducing constructed models to new audiences.

Author contributions:
P2 is based on a term paper written by Gustav Aagesen on a topic of own choice. John Krogstie has contributed to the introduction as well as with comments and suggestions based on feedback from the review process.

Publication details and reference:
Featured in *Handbook on Business Process Management 1, Introduction, Methods and Information Systems*, Series: International Handbooks on Information Systems. Editors: Jan vom Brocke and Michael Rosemann.

Gustav Aagesen and John Krogstie (2010) *Analysis and design of business processes using BPMN*, In: vom Brocke, J. and Rosemann, M. (eds.), *Handbook on Business Process Management 1, Introduction, Methods and Information Systems*, Series: International Handbooks on Information Systems, ISBN: 978-3-642-00415-5, Springer-Verlag, Berlin/Heidelberg, pp. 213-235

P9: Public service provisioning and ICT development. Synchronising the flexibility of organisations and ICT

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
In this paper we investigate the design, development and maintenance of ICT process support for government services. The motivation is based on the political ambitions for government service provisioning and the required information infrastructure to implement demand driven service provisioning. We introduce the different types of flexibility from literature, and look at approaches to achieving flexibility in process-aware information systems (PAIS). Our study shows that synchronising the flexibility of organisations and the supporting ICT has consequences for the agencies partaking in the delivery of services, and the organisation of service delivery itself. We highlight current challenges and suggest further directions in order to support development towards service flexibility for government agencies.

Description:
P9 particularly considers PAIS and flexibility, and see this in the context of e-government systems and challenges related to enabling process flexibility in a multi-agency service scenario. It revisits the IS aspects of process-oriented service provisioning with an emphasis on flexibility and cross-agency service provisioning as envisioned by the design artefact and in light of previous case studies. Current challenges, and in that sense the maturity of current technologies (RQ4), are identified. Recommendations on further development in the direction of realising process-supported service provisioning are additionally suggested.

Author contributions:
This paper is entirely written by Gustav Aagesen. John Krogstie has contributed with comments and suggestions throughout the writing process.

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Presented at *Norsk Konferanse for Organisasjoners Bruk av IT* (NOKOBIT), 22-24 November 2010, Gjøvik, Norway.

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5.2 Proposed artefact design and justification

P3: Citizen-centric process views for government service provisioning

Author:
Gustav Aagesen.

Abstract:
As users of government services, citizens spend much of their time in transit between government agencies or acting on behalf of their different roles and responsibilities. Government agencies are providers of services virtually connected, but with little or no actual integration. We believe that by allowing the citizens access to the ongoing processes in which they are involved, it would improve service delivery from the perspective of the citizen and the government organisation alike. The paper introduces the concept of citizen-centric process views, providing channel independent architectural support for knowledge management and monitoring of cross-organisational service delivery in t-government. Our focus is aimed at describing the concept, its utility, and suggested architecture.

Description:
This paper presents the design artefact through the description of the conceptual model for the citizen-centric process views. It further considers the motivation for its design through broad descriptions of aspects supporting the *My Processes* concept. This includes: focus on the citizen; process access through roles; discovery, customisation

and service integration; and multi-channel service provisioning, as well as process knowledge management and process improvement supported by capabilities for simulation, monitoring, and forecasting.

Author contributions:
This paper is entirely written by Gustav Aagesen.

Publication details and reference:
Presented at *Norsk Konferanse for Organisasjoners Bruk av IT* (NOKOBIT). 23-25 November 2009, Trondheim, Norway.

Gustav Aagesen (2009) *Citizen-centric process views for government service provisioning*, Norsk Konferanse for Organisasjoners Bruk av IT, Tapir Forlag

P4: Providing adaptive and evolving government e-services through citizen-centric process views

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
As users of government services, citizens spend much of their time in transit between government agencies acting in different roles with varying responsibilities. Government agencies are providers of services virtually connected, but with limited actual integration in practice. We believe that by allowing citizens more direct access to the ongoing processes in which they are involved, it could improve service delivery from the perspective of the citizen and the government organisation alike. In this paper we discuss the concept of citizen- centric process views, a conceptual architecture providing channel independent support for knowledge management and the monitoring of cross-organisational service delivery in transformational government. We will set the stage for the discussion of requirements for the next generation of government infrastructures and the surrounding organisations in order to support delivery of adaptive and evolving government services.

Description:
P4 presents parts of the design artefact and further emphasises on the possibility for a service co-evolution in shared service networks. This is based on the collaborative integration of existing components from the installed base with the CCPV, and extending the CCPV with new channels and capabilities. Further, different approaches for distributing process templates enable sharing of best practices and effective deployment of new service processes based on regulatory changes or upgraded technology affordances.

Author contributions:
This paper is based on **P3** and is collaboratively edited by Gustav Aagesen and John Krogstie.

Publication details and reference:
Presented at *World Computer Congress*, 20-23 September 2010, Brisbane, Australia.

Gustav Aagesen and John Krogstie (2010) *Providing adaptive and evolving government e-services through citizen-centric process views* In: Janssen M., Lamersdorf, W., Pries-Heje, H. and Rosemann, M. (eds.), *E-Government, E-Services and Global Processes*, IFIP AICT 334, 2010, Springer-Verlag, Berlin/Heidelberg, pp. 32-45

P8: Citizen centric public service provisioning - A conceptual approach for next generation information infrastructures

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
The provisioning of holistic public services requires the coordination of various government agencies, a responsibility often taken on by the service receiver. To compensate for a fragmented and complex range of government service providers, one-stop shops, online portals, and compound services are established for the most frequent patterns of interaction. National information infrastructures are being developed to act as a unified front-end towards the public, and as a point of integration between collaborating agencies. This paper describes a conceptual approach for organising delivery of citizen-centric and demand driven public services in a multi-agency setting. It is evaluated through the presentation and discussion of the case of the Norwegian Individual Plan (I-Plan), a law-given opportunity for receivers of long-term complex health and social services, aiming to provide coordinated and individually fitted services. We find that our approach supports current requirements of virtual service organisations, and we also see a potential use within other government domains.

Description:
P8 is an explorative case study within the health and social services related to the provisioning of the cross-agency *Individual Plan* (I-Plan). Data collection is based on public reports, practitioner guidelines, whitepapers as well as academic work related to the topic. The goal of the study was to acquire knowledge about a specific case. It further acts as a demonstrator to justify the design artefact with an emphasis on aspects related to supporting virtual organisations for citizen-centric service provisioning. This is achieved through the description of a case that would directly benefit the design artefact, both for case handling and process support for emergent processes in a dynamic cross-agency service scenario. The usefulness of the role concept for both public and private stakeholders as well as citizens is further demonstrated by the case.

In addition to providing an updated description of the design artefact, the paper describes the overall research process of the PhD study.

Author contributions:
This paper is entirely written by Gustav Aagesen. John Krogstie has contributed with comments and suggestions throughout the writing process.

Publication details and reference:
Presented at *5th International Conference on Methodologies, Technologies and Tools enabling e-Government*. 30 June - 1 July 2011, Camerino, Italy.

Gustav Aagesen and John Krogstie (2011) *Citizen centric public service provisioning - A conceptual approach for next generation information infrastructures*, 5th International Conference on Methodologies, Technologies and Tools enabling e - Government, 30 June - 1 July 2011, Camerino, Italy

5.3 Case studies within the problem environment

P5: Investigating requirements for transformational government information infrastructures: The case of the approval process for building applications

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
In order to handle the anticipated complexity of services and systems for future government service provisioning, next generation government infrastructures are being designed. Required capabilities involve providing support for the dynamic organisation of services, effective knowledge management, service innovation, transparency, and user centricity. The transition to full transformational government requires both a cultural and technological leap. The building application approval process is a user-initiated process with both private and public multiple stakeholders, using information from multiple systems within a domain with continuously evolving regulations, both at local and national level. As part of an ongoing study on process support for government service delivery we investigate the building application approval process. We identify potential takeaways for developing the next generation of government infrastructure through describing the current service configuration and stakeholders.

Description:
P5 presents an explorative case study using a combination of document studies, and semi-structured interviews resulting in a combination of primary and secondary data. The goal for the study is to provide a description for how process support for planning and zoning is organised. The study is interesting due to the different levels of public/private partnership and the involvement of both citizens and businesses in a process that can only be partly automated. Insights from the study include aspects related to the governance and organisational change in the implementation of a centralised validation of electronic forms based on a combination of local and global rules. It additionally sheds light the role of the software industry as providers of tools for both public and private stakeholders.

Author contributions:
This paper is entirely written by Gustav Aagesen. John Krogstie has contributed with comments and suggestions throughout the writing process.

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Gustav Aagesen and John Krogstie (2010) *Investigating requirements for transformational government information infrastructures. The case of the approval process for building applications*, European Conference on e-Government, National Centre for Taxation Studies, University of Limerick, Ireland.

P6: Service development for national government information infrastructures - the case of Norway

Authors:
Gustav Aagesen and John Krogstie.

Abstract:
There is an ongoing technological transformation as a result of e-government initiatives and the establishment of national government information infrastructures. The central standardisation and flexibility of national enterprise systems shape the overall capabilities of the governmental agencies to evolve. This paper presents a case study on the current transition and plans for deployment of the national information infrastructure of Norway, Altinn. Aspects important to service development are described, and challenges related to the adoption by stakeholders are discussed. We see that important parts of the transformation strategy include both making available tools and methods for building services on a common information infrastructure and applying political pressure on organisations to adhere to what one centrally has defined as best practice.

Description:
P6 is based on a document study on the requirements specification for the Norwegian government e-service infrastructure. Collected data was supplemented and confirmed through discussion with a member of the project. This study describes the drift of a national portal towards supporting a national infrastructure for e-service development. It is additionally a description of planned functionality of such an infrastructure while still not adopted by government agencies. This provides some indication of the desired direction of the planned shared public service offering. Insights from the study are related to the design artefact through capabilities for process support and service development, and are relevant to the realisation design through current governance supporting e-government development.

Author contributions:
This paper is entirely written by Gustav Aagesen. John Krogstie has contributed with comments and suggestions throughout the writing process.

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Gustav Aagesen and John Krogstie (2010) *Service development for national government information infrastructures - The case of Norway*, In Electronic Government and Electronic Participation: joint Proceedings of Ongoing Research and Projects of IFIP EGOV and ePart 2010, Trauner Verlag, ISBN 978-3-85499-766-5, pp.11-18.

P7: The entanglement of enterprise architecture and IT-governance: The cases of Norway and the Netherlands

Authors:
Gustav Aagesen, Anne Fleur van Veenstra, Marijn Janssen, and John Krogstie.

Abstract:
Governments are developing infrastructures to spur e-government development. These e-government infrastructures are based on the notion of ICT as a utility that can be (re-) used by organisations at all levels of government to create their own service provisioning and to facilitate interaction with each other. This paper investigates the development of such infrastructures by looking at regional and national aspects. A cross-country comparative framework is developed and 2 countries are analysed. We found that infrastructure development in both countries is similar at a global level, yet the governance is different. While Norway aims to enable integration by developing a Business Process Management building block on the national level, in the Netherlands local governments compose and integrate the building blocks with implementation support from the national level. These differences between e-government infrastructure developments of the two countries can be attributed to the degree of centralisation of government and the degree of active support given to e-government development.

Description:
P7 is a cross-national comparative case study of the Netherlands and Norway. Based on existing frameworks and literature, the study introduces a framework that is used as a guide for comparing policy documents and available public data in both countries. The framework is useful in separating various aspects of e-service development. The paper provides a comparison of the underlying enterprise architecture and IT-governance related to capabilities for providing public services. Work related to **P7** both informed the design artefact and the realisation design. Not only did the Dutch approach provide an alternative to the previous and current direction in Norway, but also the role of the more or less independent national state agencies became apparent through the investigation of the case. These agencies possess the finance and skills to innovate, and can at the same time not afford to wait for consensus on standards and collaborative directions for development.

Further work based on **P7** was accepted to appear in eService Journal, special issue on E-government Services and Information.

Author contributions:
Gustav Aagesen has developed and made the description for the framework for

comparison, provided the case study for Norway, as well as contributed to the cross-country comparison, discussion, and conclusions of the paper.

Publication details and reference:
Presented at the *44th Hawaii International Conference on System Sciences (HICSS)*, 4-7 January 2011, Koloa, Kauai, Hawaii.

Gustav Aagesen, Anne Fleur van Veenstra, Marijn Janssen, and John Krogstie (2011) *The entanglement of enterprise architecture and IT-governance: The cases of Norway and the Netherlands*, 44th Annual Hawaii International Conference on System Sciences (HICSS'11)

6 Contributions

To achieve great things, two things are needed; a plan, and not quite enough time.

- Leonard Bernstein

This chapter considers the contributions of the study. Section 6.1 presents the model describing the dynamics of e-government (C1) as materialisation of the initial studies related to understanding of e-government as an evolving domain of practice. This is followed by section 6.2 and a description of the scenarios (C2) created as a base for reasoning about requirements and expectations for a future e-government service provisioning. Section 6.3 discusses requirements for an e-service infrastructure for public service provisioning (C3) based on the previously introduced model and scenarios. This is followed by section 6.4 and a presentation of the conceptual design for a national e-service infrastructure (C4) as the design artefact for the study. The suggested design is proposed and derived based on knowledge about the three prior sections. Section 6.5 deals with the realisation design and introduces the conceptual e-service governance model (C5). Preliminary, and in part extended, presentations of the contributions are found in Appendix B.

6.1 C1: A Model describing the dynamics of e-government

Figure 11 shows the conceptual model describing the dynamics of government service provisioning and the development of government services. The concepts are illustrated as nodes connected by directed arcs. A directed arc connecting from ***A*** to ***B*** means that *a change in **A** can affect **B***. The model is described below.

Public services are provided based on available *technology affordances* and the *administrative interpretation* of the responsible service provider, be it a local government or a national government agency. A service can be limited to services provided to citizens based on interactions through electronic channels. A broader understanding of the term is however within the scope of the model and a complete understanding of the e-government problem domain. Examples of such services include development and maintenance of physical infrastructures as public roads, health and social services, public schools, police, customs, and zoning and planning.

It is the competence and resources within a public agency and administration that determines whether or not it is capable of using current technology and methods to

improve its *provided services* internally (through a reorganisation of back office functions) or externally (in interaction with citizens or other service stakeholders), and to utilise the available channels for effective and efficient service provisioning. In some cases, *provided services* from one public agency can be made available as *technology affordances* for others.

Together, the *provided services* and *technology affordances* both shape the *behaviour* of the citizens. *Behaviour* can be based on the content or malcontent of services provided relative to expectations of how these services should be. An example of failed expectations in a public e-service offering is when the public services lags behind similar commercial services. This can be found in the case where an online public service desk is compared to electronic banking.

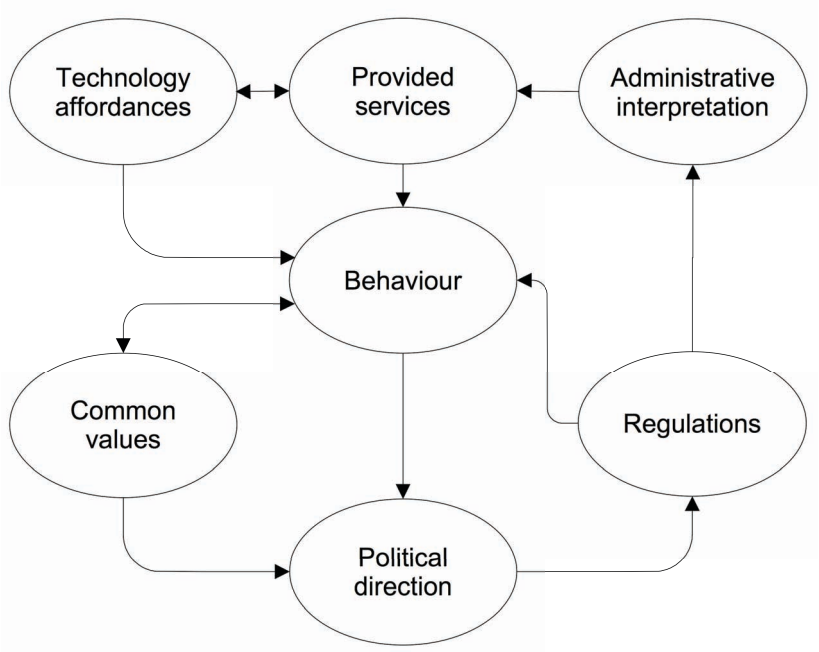

Figure 11 Dynamics of public service provisioning

Political direction is based on *common values* and the current *behaviour*. The Universal Declaration of Human Rights as a signed consensus between many nations is an example of common values, helping regulate the standard rights of individuals. Common values can also be less formal, but are associated with the notion of something being 'right' or 'best' in a given context, which means that they can be based on reasoning or faith. Political organisations or interest groups are also created based on *common values*, and causes supported by a multitude with common values are able to affect *political direction*. From this, we can see that the inner workings of the *political direction* and *common values* are complex, and that the outcomes of these are assumed to be the direction taken as a result of any multi-stakeholder conflict that might have occurred. This direction can be sub-optimal or a trade-off, but it is nevertheless the direction from which any effects are measured. There is furthermore no guarantee that the outcomes are without conflicts themselves.

The *administrative interpretation* of regulations for any given policy domain is decided by the local government or public agency, and determines how services are provided and maintained. The *regulations* and *provided services* also contribute to shape *behaviour* by either constraining or encouraging certain *behaviour*. In this understanding of government service provisioning, any *regulation* is created to help shape *behaviour* directly or indirectly in accordance with one or several laws. *Provided services* at a local or national level aid the effectiveness of the execution of these *regulations*. *Provided services* can also be internal within or across public agencies and governments and assist the effectiveness and productivity of public officials, politicians, and computerised information systems.

The combination of *political direction* and *administrative interpretation* in the different organisations within a government affect how and what services are offered. All citizens within an area are exposed to services provided by several more or less coordinated autonomous agencies. The quality of the *provided services* is based on national and local economy, political priorities, and the *administrative interpretation* of current *regulations*. When it comes to provisioning, services offered directly to the public in one area might be outsourced to private contractors in another. Services provided by, what one might describe as, a welfare state in one area might be absent or only available privately elsewhere.

These are all but comprehensive, but nevertheless important, factors contributing to a holistic understanding of government service provisioning. The model further sets the stage for the problem environment in which the design artefact will reside.

6.2 C2: Future scenarios for citizen-centric and demand driven public services

The scenario for the design artefact is based on the idea of having the *My Processes* service portal available. The scenario described suggests a national e-service infrastructure that can provide customised individual services in an evolving service environment. The scenario disregards weaknesses or presuppositions of the current state based on technology affordances, culture, policies, or regulations. In this sense, the scenario acts as the ideal situation or goal of the design process. The goal scenario is constructed from the view of the service-receiving citizens and in view of the service-providing agencies.

6.2.1 Citizens viewpoint

Figure 12 illustrates a simplified service interaction between a citizen and several service providers through a gateway device, here treated as a black box. Through the gateway device, the citizen can access instance data for its provided services. The citizen can further interact with services and service information on a subscription basis. This subscription can be role-based, and a role is based on identified relationships between the citizen and the government or recorded information about the citizen. The relationships can be eligibilities or obligations of the citizen, and the properties can be the citizen's age or location of residence. It is the roles that initiate and require the

services, and it is the coordination of the different roles that is important to the citizen. With the roles of a single citizen, come different rights and responsibilities. Some roles might vary depending on the current situation of other citizens adjacent to that particular citizen. The parent role gives access to different services depending on the age and needs of a child. The child role has a different nature when caring for elderly parents, and there is a need to take a more active role on behalf of relatives that might not be able to administrate their own roles. Having a certain health condition, or being out of work, also qualifies for access to particular services. Owning property in different regions might require access to information as well as responsibilities in those regions. In this sense, a single citizen is mobile and can have service interaction with several local governments through the same gateway device.

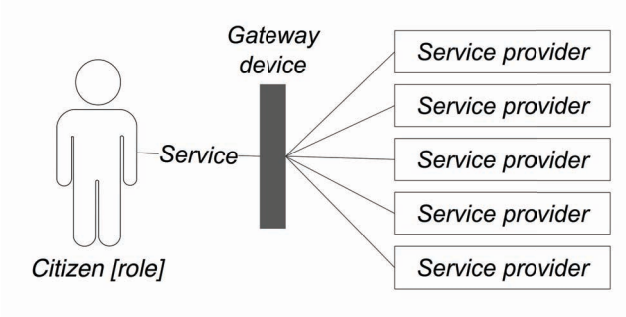

Figure 12 Simplified service interaction

From a citizen point of view, the providers themselves are not of much importance, and the organisation and location of government agencies are irrelevant until a service is required. Currently provided services might be chained to connected services located at different providers necessary at a later stage of service provision. For the public agencies involved in the service provisioning to that particular citizen, the transparency and openness of the channel creates a virtual organisation better suited to provide the service efficiently. From the citizen point of view, partly outsourcing the coordination of services to a relative or trusted peer as a role in this scenario might serve all actors involved. Alternatively, assigning the support role to a civil servant familiar with the process as responsible for the citizen's interests exclusively, providing online or offline support, will compensate for any divide (e.g.: digital, cultural) that the citizen is exposed to.

6.2.2 Service providers viewpoint

From a management and control perspective, the run-time integration of ongoing processes provides an extensive amount of information for monitoring, analysis, and policy development. This includes simulating new regulations on actual data, forecasting service demand and discovering possibilities for new services or improved service delivery. If such monitoring is to be successful, a good fit is required between the service model and the service actually provided. This is also necessary with respect to the process support. This can be achieved through equipping the process worker with a toolkit for customising the system representation of services to local practice and the service provided to the individual citizen. Such capabilities provided by a service framework can further cater for improving provided services over time by defining local best practices and starting points for new service instances.

In considering the service provider, we adopt the concept of lead users (von Hippel, 2005) as champions of local practice. Lead users are users with a special interest and competence in the specific domain that are able to quickly identify showstoppers and suggest improvements at an early stage. In our scenario, lead users would be found in positions within policy-making and governance, or participating in the provisioning of services. These are the users that might be the most able to suggest innovative use and new services. We also look to the capabilities of innovation toolkits as introduced by von Hippel when suggesting a framework to support an adaptive and evolving service environment.

Innovation toolkits should be customised to the users and the domain in question. They should provide the following five important capabilities: learning by trial and error, an appropriate solution space, user-friendliness, commonly used modules, and the ease of creating results. Together, these capabilities would enable the user to test any attempted changes to the service provisioning to measure the relative improvement of changes at the instance, type, or policy-level. Trial and error capabilities at the policy-level can involve extracting data from the execution environment, changing the rules or process flow and running simulations of the process using actual data. This would provide the user with information on how successful a new policy will be, based on an isolated and limited dataset. A similar use of system data would be possible on the type-level, and it could be used to measure improvements in cases eligible for straight through processing based on process changes. On the instance-level it is possible to assume that the user has knowledge of the instance and can supply data relevant to the trial and error simulation. This would involve measuring the process outcomes in the form of delay or cost by alternating process flow.

Integrating service delivery based on the service instance in the gateway device would provide a series of benefits for actors in a policy chain or policy network. Shared process data and updated process states would enable service providing actors to have a holistic view on the services provided. An aggregated view on service delivery based on instance monitoring can additionally provide the benefits of forecasting. Agencies responsible for late steps in process chains, can access the current active use of services qualifying for entrance to the services provided by that particular agency. The information produced by this forecasting is primarily important to planning and resource management.

6.3 C3: Requirements for an e-service infrastructure for public service provisioning

Requirements used as a basis for the suggested conceptual design for a national e-service infrastructure are presented. The model describing the dynamics of e-government and the future scenarios for citizen-centric and demand driven public services are used as a basis for the requirements. They are technology-independent and are related to provided functionality, the context, and the users of the service providing system to be designed.

The use of concepts is based on the following understanding:

- S*ervice* is conceptualised according to Section 1.3.4 and is concerned with aspects of service production in the context of a given citizen or groups of citizens.
- C*hannel* is conceptualised according to Section 1.3.3.
- S*ystem* relates to the totality of e-service infrastructure for public service provisioning as a technological artefact and the corresponding information infrastructures that form the capabilities for service production.
- Public organisations include organisations at the national and municipal level, while private organisations are organisations not owned by the public, including the voluntary sector. The use of *provider* refers to the *public* and *private* organisation as a whole, and employees/volunteers within these organisations as participants in service production.
- *Lead users* refer to employees within *public* and *private* organisations that are able to change to the current service configuration beyond the predefined flexibility of the system. This is done through the introduction of new methods and components.
- C*itizen* refers to the citizen in the role of a service receiver, both within the understanding of the term as a passive receiver and an active participant involved in various aspects of the service production.
- C*aretaker* refers to the *citizen's* family, friends, or an appointed trustee. In the *caretaker* role, these citizens are not service receivers, but rather support and contribute to the service delivery to the *citizen* that the *caretaker* role refers to.
- *Service description* refers to information about services both at the instance and type-level.

The requirements organised in the following groups: multi-channel provisioning, the participating citizen, transparency and transformation, local services in a global setting, and process support.

6.3.1 Multi-channel provisioning

Multi-channel provisioning is concerned with the various available channels supporting information and transactions for provided services.

R01 `The citizen shall be able to initiate all services using a channel of own choice.`

R02 `The citizen shall be able go from one channel to another without losing service information.`

R03 `The citizen shall be able to interact with services through several alternative channels.`

R04 `The system should be extendable to support new channels.`

R05 `It shall be possible to adapt existing services to new channels.`

R06 `It shall be possible to access information about a service through any given channel.`

R07 `In the case of citizens not able to access electronic channels, the system should provide alternative channels for personalised support.`

6.3.2 The participating citizen

The participating citizen is related to the citizen being engaged in the successful delivery of services that it receives, and contributing to benefit of the public through active involvement for an improved service delivery.

R08 The citizen shall to have access to service information based on its roles.

R09 The system shall give the citizen the possibility to interact with its service providers through electronic channels.

R10 Services shall be customisable to the needs of the citizen.

R11 The citizen's possibility to be aided by caretakers shall not be limited by the use of electronic channels.

R12 The caretaker's access to information should be limited to the services in which the caretaker role applies.

R13 Citizens shall be able to monitor and contribute to public projects and initiatives through electronic collaboration spaces.

6.3.3 Transparency and transformation

Transparency and transformation relates to monitoring of provided services and improving service delivery based on feedbacks from the system and the citizens. Transformation in the e-service infrastructure can be user-driven and based on current capabilities, or come through a reconfiguration through the introduction of new capabilities as a response to changing external factors.

R14 If the internal organisation of the provider changes, the lead user shall be able to reconfigure the system so that the support for provided services are aligned to the new organisation.

R15 The system shall support services that are manual, automatic, or semi-automatic (user assisted), or a combination of these.

R16 The provider shall be able to update the service description stored in the system so that it fits to the provided service.

R17 The system shall support updating of service descriptions that are automatic or manually performed by the provider.

R18 Providers, caretakers, and citizens shall be able to make changes to the planned service delivery.

R19 The lead user shall be able to monitor provided service to measure the effect of changes.

R20 In case of automated service delivery, all use of regulations, special criteria, and interpretations of the law shall be configurable.

R21 In case of automated service delivery, all use of regulations, special criteria, and interpretations of the law shall be logged.

R22 The lead user shall be able to make changes to regulations, special criteria, and interpretations of the law used in

automated service delivery.

R23 The provider shall be able to monitor how a service is provided, both while being provided and after completion.

R24 New services shall be created based on the identification of new needs or groups of needs requiring public intervention.

R25 The lead user shall be able to reuse improvements to services made by other lead users.

R26 The provider shall receive feedback on known consequences based on attempted service reconfiguration (e.g. cost, privacy, conflicts, or delays).

6.3.4 Local services in a global setting

Local services in a global setting is related to the autonomy of public organisations and the necessary modifications to service delivery as a consequence of local regulations. It is also related to the benefits of co-production where similar governance applies for different local governments, and collaboration when knowledge can be shared between organisational boundaries for given services.

R27 The provider shall be able to decide how a service is provided as long as it is within the limits of current regulations.

R28 Based on a given service description, the provider shall be able to locate similar services provided by other providers.

R29 Lead users shall be able to locate similar services in order to identify possibilities for co-production and knowledge exchange.

R30 A private organisation shall be able to connect to the system in order collaborate/contribute to service production.

R31 The provider shall be able to share a service with other providers.

R32 The provider shall be able to customise the service to fit with local best practice.

R33 The lead user shall be able to share best practice service descriptions with other lead users.

R34 If the citizen relocates, the service shall be reconfigured through replacing providers not operating at the new location.

R35 The system shall support the possibility of outsourcing the service production partially or completely.

6.3.5 Process support

Process support is related to the manual or electronic assistance provided to users involved with a given public service. Process support can be methods, process descriptions, task support, and access to knowledge related to the given service.

R36 The system shall provide process support that is automatic and electronic, driven by human actors, or a combination of the two.

R37 The citizen, provider, and caretaker shall receive process

support based on the current service description.

R38 Providers involved in parts of the delivery of a service shall have access to the service description so that they are able to get a broader understanding of the context of service delivery.

R39 Providers involved in late steps in a service production shall receive service forecasts based on the status of current service instances in early production phases.

6.4 C4: A conceptual design for a national e-service infrastructure

The goal of the design artefact is to facilitate the possibility of the occurrence of the scenario described in the previous section through methods, models, designs, implementations, or knowledge that can improve our understanding of the scenario or the current situation. This includes addressing one or several aspects of the research objective of enabling the *My Processes* service portal. We recognise that this is partly achieved as a by-product of the design process through conceptualisations and models for understanding, but also through the case and document studies that have been conducted. The design artefact on which the research has been focused is a conceptual model for a national e-service infrastructure, denoted as the citizen-centric process view (CCPV). The following section gives an introduction to the CCPV through a description of its service and network viewpoint.

6.4.1 Service viewpoint

The CCPV (Figure 13) is organised around the delivery of a *service* to a single citizen. The *service* comprises of a single or multiple process instance, which contribute to the completion of the *service*. That is, the *process* can be the partial delivery of a compound *service*, a *service* delivery in a chain of subsequently provided *services*, or the delivery of a single *service*. The *service* defines and organises the *processes* where all work is done.

Each *process* has a set of *actors*, which have defined *roles* in the *process*. The citizen is the *receiver* of the service produced by the *process*. There can be several *contributors* from public and private organisations as well as *caretakers* acting in the interest of the citizen. These actors together form a *virtual organisation* for the *service* in which the *processes* are defined.

The *events* contribute to synchronise the current state of the *process* between all involved *actors* in the *virtual organisation*. This allows local information systems connected through the *system interface* to subscribe to *events* within processes, or request information about the *process*. Capabilities defined in the *process* can be implemented through actors connected to the *system interface*. This can be globally available shared components or locally defined functionality in a given local government or national agency. This means that the *actors* interact with the *process* through a defined *system interface*, which can be extended to local information systems of the contributing actors, or to various user devices for *caretakers* and *receivers*. The

system interface can allow access to custom defined resources (see Section 6.4.2) connected through the interface. These can provide various views of the *process* and process-relevant data separately or combined for the different actors. Examples of these are alerts on spending, deadlines, regulations; lookups in central registries for explanations or references; support for running what-if scenarios on process changes; process documentation, central reporting, benchmarking or locating cases similar to the given process instance; translation services, or other utilities that prove useful for single actors or the *virtual organisation* as a whole.

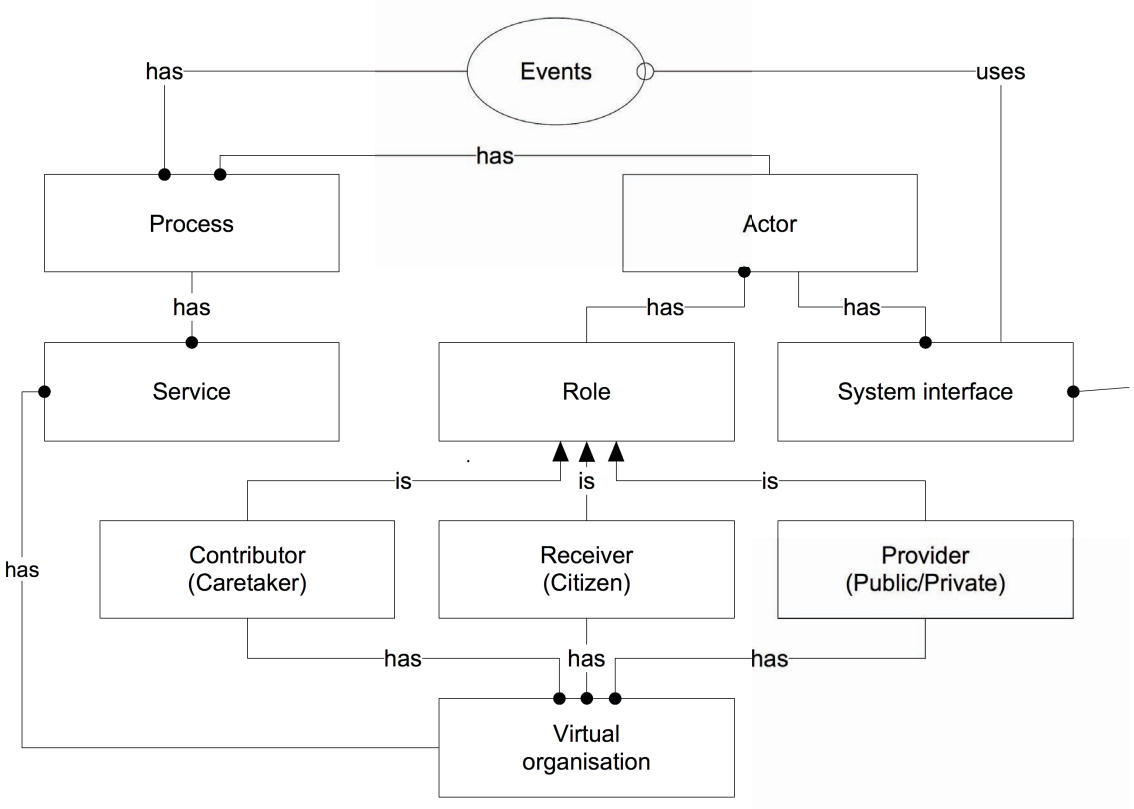

Figure 13 Citizen-centric process view service layer conceptual model

The process innovation supported by the innovation toolkit is organised around the *process template* (Figure 14). It defines the base process for a *process* contributing to the provisioning of a given *service*. Process flexibility is achieved through reorganising the *workflow* of the *process template* for a given process instance. Through integrating the installed base of the provider, *local information system representations* can be synchronised manually or automatically. *Change requests* to process data can be triggered from the process participants. Different process variants can be stored as separate templates, and through extending templates and workflow, new process templates can be made available as new best practice or in accordance with regulations or requirements. Actors in peer service networks can collaborate on process innovation and share experiences, and new process templates and process building blocks can be deployed locally or centrally.

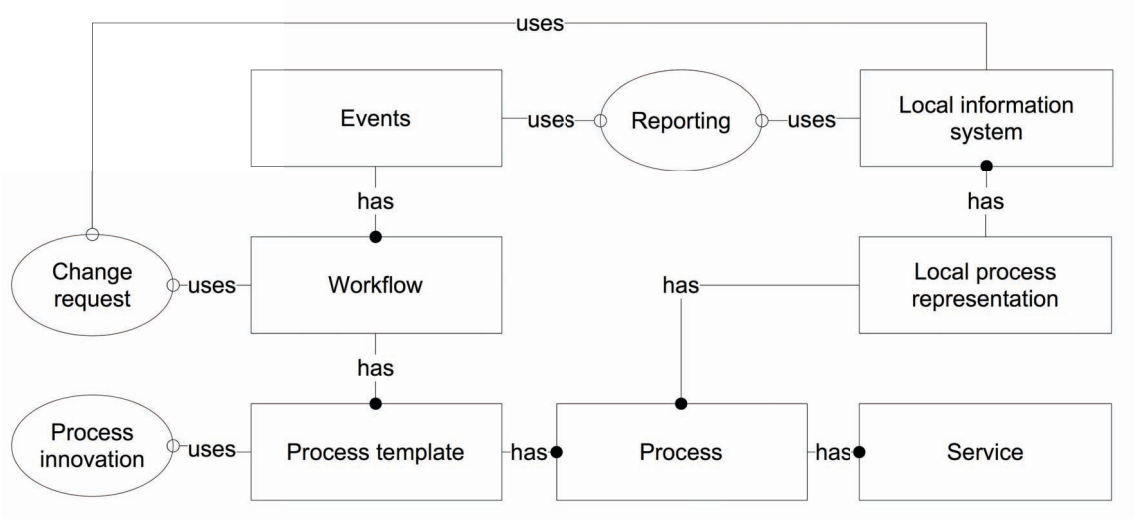

Figure 14 BPM service decomposition

6.4.2 Network viewpoint

The CCPV model will be realised through cooperating software on a network of CCPV nodes. Figure 15 illustrates the positioning of CCPV as a distributed network. A CCPV node can provide functionality based on the presence of connected resources to that node, or resources connected to other connected nodes within the scope of each node. A CCPV node can be installed within a policy network or government agency and provide gateway functionality to other nodes in the network. Connecting additional nodes increases the reach of the CCPV network and the number of agencies that can electronically collaborate and access shared resources. Service information not shared outside a node will not leave that node.

A *resource* provides a function identified by the service layer. *Resources* can be data stores, data processors (manual or automatic processes), or actors with defined roles. Examples of *resources* include: a citizen identification registry, case handling system for car registration, a medical test lab, an unemployment benefits office, a government procurement office, a building permits office, or a private building contractor.

The *resource* is defined by an internal and external presentation. The internal presentation is the necessary inputs and outputs to handle a given request from the CCPV. The external interface is the necessary information to exchange data with the installed base, requiring development efforts to add that all existing systems as resources to the CCPV. In this sense, CCPV should be extensible and channel independent. Once a *resource* is developed it should be reusable.

The nodes should be able to connect from geographically disperse locations as a distributed network or can reside within a cloud. It should be possible to access resources by type, name, or by location. It should be possible to get data for a local or central citizen registry based on the process context. The specific resource instance required need not be defined, but can be decided through just in time orchestration.

Generic overloaded local resources should be able to re-route requests by reference, and thereby outsource service delivery in the local context when possible. Actors participating at a later stage in a policy chain will be able to see the estimated time of involvement in the process, but cannot access process details. As events occur during the process, connected resources will be alerted. Process instance information not shared with a given actor or outside the scope of that actor will not be available to that actor.

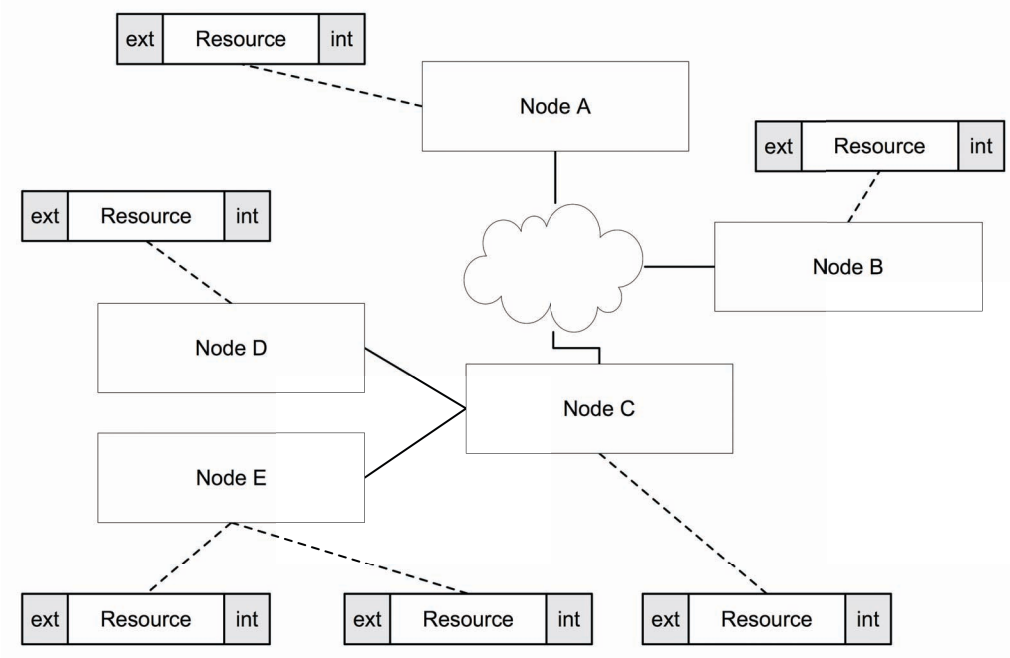

Figure 15 Example configuration of distributed network layer model for CCPV

Services within the CCPV can be defined through what information should be stored, what resources should be used, and with a possible overall process description. This enables the CCPV to provide orchestration between actors and act as an integration point for compound services. It should further buffer and store transactions for resources in order to allow asynchronous process execution not requiring nodes and resources to be connected at all times.

Citizens can access the CCPV through defined public portals, electronic channels defined as resources, or through public service providers accessing information on behalf of the citizen. A temporal approach to multi-channel service provisioning for end user devices is based on constructing walled gardens on top of an open framework (Zittrain, 2008). This implies that access to public services through smart phones will require that service-specific applications are developed for each proprietary system under the control of the various distribution networks provided by private vendors (e.g. Apple's App store and Google's Android market).

6.5 C5: A conceptual e-service governance model

While design artefact defines an artefact that will enable the goal scenario, the realisation design for a socio-technical artefact prescribes the processes that must be taken in order to achieve the intended use of the artefact within the problem domain. In our case, initiating the realisation design depends on the outcomes of the evaluation of the attractiveness of the design as a what-if scenario. Such an evaluation is not unproblematic, as a complete design is beyond the current scope. A complete understanding of the consequences of the design is further unrealistic at this point. Nevertheless, achieving consensus on the level of attractiveness of the design artefact is more likely when supported by an understanding of the implications of a corresponding realisation design.

The scope of the realisation design is limited to the investigation of available governance mechanisms through the case studies. The governance mechanisms are best described through the conceptual e-service governance model as illustrated in Figure 16. The model is a different view of C1 (Figure 11) and the framework for comparison presented in P7. In relation to C1, the focus is on the *regulations*, *administrative interpretation*, and the *provided services*.

To the left in Figure 16 we find the *policies* and other *external factors* affecting *policies* and service provisioning. The *governance* covers the organisation of the public administration and the ministries concerning matters related to e-government and service provisioning. Regulations are from here directed to the local governments and national agencies for matters related to public service and public service provisioning. This includes budget allocations, public spending, and mandatory reporting. In addition to direct governance, two types of support are developed and provided to aid service development. On the one hand are the *methods, guidelines, and standards* defined at a national level or within a given policy domain, and on the other are the *infrastructure components* provided to assist service production. These two approaches to governance can be considered as physical and methodological infrastructure support.

Examples of *methods, guidelines, and standards* include outputs from enterprise architecture initiatives as architectural principles; interoperability frameworks as reference catalogues for formats; public domain standards like electronic patient journals or archiving standards; educational programs for managers and project leaders; templates for performing various evaluations; or experience databases.

Examples of *infrastructure components* include procurement support; centralised data collection; case systems; GIS and property data; electronic identification mechanisms; various registries including citizen and business registries; centralised BPM functions; and the more obvious national e-service infrastructure supporting the integration of these components.

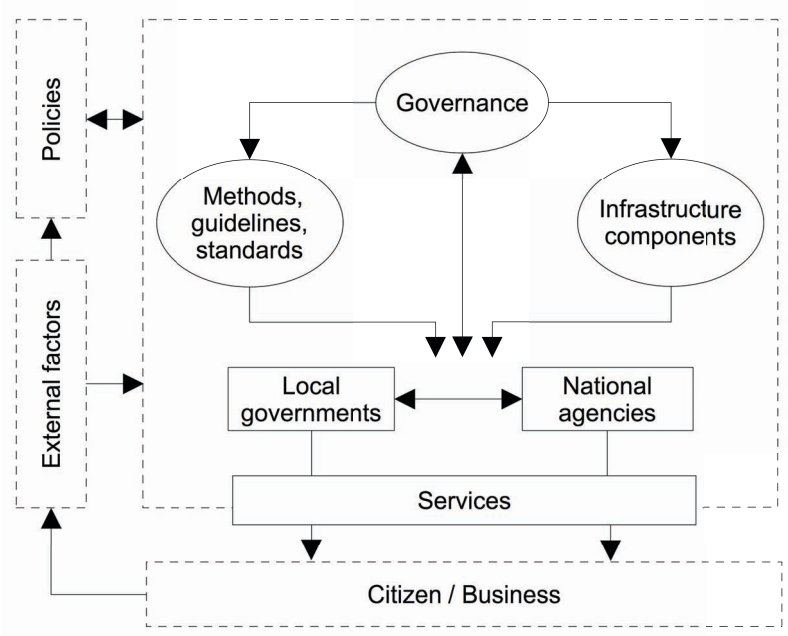

Figure 16 Conceptual e-service governance model

The consequence of a failure to provide sufficient support or not accompanying regulations with an equivalent support is mostly related to the complexity of the domain and the consequences of that complexity. The case studies in this study show that centralised governance and control of e-government development has begun after a period where multiple solutions are embraced in the line of *letting a thousand tulips bloom*. The consequence of this strategy is yet not fully understood, but it is suggested that it is not an approach that promotes interoperability. Fewer common approaches seem at this point to be better than individual, uncoordinated, quests for a good approach. Allowing local flexibility is however seminal to service improvement, but not a contradiction to standardisation.

With the establishment of global solutions, and in order to support cross-agency service provisioning, reciprocal agreements for development between the autonomous actors is necessary. This might involve accepting that parts of the installed base must be replaced and that parts of the information system must be treated as a commodity or as a central offering, as with an implementation of CCPV. Local development at this point is limited to customising local resources and extending the reach of the CCPV, or building services and process templates on top a SDK defined by the innovation toolkit of the CCPV.

In summarising the realisation design, there is a question regarding to what extent it should cover the artefact construction, and how much should cover the transformation of the environment to the intended use once the artefact is constructed. In acknowledging the importance of the realisation design, approaches contributing to the success of the design artefact have been identified. An extended consideration on possible directions for development related to C5 is provided in Section 7.4.

7 Discussion and evaluation

An expert is a person who has made all the mistakes that can be made in a very narrow field.

Niels Bohr

This chapter provides a discussion of the research questions (R1-R5), contributions (C1-C5), and research process, in addition to some general considerations based on possible directions for the study. The contributions of the study are:

C1: A model describing the dynamics of e-government.
C2: Future scenarios for citizen-centric and demand driven public services.
C3: Requirements for an e-service infrastructure for public service provisioning.
C4: A conceptual design for a national e-service infrastructure.
C5: A conceptual e-service governance model.

In the following section, the research questions are revisited and discussed in light of how the study progressed. This is followed by a similar treatment of each of the contributions. The research process is evaluated as a whole and the chapter concludes with considerations on directions for development.

7.1 Research questions

Table 2 provides a mapping between the research publications (P1-P9) and their consideration of the research questions. Each research question is discussed separately below.

	RQ1	RQ2	RQ3	RQ4	RQ5
P1	*X*	*X*			
P2				*X*	
P3		*X*	*X*		
P4		*X*	*X*		
P5				*X*	*X*
P6				*X*	*X*
P7					*X*
P8			*X*		
P9				*X*	

Table 2 Mapping between research questions and publications

RQ1: How to define a model that describes the relationship between important concepts influencing service provisioning which can be used as a basis for understanding the e-government domain?

RQ1 covers the initial phase of the study and was a preparatory task in order to get an overview of e-government literature. It also enabled familiarising with important concepts that might need special treatment in later steps. Answering RQ1 requires an understanding of the e-government as a domain of practice and calls for constructing a model based on this understanding. RQ1 is central to P1 and relates directly to the proposed model defined by C1.

RQ2: What are the requirements to a future process support system for public service provisioning?

Although RQ2 is not treated explicit in any of the research publications, the scenarios and assumptions from which the requirements are based are discussed in P1, P3, and P4. Further, both C2 and C3 originate from RQ2.

The purpose of RQ2 is to propose a set of requirements from which the design artefact can be based. Directing the requirements towards future and not current process support systems opens up for disregarding accidental limitations from current technologies and constraints. It also provides the possibility to propose a scenario that is considered appropriate from the viewpoint of this study.

A challenging aspect of proposing requirements for a future generic system is the risk of being too broad. Based on C1, there is additionally a need to focus on the transformational capabilities of the artefact that is to be constructed. That is, the system shall not have a limited scope with respect to an operational time frame. Further, it must be robust with respect to changes in public service provisioning and the arrival of new technology affordances.

RQ3: How to apply the description of process work within the context of enterprises as a basis for a design artefact, i.e. a conceptual process work model, which meets the requirement to future infrastructures for public service provisioning?

RQ3 is concerned with the proposed design artefact. It is directly related to C4, which is discussed in P3, P4, and P8.

The purpose of the design artefact proposed through answering RQ3 is to provide one approach that can satisfy the requirements proposed by RQ2. Given the broad scope of the requirements there is a risk that the solution space will not entirely fit the problem space. This situation would occur given that the design artefact chooses to address only a selection of the requirements. Another possibility is that some requirements are disregarded based on the level of abstraction of the design artefact, where the requirements may or may not be satisfied depending on how the design is implemented.

RQ4: What is the maturity of the available affordances supporting the realisation of the proposed artefact?

RQ4 suggests an investigation of current e-government implementations as well as available technology affordances related to BPM and PAIS through literature studies. Work related to the treatment of RQ4 is presented in P2, P5, P6, and P9.

The purpose of RQ4 is to identify challenges related to a possible implementation of C4 and further to both evaluate the contribution and to assess the gap between the current situation and the future scenario. Accordingly there have been several iterations between RQ4 and RQ3 during this study.

The treatment of RQ4 is multi-disciplinary as the investigation both includes case studies of the e-government domain as well as literature studies from the information systems domain. The information systems treatment is based on the current BPMN standard through the work presented in P2, and secondary data through existing information systems literature focusing on aspects related to flexibility in PAIS (P9).

As a consequence of the high-level treatment of the service providing information system taken by this study, the case studies performed deviates from the traditional case study approach. The traditional case study goes from the type-level to the instance-level, following a special case or user through a service process. The case studies conducted as part of RQ4 goes from the meta-system-level to the system-level, investigating types of systems with service-providing capabilities. For the Altinn II case (P6), this investigation even remains on the meta-system-level. In this case, investigated system capabilities are capabilities that can construct systems that can provide services.

RQ5: Assuming the realisation of the proposed artefact, how to conceptualise the needed governance?

RQ5 refers to the realisation design for the design artefact. In the case of this study, the realisation design relates to the successful diffusion of the design artefact in a socio-technical system, rather than its physical construction. The proposed conceptualisation of governance requested by RQ5 is expressed through C5. Work conducted in addressing RQ5 is presented in P5, P6, and P7.

The conceptual governance model intends to define the types of measures that can be applied in order for a service providing information infrastructure to operate. Here, the design artefact provides supporting platform functionality, but is still only one of several infrastructure components within the information infrastructure.

7.2 Research contributions

While Table 3 provides a mapping between the contributions and their relative treatment in the research publications, Table 4 provides an equivalent mapping between the contributions and the research questions. Each contribution is discussed separately below. The presentation of C1, C2, and C4 covers the *what* and *how* of the contributions, together with a discussion of aspects related to evaluation and related work. The presentations of C3 and C5 are limited to a discussion of the contributions.

	C1	C2	C3	C4	C5
P1	*X*	*X*	*i*		
P2			*i*	*i*	
P3		*X*	*i*	*X*	
P4		*X*	*i*	*X*	
P5				*i*	*i*
P6				*i*	*i*
P7					*X*
P8			*i*	*X*	
P9			*i*		

X: direct mapping; *i*: indirect mapping.

Table 3 Mapping between contributions and publications.

	C1	C2	C3	C4	C5
RQ1	*X*				
RQ2		*X*	*X*		
RQ3				*X*	
RQ4				*X*	
RQ5					*X*

Table 4 Mapping between contributions and research questions

C1: A model describing the dynamics of e-government

The suggested model for dynamics of government service provisioning aims to illustrate the complexity of change and the pairing of government service provisioning and new technology affordances. The main aspects of the model include new service channels provided by technology, changing requirements, and the freedom of interpretation of how services are provided at the local level. It suggests a relationship between important concepts in the e-government domain and how these concepts affect each other and change over time. The purpose of the model is to act as a tool for reasoning about public service provisioning and to support strategic development. It is perceived to be useful for researchers, e-government service developers, and policy makers.

The model is a product of the problem selection and development phase[6] and a conceptualisation of the result of the literature studies[7] conducted in addressing RQ1. It is the externalisation of knowledge acquired in the initial phase of the study related to the understanding of the e-government domain. It is further developed based on previous expertise and tested through explorative reasoning and analytical comparison based on observations. Abstraction is used in the development of the model to allow a conceptual treatment and in order to reduce complexity. The model is discussed in P1.

The model is not evaluated externally, which has been considered outside the current scope of the study. It has however evolved during the course of the study based on feedback and discussions with the academic community. As a result of this, the final model presented in chapter 5 deviated slightly from the one presented in P1 in how technology affordances emerge. In the final model, technology affordances are not just phenomena that appear from outside the public sector, but are additionally affected by model inertia through new provided services. In this, new services developed in one public organisation can improve services in another given that the affordances are made available.

Compared to existing models of e-government development, this model provides a supplement to models that prescribe a given course of events. In clear contrast to the maturity models, it describes a continuous dynamics of cause-effect based on a dynamic network of autonomous, nevertheless co-depending, entities. While the maturity models describe applied technology and provided functionality on the type level, C1 additionally enables context-based reasoning about how specific parts of the domain can react to changes. In this study the use of the model is limited to the type-level. It is however suggested that it may be used to support the analysis of specific cases, and creating awareness about factors affecting flexibility within the provisioning of a given service.

C2: Future scenarios for citizen-centric and demand driven public services

The scenarios constructed in this part of the study have their primary motivation related to requirements engineering, and due to that have a system focus (Go and Carroll, 2004). The goal of the system is however to provide citizen-centricity on the instance level, as well as service-centricity on the global level as a means to improve the overall service provisioning. The service-centric approach further relates to the fact that not all public services are directly provided to citizens, and that the production should be efficient from a provider point of view, despite the citizen-centricity. The type-wise treatment of all public services and the supporting processes can however be identical from the provider point of view. The scenarios are constructed so as to derive the proposed requirements of C3 in answer to RQ2, and as a tool to guide the search process for the artefact proposed by C4. They are discussed in P1, P3, and P4.

[6] See Section 2.2.2
[7] See Section 2.2.3

In contrast to scenario approaches where alternative scenarios are derived based on various future outlooks, the scenarios proposed in this study are based on different views of a single scenario. This scenario has its primary influence from the model for the dynamics of public service provisioning (C1) and the technological optimism found in later stages of e-government maturity models. In this sense, the scenario provides a conceptualisation of a service provisioning for an ideal (albeit probable) future, or a vision for e-government. This is based on the assumption that the maturity levels described by e-government stage models are probable and realistic. Classifying the scenarios as future scenarios also allows for additional simplifications: [i)] Technology aspects of PAIS that today are considered not to be fit for the design artefact can be disregarded and considered as existing. [ii)] The cultural and political gap between the current situation and the proposed scenario can be ignored, and thus address the failure to accept the scenario as a description of possible current affairs.

In order to separate the concerns related to the service provider and the service receiver, the scenario was decomposed into different views or separate scenarios. The service provider viewpoint is based on interdisciplinary solution extrapolation (Vaishnavi and Kuechler, 2007), using innovation toolkits for supporting local process flexibility. The possibility of public/private partnerships is further suggested as part of the viewpoint. This flexibility is perceived to be useful both in the case of outsourcing of services, and related to issues including transparency or business agility (van Oosterhout et al., 2005). The citizen viewpoint is based on C1, and by looking at currently known technology affordances such as new service channels and the observed behaviour related to these. The viewpoint is first modelled based on expected real world service interactions not limited by current technology or service organisation. The technology aspects are further added to support the scenario, combined with the idea of a single service portal based on the *My Processes* research objective. The channel independency, or multi-channel provisioning of services, suggests that the service providers are available to the citizen through multiple channels. The introduction of electronic channels for service delivery should however not be at the expense of the perceived service quality.

The scenarios as presented suggest an alternative service delivery based on mash-ups of current and envisioned technology and the use of these. By building scenarios that are rich and open, the risk of excluding possible artefact suggestions at a later stage is reduced. Adding too many features would on the other hand increase complexity. This complexity could be reduced through adding additional views.

The scenarios are constructed as part of the study and are not verified by individuals not involved in their construction. Since they are conceptualisations based on illustrating a possible future, a Delphi approach could be conducted in order to balance possible bias. Personal background could affect the scenarios, and as not all assumptions are made explicit, suggested features might be political or value-laden. This can particularly be related to the centralisation or devolution of government and the level of control or support provided by the central state.

The human computer interaction aspects of the scenario are not considered, as they are outside the scope of the study. These aspects are particularly related to the presentation

and usability aspects of communicating through the use of visual models. Specific aspects of the process-oriented service provisioning that are related to enterprise PAIS and to models and model understanding are further not covered by the level of abstraction selected for the scenarios.

Examples of the use of scenarios and scenario building in e-government not already mentioned include Cairns et al. (2004), van der Duin and Huijboom (2008), and Nordfors et al. (2009). These studies propose various scenarios based on alternative futures with descriptions of both trends and supporting technologies. It could be argued that the scenario construction could have been omitted from this study altogether in favour of deriving the scenario from existing sources. The high multitude of scenario studies does however suggest that a selection of scenarios is in place, and that they cover different aspects and purposes as well as providing confidence through mutual confirmation. The scenario constructed in this study is further driven by a combination of a future vision of high-level structural functionality, technological capabilities, and technology trends. The scenarios made represent a slight deviation in both construction and use compared to existing scenarios.

C3: Requirements for an e-service infrastructure for public service provisioning

Although the proposed requirements are not treated explicitly in any of the research publications, aspects of requirements work is found in P1-P4, P8, and P9. The requirements presented in Chapter 5 are proposed requirements elicited from C2 with an additional influence by the research objective and the BPM focus of the study. Due to the nature of the requirements as intermediary constructs of a creative process, they are treated as axioms and are not evaluated further. Some aspects of the proposed requirements should however be discussed in light of how they are defined.

By considering the requirements from an information infrastructure point of view it can be stated that these requirements can be satisfied within the current public service provisioning. The requirements are however not specific about which aspects that should be supported by the e-service infrastructure directly and which aspects that are handled manually by the organisation. By referencing the *system* as a combination of technology, organisation, and methods, the solution space for design artefacts is wide. In the context of this study, however, an e-service infrastructure for process work is to be constructed as a technology-platform where the e-service infrastructure is a dominant, albeit integrated, part of the information infrastructure.

As the requirements are at the functional level, they describe possible tasks and interactions between stakeholders without references to specific technologies. This is in accordance to C1, as technology affordances supporting the requirements are expected to change over time. Further, the proposed flexibility of the e-service infrastructure is important with respect to the infrastructure as an enabler of government transformation. It is further possible that parts of service delivery that are provided manually today can be automatic tomorrow, and that the processes for automation can later be improved and replaced.

Considering the flexibility for change, the flexibility for the regular user is considered as predefined, or as naturally limited by the complexity that arises when the number of possible changes increase. The lead user will, as suggested by the requirements, go beyond the scope of the lead user as suggested by Von Hippel (2005) and C2. The requirements propose that the lead user not only has available the tools to create and modify services based on the flexibility provided by the infrastructure, but that the lead user additionally can create functionality that extends the infrastructure and its flexibility. This suggests competencies within the role of the lead user that today would be found in a high-level system developer. It is possible that these roles should be separated, or remain integrated, depending on the future direction of software development and the capabilities of future technology affordances (e.g. through support for AKM, BPM or SOA approaches).

C4: A conceptual design for a national e-service infrastructure

The proposed citizen-centric process views design artefact is a conceptual model constructed to support C1 - C3. The design artefact addresses RQ3 and is discussed in P3, P4, and P8 and is influenced by P2, P5, and P6. It is additionally suggested based on an investigation of RQ4. The discussion of C4 is limited to the iterative construction and evaluation of the artefact up to its current state.

The initial version of the design artefact presents a model involving concepts related to a process-oriented service delivery with several actors organised in a virtual organisation around a process instance supported by an interactive process template. Although a direct implementation is not discussed, the concept is proposed as middleware, suggesting that its capabilities are found between existing systems providing an extended SOA functionality. It is suggested that it can be used directly through its own presentation layer, or plugged into an installed base through connections that can be reused and shared once developed.

Although the initial version was followed up with case studies P5 and P6, few changes were done to the model as presented in P4, besides the fact that P4 focused on a limited view of the model. Feedback from presenting P3 and from the reviewers of P4 did however affect the positioning of the contribution: [i)] Using the term middleware in describing the design possibly brought negative connotations due to past experiences among reviewers, suggesting a rebranding. [ii)] The information infrastructure, and thus the socio-technical, aspects of the problem environment seemed too apparent to be disregarded as part of the design. The current understanding of information infrastructure has in this sense developed during the study. Even though the study mainly perceives the design artefact as a technological platform for public service delivery, it additionally presumes organisational arrangements so as to suggest that the technological construct acts as a facilitator, and that the design solution lies in the interplay of technical and non-technical stakeholders.

Through viewing the design artefact as an interwoven component of an information infrastructure, its evaluation is perceived as problematic. Or as stated by Ciborra:

> *We can only fully figure out the meaning of new technology in business and institutions after the fact; and that we plainly have to live with such impossibility and such a state of ignorance.*
>
> *Ciborra (2002)*

A further decomposition of the design artefact for the purpose of evaluation is interesting and possible. This could be done by constructing a series of demonstrators that propose the isolated benefits of the design artefact and at the same time demonstrate the network effect through the global availability of a working e-service infrastructure. A decomposition or implementation based on the conceptual model is neither the goal nor realistic within the time and resources of this study. The challenging evaluation of an infrastructure will, however, need to be considered at some point.

Turning back to the IS success model of DeLone and McLean (2003) (Figure 3) and aspects introduced by C1, a desired system quality relates to ICT as not being considered as a barrier for change. In using this capability as a criterion for evaluation, typical e-government case studies showing how life-event services can be implemented is suggested not to be a sufficient means of evaluation, as the partial contribution of the design is based on evolving processes and service transformation. Based on the scope of the study the conceptual nature of the design artefact, the evaluation conducted conceptually to support an informed argument[8], in addition to the use of case studies.

The informed argument is supported by a deductive reasoning based on chapters 3 and 4, the material covered by P2 and P9. As C4 is based on C1-C3, acknowledging the contribution of C4 implies accepting C1-C3. Chapter 3, P2, and P9 consider technology affordances and cover the proposed direction for the implementation of C4. Evaluation of design aspects of C4 related to choice of technology is partially provided implicitly through aspects of the technologies prescribed for its construction. This is with knowledge that the technologies used in the construction are mash-ups that cannot be tested efficiently together, or which currently is not available at the level of sophistication prescribed for the design artefact. These are related to the choice of a service-oriented architecture and model-driven solutions in an open environment, which are further primarily related to aspects of the PAIS discussed in P9. The PAIS aspects are however considered to be one of several facets constituting the design artefact where additional research is needed in order for them to operate as expected for use in the CCPV. Chapter 4 considers issues related to the design and implementation of e-government. Central topics supporting the reasoning behind the design artefact include interoperability and capabilities for establishing virtual organisations for collaborative service provisioning. In addition to providing an infrastructure platform for service provisioning, and thus eliminating issues related to technology interoperability, the design artefact aims to establish an interactive collaboration space around service provisioning. This aims to enable interoperability at the organisational and semantic level, through bringing the service providers together at the service instance level.

[8] See Section 2.2.5

While case studies P5 and P6 are able to inform the design, the demonstrator case study (P8) is able to justify aspects where alternative or new approaches are proposed. This is particular for the role-based access for citizens as caretakers, and the multi-actor case handling for emergent processes. P8 shows that the ad-hoc arrangement of virtual organisations for emergent processes already exists, and that the need for systems supporting this collaboration is not currently satisfied.

Even though the design artefact represents novelty in its construction, similar and related aspects of the contribution can be identified within the scientific knowledge base. Schroth and Schmid (2008) propose a federative distributed infrastructure, where a decentralised design evolution is enabled through standardised interfaces and modularity. This allows for propagating changes through the infrastructure as local segments evolve. The approach is both relevant to the technical infrastructure of the design as well as the management of process templates for services.

Grefen et al. (2009) propose conceptualisations for instant virtual enterprises and dynamic network process management. The work is based on an industry setting and takes on an orchestration approach for fixed processes. It uses process discovery mechanisms to find services that can contribute to a given goal, and comprises a control flow for a global process to satisfy that goal. It is suggested that the orchestration approach provides improved possibilities for monitoring the global process as it is managed explicitly. In the case of the design artefact, process-mining approaches are suggested to support the control aspects where the global process is missing (e.g. emergent processes). Overbeek et al. (2009) criticise traditional SOA for not addressing distributed service networks and emergent processes, as opposed to Grefen et al. (2009), and an industry setting where service compositions are directed towards single goals, they claim that service interactions in government service networks might trigger services outside the scope of the current process or scope. To serve this purpose, Overbeek et al. (2009) propose a conceptual model for an event-driven SOA, where service interactions are subscription-based, thus suggesting an approach based on decentralised modules used to process events triggered between agencies. The processes themselves are treated as black boxes outside the separate agencies, and the integration is based on event broker intermediaries. The suggested design artefact proposes the possibility for both a central and a local representation of the process, as well as the reporting of events between those in order to maintain the global process state. Reporting to a central construct is an aspect of the design artefact that is needed in order to support a virtual one-stop shop, or where a neutral collaboration space between service providers is required.

A conceptualisation of a central citizen-construct is also discussed and proposed by Dais et al. (2008) through the Public Agency Networking Platform (PANP). The PANP provides life-event based cross-agency services through a citizen-driven orchestration. The platform accommodates personal information produced by public agencies with the explicit consent of the citizen. It is suggested that the platform should be hosted by a commonly accepted independent authority, which is constitutionally and legislatively responsible for the protection of the citizen's personal data. The portal acts as an integration point for cross agency services. The PANP is focused on the security of

personal data and complements the design artefact proposed by this study, where these aspects have not been prioritised. The service discovery capabilities of the PANP are further purely technical, and the citizen interaction with the framework is personal. The proposed design artefact extends a technical approach to support assisted service discovery, caretaker-roles and emergent processes composed by the service receiver, caretaker, or service provider.

Variable	Value				
Approach	Qualitative		Quantitative		
Artefact focus	Technical		Organisational		Strategic
Artefact type	Construct	Model	Method	Instantiation	Theory
Epistemology	Positivism		Interpretivism		
Function	Knowledge	Control	Development	Legitimization	
Method	Action research	Case study	Field experiment	Formal proof	
	Controlled experiment		Prototype		Survey
Object	Artefact		Artefact construction		
Ontology	Realism		Nominalism		
Perspective	Economic	Deployment	Engineering	Episemological	
Position	Externally		Internally		
Reference Point	Artefact against research gap		Artefact against real world		Research gap against real world
Time	Ex ante		Ex post		

Table 5 Artefact evaluation classified according to Cleven et al. (2009)

The evaluation of the design artefact is further classified based on the framework proposed by Cleven et al. (2009) as illustrated by Table 5. The evaluation approach is qualitative and the main focus of the artefact is strategic, as it proposes a future design of strategic importance. The artefact type is a model and the epistemology is that of positivism. As several separate evaluations have been performed, both through investigation of the knowledge base, the demonstrator (P9) and the case studies (P5, P6) the function of the evaluations is both for development and legitimisation of the artefact. The object of evaluation has been the artefact and the ontology is nominalism, as the e-service infrastructure and services are model representations of real world services and interactions. Even though deployment is not relevant based on the conceptual model, the issues related to the deployment and design towards a deployed artefact is the perspective of the evaluation. The evaluation has further been conducted internally in iterations against the requirements and design directions during the course of the study.

C5: A conceptual e-service governance model

The realisation design (C5) as suggested is derived from C1, from the design process, and the case study as presented in P7. The goal of the realisation design is to describe the measures to be used for the design artefact to work as intended in its environment. The measures are equivalent to a plan or strategy for deployment. At this point, it identifies the existence of type-wise approaches for governance and support, and the dynamics between the service-providing stakeholders and the central state. Analysis of the design in light of the knowledge base and the case studies confirms that the problem environment is full of wicked problems. As wicked problems cannot be solved generally, only temporal or within a specific context, a single strategy approach for a successful diffusion of the design artefact is not likely. Based on this, the scope of the realisation design for this study is limited to approaching the idea of informing (rather than solving) the problem of implementing an artefact built to satisfy the scenarios and the design artefact. Based on how the realisation design is deduced, and the nature of the design artefact, further evaluation at this point is not considered to be within the scope of the study.

7.3 Considerations on the research process

The following sections reflect on how the research was planned and conducted. This involves the choice of methods and how the research community influenced the direction of the research study. Further, the methodological aspects of the case studies are discussed as well as aspects related to research evaluation.

7.3.1 Research questions and contributions

Based on the tradition of the Information Systems research group as IDI, the design science approach for information systems research was chosen. Partial deliveries throughout the research process output would be treated as separate contributions. The contributions would further be made available as scientific knowledge and for the possible use by practitioners. As the domain of study is e-government, the academic target group is the e-government research community, and relevant practitioners are those working with various aspects of e-service development.

The initial research questions were developed to support the design process while at the same time not dictate the nature of the design artefact. An immediate consequence was that the relative open initial research questions were interpreted and refined to a new understanding as the study progressed and as the various phases of the design process were completed. Looking back, some aspects of the research questions and contributions are discussed: [i)] Answers to several of the research questions are based on patterns of creativity combined with truths established as part of the study. A consensus-based evaluation of these preliminary outcomes can be counter-productive and restrictive for the final result. For RQ2 in particular, the established requirements are treated as axioms with respect to the remaining research questions. [ii)] Although it is not optimal for the design process, backward interaction between the research questions is inevitable using the current approach, as the search process for a design artefact that

can satisfy RQ3 already starts at the point of having partial answers to RQ1 and RQ2. It is thereby possible that RQ2 is biased by RQ3. Work related to RQ3 did however not commence until after the scenarios constructed for RQ2 were completed. On the other hand: Even though C4 satisfies C3, there are possibilities for an alternative C4 that satisfy C3, or an alternative C3 that can be satisfied by an implementation of C4. This is a natural consequence of the research approach and the nature of the design artefact. [iii)] A suggested limitation of the approach in light of knowledge about C1 is based on the fact that C2 and C3 are proposed based on knowledge about current technology, from which the e-service infrastructure (C4) is suggested. But as C4 is made available as a new technology affordance in C1, the possibility of additional requirements are not taken into account. Additional iterations of this phase could be suggested to address this.

7.3.2 Use of case studies

The initial expectations for the study involved developing a prototype based on the conceptual model. The study was however at a crossroads after establishing its first version, and prior to deciding which elements of the model would be incorporated into an initial prototype. At this point, the conceptual work was not accepted for publication and there were signals pointing in the direction of a demand for case studies. There was further a risk of bringing the research out of the e-government research domain and focus on the development of prototypes based on parts of the conceptual model. A decision was then made to use case studies as input to a realisation design and to possibly test or improve the design artefact. Accordingly, the consequence for the design artefact was that it remained conceptual.

The research work following the case study approach is presented in P5-P8. It is conducted at the sector (P5), cross-sector (P8), national (P6) and cross-national (P7) level. For P5-P7 there is a certain triangulation of the observed phenomenon, being a structure analysis of system functions, governance mechanisms, and stakeholders involved the provisioning of public services. P5-P7 are used in confirming a theory that the design artefact will provide a generic solution to the investigated cases, and that the approaches taken for the cases represent type-wise configurations or preliminary solutions towards what should be satisfied by the design artefact. P8 is used for the purpose of evaluation, and to demonstrate the design artefact through investigating if the design artefact could be used to support the case as observed. P8 additionally cover aspects of the design artefact related to citizen-centricity, the role of a contributor, and the virtual organisation as a whole. These are aspects of the conceptual design that were not particularly prominent in the other cases. P5 and P8 are single observations of the current situation, while P6 and P7 consider historical aspect as the collected data both previous, current, and expected configurations. None of the case studies are based on interfering with the observed phenomenon. As C1 covers concepts important to the design artefact, an understanding of the model has guided the investigation of P5, P6, and P8, and no formal framework for conducting the case studies were established in addition to using C1 and the preliminary design artefact as a reference. As the comparative case study reported in P7 was conducted as a collaborative exercise, a supporting framework for investigating the phenomenon was established. The case study approach has a high degree of discoverability, making it easier to follow up on

certain topics during the investigation. This was particularly useful for the P5-P7, as a main motivation for these studies were to inform the design.

As the case studies have been used to inform a generic design it can be suggested that additional cases are needed. Since the case studies have focused on investigating structural and type-wise phenomenon and based on the nature of the design artefact, current case material is perceived to be sufficient. It is however expected that aspects of the design not taken into account at this point will be identified if the conceptual design is elaborated according to the work proposed in Section 8.2.

Validity of the case studies refers to the subjective nature of the data collection and analysis, and if the studies can be replicated with equivalent outcomes. The subjective nature of the data collection and analysis is affected by the depth and complexity of the investigated phenomenon and the established frameworks to guide the research. While P7 has defined a framework for comparison, the investigation of P5 and P6 has little room for interpretation. They are further both based on document studies with follow up interviews. P8 did not include follow-up interviews, but the data analysis of P8 is limited to a comparison of the collected data with the description of the design artefact.

7.3.3 Design evaluation

Changing the anticipated outcome of the study would involve going from a research challenge that could be solved and evaluated based on an engineering approach to a research challenge on a conceptual level, with holistic concerns and a wicked problem domain. This would imply that the problems are understood rather than solved, and that absolute truths are hard to establish. Methods for the evaluation and demonstration of the design were selected based on the abstraction of the concepts, resource availability and the goals of the evaluations.

As we have seen from the previous sections, each step of the research process is documented and has its own contributions representing partial deliveries towards the construction the conceptual design artefact. Contributions C1, C2, and C4 are compared to related work, while C4 has been evaluated in iteratively through the use of case studies. The informed argument supporting the efficacy of C4 has been established during the study, as the same knowledge base from which the design artefact has based its construction is later used for the purpose of its justification. This demonstrates the iterative nature of the design science research.

We further see that a similar scenario to the scenario constructed in C2 could have been used ex post to demonstrate C4. Aspects of the design artefact used for the purpose of demonstrating the artefact through P8 are related to parts of the conceptual design that is observed in public service interaction that are not well taken into account in service provisioning based on e-services. The demonstrator provided by P8 additionally provides a demonstrator from the problem environment. This provides a grounding that is more convincing than if the demonstrator was purely hypothetical. The proposed further work (Section 8.2) recommends that a different scenario approach should be used in order to demonstrate capabilities of C4 related to C1.

7.4 Considerations on directions of development

Through the design science approach of the study, current affairs with respect to the installed base were initially disregarded. This was followed by a phase where current affairs for e-government in Norway were observed in addition to conducting the specific case studies. In light of this, the research process initially focused on constructing an ideal world, only to discover that the world is not ideal. When the gap between the current situation and design artefact exceeds what is realistically possible to fill with the possibilities of the realisation design, the easiest choice would be to moderate the design to resemble the current situation. An alternative approach would be to suggest a more drastic realisation design, in order to move the current situation towards the ideal (assuming that the proposed scenarios are in fact perceived as ideal and desired). A challenge with the e-government domain is however that it is very hard to determine what is ideal, and due to that enforcing best practice is problematic. In the case of e-government, it is likely that an evolutionary approach will always be selected in favour of a revolutionary. For the sake of discussion, suggested hypothetical directions and implications for the development and use of the design artefact as physical infrastructure support and the realisation design as methodological infrastructure support are outlined. The discussion is summarised in Table 6.

Approach	*1*	*2*	*3*	*4*
Type	*Evolutionary*		*Revolutionary*	
Physical infrastructure support	N/A	Core components	Integrated service infrastructure	Service web
Methodological infrastructure support	Methods, standards, guidelines	Methods, standards, guidelines	N/A	Methods, standards, guidelines

Table 6 Possible hypothetical directions for development

1) In the first possible direction of development, the physical infrastructure support is marginalised and replaced with a realisation design comprised by guidelines, design principles and proposed methods. This would suggest an approach where there is little governance or policy involvement from the central state. The public agencies and local governments are encouraged to collaborate, but must do so based on an initiative of their own. Here, methods for streamlining this collaboration are provided together with templates for service interactions and guidelines for implementation. This direction is more or less in line with the current state of affairs in Norway.

2) The second possible direction for development suggests a simple approach to the design artefact through implementing BPM functionality as a shared component. This would provide an intermediary functionality where process state and service orchestration in policy chains can be stored on neutral ground, available to all service stakeholders. Service instance data can here be similarly added to the same component. As most service data is context-sensitive, storing the data together with the process instance is natural. The realisation design will here be supported by a platform for

service development, while methods and guidelines will focus on supporting the development of information systems that can take advantage of the core components offering. The success of this approach depends on the network effect and the number of connected service providers, as well as the access and acceptance from the software industry. This direction for development is in line with the current vision for the Altinn II project in Norway, as described in P6.

3) The third possible direction of development is one of two revolutionary approaches. It is based on observations made during the course of this study on a trend towards providing tools that cannot be complex to users that cannot be experts. This counts both for the service provider and receiver. It is further expected that public organisations innovate and transform from within, and there is a certain amount of pressure for this to occur. But from looking at the resources available, a development in the direction of these expectations is not likely. This suggested development is based on the commoditisation of the supporting IT services. The technology function of public service provisioning is entirely moved out of the local governments and public agencies, and uniform services are provided centrally and configured locally on top of a shared service infrastructure. Strict central governance replaces the autonomy of local governments on IT-matters. This approach is an opposite from the first approach, as in this case the methodological infrastructure support is marginalised. This is based on the service infrastructure being under central control together with a predefined flexibility of both services and capabilities for extending the boundaries of the system.

4) The fourth possible direction of development is one closest to the proposed design artefact. The possibility of a service web suggests a distributed process layer on top of the current Internet, where public and private actors can build services, and collaborate using domain specific modelling approaches. Citizens are separate electronic entities supported by their governments and can partake in role-based service collaboration with private and public actors. The service web is a commodity provided to the public analogous to public roads, and this direction is similar to the World Wide Web we have today. Instead of building a public service infrastructure that is closed, a global and open e-service infrastructure is provided and maintained by the public. Having an open architecture, the methodological infrastructure support is an important tool for actors contributing to the development of new physical infrastructure components.

8 Conclusion and further work

Anyone who isn't confused doesn't really understand the situation
– Edward R. Murrow

8.1 Conclusive summary

The objective of this PhD study was to contribute to the delivery of citizen-centric and demand driven services and to the establishment a hypothetical *My Processes* citizen's portal. This portal would provide process-oriented multi-channel personalised interaction for all public services.

The thesis includes 7 refereed conference papers, one journal publication, and one book chapter. One of these conference papers has later contributed to a journal publication not included as part of this thesis. The primary research methods were literature studies, exploratory case studies, and analytical work. These were applied within the context of the design science for information systems research approach.

The study has provided the following contributions:

C1: A model describing the dynamics of e-government.
C2: Future scenarios for citizen-centric and demand driven public services.
C3: Requirements for an e-service infrastructure for public service provisioning.
C4: A conceptual design for a national e-service infrastructure.
C5: A conceptual e-service governance model.

The discussion of the research questions and contributions has demonstrated the complex and evolving nature of the domain. The answers to the questions must accordingly be high-level and general, if not related to a specific context. Since the scope of the study is limited to general treatment, it has been made an attempt towards defining a generic solution. By considering the contributions as a delivery towards answering the research questions, the research objective is be considered as satisfied. It is hoped that the work reported in this thesis will contribute to a part of a field that in the coming years will be very important.

8.2 Proposed further work

Based on current knowledge about the initial research questions and contributions of the study, three directions for further work are suggested. These include the modelling of public services through service primitives, a further elaboration of parts of the design artefact to an elaboration of the service process model configuration management aspects of an implemented design artefact, and scenario construction as part of a further demonstration to validate the design artefact. An iterative approach is recommended, as knowledge from each direction would contribute to the others. Two research questions for further work are specified for each direction.

8.2.1 Service primitives

The Altinn II SDK defines a selection of high-level service types to be used for implementing public services. Based on these service types we would like to propose a new context-specific, albeit generic, service type called service primitives for use with the design artefact. Service primitives reflect a series of interactions, tasks, and lookups during the provisioning of a given service that occur often in different context, similar to patterns for workflow. The service primitives can be used in the construction of process templates for public services, and in the customisation of services to a specific service instance. Based on this, the following research questions for further work are proposed:

FW1 *What are the common service interactions and tasks, as a basis for service primitives in the context of public service provisioning, which can be used in the modelling of process work based on an interactive modelling approach?*

FW2 *What is the appropriate level of detail of the identified service primitives with regards to reuse, and complexity of configuration, and appropriateness on the level of the domain, organisation, and modeller?*

Several service primitives will be related to administrative or control aspects of collaborative service provisioning. Examples of these are locating and appointing appropriate resources, adding actors to the virtual organisation, scheduling of appointments, or other tasks that could be handled semi-automatic given an appropriate level of interoperability among the various actors. Other service primitives will be related to automation of retrieval of information from central registers, requisitions for specific tasks, verification of information, or other tasks related to parts of the actual process of delivering a service. A service primitive can also represent a manual task performed by one of the actors participating in the service provisioning. In this case, the service primitive can be a description or guide to how the task should be performed. As the task is manual, the actor performing the task will have to indicate when the task is completed so that further steps of the service provisioning can be initiated.

From the previous discussion, a development is expected that the lead user gradually take the role of a high-level system developer. This is based on the idea that a model driven and process-aware approach will be customisable and with an improved information system representation of the actual work performed. A consequence of this

is that the user of the information system necessarily needs to consider the rules and dependencies within the system as changes are made. The users participating in the service provisioning should, in that respect, be non-technical users, and the service primitives should to those users be considered as the smallest building blocks of the process. The users making the actual service primitives available for use in the service process models will be lead users or software developers, depending on the complexity of the service primitive. A complex service primitive can have several interactions with the e-service infrastructure and its available resources, while a simple service primitive can be the description of a task that is performed manually. When adding a service primitive to a service template or a process instance it is assumed that the user will partially have to configure the primitive manually, while other parameters of the primitive will be deduced automatically based on the context of the service.

The types of appropriateness in FW2 are based on the SEQUAL quality framework (Krogstie et al., 2006). *Domain appropriateness* refers to the ability of the service process models based on service primitives to be able to express service delivery within the e-government domain. *Organisational appropriateness* in this context refers to an appropriate level of reuse of service primitives and the service process models across different context within the public sector. *Modeller appropriateness* refers to the actor participating in the service provisioning as a user of the e-service infrastructure. The actor steps into the role of a modeller when making changes to a service template or a service instance. In the case of a service instance it can be expected that a model representation is not always available to the user as the process instance is an integrated part of a model driven user interface. Quality aspects as *Tool appropriateness* are omitted from the research question, as the objective should be to construct service primitives that can be used by actors involved in the service primitives. The formal syntax of the process within the primitive, used for tool interpretation, should therefore only be visible to lead users and software developers.

8.2.2 Service process model configuration management

Central to the virtual organisation and aspects related to collaborative service provisioning in the design artefact is the process instances that spans across agencies and the possibility for distributed process innovation. Concepts within the design artefact (Figure 14) relevant to this are the reporting of events between the CCPV and the local information system, change requests on a process instance, and the process innovation on the process template. The design artefact has until now been conceptual and based on a viewpoint considering information elements, but not with an explicitly defined manipulation of these. In continuing the research towards a possible implementation, it is necessary to elaborate on the functionality related to the management aspects of the design artefact. This will provide a level of detail where it is possible to discuss an implementation at a level where system components and interactions between system components can be identified. Based on this, the following research questions for further work are proposed:

FW3 *How is it possible to support distributed collaborative editing of interactive process models using a domain specific modelling approach?*

FW4 *How is it possible to implement process logging, using the occurrence of events, to maintain process state for interactive processes in a multi-actor service network?*

Considering FW3, editing of interactive process models suggests that a provided service is based on a process template where all aspects of the progression of the service are necessarily not known when the service is instantiated. The process template can be empty so that the service process is created progressively, the process template is not accurate and needs to be customised to the actual service instance, or the process template requires that information based on context or timely knowledge is added at run-time. It is also possible that the process template is changed. This can be based on changes in service primitives used in its construction, or through modifications of process flow. In both the case of updating a process template or instance, interfaces, interactions, and constraints has to be established. Revising existing service primitives will also require propagation throughout the system.

Considering FW4, process logging is related to updating process state and to catch events within a heterogeneous collaboration environment. This can be related to logging changes to the process instance based on changes in the local information system, and further distributing those changes so that they are made available for the relevant process actors. It is expected that the approach to be used will depend on the process or task in combination with the type of task and the environment in which the task is performed. Possible approaches can be based on process mining techniques, or active reporting by the process actors.

8.2.3 Validation of artefact agility

Business agility is discussed in P9 and is central to the requirements covering the transformation capabilities of the design artefact (Chapter 6.3). The consequence of a satisfactory solution to these requirements suggests not only that the design artefact should be capable of supporting any public service with a predefined flexibility, but also that it further should be able to support unpredictable changes in the service. In this, it would not be sufficient to construct a scenario for a given public service in order to demonstrate the design artefact, but it would also be necessary to construct scenarios for how a service could transform and how the artefact would handle transformations. This could be done through classifying existing public services with respect to where flexibility is needed. In addition to the predefined flexibility and flexibility for unpredictable changes, aspects related to an administrative reorganisation of how a service is provided in Chapter 6.3 (e.g.: relocating of a citizen) are also considered to be within the scope. Constructing scenarios would further not only demonstrate the benefits for the isolated public agency and the citizen, but also demonstrate the network effect through a global availability of a working e-service infrastructure. Using narratives as storyboards or role-plays could help bring the artefact description to a level where it could be demonstrated to various audiences for feedback, and simulations or scenario descriptions could be elaborated to a level where Delphi studies or the use of focus groups are made possible. The following research questions for further work are defined:

FW5 *What are the generic type-wise changes to public service provisioning, having an origin both internal and external to the service, which have consequences for the planned service provisioning?*

FW6 *How to construct scenarios for citizen-centric and demand driven public service provisioning, based on the proposed artefact, as a basis for demonstrating the agility of the design artefact?*

Considering FW5, changes that are internal to the service would under most circumstances be related to the flexibility of the service and changes that are initiated by one of the actors providing the service. This could be that a central actor to the service provisioning leaves the virtual organisation so that the resources will have to be reorganised, or that citizen relocates suggesting an equivalent resource reallocation. The external changes are initiated outside the service instance, and could be related to budget cuts, changing regulations, or other external factors constraining or enabling the service.

Considering FW6, using the identified type-wise changes in FW5 and scenario descriptions for public services, it would be possible to validate how changes to the service are supported through collaborative editing of service primitives in the process templates and process instances.

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Glossary

Active model – A model that influences the reality it reflects. Further, that changes to the models representation also change the way some actors perceive reality (Jørgensen, 2004)

Business Process – The logical organisation of people, materials, energy, equipment, and procedures into work activities designed to produce a specified end result (Pall, 1987).

Business Process Management (BPM) – an approach supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information. (van der Aalst et al., 2003)

Business Process Management System (BPMS) – A generic software system that is driven by explicit process designs to enact and manage operational business processes (van der Aalst et al., 2003)

Citizen-centric – An approach focusing on the needs and behaviour of the citizen implying that the design of a citizen-centric service is centred on the citizen.

Cloud Computing – Internet-based computing, whereby shared resources, software, and information are provided on demand, like the electricity grid (van der Aalst, 2010).

Complex adaptive system – a system that emerges over time into a coherent form, and adapts and organises itself without any singular entity deliberately managing or controlling it (Holland, 1996)

Demand driven – A service provisioning strategy where new services are developed based on an identified need previously not satisfied through existing services.

E-government – the use of information and communications technologies in public administrations - combined with organisational change and new skills – to improve public services and democratic processes and to strengthen support to public policies. (European Commission, 2003)

E-service – a public service that is provided in such a way that that data that is related to the service can be collected, updated and made available through the use of electronic channels.

Enterprise – any collection of organisations that has a common set of goals and/or a single bottom line. An enterprise can be a government agency, a whole corporation, a division of a corporation, a single department, or a chain of geographically distant organisations linked together by common ownership. (The Open Group)

Enterprise architecture – A coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure (Lankhorst, 2009).

Event-driven – An architecture approach based on the detection and reaction to events.

Globalisation – The intensification of world-wide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa (Giddens, 1990).

Information infrastructure – A shared, evolving, heterogeneous installed base of IT capabilities among a set of user communities based on open and/or standardised interfaces (Hanseth and Lyytinen, 2004).

Installed base – A loosely coupled combination old and new systems and the corresponding organisations, cultures, and methods that surround them (Hanseth and Lyytinen, 2004).

Integration – the forming of a larger unit of government entities, temporary or permanent, for the purpose of merging processes and/or sharing information (Scholl and Klischewski, 2007).

Interactive Model – An active model having prescribed aspects that are automatically interpreted by software components, and ambiguous parts that are left for the user to resolve with tool support (Jørgensen, 2004).

Interoperability framework – An interoperability framework is an agreed approach to interoperability for organisations that wish to work together towards the joint delivery of public services. Within its scope of applicability, it specifies a set of common elements such as vocabulary, concepts, principles, policies, guidelines, recommendations, standards, specifications and practices (European Commission, 2010b)

Life-event – Life-event services or services based on life-events refer to a structural organisation of public services around specific life-events of the citizen (e.g. birth, marriage, and visa or driving licence acquisition).

Local government – Used in referring to municipalities or government organisations with policy domain limited by geographical boundaries.

Network effect – An effect of increasing value of a product or service to a user depending on an increasing number of other users.

Modelling – a means essentially to describe a set of abstract or concrete phenomena in a structured and, eventually, in a formal way (Bubenko, 1992).

Multi-Channel Provisioning – The use of multiple service channels within one public service delivery process, or the use of different channels for different service delivery processes (Pieterson and van Dijk, 2006).

One-stop shop – a single point of contact where arrangements for most public services can be made.

Policy chain – a multi agency service process having a sequential dependency between the actors (Thompson, 1967).

Policy network – a multi agency service process with a dependency between the actors of a reciprocal nature (Thompson, 1967).

Public agency – A government organisation with a policy domain not limited by geographical boundaries.

Public-private network – A multi-agency service process of actors from both the public and private sector.

Software as a Service (SaaS) – A software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet (van der Aalst, 2010).

Transformational government – a government that is able to holistically provide services that evolve with the changing needs of their stakeholders.

Virtual organisation – a temporary or semi-permanent arrangement of resources selected independently of the normal organisational boundaries in order to solve a given task or tasks.

Wicked problem – A problem having a level of dynamic complexity in solution criteria that cause a situation were there is no definite formulation of the problem.

Workflow – The automation of a business process, in whole or part during which documents, information or tasks are passed from one participant to another for actions, according to a set of procedural rules. Lawrence (1997)

Workflow management system – A system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications. Lawrence (1997)

Appendix A: Initial research questions

RQ1 What are the generic requirements for process support related to public services, and are there possible additional requirements caused by a future scenario?

RQ2 Are the problems faced by organisations today with respect to the description, implementation and maintenance of processes work sufficient to describe a transformational government scenario?

RQ3 Are the technologies and methods available today sufficient for the realisation of process support for multi-channel provisioning of public services?

RQ4 How is it possible to easily implement multi-channel process support systems for public services with both dynamic and interactive capabilities?

Appendix B: Selected publications

P1 Gustav Aagesen and John Krogstie (2011) Service delivery in transformational government – Model and Scenarios, *Electronic Government, an International Journal (EG)*, Special Issue on: E-Government: Past, Present, and Future, 8(2/3), pp. 242-258

P2 Gustav Aagesen and John Krogstie (2010) Analysis and design of business processes using BPMN, In: vom Brocke, J. and Rosemann, M. (eds.), *Handbook on Business Process Management 1, Introduction, Methods and Information Systems*, Series: International Handbooks on Information Systems, ISBN: 978-3-642-00415-5, Springer-Verlag, Berlin/Heidelberg, pp. 213-235

P3 Gustav Aagesen (2009) *Citizen-centric process views for government service provisioning*, Norsk Konferanse for Organisasjoners Bruk av IT, Tapir Forlag

P4 Gustav Aagesen and John Krogstie (2010) Providing adaptive and evolving government e-services through citizen-centric process views In: Janssen M., Lamersdorf, W., Pries-Heje, H. and Rosemann, M. (eds.), E-Government, E-Services and Global Processes, IFIP AICT 334, 2010, Springer-Verlag, Berlin/Heidelberg, pp. 32-45

P5 Gustav Aagesen and John Krogstie (2010) Investigating requirements for transformational government information infrastructures. The case of the approval process for building applications, *European Conference on e-Government*, National Centre for Taxation Studies, University of Limerick, Ireland.

P6 Gustav Aagesen and John Krogstie (2010) Service development for national government information infrastructures – The case of Norway, *IFIP E-Government Conference 2010*, Lausanne, Switzerland.

P7 Gustav Aagesen, Anne Fleur van Veenstra, Marijn Janssen, and John Krogstie (2011) The entanglement of enterprise architecture and IT-governance: The

cases of Norway and the Netherlands, *44th Annual Hawaii International Conference on System Sciences (HICSS'11)*

P8 Gustav Aagesen and John Krogstie (2011) Citizen centric public service provisioning - A conceptual approach for next generation information infrastructures, *5th International Conference on Methodologies, Technologies and Tools enabling e -Government*, 30 June - 1 July 2011, Camerino, Italy

P9 Gustav Aagesen and John Krogstie (2010) *Public service provisioning and ICT development. Synchronising the flexibility of organisations and ICT*, Norsk Konferanse for Organisasjoners Bruk av IT, Tapir Forlag

Paper 1

Service delivery in transformational government: Model and scenarios

Gustav Aagesen and John Krogstie (2011) Service delivery in transformational government – Model and scenarios, *Electronic Government, an International Journal (EG)*, Special Issue on: E- Government: Past, Present, and Future, 8(2/3), pp. 242-258

SERVICE DELIVERY IN TRANSFORMATIONAL GOVERNMENT: MODEL AND SCENARIOS

Gustav Aagesen and John Krogstie

Abstract

By formalising the processes related to government service provisioning, it is possible to identify best practice, rooms for improvement and potential for added service value. Work supported by ICT has the potential of increased efficiency and control, but there is also danger of locking down to a sub-optimal service delivery with low flexibility. Through experimental methods and supported by case studies, we have established a model to aid the conceptual understanding of the dynamics of modern government service delivery. In light of this model, scenarios for service-centric and citizen-centric delivery of government services are presented. The paper describes areas crucial to government service delivery and its supporting tools, methods and infrastructure for process work in the transformational government scenario.

Keywords: e-government; transformational government, service delivery, process modelling, requirements, infrastructure, model, scenario, citizen-centric, inter-organisational collaboration.

1 INTRODUCTION

E-government is about the continuous optimisation of public administration and service delivery. It is mainly motivated through the use information and communication technology, facilitating the reorganisation and development of new services and with the potential of reorganising the service administration as well. Even though ICT-driven government modernisation has been going on for decades (Yildiz, 2007), the first wave of e-government initiatives has come as a reaction to e-mail, the World Wide Web and the Internet reaching critical mass and opening for new service channels. Most e-government system implementations until now have been about the digital representation of prior existing workflows and providing service information online. The early models describing the maturity of e-government (Mofleh et al., 2009) have so far been aligned to the reality they describe. However, e-government has basically moved public administration from one representation of a solid state to another; the old routines and file cabinets have been electrified and computerised.

It is suggested that e-government perhaps overpromises solutions to many public sector problems (Heeks, 2006). Transformational government (Janssen and Shu, 2008) is in many ways credited the solution to all problems not yet solved by current e-government initiatives. But the truth is that even though the outcomes of transformational government are known, the concept is not very well investigated, and so far, it is easy to add solutions to issues such as wicked problems into black boxes or to disregard them as a whole. Within transformational government lays the promise of an effective platform and administration of systems in constant change, supporting a modern government. As put by The Norwegian Ministry of Government Administration and Reform (FAD, 2009):

Public administration must adapt to a highly changing society while adhering to set fundamental values. Adaptation must be consistent with the Nordic traditions of three-party cooperation, codetermination and participatory inclusion of the employees.

To support this adaptation from a technological point of view, the necessary infrastructure is required. It is, however, not currently apparent what this necessary infrastructure, *Cyber Infrastructure* (Wimmer et al., 2008), or *Next Generation of Digital Government Infrastructure* (NGI) (Janssen et al.,

2009) implies. We seek out to identify important capabilities of this infrastructure, and through an exploratory approach, combine current trends and technology forecast together with the promises made by transformational government to create a scenario in which we can base assumptions for a given problem domain. The suggested scenarios, which stem from service- and citizen-centric (as opposed to organisation-centric) service provisioning, will help to identify areas in current research and technology affordances relevant to solving important technical aspects of transformational government.

Our work is focused on business process modelling and model representation of information structures; on processes and how these can aid the understanding, development, implementation and management of service provisioning both from the view of the citizens and the public administration.

We believe that the problems found in the future scenario have root in many of the problems that we face today: That some issues typically defined as problems in implementing information systems such as the unpredictable nature of organisations and users, must be addressed in favour of the requirements of the organisation and users, rather than the implemented system (i.e., the system should support its users not vice versa). The complexity of transformational government might in many ways be that all the problems will have to be addressed at once. In that manner, our future scenario is based on the current situation, and the requirements for the future scenario are found in the identified problems of this situation. This means that we should be able to address some areas for improvement by understanding the current situation.

In the next section, we will present our understanding of the dynamic nature of government service provisioning through our suggested model. In Section 3, we will discuss provisioning of government services in the transformational government scenario both from the view of the providers and receivers of government services. The identification of the areas important when addressing the problems in the scenarios will be discussed in the related work section. This is followed by discussion of limitations and the conclusion.

2 DYNAMICS OF GOVERNMENT SERVICE DELIVERY

In this section, we will look at the delivery of government services from a larger perspective. This is presented through a model (Figure 1) created in iterations through explorative reasoning based on descriptions of transformational government and current trends in service delivery. The model illustrates the dynamic nature of the environment in which government services are provided by identifying core contributors to changes in service delivery and how these interrelate. In doing this, we position government service delivery within e-government and e-government within e-governance and civil society. Basically, the model presents the dynamic aspects as we observe them today, but the accompanied scenarios add assumptions based on technology forecast and the required infrastructure to deliver services in a transformational government context. The scenarios take on an approach to transformational government with a strong belief in the role of the individual, which we feel is in line with what the future expectations for e-government in general is. The model serves as a motivation for further research on/and the development of an infrastructure capable to withstand an evolving environment. After presenting our model with examples, we will discuss its validity.

In understanding e-government as a field, it is helpful to know that no government is alike. The fundamental functionality of a democracy is to serve the citizens (Ringen, 2007) while the aim of e-government is to transform and improve service delivery in the public sector (Irani et al., 2008). In our model, *political direction* is based on *common values* and the *behaviour* of residents (citizens or companies). The Universal Declaration of Human Rights[i] as a signed consensus between many nations is an example of *common values*, helping to regulate the standard rights of individuals. Common values can also be less formal but are associated with notion of something being ‘right’ or ‘best’ in a given context, which means that they can be based on reasoning or faith. Political organisations or interest groups are also created based on common values and causes supported by a multitude having common values are able to affect *political direction*.

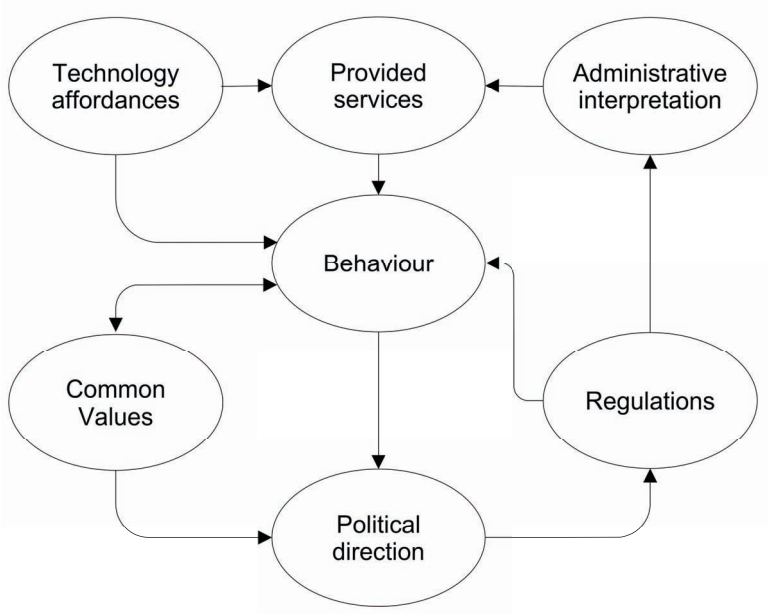

Figure 1 Dynamics of government service delivery

From this, we can see that the inner workings of the political direction and common values are complex and that the outcomes of these are assumed to be the direction taken as a result of any multiple stakeholder conflict that might have occurred. This direction can be sub-optimal or a trade-off, but it is nevertheless the direction from which any effects are measured. There is further no guarantee that the outcomes are without conflicts themselves.

The *administrative interpretation* of *regulations* for any given *policy domain* are decided by the government organisations in the central and/or local state and determines how services are provided and maintained. The *regulations* and *provided services* contribute to the *behaviour* of residents within an area, either constraining or encouraging certain *behaviour*. In this understanding of government service provisioning, any *regulation* is created to help shape *behaviour* in accordance to one or several laws directly or indirectly. *Provided services* at a local or national level aid the effectiveness of the execution of these *regulations*. *Provided services* can also be internal within or across public organisations and assist the effectiveness and productivity of government officials, politicians and computerised information systems.

The dominating *political direction* in the different organisations within a government might vary just as the range and magnitude of services offered varies. All residents within an area are exposed to services provided by several more or less coordinated autonomous government organisations. The quality of the *provided services* is based on national and local economy, political priorities and the *administrative interpretation* of current *regulations*. When it comes to provisioning, services offered directly by the public in one area might be outsourced to private contractors in another, and services provided by what one might describe as a welfare state in one area might be absent or only available privately elsewhere.

Technology affordances come as an additional factor, and it is the competence and resources within an administration that determines whether or not it is capable of using current technology to improve its *provided services* internally or externally, and to utilise the available channels for effective and efficient service provisioning. At the same time, *technology affordances* affect expectations, and in that the *behaviour*, of the residents.

These are all but comprehensive, but nevertheless important, factors contributing to the understanding the dynamics of governments, and one can say that any e-government initiative is connected to the improvement, understanding, communication or efficiency in the realisation of any part or parts of this model.

Take this example: Due to heavy traffic (*behaviour*) downtown pollution is up. *Common values* in the community promoting a clean environment call for the need to attend to the situation. After continuous efforts to move commuters to public transportation through information campaigns, it is decided to reduce the amount of lanes open for private transport in certain areas through *regulation*. The initiative reduces traffic significantly, but at the same time, tendencies in public opinion grows towards favouring politicians who value the freedom of driving private cars to work to the ones who value a clean environment.

There are several apparent *provided services* in this example; first of all the public road is a service, and the awareness campaign for reduced traffic is a service, just as well as the communication between citizens and politicians can be regarded as a service. It would probably be possible to use alternative approaches to reducing traffic in the area as well, but knowing what is more successful and cost effective might not be apparent upfront. A minor change in *regulation* (e.g., introduce toll roads) could change *behaviour* and might further cause a change of flux towards *political direction* and *common values* in an area. This is similar to the behaviour found in system dynamics models (Sterman, 2000): Priorities in one field or problem might be at the expense of others, and by increasing the effectiveness of one task, one will have the spare time and resources to address other important issues. Ideally, political direction is affected by the residents' values and opinions (at least in the long run). All tasks, rules and regulations within one area should at one point be connected to an identified goal, and by changing the configuration of provided service, one is changing the dynamics of the government.

On accounts to the validity of the model, it is purely explorative and not tested to any extent beyond the fact that the conceptual reasoning is aligned to real world observations within the domain it describes. In that sense, the naming and the level of abstraction of the different elements of the model could be adjusted based on a given scenario. This is a question of how much complexity it is necessary to add for the model to be sufficiently complete, and if the completeness has a negative effect on the complexity. To our use, this is so far the proper level of detail in which we are able to express and distinguish the various phenomena within the model. It is however, possible to compare and identify parts of the model within existing models.

In its simplest form, the cycle going from *political direction* and *regulations* through *administrative interpretation* to *provided services* and to *behaviour* is a closed loop similar to the Deming Cycle (Plan, Do, Check, Act) (Deming, 1986). On the basis of the general nature of the loop, it is here probably hard to find any improvement cycle not fitting with the nature of this particular cycle.

Advancing a step to the Policy Cycle (Jones, 1984) (agenda setting, policy formulation, decision making, implementation and evaluation), the same loop in our model is covered as was covered by the Deming Cycle, but the steps can be mapped more clearly between the model and the cycle. Being dynamic aspects providing external input, the *common values* and *technology affordances* are areas not covered by the cycles. These are however outside the scope of the models compared.

The technology affordances are, however, identified and classified as areas of evolving ICTs within the conceptual model for e-governance proposed by Rossel and Finger (2007). They further tell us that there is...

a parallel evolution between the ICTs on the one hand and the political institutions on the other. ICTs increasingly pervade political institutions, while the evolution of the ICTs is simultaneously affected by the policies and policy-based decisions. (Rossel and Finger, 2007)

In our model, the technology affordances directly affect the delivery of provided services and indirectly affect the policy decisions through the behaviour, described by Rossel and Finger as pressure. Their conceptualisation of e-governance also provides a means to distinguish e-government from e-governance within our model: E-government is mainly located in the top row of the model in the cluster between *administrative interpretation*, *provided services*, *technology affordances* and *behaviour*. E-governance encapsulates all aspects of the model. This also includes the policy aspects

discussed regarding the autonomous nature of government organisations and privatisation of government services. This devolution of government (Farooq et al., 2006) is one outcome of transformational government that is important when establishing the next-generation digital government infrastructures.

In addition to the pressure caused by ICTs, the conceptualisation of e-governance by Rossel and Finger also includes aspects in context of globalisation, liberation and state transformation. These aspects are mainly expressed through the *common values* and *behaviour*. The *common values* in our model are primarily a description of the long running cycles of societal changes and the values expressed through these. And while the economic aspects of a globalised economy might cause a change of values that occur seemingly immediately, these are most probably the results of processes that have been building up over some time, and the change of values is just an expression of the result caused by regulation and behaviour over time.

So why is this model important? The model gives an understanding of the environment in which government services are provided and in which the infrastructures supporting service delivery are created. The pressure on service delivery increases as better services are provided, with the rise of new technology affordances and from services delivered to the citizens by actors in a commercial context. Any change that happens in a part of this model will affect the other in some way not known at the time where the change is activated. Knowledge of these dynamics should have an impact on how systems supporting the provisioning of government services are created in the future.

3 PROVISIONING OF E-GOVERNMENT SERVICES

As stated by Chan Kim and Mauborgne (1999), it is inherently impossible to predict the future. Innovation work focuses on finding insight in trends observable today, seeking opportunity in combining trends or finding elbowroom in the gap between two diverging trends. Change in trends might be "*a discontinuity in technology, the rise of a new lifestyle, or a change in regulatory or social environments*" (Chan Kim and Mauborgne, 1999). New technology opens up for new channels, services and markets, which again can lead to new understanding and new requirements. This described situation fit well to the pre-transformation-stage e-government scenario (Siau and Long, 2005): Computer-assisted processing of services has started, information is online and users are culturally starting to adjust to the new technology through personal experiences with Internet banking, mobile services and social media.

Innovation in public sector is not a new phenomenon (Windrum and Koch, 2008), but with the increasing presence of information systems, there is an increase in complexity and risk associated with process change. Riedl (2003) mentions two opposing hidden threats to designing e-government services. One being abstract design, distancing from the actual problems; the other is situated design, where complexity of architecture comes to the point where the described service cannot be implemented.

There are lots of smart concepts supporting the development of services, but the holistic IT architecture to realise these concepts are still missing, and there are many critical engineering issues that have not yet been solved. (Riedl, 2003)

There is a fundamental need to understand how to create flexible systems that can adapt and change with demand (Elliman et al., 2007).

With all this in mind, we are now research-wise at a point with the promise of a coming information architecture that will support transformational government. We can assume that the requirements to build such an architecture are basically represented by the capabilities to adapt to new operational requirements and for a system or network of systems of e-government scale to operate.

In this section, we will present two scenarios within transformational government built on the same principle but providing different views on government service delivery. The first scenario is based on

a service-centric view, with government organisations improving provided services towards some kind of best practice delivery. The second scenario is a citizen-centric view of the citizen as a receiver of government services. The goal of the scenarios is to provide a ground for conceptual reasoning about the systems supporting them.

3.1 Best practice provisioning in service-centric systems

Given the organisation of government agencies, similar services are provided to support the same goals at different locations. The initial best practice process for providing a particular service should possibly be made available to those providing that service. Investigations from the Irish software industry looking at the use of software process improvement and best practice process methodology (Coleman and O'Connor, 2008) give some insights that might be applicable to process work in governments:

A life cycle is described within a process evolution model starting with an undesired process as an 'as-is' situation followed by a process improvement effort. Soon after the new process is available and is implemented, process erosion kicks in, slowly pulling the process towards a minimum process.

Conclusions from the investigations point out that all companies engage in some kind of process tailoring and adapt the work process to their own operating context, or in other words: no one uses the process as it is defined. On the question of why the companies are not using best practice software process improvement, it is mainly due to the time and cost related to following best practice. Additionally, the burden of increased documentation and bureaucracy, and the further loss of creativity and flexibility, is listed as reasons for not being able to keep to the best practice process. Given the autonomy of government agencies, they are free to provide services as they choose as long as they follow the necessary regulations. Even though some agencies provide the same services, their regulations might differ due to regional policies.

One contribution provided by a best practice framework is to give a starting point for developing own routines, saved time and effort in reinventing obvious mechanisms. From this starting point, there will always be a need to tailor the process to local context. For process erosion, it can be favourable to be able to align the formal and the actual process as changes occur. From an e-government point of view, it would be desirable to be able to supply best practice process descriptions as part of a centralised core component offering. These descriptions should effectively be open for customisation to local contexts taking special software, stakeholder characteristics or regulations into account.

Von Hippel (2005) introduces *lead users* as important to product innovation and recommends developing innovation toolkits to assist innovation work. Lead users are users with special interest and competence in the area in question that are able to quickly identify showstoppers and suggest improvements in an early phase. In our scenario, lead users would be found within the government administrations and as employees involved in the government service provisioning. These are the users that might be the most fit to suggest innovative use and new products. Innovation toolkits should be customised to the users and the domain in question. Five important aspects of innovation toolkits are suggested: Learning by trial and error, an appropriate solution space, user-friendliness, commonly used modules and the ease of creating results.

The questions we are left with, with regards to requirements for process innovation is: How can users participate in process innovation? What are the boundaries to innovation? Are there legal risks to user innovation and how can these be controlled or verified? How can one facilitate continuous innovation of e-government services? This further calls for the choreography, validation and verification of active processes as well as monitoring, version handling and visualisation of these to provide the proper understanding of the complexity of services provided and to be able to optimise these.

It is, however, not given that a process-reengineering attempt will change to a more optimal situation altogether. The optimality of any service delivery will decline as expectations grow, new technology affordances emerge and regulations change. Additionally, the complexity of the relations in society

will increase, which means that the perception of having a better service delivery will never change (van Deursen, 2007).

Figure 2 illustrates the optimality of a system as a function of time and implemented changes: The desired configuration of resources, systems and processes is constantly high and aligned to the optimal possible configuration, while the optimality of the actual configuration declines over time, even with a stable configuration. Examples of factors contributing to this change are the leverage of resources and scalability of the solution, changes in the technological affordances through the availability of new channels or technology or the change of regulations and required service level.

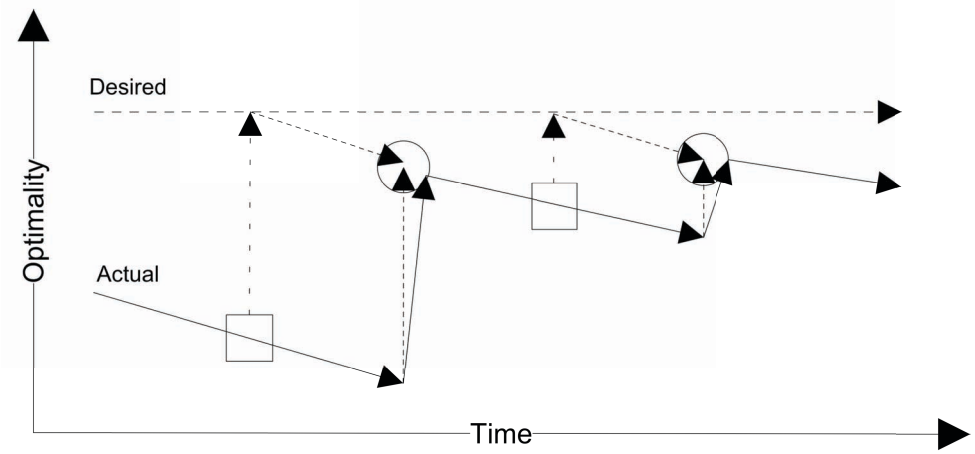

Figure 2 Alignment of desired and actual system configuration over time

From the point were it is decided to align the actual and desired service configuration (squares), there will still be some time before the new configuration is available for use. From the time of launch of the new system of method, there will be some time before the organisation is adjusted to the new reality. Due to this, there is already a discrepancy between the desired and actual configuration (circles). To cope with this, the time between reengineering can be shortened or one could facilitate for user-driven innovation and process management, which might allow a more continuous synchronisation of the desired and actual system configuration.

One should be aware of that the political dimension of the perceived optimality of a current configuration is multi-faceted. However, this situation is not specific from government organisations per se, as the possibility of hidden agendas is present in any organisation. The perceived optimality described in Figure 2 is not subject to individual reasoning but based on goals stated at the point where the pursued configuration was initiated.

If the innovation is user-driven, the users should be able to fully describe the process change in such a manner that the model as far as possible represents the new reality. It should also be possible for the user to see the consequences of the requested change (run *what-if* scenarios on existing data with new rules or alternative process flow) and be able to request changes within the defined laws and flexibility of the process execution platform.

We distinguish between process innovation and process flexibility. Where process innovation can be the continuous optimisation of processes and synchronising the local best practice to the formal documented and system supported process, process flexibility is the possibility for tailoring one single process instance to the local requirements of that instance. This could include adding or removing milestones, process actors or similar phenomena for one single process instance. It would also be feasible to differentiate process innovation from process invention, where process invention is the creation of novel approaches, which do not become innovations until others adopt them. This being said, provisioning of best practice need not only be top down but also between peers providing similar services, in different government organisations.

There has been a critique of e-government initiatives taking on a techno-centric, rationalist focus, ignoring the value of knowledge management and that knowledge management is an important aspect of future government strategies (Kolsaker and Lee-Kelley, 2005). From the areas discussed above, we have created a scenario where the users are central to the change process. The service configuration and innovation life cycle is constantly in flux to meet the requirements of best practice. We describe a scenario where users within a given service domain can change the configuration of their process support infrastructure to align to the desired changes within human or ICT-driven process work. It should be possible to extract and replace process descriptions, modules or models used to support a given process without compromising issues related to the governance of provided services using different service configurations. Service domain peers should be able to exchange and adapt process descriptions to fit local service configuration. Artefacts related to the scenario involve creating innovation toolkits for public services, validation of process reconfiguration and support in the process of merging different kinds of existing models.

3.2 Citizen-centric systems

In the previous subsection, we presented the scenario related to the processes and services of single government agencies and the sharing of best practice between government agency peers. Even though the need for collaboration between government agencies exists, the citizens as users of public services spend much of their time in transit between public offices or acting on behalf of the different roles or responsibilities they might have.

There are numerous approaches to measuring the public value of enterprise applications in e-government (Prakash et al., 2009). Socioeconomic value includes the reduced amount of time spent for using government services for citizens as well as time spent by the government organisation (SSØ, 2006). By mapping the citizen process across government agencies, it might open for better understanding and potentially increased efficiency in service delivery. Through the monitoring of process instances within one public agency, it will be possible to predict demand in another, and by doing this, it will be able to offer a better service altogether. In cases where one has consolidated channels by grouping services or sharing infrastructure through a shared service centre (Janssen and Wagenaar, 2004) or simply taking advantage of service system transparency, it would be to offer more services to the citizen from one location.

There are some collaboration issues and organisational challenges to the transformation government scenario from an optimal service delivery and the citizen point of view. The question of developing one omnipresent all-knowing system or many smaller interconnected systems with no central architecture is not so important. It is most important to support governing democratic principles and autonomous sovereignty, as well as the required level of access restrictions and privacy within the system. Our focus is not on these issues in particular, but rather discussing the functional aspects that can be achieved with a system architecture that provides cross-domain access and information when and where required.

One example of challenges grounded in collaboration issues is the citizen working and using childcare services in the neighbouring municipality from where he resides. As he does not live within this area, he does not have the required access to online government services provided there. If this restriction occurs, it might be based on limitations to access, limited service integration caused by proprietary or closed standards or simply by design. Future provided services should be flexible for roaming users and allow service-shopping based on convenience, where the user chooses from a range of similar services and is able to opt for the one best fit to individual needs.

From the citizen's point of view, it would additionally be desirable to access services based on roles or the opportunity to act on behalf of others without stepping out of their individual context. One example of this is acting on behalf of an elder relative or person hindered by digital illiteracy for access to web-based services using ones own personal credentials.

By combining some of the functional properties above, the citizens could be provided with a process view and timeline in which they are the central actors. Furthermore, it would be possible to give the citizens opportunity to invoke and configure service delivery, receive process support based on individual needs, monitor progress on pending requests or to view upcoming events giving a more complete picture and the possibility for proactive involvement; and in that possibly also acting as lead users or providers of feedback to the government lead users.

In situations where complex or emotional services are required, it should be possible to invoke a service from one service channel and continue to another with the process history intact. A simple example illustrate this: by providing information (supplementary channels) in a waiting room educating the citizen prior to an appointment with a public official, one will be more able to express needs or understand regulations. Similar principles could be applied when using online services where the user is either informed or is required to supply a certain amount of information qualifying for the next step. It is further important that the process state can be passed on between different organisations involved in the continuing process to reduce redundant loops. For users with special needs or with custom individual process, it is similarly important that the process instance dynamics and goals are accessible to involved actors to allow the required process execution.

From the citizen's point of view, process support would involve providing alerts and information about the state of currently acquired services. It could also involve updates for supplementary or replacement services based on needs or rights, or potential caveats that exists by using certain services, or limitations to customisation of service content. From the service provider or regulatory point of view, it would be necessary to coordinate ongoing processes involving services that are to be discontinued, replaced or changed. By mapping provided services to goals and individuals, different government organisations might also be able to see possibilities for joint collaboration for commonly used services or improved service synchronisation.

4 DISCUSSION AND RELATED WORK

Through our model of the dynamics of e-government service delivery and the scenarios presented, we have started the work of providing descriptions of the environment in which the next-generation digital government infrastructure will operate. There is a gap between the current and desired situation which is not identified, as well as we can say that the capabilities of the desired state are mainly related to the operational infrastructure, rather than the functionalities and outcomes of the services provided. Some of the ongoing work on identifying and filling the gap will be discussed with relation to our work and the model and scenarios presented.

Klievink and Janssen (2009) have developed a stage model focusing on growth and transformation between the stages identified by previously developed e-government stage models. They have started the work on identifying dynamic capabilities required to move from one stage to the next and the timing of developing these capabilities for them to be most effective. The capabilities are divided into four main groups covering stakeholders and the interaction of stakeholders, technological capabilities, capabilities to enable organisational change and the capabilities to handle the reconfiguration of service delivery.

Fountain (2001) looks at technology enactment and institutional change. She concludes that it is erroneous to attribute structural change directly to technology and that organisational, network, and institutional arrangements – and the behaviour embedded in them – play key roles in technology enactment. She refers further to three aspects of technological change that has contributed to an increase in network formation. These include the significant growth in the base of technologies that agencies can use and that one single agency cannot maintain proficiency in all the technical fields relevant to their policy domain. Furthermore, that the rapid pace of technological change makes it increasingly difficult for any single agency to keep up with the relevant technologies. Fountain points

to using virtual agencies as a means to handle the challenges government organisations are faced with due to these aspects.

There is an ongoing effort in several European countries focusing on the development of core components for e-government. A system for digital identification is one example of a core component that can facilitate service development and improved interoperability. Janssen and Kuk (2006) look at enterprise architectures in the perspective of complex adaptive systems, which describe transformational government quite well. One of the challenges with complex adaptive systems is in optimising the systems to find a best practice, as the solution space and number of possibilities are too vast and there is no practical way of finding the optimal configuration. Their case studies show that the development of core components to support autonomous development of independent systems that are later generalised and scaled up seems to be the right approach. This includes developing modular functionality and interface definitions to support the variety of systems at the local level, rather than through centralised definitions at the national level. The Norwegian project Tjenester på nett (online services), aimed to help municipalities, increases the amount of online self-service services to citizens, companies and organisations. The project included the modelling and documentation of the most commonly available municipal services, and by doing this, helping define best practice and create awareness of process documentation in municipalities.

Service science has been suggested as a separate field of research, among others touted by a group of researchers affiliated with IBM (Chesbrough and Spohrer, 2006). The focus area of service science is somewhat in convergence with e-government service delivery and that of complex adaptive systems. This includes the frequent lack of a central artefact in the exchange of services between several stakeholders and the role of transparency of service operations. Zieman et al. (2008) proposes a framework to systematically develop interoperable systems in public sector and Gottschalk and Solli-Sæther (2008) present stages of e-government operability up to the transformational government scenario. In the case of interoperability in both the service-centric and citizen-centric scenario, there is obviously a challenge of ownership and responsibility of the processes that fall between the traditional organisational barriers. Especially for the citizen-centric scenario this is the case, where a great deal of the information and processes around the citizen are outside the domain of the government agencies. There is research related to the ownership and coordination of cross-domain processes where one of the suggestions is using third-party intermediaries for the coordination of processes between autonomous and independent government organisations (Punia and Saxena, 2004).

Another important property in designing lasting enterprise architectures, as we have suggested earlier, is separating the functional framework capabilities and the functional requirements of the services. In addition to this comes the separation of rules or business logic of the functional requirements and the actual flow between process entities within a system or across system boundaries. Corradini et al. (2009) have looked at business rules in e-government applications and the combination of business procedures with business rules. In a scenario with customised citizen-centric service delivery, there is a question about having the access to change the rules and changing the flow and whether the rules add any constraints to the process flow.

When it comes to the BPM systems, there are several commercially available frameworks. The Itensil *dynamic process platform* is a solution supporting ad-hoc collaborative process work different from what found in traditional BPM systems, allowing process change on the fly and version control of individual process instances. Itensil uses a wiki-style framework integrated with Google Wave, supporting effective workspace redistribution. While the Itensil framework is designed for ad-hoc knowledge work in smaller teams, the approach is interesting with respect to large-scale process distribution, innovation and flexibility in government organisations. Lillehagen and Krogstie (2008) discuss active knowledge modelling and active models. Models are active when they available to the users at run time and support automatic synchronisation of the execution environment and behaviour of the system based on changes to the model made by the user. The models can further be dynamically extended to fit local contexts. Active knowledge modelling extends enterprise modelling and focus on the knowledge supporting work through models, methods and tools. Systems can evolve with

corporate knowledge and users build and manage their own work environment through model-generated workplaces. The work includes an overview of challenges structured into the following areas: society and community cooperation, collaborative business networking, interoperable enterprise cooperation, innovation and holistic design, knowledge and data representation and workplace regeneration and adaptability.

5 LIMITATIONS

Regarding the limitations of our work, there are some aspects of the model and scenarios that should be discussed. First of all, the model does not consider the inner workings of the elements of the model. It only identifies the main relations between the elements and how they affect each other. This means that any use of the model with respect to actual cases will have to be detailed to the given context. The missing depth is particularly important for the legislation process and its underlying politics. One can probably say that political direction is additionally affected from within, but internal processes of the elements are at this point outside the scope of our work.

An outcome of some political decisions is path dependency. This is not directly expressed in the model but is still an important factor to its understanding. The model incorporates short and long-running loops and the consequences of path dependency are a lock-in not easily to get out of. Nevertheless, seemingly unexpected occurrences take place, which can be the result of long-running processes one has previously been unaware of. Disruptive technology is also a key factor, as new technology affordances can change behaviour and introduce a process of change that allow a current service, infrastructure and organisational configuration to evolve. The scenarios we discuss are, however, based on the assumption that the transition to the infrastructure that supports transformational government has already taken place.

With this, the scenarios describe a technical goal-oriented rationality, which is in general not realistic for most large-scale government structures and organisations. Our focus for the scenarios is on the technical, business process, process modelling aspects and methods to coordinate these. That being said, it is important to understand that the gap between the described scenarios and current situation is not only technical. From the current situation to a complete transformational government, massive cultural and organisational changes are anticipated, if not required. We believe that by describing the scenarios based on the assumptions of an infrastructure and culture that supports the dynamics of a transformational government, these limitations can be made explicit. This can further make ground for reconsidering any over-optimism one might have on this matter.

Inter-agency cooperation is wrought with challenges, as the difficulty of adoption of universal best practices and the establishment of interoperability standards in e-government will attest. If it is not difficult enough to find and maintain a best practice within organisations, inter-agency standards for process work will have to be on a minimal level to allow individual flexibility and access to shared data. This is probably one of the main issues of the next-generation government infrastructures. The scenarios described, suggests that there should not be one best practice for all, but rather local best practices on the process level, based on infrastructure components that allow flexibility and co-evolution of virtual organisations that share the idea of best practice, even within the collaboration space of autonomies.

There is also a potential over-optimism related to our description of the role of the lead user, both from the provider's and citizen's point of view. In general, the scenarios take the position of the educated user. This position is basically based on the cultural leap anticipated prior to a true transformational government and from topics within e-inclusion and e-participation. We do not expect that all users have access, nor the competence to operate the adaptable parts of the interfaces of the scenarios described. This is neither required. Different groups can be responsible for developing functional modules and making them available within the active models. Process changes can be collective decisions of peers, and innovations occur at the point where suggested changes are adopted.

Access to services for citizens can be customised to the individual or through the assistance of a third party or from government service centres. The idea is that even though there is an infrastructure for customised individual processes and full transparency from the citizen point of view, the user does not need to access this information on an individual level for it to be useful.

When it comes to infrastructure components, lead users as developers are basically what we observe from the open-source communities today. And when government agencies consider open source software as a platform or tools in the delivery of services, lead user development is probably taken for granted. How open-source software development in a government setting will work in the long run is yet not known.

As our scenarios mainly discuss the evolution of processes and process work based on an infrastructure supporting transformational government, it also would have to be shown that the approach is valid for the development of infrastructure components not related to the provision of specific services or core components. One approach to this is local testing as proof of concept prior to global adoption. This might involve users in peer municipalities customising or developing infrastructure components for improving service administration or reducing costs related to service provisioning. On the basis of the outcome and success and the ability to communicate the improvements, the components can be shared with other municipalities with a similar service configuration.

When it comes to infrastructure components and technology affordances, there is a case where technology affordances at first are introduced as services and later evolve to become infrastructure components in which will be relied on for a long period of time. An example of this is the access and connectivity initiatives provided by the first e-government wave (Murphy, 2005) through the establishment of national connectivity for broadband Internet. Currently, citizens still have the choice whether they are willing to take advantage of e-government or access services based on what one can consider as a traditional service delivery. However, at the point where government service delivery is permeated with e-government, this is no longer a choice. One possible worst-case scenario for future service delivery is if the path dependency of e-government systems ends up in a state of lock-in, providing no service or infrastructure flexibility and with a cost of changing the systems supporting service delivery too high to align the supporting systems to changing regulations.

A proper infrastructure to support process work and collaboration in transformational government is vital to its success. We have created our scenarios where this infrastructure is assumed to be available. In this way, the scenarios provide examples of utility given the proper infrastructure and can act as a reference for future development of government support systems.

6 CONCLUSIONS

In this paper, we have introduced a model for the dynamics of service delivery useful for understanding important aspects of transformational government. On the basis of this model, we have created two scenarios using service-centric and citizen-centric approach. The goal is to use these scenarios for further work in understanding the requirements for the next-generation digital government infrastructure and the process execution, administration and innovation capabilities of such an infrastructure. Central to the service-centric scenario is the concept of a lead user and autonomous peer government agencies co-evolving the delivery of services provided based on the same set of regulations, but with local adjustments. Central to the citizen-centric scenario is an informed citizen able to interact proactively on services provided and potential services based on requirements of the different roles he has. Both the scenarios and the proposed model are discussed related to existing research and literature.

Our future work will focus on aspects related to the process support needed for users providing or receiving government services. We believe that true government transformation cannot be

accomplished without addressing the key features in our scenarios. This will most probably require work related to engineering, methods, organisation, culture and individuals.

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Paper 2

Analysis and design of business processes using BPMN

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ANALYSIS AND DESIGN OF BUSINESS PROCESSES USING BPMN

Gustav Aagesen and John Krogstie

Abstract

In 2004, the Business Process Modeling Notation (BPMN) was presented as a standard business process modeling language. Its development was considered to be an important step in reducing the fragmentation that was witnessed between the existing process modeling tools and notations. Since then BPMN has been evaluated in different ways by the academic community and has become widely supported by the industry. After completing the first major revisions of BPMN, the Object Management Group (OMG) is working toward a new BPMN standard, BPMN 2.0. This chapter summarizes some of the evaluations of BPMN and presents these together with reported experiences as well as some examples of proposed extensions and future expectations based on these.

1 INTRODUCTION

Models of business and work processes have for a long time been utilized to learn about, guide, and support practice in a number of areas. In software process improvement (Derniame, 1998), enterprise modeling (Fox and Gruninger, 2000), active knowledge modeling (Lillehagen and Krogstie, 2008), and quality management, process models describe methods and working procedures. Simulation and quantitative analyses are also performed to improve efficiency (Kuntz et al., 1998) (van der Aalst et al. 2010). In process-centric software engineering environments (Ambriola et al., 1997) and workflow systems (WfMC, 2000), model execution is automated. Thus, process modeling is not done for one specific objective only, which partly explains the great diversity of approaches found in literature and

Five main categories of usage of process modeling can be distinguished (Krogstie et al. 2008):

1. Human sense-making and communication to make sense of aspects of an enterprise and to support communication between different stakeholders. Sense-making models are used within an activity to make sense of something in an ad hoc manner, and will usually not be maintained afterwards.

2. Computer-assisted analysis to gain knowledge about the enterprise through simulation or deduction based on the contents of the model.

3. Quality management, following up the adherence of the work process to standards and regulations. Here the model is meant to act as part of a corporate memory meant to exist as a reference point over time and as input to and basis for process improvement.

4. Model deployment and activation to integrate the model in an information system. Deployment can be manual, automatic (in automated workflow systems), or interactive (Krogstie and Jørgensen, 2004).

5. Using the model as a context for a system development project, without being directly implemented (as it is in category 4).

Business Process Management (BPM) is a structured, coherent, and consistent way of understanding, documenting, modeling, analyzing, simulating, executing, and continuously changing end-to-end business process and all involved resources in light of their contribution to business performance (Recker et al., 2006). We see that the potential usage of modeling in BPM covers all the areas of use for process modeling in general as outlined above.

Traditionally, a wide variety of approaches and notations have been used for BPM and workflow. Inspired by a number of previous languages, BPMN has over the last years been promoted and

suggested as a standard and has been met with the same kind of diverse needs; i.e., to create models to be understandable both for humans and machines, for sense-making, quality management, simulation, and execution. The main approach for execution is the mapping of BPMN models to BPEL.

This chapter aims to identify and report on the main efforts to evaluate BPMN, both analytical and empirical, and by this providing a current state of the art on this area.

The following section will introduce BPMN and the remaining sections will focus on the evaluation of the language. We will introduce the methods used in evaluating BPMN briefly. The trends of the outcome of the evaluations will be presented. Some of the proposed extensions of BPMN will then be described.

2 BUSINESS PROCESS MODELING AND BPMN

The wide range of applications of process modeling described in the introduction is reflected in current modeling notations, which emphasize different aspects of work. Ten years ago, Carlsen (1998) identified five categories of process modelling languages: transformational, conversational (speech-act-based), role-oriented, constraint-based, and systemic. The increased interest in modeling processes with UML indicates that object-oriented process modeling can be looked upon as a sixth category. On the other hand, most process modeling languages take a transformational approach (input–process–output). Processes are divided into activities, which may be divided further into subactivities. Each activity takes inputs, which it transforms to outputs. Input and output relations thus define the sequence of work. This perspective is chosen for the standards of the Workflow Management Coalition (WfMC, 2000), the Internet Engineering Task Force (IETF) (Bolcer and Kaiser, 1999), and the Object Management Group (OMG, 2000) as well as most commercial systems for the last 10–15 years (Abbot and Sarin, 1994; Fischer, 2000). IDEF (1993), Data Flow Diagram (Gane and Sarson, 1979), Activity Diagrams (Booch et al., 2005), Event-driven Process Chains (Scheer, 2000), BPMN (BPMI.org; OMG, 2008) and Petri nets (van der Aalst et al., 2000) are well-known transformational languages. We focus here on this type of process modeling, with the emphasis on BPMN.

2.1 BPMN

In 2004, the Business Process Modeling Notation (BPMN) was presented as the standard business process modeling notation (White, 2004). Since then BPMN has been evaluated in different ways by the academic community and has become widely supported in industry.

There are currently 50 current and 4 planned implementation of (BPMN)[1]. The tool support in industry has increased with the awareness of the potential benefits of BPM. Analytical evaluations showing weaknesses in BPMN have been available for some time, but the first reports on the experiences and perceived use of BPMN have however been published just recently.

The Business Process Modeling Notation (BPMN version 1.0) was proposed in May 2004 and adopted by OMG for ratification in February 2006. The current version is BPMN 1.1 (OMG, 2008) and the following version BPMN 2.0 is in development. BPMN is based on the revision of other notations and methodologies, especially UML Activity Diagram, UML EDOC Business Process, IDEF, ebXML BPSS, Activity-Decision Flow (ADF) Diagram, RosettaNet, LOVeM, and Event-driven Process Chains.

The primary goal of BPMN was to provide a notation that is readily understandable by all business users, from the business analysts who create the initial draft of the processes, to the technical developers responsible for implementing the technology that will support the performance of those

[1] http://www.bpmn.org/

processes, and, finally, to the business people who will manage and monitor those processes (White, 2004).

Another factor that drove the development of BPMN is that, historically, business process models developed by business people have been technically separated from the process representations required by systems designed to implement and execute those processes. Thus, it was a need to manually translate the original process models to execution models. Such translations are subject to errors and make it difficult for the process owners to understand the evolution and the performance of the processes they have developed. To address this, a key goal in the development of BPMN was to create a bridge from notation to execution languages. As indicated above BPMN models can be activated through the mapping to BPEL.

BPMN allows the creation of end-to-end business processes and is designed to cover many types of modeling tasks constrained to business processes. The structuring elements of BPMN will allow the viewer to be able to differentiate between sections of a BPMN Diagram using groups, pools, or lanes. Basic types of submodels found within a BPMN model can be *private business processes* (internal), *abstract processes* (public), and *collaboration processes* (global).

Private business processes are those internal to a specific organization and are the types of processes that have been generally called workflow or BPM processes.

Abstract processes represent the interactions between a private business process and another process or participant. Abstract processes are contained within a Pool and can be modeled separately or within a larger BPMN diagram to show the message flow between the abstract process activities and other entities.

Collaboration processes depict the interactions between two or more business entities. These interactions are defined as a sequence of activities that represent the message exchange patterns between the entities involved.

2.2 Language constructs and properties

The Business Process Diagram is the graphical representation of the BPMN. Its language constructs are grouped in four basic categories of elements, viz., Flow Objects, Connecting Objects, Swimlanes, and Artifacts. The notation is further divided into a core element set and an extended element set. The intention of the core element set is to support the requirements of simple notations and most business processes should be modeled adequately with the core set. The extended set provides additional graphical notations for the modeling of more complex processes.

Flow objects (Fig. 1) contain events, activities, and gateways. Events are either start events, intermediate events, or end events. Activities are divided into process, subprocess, and tasks and denote the work that is done within a company. Gateways are used for determining branching, forking, merging, or joining of paths within the process. Markers can be placed within the gateway to indicate behavior of the given construct.

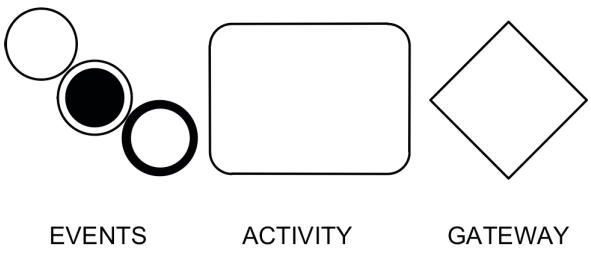

Figure 1 BPD elements events (start, intermediate, and end), activity, and gateway

Connecting objects (Fig. 2) are used for connecting the flow objects. Sequence Flow defines the execution order of the activities within a process while Message Analysis and Design of Business Processes Using BPMN 217

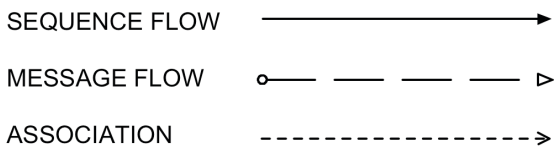

Figure 2 BPD connection objects: Sequence flow, message flow, and association

Flow indicates a flow of messages between business entities or roles prepared to send and receive them. Association is used to associate both text and graphical nonflow objects with flow objects.

Swimlanes (Fig. 3) are used to denote a participant in a process and acts as a graphical container for a set of activities taken on by that participant. By dividing Pools into Lanes (thus creating subpartitioning), activities can be organized and categorized.

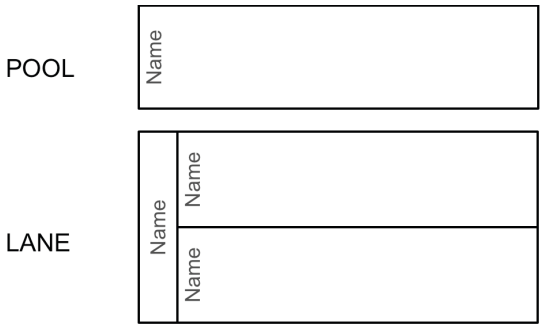

Figure 3 BPD pool and lanes

Artifacts (not illustrated) are data objects, groups, and annotations. Data Objects are not considered as having any other effect on the process than information on resources required or produced by activities. The Group construct is a visual aid used for documentation or analysis purposes while the Text Annotation is used to add additional information about certain aspects of the model.

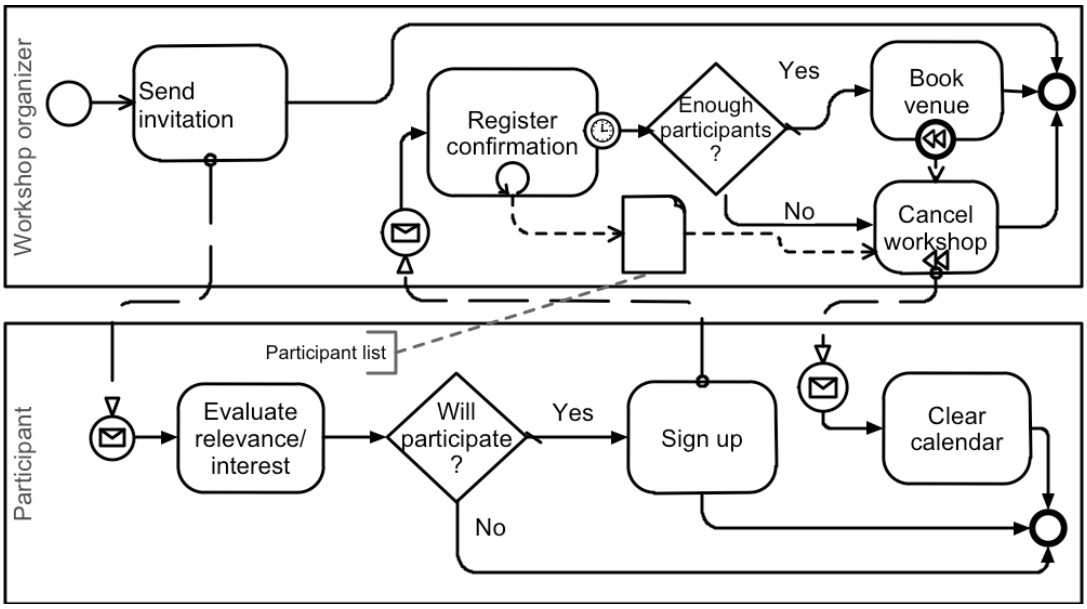

Figure 4 BPMN model showing the summons for a workshop

Figure 4 shows an example BPMN process summoning participants for a workshop. The workshop organizer sends out the invitations, which are received by the potential participants. The participants evaluate the relevance of the workshop and decide whether they will participate or not. Those who want to participate, sign up for the workshop by informing the organizer.

The organizer registers the confirmations from the participants until the deadline for registering, making a list of participants. When the deadline is reached (indicated by the timer event on the looping register confirmation activity), the organizer will see if there are enough participants to conduct the workshop. If there are too few participants, the organizer will inform those participants who signed up that the workshop is canceled, and the registered participants will clear their calendar for the day.

If there are sufficient participants registered for the workshop, the organizer will try to book a venue. But if there is no venue available, the workshop will have to be canceled by informing registered participants. This is shown using the compensation and undo activity.

3 EVALUATIONS OF BPMN

The importance of evaluating available methods for modeling increases as the amount of available methods grow, since the results will guide the users in selecting the most fit method for the task at hand. Traditionally the research community has focused on creating new modeling languages rather than evaluating those that already exist (Wahl and Sindre, 2005).

By evaluating existing methods one will not only be able to compare their suitability for solving the problem at hand, but it will also help determine the skills required of the user and model audience, before taking on the modeling task. By using formalized frameworks in the assessment of newly arrived methods and comparing the data with results from earlier studies it would be possible to determine whether the overall rating of the new method is higher than its predecessors.

Different approaches to evaluating modeling languages include analytical and empirical methods, and both single-language and comparative evaluations exist. Empirical methods should investigate both the possibility for modelers to use the language, comprehension of models developed in the language, and the ability to learn from and act according to the knowledge provided in the models (Gemino and Wand, 2003; Krogstie et al., 2006). While analytical evaluations can be conducted as soon as the specification of the language is made available, empirical evaluations would in most cases require the users of the new method to have some experience with its use, and for that the method would need some time with the user community before evaluations can take place. Empirical studies might involve the investigation of whether the results from the analytical studies are supported and to what extent they have impact in practice. It would also involve performing case studies and surveys to discover if the method is as appropriate as expected and if it is used according to expectation.

BPMN is no longer considered to be new and it has been evaluated both analytically and empirically. The following section introduces the evaluation approaches followed by their outcomes. The evaluation results will be summarized in Sect. 4. For details about the evaluations please refer to their original reporting.

3.1 Ontological analysis using the Bunge-Wand-Weber framework

As computerized information systems are representations of real-world systems, Wand and Weber suggest that a theory of representation based on philosophical ontology can be used to help define and build information systems that contain the necessary representations of real-world constructs including their properties and interactions (Rosemann et al., 2006). The Bunge–Wand–Weber framework defines a set of models based on an ontology defined by Bunge in 1977 (Wand and Weber 1993; Recker et al., 2006). The BWW representation model is one of these models, and it is suggested that it can be used to analyze a particular modeling technique so as to make predictions on the modeling strengths and weaknesses of the technique, in particular its capabilities to provide complete and clear

description of the domain being modeled. The current key constructs of the BWW model can be grouped into the following clusters: things including properties and types of things; states assumed by things; events and transformations occurring on things; and systems structured around things.

Two main evaluation criteria may be studied according to *Ontological Completeness* and *Ontological Clarity*.

Ontological Completeness is decided by the degree of construct deficit, indicating to what level the modeling language maps to the constructs of the BWW representation model.

Ontological Clarity is decided by construct overload, where the modeling language constructs represent several BWW constructs, construct redundancy, where one BWW construct can be expressed by several language constructs and construct excess, having language constructs not represented in the BWW model.

Three reasons for selecting the BWW framework for evaluating BPMN is stated by Recker et al. (2005): It has, unlike other ontologies, been derived with the Information Systems discipline in mind. It is an upper ontology, with a comprehensive scope that allows wide applicability. Further, there is an established track record and demonstrated usefulness of ontological analyses of modeling techniques using BWW.

BWW based evaluations are presented in Recker et al. (2005), Rosemann et al. (2006), and Recker et al. (2007) and their findings include:

Representation of state. The BPMN specification provides a relatively high degree of ontological completeness (Rosemann et al., 2006), but BPMN is not ontologically complete. For example, states assumed by things cannot be modeled with the BPMN notation. This situation can result in a lack of focus in terms of state and transformation law foundations for capturing business rules.

System structure. Systems structured around things are under-represented, and as a result of this problems will arise when information needs to be obtained about the dependencies within a modeled system.

Representational capabilities compared with other approaches. A representational analysis was done in Rosemann et al. (2006) on different approaches that show that BPMN appears to be quite mature in terms of representation capabilities. This can perhaps be partly explained by the fact that the previous approaches like EPC and Petri nets influence the development of BPMN. It is interesting that only BPMN of the process modeling notations is able to cover all aspects of things, including properties and types of things. From this it is possible to note that BPMN appears to denote a considerable improvement compared with other techniques. The combination of ebXML and BPMN would provide maximum ontological completeness (MOC) with minimum ontological overlap (MOO) (Recker et al., 2005).

3.2 The workflow patterns framework

The Workflow Patterns Framework[2] (van der Aalst et al., 2003; Russell et al., 2006) provides a taxonomy of generic, recurring concepts, and constructs relevant in the context of process-aware information systems (Wohed et al., 2005) (see also Ouyang et al., 2010).

The workflow patterns describe a core of foundational structures that one could expect workflow systems to support. Defining these patterns made it possible to compare the expressive power of available commercial tools for business process modeling. Later, the patterns have been found applicable in a much broader sense and they have been used to examine the capabilities of business process modeling languages such as BPMN, UML Activity Diagrams, and EPCs; web service

[2] http://www.workflowpatterns.com/

composition languages such as WCSI; and business process execution languages such as BPML, XPDL, and BPEL (Russell et al. 2006).

The available patterns are divided into the *control-flow perspective*, the *data perspective*, and the *resource perspective*. The original patterns were comprised of 20, 40, and 43 patterns, respectively. A revision of the control-flow patterns conducted in 2006 resulted in additional 23 patterns.

Three reasons for selecting the Workflow Patterns Framework are stated by Recker et al. (2007). It is a well accepted framework that has been widely used both for the selection of workflow management systems as well as vendor's self-evaluations of process modeling products; The framework has proven impact in the industry and it has triggering extensions to process modeling systems and inspired their development.

Workflow pattern-based evaluations are presented in Recker et al. (2007) and Wohed et al. (2005; 2006). The outcomes of the evaluations include:

Representation of state. Due to the lack of representation of state in BPMN there are difficulties in representing certain control-flow patterns (Wohed et al., 2006). There are further inherent difficulties in applying the Workflow Patterns Framework for assessing a language that does not have a commonly agreed-upon formal semantic or an execution environment. The BPEL mapping provided in the BPMN specification is only partial, leaving aside models with unstructured topologies. There are several ambiguities that can be found in the BPMN specification due to the lack of formalization (Wohed et al., 2006).

Multiple representations of the same pattern. The simple workflow patterns have multiple BPMN representations while capturing the most advanced patterns required deep knowledge of the attributes associated to BPMN's modeling constructs that do not have a graphical representation.

Support for instances. Workflow and environment data patterns are not supported due to the lack of support for instance-specific data for a task or subprocess with a "multiple instance" marker cannot be specified.

Resource modeling. Support for the resource perspective in BPMN is minimal, but the modeling of organizational structures and resources is regarded to be outside the scope of BPMN. The authors state that the lane and pool constructs are in contradiction to this.

3.3 SEQUAL

SEQUAL (Semiotic Quality Framework) (Krogstie et al., 2006; Lillehagen and Krogstie, 2008) is used for evaluating different quality aspects of models, and for evaluating the potential of the language to build models having high quality based on the appropriateness of the domain in which the language is applied. The framework is based on linguistic and semiotic concepts (Reijers et al., 2010).

The dimensions in which model quality is determined are as follows. *Physical quality*: The basic quality goal is that the model is available for the audience. This includes aspects related to digital distribution and file formats. *Empirical quality* deals with predictable error frequencies when a model is read or written by different users, coding (e.g., shapes of boxes) and HCI-ergonomics for documentation and modeling-tools. *Syntactic quality* is the correspondence between the model and the modeling language extension. Semantic quality is the correspondence between the model and the domain, including validity and completeness. *Perceived semantic quality* is the similar correspondence between the audience interpretation of a mode l and his or hers current knowledge of the domain. *Pragmatic quality* is the correspondence between the model and the audience's interpretation and application of it. SEQUAL differentiates between social pragmatic quality (to what extent people understand and are able to use the models) and technical pragmatic quality (to what extent tools can be made that interpret the models, e.g., for execution purposes). Pragmatic quality also includes in what extent the participants and audience after interpreting the model are able to learn based on the model and are able to act based on that knowledge to interact with or change the domain (preferably in a

positive direction relative to the goal of modeling). *Social quality* is determined based on agreement among audience members' interpretations of the model while the *organizational quality* of the model relates to that all statements in the model contribute to fulfilling the goals of modeling (organizational goal validity), and that all the goals of modeling are addressed through the model (organizational goal completeness).

Language quality is a mean to achieve model quality and relates the modeling language used, and its appropriateness for the modeling task based on six quality areas. *Domain appropriateness* relates the language and the domain. Ideally, the language must be powerful enough to express anything in the domain, not having what Wand and Weber (1993) terms construct deficit. On the other hand, you should not be able to express things that are not in the domain, i.e., what Wand and Weber (1993) terms construct excess. Domain appropriateness is primarily a mean to achieve semantic quality. *Participant appropriateness* relates the social actors' explicit knowledge to the language. Participant appropriateness is primarily a mean to achieve pragmatic quality both for comprehension, learning, and action. *Modeler appropriateness* relates the language to the knowledge of the modeler. Modeler appropriateness is primarily a mean to achieve semantic quality. *Comprehensibility appropriateness* relates the language to the social actor interpretation. The goal is that the participants in the modeling effort using the language understand all the possible statements of the language. Comprehensibility appropriateness is primarily a mean to achieve empirical and pragmatic quality. *Tool appropriateness* relates the language to the technical audience interpretations. For tool interpretation, it is especially important that the language lend itself to automatic reasoning. This requires formality (i.e., both formal syntax and semantics being operational and/or logical), but formality is not necessarily enough, since the reasoning must also be efficient to be of practical use. This is covered by what we term analyzability (to exploit any mathematical semantics of the language) and executability (to exploit any operational semantics of the language). Different aspects of tool appropriateness are means to achieve syntactic, semantic, and pragmatic quality (through formal syntax, mathematical semantics, and operational semantics, respectively). *Organizational appropriateness* relates the language to standards and other organizational needs within the organizational context of modeling. These are means to support organizational quality.

For more information on SEQUAL, please refer to Krogstie et al. (2006) and Lillehagen and Krogstie (2008).

3.3.1 Evaluating BPMN using the semiotic framework

Semiotic evaluations of BPMN are performed by Nysetvold and Krogstie (2006), Wahl and Sindre (2005) and discussed in Recker et al. (2007). The approach has also been used for the evaluation and comparison of a number of other modeling notations. In relation to BPMN the following findings can be mentioned:

Support for business-specific terms. Wahl and Sindre (2005) confirm that the constructs of the language do not contain any business-specific terms even though the purpose of the language is the modeling of business processes. Because of this, it would be applicable to model nonbusiness-related processes using BPMN, but only to a certain extent.

Understanding and use of constructs. The language notation is similar to that of other available languages with the same purpose, which would be helpful with users familiar with different approaches. The goal of BPMN is, however, to be understandable not only for users with previous experience and the complexity of the most advanced aspects of BPMN is, according to the authors, unrealistic to grasp without extensive training. This is somewhat confirmed by the case study reported by zur Mühlen and Ho (2008) (see Sect. 3.7).

Diagram layout. The authors also argue that it would be hard to externalize relevant knowledge using only BPDs if the knowledge in question goes beyond the domain of business processes. There are few strict guidelines in the BPMN specification on how to layout diagram constructs in relation to each other, which proposes a potential for creating BPDs with poor empirical quality.

3.3.2 Empirical evaluation of BPMN, EEML, and UML activity diagrams

Nysetvold and Krogstie (2006) conducted an empirical evaluation of BPMN relative to EEML (Krogstie, 2008) and UML Activity Diagrams using the SEQUAL framework. The usage area to be supported was process modeling in relation to implementation of Service-Oriented Architecture (SOA) in an insurance company. The evaluation rank BPMN highest in all categories except domain appropriateness (expressiveness), in which EEML came out best. However, EEML lost to BPMN on both tool and modeler appropriateness. The evaluation on domain appropriateness partly overlapped the evaluations above, e.g., by including an evaluation relative to control patterns. Other parts of this evaluation were adapted particularly to the expressed needs in the organization based on existing experience.

Comprehensibility appropriateness is the category that was appointed the second highest importance (based on number of criteria), since the organization regarded it to be very important that it was possible to use the language across the different areas of the organization and to improve communication between the IT-department and the business departments. In this category, BPMN and Activity Diagrams ranked equally high, which is not surprising given that they use the same swimlane-metaphor as a basic structuring mechanism. The reason why EEML came out behind is primarily due to the graphical complexity of some of the concepts, combined with the fact that EEML has a larger number of concepts in total, not surprising given that is a general enterprise modeling notation also useful for data, resource, and goal modeling.

Participant appropriateness and tool appropriateness were given equal importance, and BPMN ranked somewhat surprisingly high on both areas. When looking at the evaluation not taking tool appropriateness into account, the three languages ranked almost equal. Thus, it was in this case the focus toward the relevant implementation platforms (BPEL and web services) that ranked BPMN highest. On the other hand, the focus on tool appropriateness did not appear to get in the way for the language as a communication tool between people, at least not in this case.

In the category organizational appropriateness, BPMN and Activity Diagrams ranked almost equal. The organization had used UML and Activity Diagrams for some time, but it also appeared that tools supporting BPMN were available for the relevant parts of the organization.

3.4 Combined semiotic, ontological and workflow patterns evaluation

Recker et al. (2007) propose a generic framework for language evaluation based on the combination of ontological, semiotic, and pattern-based evaluation. They report on the first attempt to classify existing theoretical frameworks for process modeling language evaluation by using this framework. Their work provides an evaluation of existing frameworks as well as an evaluation of BPMN. For more information on the framework, consult Recker et al. (2007).

Some general statements on BPMN can be summarized from the analysis based on the study of Recker et al. (2007), which partly confirms the findings of the studies performed by the standalone approaches:

Representation of state. BPMN lacks the capabilities to model state-related aspects of business processes and is limited, if not incapable of modeling states assumed by things and state-based patterns.

Specialization of constructs. BPMN lacks attributes in the specification of the language constructs.

Weak support for resource modeling. There is lacking support for representing resource patterns and the evaluation comment the same as Wohed et al. (2006) when regarding the lane and pool constructs that are additionally criticized for being overloaded.

Redundant constructs. There is a relatively high degree of construct redundancy, which might explain why there are as many as three different BPMN representations for the same basic workflow patterns (Wohed et al., 2006).

3.5 Formal analysis using Petri nets

Dijkman et al. map BPMN models to Petri Nets to be able to use efficient analysis techniques already available for Petri Net models. In doing this, they are able to evaluate the semantic correctness of BPMN models as well as disambiguating the core constructs of BPMN. The approach is used for empirical analysis with BPMN models found online. For more information on their work, consult Dijkman et al. (2007).

In converting BPMN diagrams to Petri Nets, Dijkman et al. (2007) discovered some issues in the BPMN specification and discuss possible solutions for these.

Process models with multiple start events. This is a situation where the BPMN specification indicates that each start event should generate a process instance. In situations where there are multiple start events without wait, there has to be some correlation mechanism to link the occurrence of a start event to an appropriate process instance.

Process instance completion. This is a situation where there are multiple end events and no clear indication in the specification when a process model is considered to be "completed". When the first end is reached, or when all tasks have met their end.

Exception handling for concurrent subprocess instances. There are unaddressed issues in the specification regarding the interrupt caused by subprocesses experiencing exceptions in a parallel multi-instance activity. The unclarity is related to whether the exception caused would only affect the subprocess in question or all subprocess instances spawned by the invocation activity.

OR-join gateway. The semantics of OR-join gateways is argued to be unclear regarding the relative definition of "upstream". It is advised that the BPMN specification adopt existing semantics with a formal foundation rather than attempting to define a new one.

3.6 Semistructured interviews of BPMN users

One effort to seek empirical evidence of theoretical propositions is done by following up a BWW representational analysis (see Sect. 3.1) with semistructured interviews with BPMN users. The research questions for this study were initially to discover the representational shortcomings of BPMN in light of the BWW-framework and to discover which of these were perceived as actual shortcomings by the BPMN users. This study involved 19 participants from six organizations distributed over four Australian states. The results are reported in Recker et al. (2005; 2006).

A follow-up of this study is the latest reported empirical evaluation of BPMN. A web-based survey performed between May and August 2007 including 590 BPMN users from different parts of the world. A presentation of the results is available in Recker (2008).

Interviews based on weaknesses discovered by representational analysis uncover how this affects the users (Recker et al., 2006).

Workarounds to fit local needs. The general impression regarding construct deficit is that even though the participants claim that they do not need to model state changes, business rules, or system structure they in fact find workarounds and represent this information outside the BPD itself. In modeling events, as many as 74% did not experience any limitation in using BPMN for this, and the problem declined for users using the expanded set compared with interviewees using the core set of elements. This is in contradiction to the theoretical proposition claiming that there would be confusion connected to using the expanded set.

Construct overload. The analytical evaluation proposed that there would be ambiguities regarding the lane and pool constructs. This was supported by the interviews and is mainly based on the fact that these constructs are used to represent a whole range of different real-world constructs as discussed in Recker et al. (2007).

In reporting the web-based quantitative survey (Recker, 2008), the following issues were identified:

Support for business rule specification. Rule specification is an essential task in understanding business processes, and it would be good to see that process modeling solutions acknowledge this a bit better and provide support for this. This is suggested by one of the participants to be as simple as an additional graphical symbol implying that there is a business rule at work.

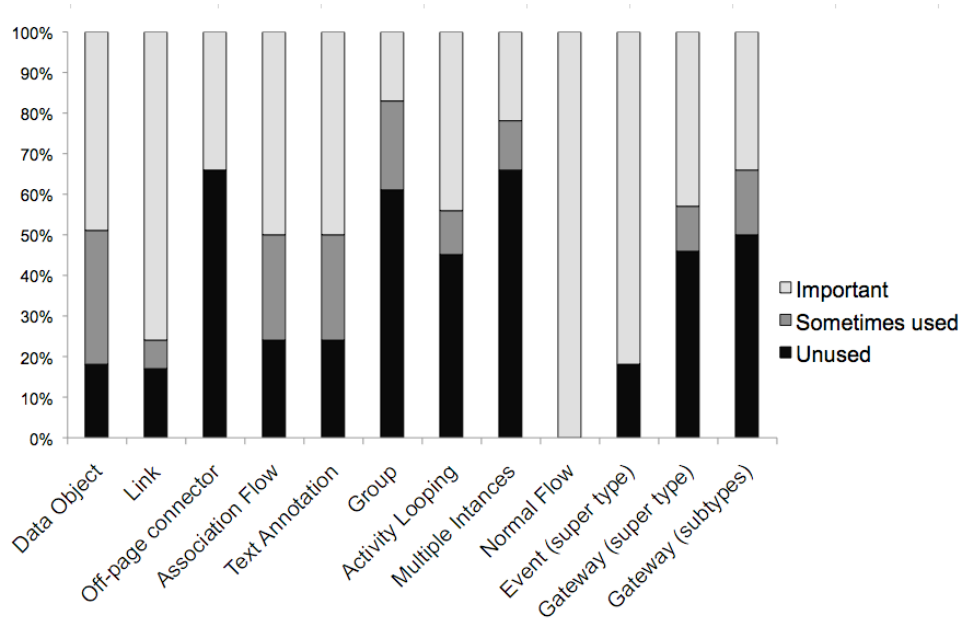

Figure 5 Reported need for BPMN constructs (Adapted from Recker, 2008)

Figure 5 shows results from the survey for the expressed need for the different BPMN constructs.

Weak support for resource modeling. The ambiguity that comes with the flexible semantics of lanes and pools is contradictory to their ease of use in modeling. One advice here is to provide better support for differentiating the multiple purposes for which lanes and pools can be used.

Understanding and use of constructs. The survey show that there is some doubt related to the use of gateways, off-page connectors, and groups. Basically, there is confusion on when to use these concepts and why. This might stem from the fact that they are constructs of the model and not the process modeled. When it comes to events, it is a question of frustration related to selecting the right kind of event.

3.7 Case study of BPMN in practice

zur Mühlen and Ho (2008) followed the redesign of a service management process in a truck dealership in USA using action research. The study included reports on experiences from using BPMN with participatory modeling of the AS_IS and TO_BE process and the activation of the models for simulation purposes, providing the following results:

Understanding and use of constructs. Experience from the case study shows that the core set is used and understood. In cases where the entire set of BPMN constructs is used the audience tends to

disregard the richer meaning provided by the extended set (zur Mühlen and Ho, 2008). The applied notation is primarily limited to the core constructs.

Workarounds to fit local needs. Use of constructs different from what suggested in the specification has been observed. Modelers purposely create syntactically wrong models to improve readability and to simplify the modeling task. One example of this is placing activity constructs across lanes to indicate that there are several organizational units participating in completing a task.

Tool dialects. The tool used had its own BPMN dialect that was not fully compliant with the official BPMN specification.

3.8 Statistical analysis of BPMN models

Similar to the work of Dijkman et al. (2007) mapping models to Petri Nets for analysis, zur Mühlen and Recker (2008) have coded BPMN models to Excel spreadsheets and used the representation with different mathematical tools for statistical analysis and comparison. The models investigated were collected from three different groups: models used in consulting project, models created as part of BPMN education seminars, and models found online. Investigated phenomena include the general use of constructs, their frequency of use, and the correlation of use of different constructs.

Modeling constructs use similar to that of natural language. By arranging constructs by frequency, the study revealed a distribution similar to the distribution previously observed for natural languages. This suggests that the use of BPMN constructs for expressing business processes mirrors the use of natural language. This would further suggest that expressiveness is based on the modelers existing vocabulary and that one will use whatever constructs one has knowingly available. The study found further support for this through observing that precise semantics is used by the consultant group and for models created in seminars, thus suggesting that this is based on formal training increasing construct vocabulary. Like many natural languages, BPMN has a few essential constructs, a wide range of constructs commonly used, and an abundance of constructs virtually unused (zur Mühlen and Recker, 2008).

Precise constructs replace the need for text annotations. Another issue discovered by mapping the correlation of constructs is based on the negative correlation between the extended set gateways and text annotations. Text annotations seem to act as a substitute for formal event and gateway types by describing their behavior informally.

Practical language complexity does not equal theoretical complexity. Based on the result, the study also made an attempt to measure the practical complexity of BPMN based on the number of semantically different constructs used in each model. On average this resulted in the number of different constructs used as 9 (consulting), 8.87 (web), and 8.7 (seminars). There is, however, variation in what constructs are used, but nevertheless this has provided an image of a far less practical complex language compared with its theoretical complexity opening for as many as 50 different constructs in one model. Altogether, there was found six pairs of models out of 120 models examined that shared the same constructs, but there were several models sharing the same construct combinations or subsets.

Models focus on choreography or orchestration, not both. By organizing the model subsets using Venn diagrams showing what subsets were used in combination, the study revealed that modelers either focus on process orchestration by refining models by means of extended gateways or they focus on process choreography by adding organizational constructs, such as pools and lanes (zur Mühlen and Recker, 2008).

4 REPORTED RESULTES OF THE EVALUATIONS

Even if there were criticism of a modeling approach based on analytical evidence, the potential weaknesses would have to be backed up or confirmed empirically to determine its real impact. A

weakness based on analytical proof found in some remote part of a specification might not even be apparent to the user not aware of its existence, or in the opposite case the user might end up designing erroneous or ambiguous models due to poor formalism or tool support.

In this section, we will look at both the analytical and empirical evaluations together to identify similarities and difference. We will see that the consequences of the findings to a large extent depend on the goal of the modeling task, and that the goal of the language itself also must be taken into consideration when assigning the final score. BPMN seeks to serve both a broad audience in the business segment on the one hand, and on the other hand it reaches out to the technical community. In doing so, it is of potential use within all five categories of process modeling, as suggested by Krogstie et al. (2008), and further it has several groups of users whose requirements for use and modeling goals are quite different.

We will use the six language quality areas of SEQUAL (Krogstie et al., 2006) to classify the findings in the different evaluations. This is both out of convenience and based on the fact that it is a readily available framework for classifying quality, and thus it should be able to cover the findings.

4.1 Domain appropriateness

Weak support for resource modeling is discovered using the Workflow Patterns Framework and the generic framework. This is confirmed also by the semistructured interviews and web-based surveys. In addition the BWW framework finds BPMN to have weak support for modeling system structure. The statistical analysis shows that BPMN models focus on choreography or orchestration, not both.

The BWW and Workflow Patterns Framework also find the representation of state to be weak. The generic framework confirms this, which does not come as a surprise since it is based on the first two

4.2 Modeler appropriateness

Missing support for business rule specification is one weakness mentioned in the web-based survey, whereas the semiotic and generic evaluation framework is missing the support for business-specific terms or specialized constructs. One workaround for these issues is observed in the semistructured interviews where there are cases where own constructs are used to fit the modeling needs. There is also an observed difference in the use of text annotations, particularly they tend to be used less for models designed by using more precise constructs from the extended set and in the opposite case act as a surrogate for the expressiveness of rich constructs in less precise models.

4.3 Participant appropriateness

Several evaluations discuss the understanding and use of constructs and the key findings include the fact that some form of training is needed to use BPMN properly. Constructs like the off-page connectors support modeling and not the process which can be confusing for some users.

4.4 Comprehensibility appropriateness

There are redundant constructs in BPMN and there are cases of multiple representations of the same patterns. In addition the lane and pool constructs are considered to be overloaded. The practical language complexity does not, however, equal the theoretical complexity and in understanding models, there is a tendency to disregard the richer meaning of the extended set. This is probably the only area in which the empirical evaluations do not directly support the analytical.

4.5 Tool appropriateness

Workflow patterns report the lack of support for representation of multiple instances.

The Petri net analysis reveals some issues regarding the use of BPMN for simulation in cases with multiple start or end events and concurrency of subprocesses. There are also indications of a need for a more formal definition of the semantics of the language.

4.6 Organizational appropriateness

The case study of BPMN in practice discovered an issue related to the fact that there are several different tool dialects and these are not fully compliant with the BPMN specification.

5 BPMN EXTENSIONS

Results from the evaluations show that users are able to find workarounds for some of the weaknesses found in BPMN. In most of these cases, there is a gap between what is possible to achieve using BPMN and the desired goal of the user. One way to approach this problem is by building extension to close this gap, and by doing this, prototype different kinds of functionality possible to include in the BPMN specification. The following section presents four reported efforts to extend BPMN and by this show identified weaknesses discovered by means of practical use and proposed solutions for these weaknesses. The first three proposals address issues related to choreography, semantic correctness, and modeling of resources while the fourth discusses a topic not discussed in the evaluations but which is still important: Combining user-interface modeling with process modeling which is relevant in scenarios involving the reengineering of existing processes supported by information systems for the end user.

5.1 Using BPMN for modeling choreography

An assessment of BPMN using the Service Interaction Patterns (Barros et al. 2005) presented by Decker and Puhlmann (2007) shows weak support for modeling complex choreographies in BPMN. This weakness is connected to distinguishing between several instances of participants and using references to single participants for messaging. By adding participant sets, references, reference sets, and reference passing to BPMN this paper demonstrates that it would be possible to support most of the service integration patterns. The authors also point out an unclarity in the semantics of the BPMN data objects regarding their ability to buffer data similar to what is possible in UML Activity Diagrams. Based on this, a required distinction between data object and data object sets is introduced to their extension of BPMN. Aspects raised by the need of choreography modeling are discussed by Barros et al. (2009) in this Handbook.

5.2 Checking semantic correctness using Petri Nets

By using the XML serialization created by a BPMN tool, Dijkman et al. (2007) have implemented a tool to translate BPMN models to Petri Nets via the Petri Net Markup Language (PNML). Once converted to a Petri Net, the BPMN model can be semantically analyzed using Petri net analysis toolset. This work is limited to the control-flow perspective of BPMN and the order in which activities and events are allowed to occur. Weaknesses found in this paper are discussed in Sect. 4, but the suggested extension allowing semantic validation of BPMN models is considered to be a potentially helpful tool for assisting the building of formal models.

5.3 Modeling of task-based authorization constraints in BPMN

An extension of BPMN is suggested by Wolter and Schaad (2007) to support resource allocation patterns. These patterns allow specifying authorization constraints, for instance role-task assignments, separation of duty, and binding of duty constraints. This is done by adding security relevant semantics to the group and lane elements of BPMN and deriving a new textual artifact from the textual

annotation element. Extending BPMN with the support for describing security aspects of workflow can widen its scope and application and can be relevant also for modeling business scenarios.

5.4 Combined user-interface and process modeling

The main approach for execution support of BPMN is mapping to BPEL. On the other hand, the focus of BPEL engines is on process executions and not on the user- interface of the applications, which in practice can result in good process support systems that is hampered by an inappropriate user-interface, thus meeting unnecessary implementation problems. Trætteberg (2008) presents an approach for combining model-based user-interface design (MBUID)-approaches with BPMN as a task modeling language to make it easier to develop appropriate user-interfaces and user-interfaces applicable for user tailoring for BPM-solutions.

6 DISCUSSION AND CONCLUSION

This chapter has identified and reported on the main efforts to evaluate BPMN, both analytical and empirical. From the findings it is possible to suggest that the analytical evaluations performed are at this point sufficient and self-confirming. Even though there is little evidence from the empirical investigations so far, it seems like most of the weaknesses uncovered by analytical evaluations are by the users treated lightly and through workarounds.

Local model interpretation and tool dialects might be problematic, as models will not be directly available for externalization and interoperability issues might arise when moving models between organizations or groups within organizations.

Two issues related to tool appropriateness not mentioned by the reported evaluations covered already, but which are apparent problems in BPMN, are that there is no explicit meta-model for BPMN and there is not specified any means for interchanging BPDs between the different modeling tools (Frankel 2008).

By limiting the evaluation of practical use of BPMN within one organization or group, some of the analytically identified weaknesses might not be problematic since the model has limited use and fit local (but not organizational) goals. When evolving the same model through different phases, from sense-making to analysis through simulation, and when integrating the model to the process by involving different tools for modeling, simulation, and execution, which also requires different levels of formalism and detail and user skill, this suggests that BPMN in fact does not scale up for the use across organizations unless there is formal training based on precise semantics and that the BPMN tools are built on a precise meta-model.

There is a level of freedom requested by the modelers not needing to express formal models and by restricting the creation of ad hoc models and process sketches one might discriminate against one of the key user groups. The question is whether formality and freedom are in conflict and if there are conflicts within the goal of the language of being readily available for both technical and nontechnical users.

The focus in most evaluations so far has been on BPMN in isolation and, except for two cases, little comparison between BPMN and other approaches has been done. The evaluations on which this report is based are primarily based on BPMN 1.0 and not the maintenance version (BPMN 1.1). As for the empirical studies these are partly reliant on the local implementation of BPMN and the dialect of the BPMN tool in question, rather than the specification.

On the account of BPMN 2.0 it might be that there are issues within BPMN that are more important to solve than others in order for the continued use and growth of BPMN. The overall goal for BPMN 2.0 (OMG, 2007) is to integrate both notations, meta-model and interchange format within one language. Requested features include the following: Aligning BPMN with the Business Process Definition Meta-model (BPDM). Based on current proposals (Frankel 2008), it is not sure whether BPMN will be used

as meta-model or if there will be a dedicated BPMN 2.0 meta-model mapping to BPDM; Enabling the exchange of business process models and their diagram layouts among process modeling tools to preserve semantic integrity; Expand BPMN to allow model orchestrations and choreographies as stand-alone or integrated models; Support the display and interchange of different perspectives on a model that allow a user to focus on specific concerns; Serialize BPMN and provide XML schemas for model transformation and to extend BPMN toward business modeling and executive decision support (Recker, 2008). The RFP also rate consistency checks and model validation as important features.

From the empirical studies one can further see that there is a difference in the perceived use of BPMN regarding the use of the core or the expanded set. Few of the studies indicate whether they are based on the one or the other, which might impose a problem on the user-side. One might select BPMN for a task based on expressiveness, but planning to use the core set which at one point would go wrong.

There is room for more empirical work on the actual use of BPMN. It would be wise to perform replication studies on future BPMN work on the revision of the standard when it becomes available to determine eventual improvement.

Some other questions for future work are: How fast the tool support for a revised version of the standard will be available and what are the consequences of having two significantly different versions available? How will the different versions of BPMN map to each other? If the proposed weaknesses found impose actual problems or if the workarounds found among the users (extending BPMN with local support utilities of their choice) provide a better approach all together than trying to build an all-in-one language.

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Paper 3

Citizen-centric process views for government service provisioning

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CITIZEN-CENTRIC PROCESS VIEWS FOR GOVERNMENT SERVICE PROVISIONING

Gustav Aagesen and John Krogstie

Abstract

As users of government services, citizens spend much of their time in transit between government agencies or acting on behalf of their different roles and responsibilities. Government agencies are providers of services virtually connected, but with little or no actual integration. We believe that by allowing the citizens access to ongoing processes in which they are involved, it would improve service delivery from the perspective of citizen and the government organization alike. The paper introduces the concept of citizen-centric process views, providing channel independent architectural support for knowledge management and monitoring of cross-organizational service delivery in transformational government. Our focus is aimed at describing the concept, its utility, and suggested architecture.

Keywords: e-government, interoperability, process modeling, services, information systems, knowledge management, citizen-centric, next-generation government infrastructure.

1 INTRODUCTION

E-government is about the continuous optimization of public administration and service delivery. It is mainly motivated through the use of information technology, facilitating the reorganization and development of new services and with the potential of reorganizing the service administration as well.

Services to the citizens are provided from government agencies organized based on what could be understood as an optimal service delivery from the provider point of view, and based on historical organization and responsibilities. Single government agencies deliver services of similar nature to citizens, and the citizens receive combined government services from different agencies based on the complexity of the needs of the citizen. From the citizen point of view, orchestration of services is weak, and there is a risk of being caught between uncoordinated service providers.

By connecting services provided to single citizens, new services and service features supporting the potential for increased value to service delivery can be added. Examples include updated information to citizens, allowing proactive interference and better coordination of compound services, better control with customized services fitted to individual needs, and improved organization of services. Additionally, a more efficient service configuration has socio-economic gains (SSØ, 2006).

The technical and organizational barriers for citizen access to connected government services are extensive (Estevez and Janowski, 2007; Papazoglou et al., 2008). But rather than focusing on barriers, our focus is related describing the opportunities provided, and identify technical aspects important to the realization of a service delivery organized around the citizen.

In the next section we provide a brief background on the current status of e-government service delivery for transformational government and the motivation of our work, followed by our description of the citizen-centric process views. In the related work section we present research relevant to the functional aspects of the implementation followed by discussion and conclusion.

2 BACKGROUND

Existing stage models for e-government maturity (Iyer et al, 2007; Siau and Long, 2005; Irani et al., 2006) describe the complexity of provided services and the cultural, technological and political prerequisites associated with service delivery on the different stages. The stages depict interactions between government agencies and citizens spanning from the simple availability of information online, to interaction and transaction services and to complex long-running transactions with multiple actors involved. There is both a cultural and a technological gap between the government service provisioning we see today and that of the transformational government scenario described in literature.

There is a need for further research on the next generation digital government infrastructures (Jansen et al., 2009; Wimmer et al., 2008). Research areas include among other building a secure and flexible infrastructure, application areas for service provisioning, establishing business models for the component industry as well as the organizational aspects related to the responsibility of development and maintenance of components. The European Commission has identified three priority areas for future development and the improvement of provided services (United Nations, 2007):

- Making efficiency and effectiveness a reality through high user satisfaction with public services through using IT appropriately to reduce the administrative burdens of citizens and businesses
- Using common platforms to achieve efficiency gains
- Improved interoperability between e-government through the use of e-signatures and electronic identification management.

Further, several key processes are undertaken by the European Commission (Blakemore, 2006):

- Promoting innovative change to manage the complex balance between the finance and resources, organizational change, and meeting the needs and the expectations of citizens
- Championing the citizen as a consumer of government services
- Maximizing the flow, and use, of good practice through Europe.

User centricity implies that the needs of the different users affect the contents and reach of the services provided. User centricity also involves facilitating for the needs of the individual user in terms of customizing the services offered to that particular user and it involves taking action to improve the service delivery to all users (FAD, 2009). Examples of improved service delivery for common good involve extending opening hours and reducing the time spent waiting to be served. By establishing municipal service offices and through active collaboration between the central state and municipalities, shared service centers (Janssen and Wagenaar, 2004) are being developed to support a one-stop government and free citizens from being tossed between governmental offices. The Norwegian NAV is one example of shared service centre, where grouping of services and infrastructure and consolidating channels simplifies interaction for both government and citizen.

The consolidation of services and channels and the priority functions of the European commission are all aspects related to back office integration of e-government. Key drivers for back office integration suggested by the United Nations (2007) are cost, service improvement/efficiency, service innovation, increased control and modernization. Within these drivers is a promise of increased transparency, less time spent on administrative tasks, more money available to value creation, a more complete and immediate understanding of provided services as input to improved policy development. These are all drivers that support a better front office delivery of services.

There has been a critique of e-government initiatives taking on a techno-centric, rationalist focus, ignoring the value of knowledge management (KM), and that KM is an important aspect of future government strategies (Kolsaker and Lee-Kelley, 2005). It is further important that e-government strategies for transformation does not move back to organizational re-engineering and an attempt to ‘reinventing government’, but promote the development of an ICT strategy that underpins the

implementation of organizational change (Blakemore, 2006). The work presented in this paper is a part of a study on service provisioning in the transformational government scenario. Constraining factors of the scenario includes the autonomy of actors, the changing government organizations and policies, the necessary support for process innovation and service reorganization, and the changing requirements of users and systems from the availability of new technology affordances.

The 'citizen-centric process views' is a suggested artifact created within a scenario of the next generation government infrastructure. It is a (de-) centralized middleware connecting core components, legacy- and government front office systems for the organization of ongoing and completed instances of provided services to the citizen. It does not provide a user-interface and is in that sense channel independent and extendable through various interfaces. It is a 'what if"-scenario, disregarding the cultural, political and technological gaps between the current situation and the envisioned transformational government. At the same time it provides ground for discussion of the possible utility provided by the technical architecture and the discovery new directions of research.

3 CITIZEN-CENTRIC PROCESS VIEWS

In this section we will present and discuss a possible development of services and service capabilities provided by what we like to refer to as citizen-centric process views. First, we will give a conceptual introduction. Then, we will discuss some of the possible services that could be added, given that the cultural, political, and technological prerequisites for transformational government are met. Our focus in this section is on the introduction and the discussion of the functional aspects. The technical aspects will be discussed briefly in relation to the conceptual architecture.

3.1 Focus on the citizen

Using Figure 1 to illustrate, the scenario to the left (I) show a traditional understanding of service delivery between a government agency (A) and the citizens (I-N). Each citizen is served directly and service production is centered on the service provider and the isolated service requests. The scenario in the middle (II) provides a shift in focus and places the citizen (X) in the centre of service delivery, and we can see that the citizen interacts directly with several government agencies (A, B, C) although the coordination of the process and service delivery is still left to the citizen.

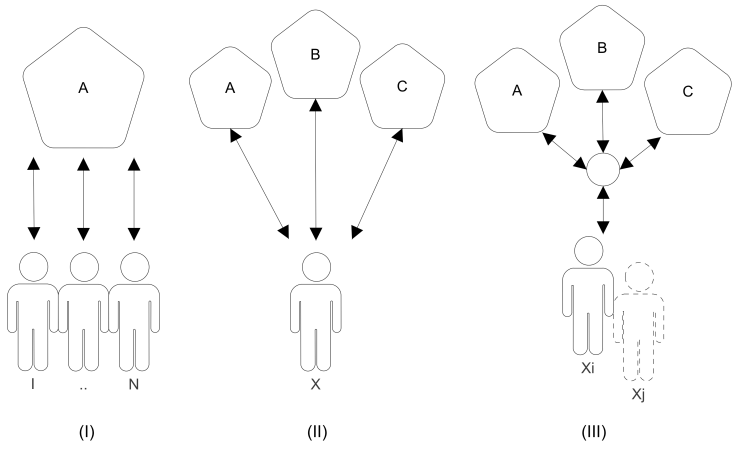

Figure 1 Service delivery to citizens

The scenario to the right (III) illustrates the conceptual artifact we refer to as a citizen-centric process view: The citizen remains as the main subject, but instead of being the main responsible for coordinating the delivery of services provided, the citizen, government, and non-government agencies are all actors in the choreography of services. These actors are allowed access to review the whole citizen process rather than the individual service stubs in which the process is comprised.

Van der Aalst (2000) differentiate enablers of inter-organizational workflows as *capacity sharing*: Tasks are executed by external resources under the control of one workflow manager, *chained execution*: The process is divided into subsequent phases and each business partner takes care of one phase, *subcontracting*: A sub-process is executed by another organization, *case transfer*: Each partner uses the same workflow process and cases are transferred from one partner to another, and *loosely coupled*: Each partner takes care of a specified part of the process. Regardless of the internal organization of the service provisioning, the current state of the process should be reported to some central artifact in order for the citizen and involved actors to monitor progress, and by doing that support quality assurance.

3.2 Process access through roles

Central to the citizen-centric process view is the citizen and the different roles the citizen has in its various interactions with government services. It is the roles that initiate and require the services and it is the coordination of the different roles that is important to the citizen. With the roles of a single citizen (Figure 1, X_i and X_j), come different responsibilities. Some roles might vary depending on the current situation of other citizens adjacent to that particular citizen. The *parent* role gives access to different services depending on the age and needs of a child, the *child* role has a different nature when caring for elderly parents and there is a need to take a more active role on behalf of relatives that might not be able to administrate their own roles. Having a certain health condition or being out of work also qualifies for access to particular services, or owning property in different regions might require access to information as well as responsibilities in those regions.

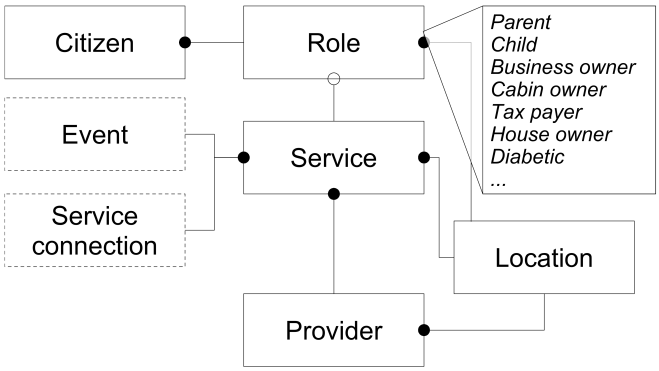

Figure 2 Conceptual components of citizen-centric provisioning

As we see from the suggested service-provisioning model in Figure 2, the providers themselves are not of much importance to the citizen, and the organization and location of government agencies are irrelevant until a service is required. From a citizen point of view, currently utilized services might be chained to connected services located at different providers necessary at a later stage of service provision. Take hospital-services, followed by home-care, lending of equipment to support a quick recovery and financial compensation in case of having to stay out of employment for a longer period. All these services are connected and provided by different government agencies. The service provider is not important for the citizen, and by connecting the services the citizen will be informed of the required steps and procedures and events. For the government agencies involved in the service provisioning to that particular citizen, the transparency and openness of channel creates a virtual organization (Fountain, 2001) better suited to provide the service efficiently. From the citizen point of view, partly "outsourcing" the coordination of services to a relative or trusted peer as a role in this scenario might serve all involved actors. Alternatively, assigning the support role to a civil servant familiar with the process as responsible for the citizen's interests exclusively, providing online or offline support, will compensate for any divide (digital, cultural, etc) the citizen is exposed to.

3.3 Discovery, customization and service interaction

By looking at services commonly used in relation, one could use the service connections to discover eligible services based on the role of the citizen or through current service use. This might typically be related to new regulations opening for extra support for citizens in a given situation. Allowing citizens to discover eligible services using current service configuration could provide extra value to the citizen and increased efficiency in the service distribution from the government side. Connected services are typically found in collections commonly referred to as life-events (Vintar and Leben, 2002). Most life-event approaches to service discovery are based on semantic models of services rather than information about actual use, involved actors or historical data. There can be situations where information about the services themselves might not be sufficient to provide the necessary information in order to discover complimentary or follow-up services. Using process goals (i.e. the why's) for the citizen in addition to the current services it could be less cumbersome to locate replacement services or to validate whether the current service configuration is the most optimal for the given citizen. This would however require that the involved actors should be granted access to information not necessarily limited to the virtual organization created by the delivery of a single service.

Citizen-centricity can involve customizing single services to each citizen's individual needs. This means that the process view should show the actual planned process of the service in which the particular citizen is receiving, including providers, events and other relevant information. This enables proactive behavior from the citizen as well as providers. In the case of the citizen, by merging the workflow for all processes in which it is involved, it is possible to resolve any conflicts that might occur between different services and allow a timely coordination of services.

For some services, it might also be possible for the citizen to interact with the process model and change the order of occurrence, poll status, postpone events or cancel ongoing requests. All in all, the interface of the involved actors should invite to a continuous open dialogue between the government and the citizens. The level of process transparency exposed could depend on the requested or necessary involvement of the different actors as well as the nature of the service provided. In its simplest form, the process view provided to the citizen can be limited to a calendar with the planned occurrence of events with event descriptions, deliveries and locations. And for the citizen, some of the bureaucratic elements of a single process might be more confusing than helpful, and might be better off left out.

The implementation of the centralized component is conceptually similar to the functionality of that of a Public Service Broker found in earlier transaction based e-government initiatives, allowing the citizen to see what government organizations are currently using information about the citizen. The individual user will further have authority over their personal data and can specify what organizations that can access different information (Golden et al., 2003).

3.4 Multi-channel service provisioning

The location of the citizen and the service provider is sometimes important to service delivery. As services delivered at a municipal level might vary in different municipalities, moving from one area to another should be coordinated efficiently. Citizens receiving services from different municipalities in cases where they are property owners in a different municipality from where they live, or live and work in different municipalities and wish to receive kindergarten services close to work. Citizens should be able to interact and receive information regarding these services seamlessly using the same channels. (I.e.: not requiring to register and familiarize oneself to a new web-based portal or access point in order to receive additional or similar services from virtually identical government agencies operating in different polity domains). Additionally, moving from one location to a new might keep a previously defined process as a whole, but replace several participating actors with actors physically available at the new location.

When it comes to channels, it is however clear that receiving a great deal of government services requires physical presence at the point where the service is provided. Complex or emotional services where the citizen receives counseling can however be initiated from less rich channels to increase efficiency. One could for instance provide information in a waiting room educating the citizen prior to an appointment with a public official in order to be more able to express needs or understand regulations. Similar principles could be applied when accessing services online where the user is either informed or is required to supply a certain amount of information qualifying for the next step. It is further important that the process state can be passed on between different agencies involved in the chained process to reduce redundant loops.

By providing information about delivered services directly to the citizen, and by allowing the citizen share that information on request with civil servants or others involved in service delivery, it might improve service delivery based on known information not expressed formally in the system. It is equally important to extract information formally to the citizen based on events not only occurring based on automated or semi-automated transactions of schema-based requests. Providing updated information on regular interactions like home care visits, or public office consultations, provides a holistic picture of the interaction with government, and does not separate online and offline interactions. Thus preventing a false separation of services and e-services.

3.5 Simulation, monitoring and forecasting

From an administrative perspective, the run-time integration of ongoing processes provides an extensive amount of information for monitoring, analysis and policy development. This includes simulating new regulations on actual data, forecasting service demand and discovering possibilities for new services or improved service delivery.

In discovering new process innovations, the need to allow trial and error is one of the aspects of the innovation toolkits introduced by von Hippel (2005). This involves that the user will be allowed to test any changes done to measure the relative improvement of the changes to the artifact, which in our case in most situations will be a process on the instance-level or policy-level. One approach for trial and error on the policy-level has been to extract data from the execution environment, change the rules or process flow and run the process using actual data. This would provide important information to the modeler on how successful a new policy will be based on an isolated and limited dataset. This approach does however have some weaknesses: First, it is required and assumed that the only those who are eligible and have applied for a service based on the old policy will be within the window of the new policy. I.e.: the new policy will not attract new subjects. Further, any new policy addressing different properties and criteria from previous policies will not be open for simulation, since the properties required will most probably not be within the data available for simulation. There is further only a particular kind of services which are open for such simulation. Human driven processes might leave traces of information in the system, and would allow some simulation with respect to breadth and reach of the provided services (i.e. who is eligible, and what outputs exists and the economy of each contact). On the instance-level this trial and error might prove more fruitful, since one can assume that the modeler has knowledge of the instance and can supply data relevant to the trial and error simulation. This would involve measuring the process outcomes in form of delay and cost by alternating process flow.

As for government agencies responsible for late steps in process chains, the forecasting element is based on current active use of services qualifying for entrance to the services provided by that particular provider. The information produced by this forecasting is primarily important to planning and resource management.

3.6 Process Knowledge Management

The ability to monitor and learn from the actual process flow of the services provided is one of the utilities of the citizen-centric process views. It opens up for knowledge creation on the central, local,

service and instance level. This contributes both to making knowledge visible, and promotes knowledge in the organization; it promotes sharing and a knowledge-intensive culture; supports a knowledge infrastructure of technical systems and a web of connections among people given space, time and tools (Alavi and Leidner, 2001).

Changes made to default process templates for the actual running processes can be monitored centrally and locally. Trends can be identified, which can suggest the need for adjusting the process templates. Actual use can further be observed and new policies can be formed for future process executions.

At the service level, virtual organizations providing services using similar systems, configurations or acting on similar policies, or municipalities with a similar fingerprint (policies, size, budgets, or key-figures) can share experiences and best-practice and in that way co-evolve and share innovations.

At the instance level, access to similar scenarios and experiences is functionality the involved actors can benefit from. However, the collaboration of actors and availability of information beyond the isolated task of the single actor is itself a resource that can promote sharing of tacit, individual knowledge of the participating actors and thus improve service delivery.

3.7 Conceptual Architecture

The conceptual architecture of the citizen-centric process views (Figure 3) is organized around the *process*. The *process* can support or contribute to the completion of a process defined at a higher level, the service. That is, the process can be the partial delivery of a compound service, a service delivery in a chain of subsequently provided services, or the delivery of a single service. The *service* defines and organizes the *processes* where all work is done. The *service* and *processes* share the same *goals*, or the *processes* partly fulfill the goals of the *service*.

Connected to the *process*, are *actors*, which again have defined *roles* and an *interface* for accessing and interacting with the *process*. The citizen is the *subject* who is the *receiver* of the services produced by the process. There can be several contributors from government and non-government organizations as well as caretakers acting in the interest of the citizen. These actors together form a *virtual organization* for the *service* in which the *processes* are defined. In cases of process hand-over between different contributors there is always defined a *temporary owner* of the process responsible for service delivery.

The *workflow* for each process is based on a process template defining the default *workflow*. *Actors* can alter this *workflow* and perform *change requests* that are accepted or rejected by the *local information systems* connected to the process execution platform or through the actor interface by other actors responsible for the process steps that are changed or steps affected by the changes. If the process execution platform is connected to local information systems at the different government agencies, *reporting* of *events* between the *local process representations* and the process execution platform contribute to synchronize the current state of the process and inform the *virtual organization*.

Actors not connected through a *local information* system can access the process through the *interface* for the *actor* and the underlying *system interface*. The *system interface* allows open access to add different user interface applications for multi-channel connectivity as well as modules running separately or within predefined user-applications. Modules are specially designed applications that can include various views of the process separately or combined for the different actors; alerts on spending, deadlines, regulations; lookups in central registries for explanations or references; support for running what-if modules on process changes; modules for process documentation, central reporting, benchmarking or locating similar cases as the given process instance; translation services or other utilities that prove useful for single actors or the virtual organization as a whole.

Central or local process monitoring help keep the process templates updated to best practice. Repeated changes in workflow in one direction is important feedback to process innovation. Using templates distributed and managed centrally within the polity domain allows efficient implementation of new policies.

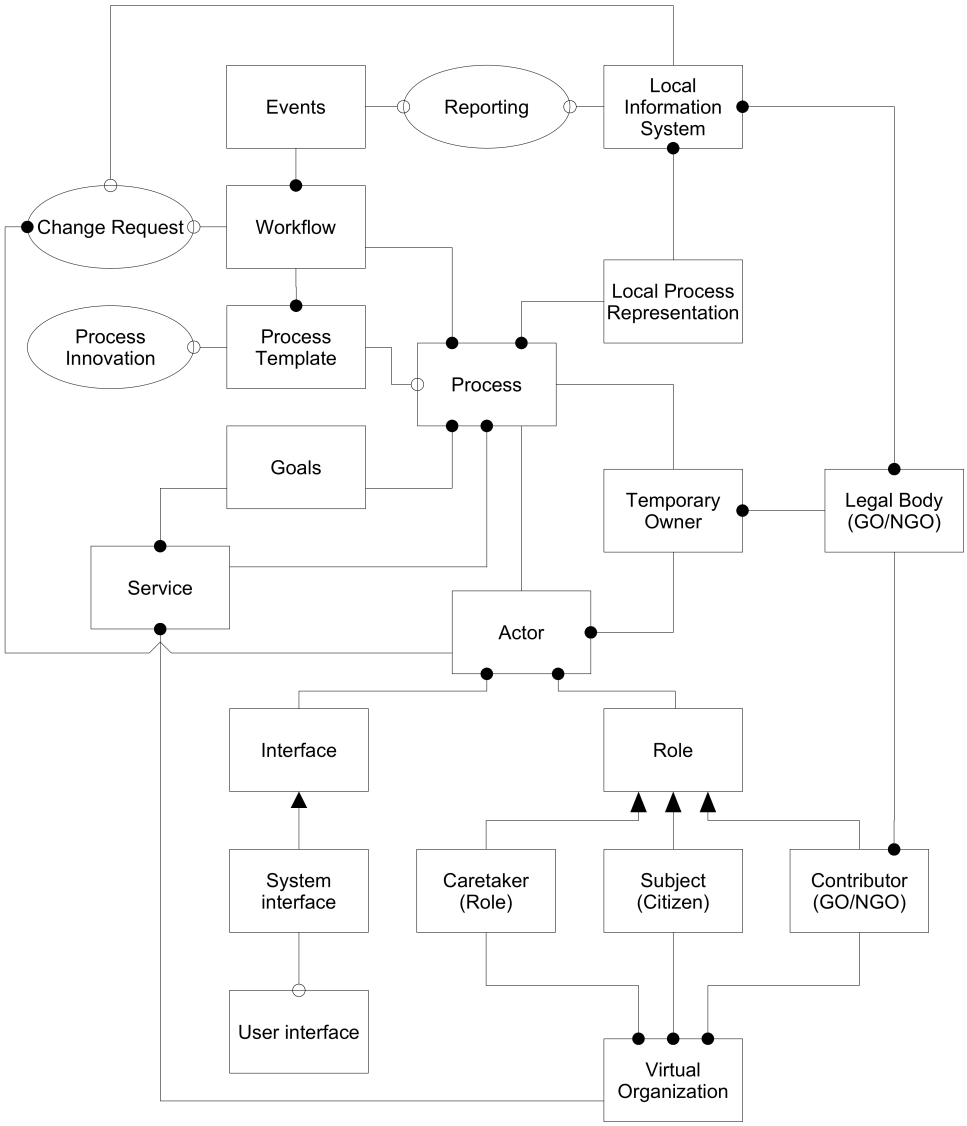

Figure 3 Conceptual architecture for citizen-centric proces views

As we can se from the described conceptual architecture, the citizen-centric process view is a single point access point for the citizen where it can interact with the government on currently provided services. It provides an infrastructure for service collaboration, knowledge management and innovation. It supports flexible organization of providers and the different government information systems and with that supports continuous transformation of government services.

In the next section, we will discuss related work and available technology relevant to the scenario

4 RELATED WORK

In the previous section we described the citizen-centric process view concept and what functional capabilities and new services that could be added based on an integration of government back office and a more active involvement of individual citizens for the services they are provided. There is a gap between currently available technology affordances, organizational culture and political ambitions required to take on the full implementation of such a scenario. Some of these are disregarded by our work and are not needed when establishing scenario descriptions or working prototypes. Others are currently addressed and are assumed to receive the proper attention by related work. In this section we

will look at current concepts and research that we believe is relevant to our scenario. The relevant work includes architecture principles, work within life-events, enterprise interoperability, government projects, commercially available applications and research on dynamically adaptable processes.

4.1 Organization around services

Service Oriented architecture (SOA) is one of the cornerstones to the transformational government infrastructure. "Although SOAs might not be new, they address the fundamental challenges of open systems, which are to operate efficiently and achieve coherence in the face of component autonomy and heterogeneity" (Huhns and Singh, 2005). Equally important is the ability to renew, add and remove services dynamically as the requirements of the systems change. Building on the concept of the Enterprise Service Bus, the citizen connects to government agencies and service registries for discovery of services and service interactions. So far, this is similar to the concept of Active Life-Event Portals (Vintar, and Leben, 2002), aiding service discovery based on the life events of the citizen. Further, Bercic and Vintar (2003) suggest allowing agents act on behalf of the citizen as proxies in the interaction with the government. We see that the use of agents to discover eligible services and acting on behalf of the citizen is useful. In the case of the citizen-centric process views, using agents as proxies in the virtual organization, responding to the occurrence or non-occurrence of events as one of the application areas. The Norwegian *LivsIT* project (later named *LOS*) started out as a standardization project for semantic interoperability of public services organized around life-events. The life-event focus was later abandoned due to fact that the scope of services related to single life-events is hard to determine. This work is now focused on providing standardization information related to the delivery of single services (Elgemsen, 2008).

4.2 Inter-organizational collaboration

Due to the autonomy of government agencies, obstacles for inter-agency cooperation on the process level occur when the different agencies use different process description languages. Karagiannis and Hofferer (2008) have performed a survey looking at the use of meta-models to integrate process across organizations. Ziemann et al (2008) propose a framework to model and transform cross-organizational business processes to technical process model based on web service protocols. The approach involves establishing process descriptions using Event Process Chains, which is further converted to BPEL syntax.

Holm Larsen and Klischewski (2004) discuss the challenges of process ownership in relation to inter-organizational collaboration. They conclude that there is no recipe or guidance available on how to proceed in situations where there is an absence of an overall process ownership or where the overall process ownership is not desired. Punia and Saxena (2004) suggest three approaches involving establishing the super-ordinate role, a common shared workspace or interacting through a third party intermediary. Our suggested approach points towards establishing the third party intermediary in the custody of the citizen-centric process view, but it is important that the overall process ownership is not left up to the citizen, and that a separate role independent from the agencies providing services take the overall process ownership and the promote the interest of the citizen. 4.3 Next generation government infrastructure in Norway

There are several government projects focusing on the next generation government infrastructure, one of them is the Norwegian Semicolon (Semicolon, 2008). The main goal of Semicolon is to develop and test ICT-based methods, tools and metrics to obtain faster and cheaper semantic and organizational interoperability both with and within the public sector.

The Norwegian Ministry of Government Administration and Reform have in the recent years, among others, published two whitepapers (FAD, 2006; FAD, 2009) and one green-paper (FAD, 2007) important to policy creation and the future strategy and directions for the development of e-government in Norway. The work includes mapping of standard services and their use of central registries as well as planning access to centrally developed components as common platforms, and the

use of e-signatures and electronic identification management. Similar to concept of the citizen-centric process view is the organization of compound services through *eDialog*, an initiative from the Norwegian tax authorities which aim is to maintain a holistic, and user-friendly two-way electronic dialog between the user and the government. Other identified core processes include: public procurement, holistic processes for patient care, building permits, reporting of income and tax, and case handling. The future directions are aligned to that of the European Commission, focusing on core components supporting electronic identification, providing a common IT-platform, and promoting citizen-centricity. As of now, Norway's *Altinn* (www.altinn.no) provides a single front-end for transaction based schema delivery. The next generation *Altinn*, launched in stages between late 2009 and late 2010, will among other support service collaboration and several process owners for cross-organizational processes presented as one connected process for the users.

4.3 Process modeling and platforms

When it comes to the BPM systems, there are several commercially available frameworks. The Itensil dynamic process platform (BPMFocus, 2008) is a solution supporting ad-hoc collaborative process work different from what found in traditional BPM systems, allowing process change on the fly and version control of individual process instances. Itensil uses a wiki-style framework and AJAX-based user interfaces, supporting effective workspace redistribution. While the Itensil framework is designed for ad-hoc knowledge work in smaller teams, the approach is interesting with respect to large-scale process distribution, innovation and flexibility in government organizations.

Lillehagen and Krogstie (2008) discuss Active Knowledge Modeling and Active Models. Models are active when they available to the users at run-time and support automatic synchronization of the execution environment and behavior of the system based on changes to the model made by the user, the models can further be dynamically extended to fit local contexts. Active knowledge modeling extends enterprise modeling and focus on the knowledge supporting work through models, methods and tools. Systems can evolve with corporate knowledge and users build and manage their own work environment through model-generated workplaces. The work includes an overview of challenges structured into the following areas: Society and community cooperation, collaborative business networking, interoperable enterprise cooperation, innovation and holistic design, knowledge and data representation and workplace regeneration and adaptability.

5 DISCUSSION AND CONCLUSION

This paper has introduced the concept of citizen-centric process views for e-government services. The concept is located within the next generation government infrastructure and the application area for services in the transformational government scenario. It is a (de-) centralized middleware connecting core components, legacy- and government front office systems for the organization of ongoing and completed instances of provided services to the citizen. The concept is similar to the one-stop

government and active life-events portals where the citizen has online access to discover services. It extends on to those concepts by focusing on the monitoring, choreography and knowledge management aspects of the actual workflow of ongoing service delivery. The citizen-centric process views create a virtual organization around the citizen and the service provided. In contrast to similar concepts, it suggests that there is knowledge about the optimal service delivery present in the virtual organization that is not formalized and therefore preventing the process from being subject to automated processing or agent based reasoning. This might also be due to the fact that the actual services provided are physical or emotional services, and that the process view acts as a documentation and collaboration space for the involved actors. The models used in the process view can be interactive, and changing the model workflow will affect the actors' involvement and actual workflow of the process in question.

The citizen-centric process view is one step closer to the recognition of the e-citizen as a separate entity. Traditional government systems identify individuals through references and variables in information system without any binding to the citizen itself. With the process views the citizen will govern information previously not available and which is not controlled by any government agency. Rech Filho (2005) suggests that the development of the e-citizen concept might not be a priority interest of the government and that its function might just as well be of commercial interest. We believe that the access to government or non-government actors should be open, or at least that it is a political discussion rather than technological limitation whether the access should be open or not. In transformational government, government services might just as well be provided through private contractors. On the question of citizen-centricity, Kolsaker and Lee-Kelley (2006) stresses the fact that "if the needs of the citizens are not understood, provision will be designed around the needs of the state; if the needs of the state are prioritized, e-services will only be used where the needs of the citizens and state coincide".

We observe that a majority of the related work within life-events and one-stop government is relatively old. Some of the suggested life-events frameworks rely on semantic operability and interoperability support not yet mature for proper implementation. We believe that our approach is similarly relying on cultural interoperability, but additionally take advantage of the knowledge of the people involved in service delivery, rather than that of formalized information stored prior to service execution. This approach could be more agile and should be able to support a dynamic service configuration and changing systems as a result of changing prerequisites caused by political, technological and regulatory change.

The work so far does not involve a prototype nor does it critically evaluate the concept. We will continue our work on the conceptual model before we can take on the development of any prototype within the citizen-centric process views.

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Paper 4

Providing adaptive and evolving government e-services through citizen-centric process views

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PROVIDING ADAPTIVE AND EVOLVING GOVERNMENT E-SERVICES THROUGH CITIZEN-CENTRIC PROCESS VIEWS

Gustav Aagesen and John Krogstie

Abstract

As users of government services, citizens spend much of their time in transit between government agencies acting in different roles with varying responsibilities. Government agencies are providers of services virtually connected, but with limited actual integration in practice. We believe that by allowing citizens more direct access to ongoing processes in which they are involved, it could improve service delivery from the perspective of citizen and the government organization alike. In this paper we discuss the concept of citizen-centric process views, a conceptual architecture providing channel independent support for knowledge management and monitoring of cross-organizational service delivery in transformational government. We will set the stage for the discussion of requirements for the next generation government infrastructures and the surrounding organizations in order to support delivery of adaptive and evolving government services.

Keywords: e-government, services, knowledge management, workflow, evolving IS.

1 INTRODUCTION

E-government is about the continuous improvement of public administration and service delivery. It is supported through the use of information technology, facilitating the reorganization and development of new services and with the potential of reorganizing the service administration as well.

Services to the citizens are normally provided from government agencies based on what could be understood as an optimal service delivery from point of view of the service provider, and based on historical organization and responsibilities. Individual government agencies deliver services of similar nature to citizens, and the citizens receive combined services from different agencies based on the complexity of the needs of the citizen. From the citizen point of view, orchestration of services appears to be weak, and there is a risk of being caught between uncoordinated service providers.

By connecting services provided to single citizens, new services and service features supporting the potential for increased value of service delivery can be added. Examples include updated information improving expectation management, allowing proactive interference and better coordination of compound services, better control with customized services fitted to individual needs, and improved organization of services.

The goal of this paper is twofold: First we discuss the motivation and opportunities of a citizen-centric configuration of service delivery, being aware of that the technical and organizational barriers for citizen access to connected government services are extensive (Estevez and Janowski, 2007; Papazoglou et al., 2008). We further know that providing citizen-centric organization of services require changes in technology, changes that can significantly affect the direction and progress of applications development, by either enhancing or limiting choices or functionality (Ziemann et al., 2008). Based on that we will discuss the possibilities of an adaptive infrastructure and organization supporting delivery of evolving e-services.

In section 2 we provide a background on the current status of e-government service delivery and the motivation of our work. This is followed by a description of the citizen-centric process views, the conceptual architecture, and the discussion of the associated knowledge management scenarios. In the

related work section we present research relevant to the functional aspects of the implementation followed by discussion and conclusion.

2 BACKGROUND

Existing stage models for e-government maturity (Huhns and Singh, 2005; Lyer et al., 2006; Siau and Long, 2005) describe the complexity of provided services and the cultural, technological and political prerequisites associated with service delivery on the different stages. The stages depict interactions between government agencies and citizens spanning from the simple availability of online information, to interaction and transaction services and to complex long-running transactions with multiple actors involved. There is both a cultural and a technological gap between the government service provisioning we see today and that of the transformational government scenario described in literature.

The need for further research on the next generation digital government infrastructures has previously been identified (Janssen et al. 2009; Wimmer et al., 2008). Research areas include among other building a secure and flexible infrastructure, application areas for service provisioning, establishing business models for the component industry as well as the organizational aspects related to the responsibility of development and maintenance of components. The United Nations has identified three priority areas for future development and the improvement of provided services (United Nations, 2007):

- Making efficiency and effectiveness a reality through high user satisfaction with public services through using IT appropriately to reduce the administrative burdens of citizens and businesses
- Using common platforms to achieve efficiency gains
- Improved interoperability between e-government through the use of e-signatures and electronic identification management.

The 2009 *Ministerial Declaration on eGovernment* (EU, 2009) promotes shared European objectives by 2015 including the development of user-centric services that provide flexible and personalized ways of interacting with the public administration. It further actively seeks collaboration with third parties, for example businesses, civil society or individual citizens, in order to develop user-driven e-government services.

The future strategy and directions for the development of e-government in Norway includes mapping of standard services and their use of central registries as well as planning access to centrally developed components as common platforms, and the use of e-signatures and electronic identification management.

Altinn II, which is an important part of future information infrastructure in Norway, will among other things support service collaboration and several process owners for cross-organizational processes presented as one integrated process for the users.

User centricity implies that the needs of the different users affect the contents and reach of the services provided. User centricity also involves facilitating for the needs of the individual user in terms of customizing the services offered to that particular user, and taking action to improve the service delivery to all users (FAD, 2009). Examples of improved service delivery for common good involve extending opening hours and reducing the time spent waiting to be served. Through active collaboration between the central state and municipalities, shared service centers (Janssen and Wagenaar, 2009) are being developed. This promotes a one-stop government and free citizens from being tossed between governmental offices.

There has been a critique of e-government initiatives taking on a technocentric, rationalist focus, ignoring the value of organizational learning and knowledge management (KM), and that KM is an important aspect of future government strategies (Kolsaker and Lee-Kelley, 2006). It is further

important that e-government strategies for transformation does not move back to organizational re-engineering and an attempt to 'reinventing government', but promote the development of an ICT strategy that underpins the implementation of organizational change (Blakemore, 2006).

The work presented in this paper is a part of a study on service provisioning based on the transformational government scenario. Constraining factors of the scenario includes the autonomy of actors, the changing government organizations and policies, the necessary support for process innovation and service reorganization, and the changing requirements of users and systems caused by the availability of new technology affordances.

The 'citizen-centric process views' is a suggested artifact created within a scenario of the next generation government infrastructure. It is based on the idea of a (de-) centralized middleware connecting core components, legacy- and government front office systems for the organization of ongoing and completed instances of provided services to the citizen. It does not provide a user-interface and is in that sense channel independent and extendable through various interfaces. It is a 'what if'-scenario, disregarding many cultural, political and technological gaps between the current situation and the envisioned transformational government. At the same time it provides a basis for discussion of the possible utility provided by the technical architecture and the discovery new directions of research.

3 CITIZEN-CENTRIC PROCESS VIEWS

In this section we will present and discuss a potential development of services and service capabilities provided by what we refer to as citizen-centric process views.

First, we will introduce the main concepts. Then, we will discuss some of the functional capabilities given that the cultural, political, and technological prerequisites for transformational government are met.

3.1 From organization- and service-centric to citizen-centric service delivery

Using Fig. 1, (I) illustrates a traditional understanding of service delivery between a government agency (A) and the citizens (1-N). Each citizen is served directly and service production is centered on the service provider and the isolated service requests. The scenario in the middle (II) provides a shift in focus and places the citizen (X) in the centre of service delivery, and we can see that the citizen interacts directly with several government agencies (A, B, C) although the coordination of the process and service delivery is still left to the citizen.

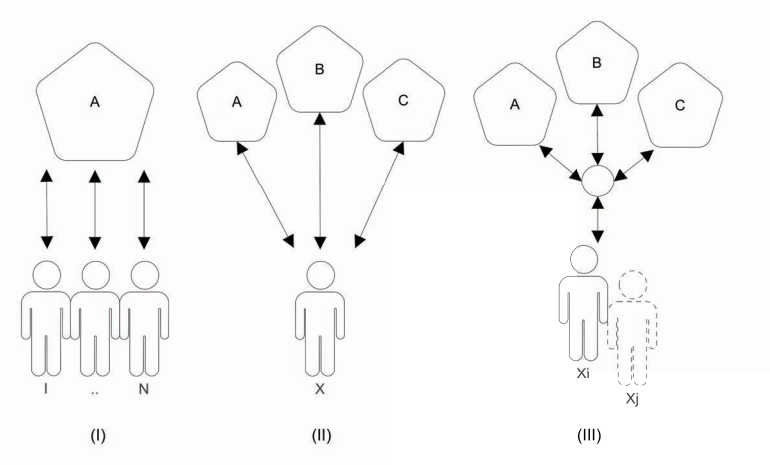

Figure 1 Service delivery to citizens

The scenario to the right (III) illustrates the conceptual artifact we refer to as a citizen-centric process view: The citizen remains as the main subject, but instead of being the main responsible for coordinating the delivery of services provided, the citizen, government, and non-government agencies are all actors in the choreography of services. These actors are allowed access to review the whole citizen process rather than the individual service stubs in which the process is comprised.

Van der Aalst and Weijters (2004) differentiate enablers of inter-organizational workflows as *capacity sharing*: Tasks are executed by external resources under the control of one workflow manager, *chained execution*: The process is divided into subsequent phases and each partner takes care of one phase, *subcontracting*: A sub-process is executed by another organization, *case transfer*: Each partner uses the same workflow process and cases are transferred from one partner to another, and *loosely coupled*: Each partner takes care of a specified part of the process. Regardless of the internal organization of the service provisioning, the current state of the process should be reported to some central artifact in order for the citizen and involved actors to monitor progress, and by doing that support quality assurance.

3.2 Process access through roles

Central to the citizen-centric process view is the citizen and the different roles the citizen has in its various interactions with the government. It is the roles that initiate and require the services, and it is the coordination of the different roles that is important to the citizen. With the roles of a single citizen (Fig. 1, X_i and X_j), come different responsibilities. Some roles might vary depending on the current situation of other citizens related to that particular citizen. The parent role gives access to different services depending on the age and needs of a child, the child role has a different nature when caring for elderly parents and there is a need to take a more active role on behalf of relatives that might not be able to administrate their own rights and responsibilities. Having a certain health condition or being out of work also qualifies for access to particular services. Similarly owning property in different regions might require access to information as well as responsibilities in those regions.

The service providers themselves are not of much importance to the citizen, and the organization and location of government agencies are irrelevant until a service is required. From a citizen point of view, currently utilized services might be chained to connected services located at different providers necessary at a later stage of service provision. Take hospital-services, followed by home-care, borrowing of equipment to support a quick recovery and financial compensation in case of having to be out of work for a longer period. All these services are connected, but provided by different government agencies. The service provider is not important for the citizen, and by connecting the services the citizen will be informed of the required steps and procedures and events. For the government agencies involved in the service provisioning to that particular citizen, the transparency and openness of a channel creates a virtual organization (Fountain, 2001) better suited to provide the service efficiently. From the citizen point of view, partly "outsourcing" the coordination of services to a relative or trusted peer as a role in this scenario might serve all involved actors. Alternatively, assigning the support role to a civil servant familiar with the process as responsible for the citizen's interests exclusively, providing online or offline support, will have the potential to compensate for any divide (digital, cultural, etc) the citizen is exposed to.

3.3 Discovery, customization and service interaction

By looking at services commonly used in concert, one could use the service connections to discover eligible services based on the role of the citizen or through current service use. This might typically be related to new regulations opening for extra support for citizens in a given situation. Allowing citizens to discover eligible services using current service configuration could provide value to the citizen and increased efficiency in the service distribution from the government side. Connected services are typically found in collections commonly referred to as life-events (Vintar and Leben, 2002). Most life-event approaches to service discovery are based on semantic models of services rather than

information about actual use, involved actors or historical data. There can be situations where information about the services themselves might not be sufficient to provide the necessary information in order to discover complimentary or follow-up services. Using process goals for the citizen in addition to the current services it could be less cumbersome to locate replacement services or to validate whether the current service configuration is the best for the given citizen. This would however require that the involved actors should be granted access to information not necessarily limited to the virtual organization created to support the delivery of a single service.

Citizen-centricity can involve customizing single services to each citizen's individual needs. This means that the process view should show the actual planned process of the service in which the particular citizen is receiving, including providers, events and other relevant information. This enables proactive behavior from the citizen as well as providers. In the case of the citizen, by merging the workflow for all processes in which it is involved, it is possible to resolve any conflicts that might occur between different services and allow a timely coordination of services.

For some services, it might also be possible for the citizen to interact with the process model and change the order of occurrence, poll status, spin out additional sub-processes, postpone events or cancel ongoing requests. All in all, the interface of the involved actors should invite to a continuous open dialogue between the government and the citizens. The level of process transparency exposed could depend on the requested or necessary involvement of the different actors as well as the nature of the service provided. In its simplest form, the process view provided to the citizen can be limited to a calendar with the planned occurrence of events with event descriptions, deliveries and locations. And for the citizen, some of the bureaucratic elements of a single process might be more confusing than helpful, and might be better left out of the process-view of the citizen.

The implementation of the centralized component is conceptually similar to the functionality of that of a Public Service Broker found in earlier transaction based e-government initiatives, allowing the citizen to see what government organizations are currently using information about the citizen. The individual user will further have authority over their personal data and can specify what organizations that can access

3.4 Simulation, Monitoring and Forecasting

From an administrative perspective, the run-time integration of ongoing processes provides an extensive amount of information for monitoring, analysis and policy development. This includes simulating new regulations on actual data, forecasting service demand and discovering possibilities for new services or improved service delivery.

In discovering new process innovations, the need to allow trial and error is one of the aspects of the innovation toolkits introduced by von Hippel (2005). This involves that the user will be allowed to test any changes done to measure the relative improvement of the changes to the artifact, which in our case in most situations will be a process on the instance-level or policy-level. One approach for trial and error on the policy-level has been to extract data from the execution environment, change the rules/regulations or process flow and re-run the process using actual data. This would provide important information to the modeler on how successful a new policy will be based on an isolated and limited dataset. This approach does however have some limitations: First, it is required and assumed that the only those who are eligible and have applied for a service based on the old policy will be within the window of the new policy. Further, any new policy addressing different properties and criteria from previous policies will not be open for simulation, since the properties required will most probably not be within the data available for simulation. There is further only a particular kind of services which are open for such simulation. Human driven processes might leave traces of information in the system, and would allow some simulation with respect to breadth and reach of the provided services (i.e. who is eligible, and what outputs exists and the economy of each contact). On the instance-level this trial and error might prove more fruitful, since one can assume that the user has

knowledge of the instance and can supply data relevant to the trial and error simulation. This would involve measuring the process outcomes in form of delay and cost by alternating process flow.

As for government agencies responsible for later steps in the process chains, the forecasting element is based on current active use of services qualifying for entrance to the services provided by that particular provider. The information produced by this forecasting is primarily important to planning and resource management.

4 CONCEPTUAL ARCHITECTURE

The conceptual architecture of the citizen-centric process views (Fig. 2 illustrates a part of this) is organized around the delivery of a service to a single citizen. The service comprises of a single or multiple *process* instances, which contribute to the completion of the *service*. That is, the *process* can be the partial delivery of a compound *service*, a *service* delivery in a chain of subsequently provided *services*, or the delivery of a single *service*. The *service* defines and organizes the *processes* where all work is done. The *service* and *processes* share the same goals, or the *processes* partly fulfill the goals of the *service*.

Each *process* has a set of *actors*, which have defined *roles* in the *process*. The citizen is the *subject* who is the receiver of the *service* produced by the *process*. There can be several *contributors* from government and non-government organizations as well as *caretakers* acting in the interest of the citizen. These *actors* together form a *virtual organization* for the *service* in which the *processes* are defined. In cases of hand-over of control between different contributors there is always defined a temporary owner of the *process* responsible for *service* delivery.

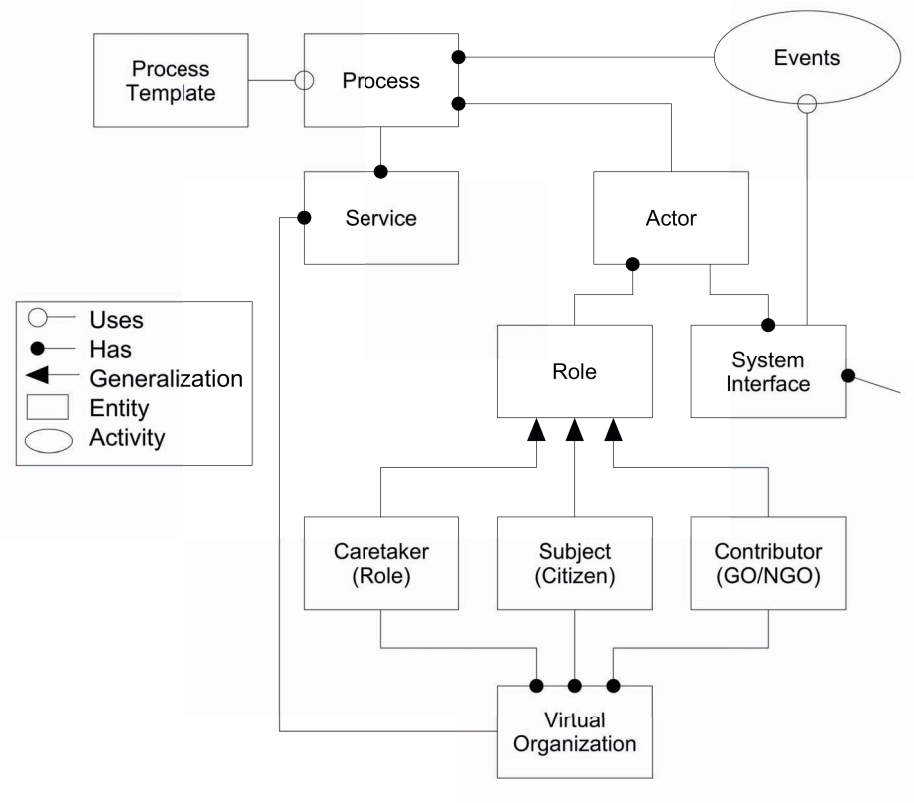

Figure 2 Conceptual architecture for citizen-centric process views

The *process* is created based on a *process template* at the time of instantiation. *Actors* can alter the *process* either directly if authorized or through change requests (*events*) that are accepted or rejected

by other actors responsible for the process steps that are requested to be changed or affected by the requested changes.

The *events* contribute to synchronize the current state of the *process* between all involved *actors* in the *virtual organization*. This allows local information systems connected through the system interface to subscribe to events within processes or they can request information about the process. Capabilities defined in the *process* can be implemented through *actors* connected to the *system interface*. This can typically by core components in the national infrastructure or locally defined functionality in the given municipality. This means that the *actors* interact with the *process* through a defined system *interface*, which can be extended to local information systems at the *contributors*, or to various user devices for *caretakers* and *subjects*. The *system interface* can allow access to custom defined modules running within devices connected through the interface. These can provide various views of the process separately or combined for the different actors. Examples of these are alerts on spending, deadlines, regulations; lookups in central registries for explanations or references; support for running what-if scenarios on process changes; process documentation, central reporting, benchmarking or locating similar cases as the given process instance; translation services, or other utilities that prove useful for single actors or the virtual organization as a whole.

As we can see from the described conceptual architecture, the citizen-centric process view is a single point of access for the citizen where it can interact with the government on currently provided services. It provides an infrastructure for service collaboration, knowledge management and innovation of service delivery. It supports flexible organization of providers and the different government information systems

5 ADAPTIVE AND EVOLVING CAPABILITIES

In the previous section we discussed the conceptual infrastructure of the citizen-centric process views. As mentioned, an important aspect is not only to provide services based on a fixed configuration, but also to support service delivery in a transformational government scenario. This requires supporting both dynamic aspects in a static environment, and dynamic aspects in an environment that is dynamic itself.

This involves changing process instances at run-time, evolving through updating templates, replacing functional components, or redeploying the process as a whole.

The ability to monitor and learn from how the services are provided is one of the utilities of the citizen-centric process views. It enables knowledge creation on the central, local, service and instance level. This further contributes both to making knowledge visible, and promotes knowledge in the organization; it promotes sharing and a knowledge-intensive culture; supports a knowledge infrastructure of technical systems and a web of connections among people given space, time and tools (Alavi and Leidner, 2001).

Changes made to process templates for the running processes can be monitored centrally and locally. Trends can be identified, which can suggest the need for adjusting the process templates. Actual use can further be observed and new policies can be formed for future process executions. At the service level, virtual organizations providing services using similar systems, configurations or acting on similar policies, or municipalities with similar core characteristics (policies, size, budgets, or key-figures) can share experiences and best-practice and in that way co-evolve and share innovations (Fig. 3.). This means that government agencies providing similar services can collaborate on how their process should evolve. They can also share the expenses of improving the systems supporting the process. Having a shared understanding of how services are delivered and a (executable) process description further simplifies the replacement of system components.

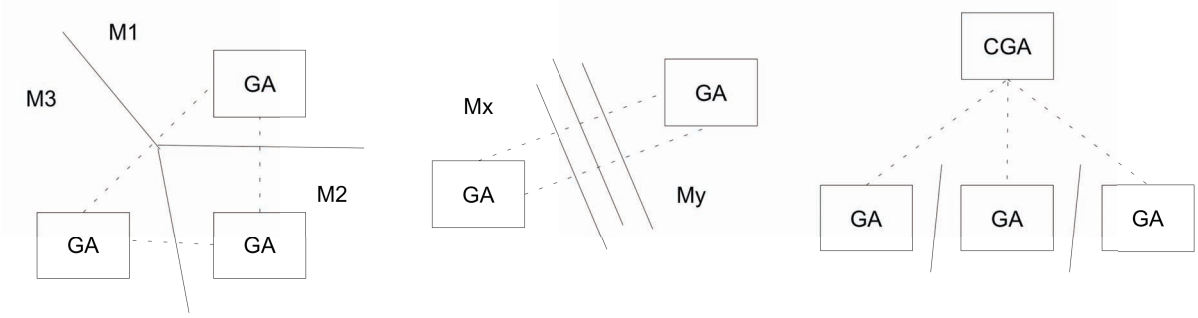

Figure 3 Co-evolution in virtual organizations or process change coordinated centrally. M: Municipalities; GA: Government Agency; CGA: Central Government Agency.

At the instance level, access to similar scenarios and experiences is functionality the involved actors can benefit from. However, the collaboration of actors and availability of information beyond the isolated task of the single actor is itself a resource that can promote sharing of tacit, individual knowledge of the participating actors and thus improve service delivery.

Using process-mining techniques (Van der Aalst, and Weijters, 2004) can also assist the alignment of the formal and actual process, and questionnaire-based pre-process support (Gottschalk et al., 2009) can help create the process templates and involve the required actors.

6 RELATED WORK

There is a gap between currently available technology affordances, organizational culture and political ambitions required to take on the full implementation of the scenario presented in the last section. Some of these are disregarded on purpose by our work and are not needed when establishing scenario descriptions or working prototypes. Others are currently addressed and are assumed to receive the proper attention by related work. In this section we will look at current concepts and research that we believe is relevant to our scenario. The relevant work includes architecture principles, work within life-events, enterprise interoperability, commercially available applications and research on dynamically adaptable processes.

6.1 Organization around Services

Service Oriented architecture (SOA) is one of the cornerstones to the transformational government infrastructure. “Although SOAs might not be new, they address the fundamental challenges of open systems, which are to operate efficiently and achieve coherence in the face of component autonomy and heterogeneity” (Huhns and Singh, 2005). Equally important is the ability to renew, add and remove services dynamically as the requirements of the systems change. Building on the concept of the Enterprise Service Bus, the citizen connects to government agencies and service registries for discovery of services and service interactions. So far, this is similar to the concept of Active Life-Event Portals (Vinter and Leben, 2002), aiding service discovery based on the life events of the citizen. Further, Bercic and Vintar (2003) suggest allowing agents act on behalf of the citizen as proxies in the interaction with the government. We see that the use of agents to discover eligible services and acting on behalf of the citizen is useful. In the case of citizen-centric process views, using agents as proxies in the virtual organization, responding to the occurrence or non-occurrence of events as one of the application areas. The Norwegian LivsIT project (later named Los) started out as a standardization project for semantic interoperability of public services organized around life-events. The life-event focus was later abandoned due to fact that the scope of services related to single life-events is hard to determine. This work is now focused on providing standardization information related to the delivery of single services (Elgemsen, 2008).

6.2 Inter-organizational Collaboration

Due to the autonomy of government agencies, obstacles for inter-agency cooperation on the process level occur when the different agencies use different process description languages. Karagiannis and Hofferer (2008) have performed a survey looking at the use of meta-models to integrate processed across organizations. Ziemann et al. (2008) propose a framework to model and transform cross-organizational business processes to technical process model based on web service protocols. The approach involves establishing process descriptions using Event Process Chains (EPC), which is further converted to BPEL syntax.

Holm Larsen and Klischewski (2004) discuss the challenges of process ownership in relation to inter-organizational collaboration. They conclude that there is no recipe or guidance available on how to proceed in situations where there is an absence of an overall process ownership or where the overall process ownership is not desired. Punia and Saxena (2004) suggest three approaches involving establishing the super-ordinate role, a common shared workspace or interacting through a third party intermediary. Our suggested approach points towards establishing the third party intermediary in the custody of the citizen-centric process view, but it is important that the overall process ownership is not left up to the citizen, and that a separate role independent from the agencies providing services take the overall process ownership and the promote the interest of the citizen.

6.3 Process Modeling and BPM Oriented Tools

When it comes to the BPM systems, there are several commercially available frameworks. The Itensil dynamic process platform (BPMFocus, 2008) is a solution supporting ad-hoc collaborative process work is different from what found in traditional BPM systems, allowing process change on the fly and version control of individual process instances. Itensil uses a wiki-style framework and AJAX-based user interfaces, supporting effective workspace redistribution. While the Itensil framework is designed for ad-hoc knowledge work in smaller teams, the approach is interesting with respect to large-scale process distribution, innovation and flexibility in government organizations. More traditional BPM-approaches provided in the cloud can be found, e.g. Appian Anywhere[1] and Cordys Process Factory[2]. Cordys also provides support for more informally defined case-processing systems, but this is so far not available “in the cloud”.

Lillehagen and Krogstie (Lillehagen and Krogstie, 2008) describe Active Knowledge Modeling and interactive Models. Models are interactive when they are available to the users at run-time and support automatic synchronization of the execution environment and behavior of the system based on changes to the model made by the user. Active knowledge modelling extends enterprise modeling and focus on the knowledge supporting work through models, methods and tools. Systems can evolve with corporate knowledge and users build and manage their own work environment through model-generated workplaces proving process support and access to relevant information (Krogstie and Jørgensen, 2004). So far these approaches have not been applied in a transformational government setting.

7 DISCUSSION AND CONCLUSION

his paper has introduced the concept of citizen-centric process views for e-government services. The concept is located within work on next generation government infrastructure and the application area for services in the transformational government scenario. It is a (de-)centralized approach connecting core components, legacy- and government front office systems for the organization of ongoing and completed instances of provided services to the citizen. The concept is similar to the one-stop

[1] http://www.appian.com/bpm-saas.jsp
[2] http://www.theprocessfactory.com/

government and active life-events portals where the citizen has online access to discover services. It extends those concepts by focusing on the monitoring, choreography and knowledge management aspects of the actual workflow of ongoing service delivery. The citizen- centric process views create a virtual organization around the citizen and the service provided. In contrast to similar concepts, it suggests that there is knowledge about the optimal service delivery present in the virtual organization that is not formalized and therefore preventing the process from being subject to automated processing. This might also be due to the fact that the actual services provided are physical or emotional services, and that the process view acts as a documentation and collaboration space for the involved actors. The models used in the process view can be interactive, and changing the workflow model will affect the actors' involvement and actual workflow of the process in question, supporting the evolution of the overall information system.

The citizen-centric process view is one step closer to the recognition of the e-citizen as a separate entity. Traditional government systems identify individuals through references and variables in information system without any binding to the citizen itself. With the process views the citizen will govern information previously not available and which is not controlled by any government agency. Rech Filho (2005) suggests that the development of the e-citizen concept might not be a priority interest of the government and that its function might rather be of commercial interest. We believe that the access to government or non-government actors should be open, or at least that it is a political choice rather than technological limitation whether the access should be open or not. In transformational government, government services might just as well be provided through private contractors. On the question of citizen-centricity, Kolsaker and Lee-Kelley (2006) stresses the fact that "if the needs of the citizens are not understood, provision will be designed around the needs of the state; if the needs of the state are prioritized, e-services will only be used where the needs of the citizens and state coincide".

We observe that a majority of the related work within life-events and one-stop government is relatively old. Some of the suggested life-events frameworks rely on semantic operability and interoperability support not yet mature for large-scale implementation. We believe that our approach is similarly relying on cultural interoperability, but additionally take advantage of the knowledge of the people involved in service delivery, rather than that of formalized information stored prior to service execution. This approach is believed to be more agile and should be able to support a dynamic service configuration and changing systems as a result of changing prerequisites caused by political, technological and regulatory change.

The work so far does not involve a prototype nor does it critically evaluate the concept. We will continue our work on the conceptual model before we can take on the development of any prototype and evaluation within the citizen-centric process views.

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Paper 5

Investigating requirements for transformational government information infrastructures. The case of the approval process for building applications

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INVESTIGATING REQUIREMENTS FOR TRANSFORMATIONAL GOVERNMENT INFORMATION INFRASTRUCTURES.

The Case of the Approval Process for Building Applications

Gustav Aagesen and John Krogstie

Abstract

In order to handle the anticipated complexity of services and systems for future government service provisioning, next generation government infrastructures are being designed. Required capabilities involve providing support for dynamic organisation of services, effective knowledge management, service innovation, transparency, and user centricity. The transition to full transformational government requires a leap both cultural and technological. The building application approval process is a user-initiated process having multiple stakeholders both private and public, using information from multiple systems within a domain having continuously evolving regulations, both at local and national level. As part of an ongoing study on process support for government service delivery we investigate the building application approval process. We identify potential takeaways for developing the next generation government infrastructure through describing the current service configuration and stakeholders.

Keywords: e-government, information infrastructure, transformational government, services, case study, stakeholders

1 INTRODUCTION

Beyond what we today refer to as e-government we find the idea of transformational government. Features of transformational government include complete horizontal and vertical integration of services, and an infrastructure capable of handling the continuous dynamics imposed by changing regulations and organisation of government service delivery. Given the technological, organisational and political requirements of such a scenario, it is questionable whether full transformational government is realistic in the short term. Nevertheless, the scenario is from a research point of view a goal one should pursue in order to discover best practice approaches and infrastructures required to support next generation government service provisioning.

The need for research on Next Generation Government Infrastructures (NGI) (Janssen et al., 2009) has previously been indentified (Wimmer et al., 2008). Currently in Europe, national infrastructures are being designed with reusable components and citizen-centric service delivery in mind (MEC, 2009). This enables a collaborative development effort across nations, and a further co-evolution of systems, knowledge and methods towards transformational government.

The building application approval process is a user-initiated process having multiple stakeholders both private and public, using information from multiple systems within a domain having continuously evolving regulations, both at local and national level. In this paper we present the work of an explorative case study conducted on the building application approval process in Norway. The case study is performed as part of a general design cycle (Vaishanavi and Kuechler, 2008) within a design science research project on information infrastructures supporting transformational government. Our research questions seek to discover the overall building application approval process, its involved stakeholders, and tools supporting the process. By answering these we hope to provide some understanding of a complex but stable and possibly self-regulating domain within government service

provisioning. We will use the case as a reference in the suggestion and development of our artefact. The case can further be useful for comparative studies or to those working with service design and information infrastructures for current and future government.

In the next section we will present background and related work followed by the methodological background and the research process used to explore the case. The different aspects related to our research questions are presented in section 4. This is followed by discussion of the case and conclusion.

2 BACKGROUND AND RELATED WORK

The Norwegian Ministry of Government Administration and Reform have in the recent years, among others, published two whitepapers (FAD, 2006; FAD, 2009) and one green-paper (FAD, 2007) important to policy creation and the future strategy and directions for the development of e-government in Norway. The work includes mapping of standard services and their use of central registries as well as planning access to centrally developed components as common platforms, and the use of e-signatures and electronic identification management. The organisation of compound services through *eDialogs* is an initiative from the Norwegian Tax Authorities, which aim is to maintain a holistic, and user-friendly two-way electronic dialog between the user and the government. Other identified core processes include: public procurement, holistic processes for patient care, building permits, reporting of income and tax, and case handling. The future directions are aligned to that of the European Commission, focusing on core components supporting electronic identification, providing a common IT-platform, and promoting citizen-centricity. As of now, Norway's Altinn (www.altinn.no) provides a single front-end for transaction based schema delivery. The next generation of Altinn, launched in stages from mid 2010, will among other support service collaboration and several process owners for cross-organisational processes presented as one connected process for the users.

There has been a critique of e-government initiatives taking on a techno-centric, rationalist focus, ignoring the value of knowledge management (KM), and that KM is an important aspect of future government strategies (Kolsaker and Lee-Kelley, 2005). It is further important that e-government strategies for transformation does not move back to organisational re-engineering and an attempt to 'reinventing government', but promote the development of an ICT strategy that underpins the implementation of organisational change (Blakemore, 2006).

Through our research we have started the work of providing descriptions of the environment in which the next generation digital government infrastructure will operate. There is a gap between the current and desired situation that is not yet identified, as well as we can say that the capabilities of the desired state are mainly related to the operational infrastructure, rather than the functionalities and outcomes of the services provided.

Klievink and Janssen (2009) have developed a stage model focusing on growth and transformation between the stages identified by previously developed e-government stage models. They have started the work on identifying dynamic capabilities required in order to move from one stage to the next, and the timing of developing these capabilities in order for them to be most effective. The capabilities are divided into four main groups covering stakeholders and the interaction of stakeholders, technological capabilities, capabilities to enable organisational change, and the capabilities to handle the reconfiguration of service delivery.

Janssen and Kuk (2006) look at enterprise architectures in the perspective of complex adaptive systems, which describe transformational government quite well. One of the challenges with complex adaptive systems is in optimising the systems to find a best practice, since the solution space and number of possibilities is too vast, and there is no practical way of finding the optimal configuration. Their case studies show that the development of core components to support autonomous development of independent systems that are later generalised and scaled up seems to be the right approach. This

includes developing modular functionality and interface definitions to support the variety of systems at the local level, rather than through centralised definitions at the national level.

3 RESEARCH APPROACH

The work presented in this paper is part of an information system research project using design science approach (Hevner et al., 2004) to discover, suggest and evaluate an artefact related to the next generation government infrastructures. We have used the transformational government scenario as a starting point for our investigation of the problem domain. This has allowed us to initially disregard the cultural and technological barriers found in the gap between e-government as we know it today, and the transformational government described in various stage models (Siau and Long, 2005). Using this kind of abstraction in the suggestion phase has served as a useful mechanism to focus our work. We see, however, that the initially suggested artefacts will have to be verified, and that we through case studies are able to get feedback in the reformulation/refinement phases of our work.

By investigating the case of the building application approval process we hope to be able to discover any properties in our initial scenario that should be incorporated to our model rather than leaving them disregarded through abstraction.

The case selection was made based on the idea that the concepts within the domain would be generally understandable. We believe that building permits and city regulation is an area that many people find interesting, as it is a contributing fact to the wellness of our surroundings, and that we all at one point sooner or later in our lives will be exposed to this process from a point of view. City planning, development, and regulation are important tasks taken on by governments. In Norway, the building application approval process is a user-initiated process having multiple stakeholders both private and public, using information from multiple systems within a domain having continuously evolving regulations, both at local and national level. We believe that this at a high level can serve as a generic description for public service provisioning in general.

This study was initiated as an explorative case study with somewhat broad research questions. In order to get an understanding of the case we seek to a) discover the overall building application approval process, b) its involved stakeholders, and c) tools supporting this process. Additionally we hoped to get some impression of whether the process and tools was designed with any particular stakeholder or task in mind. Such particular design might skew the balance of the supporting information system in case of a transformational scenario changing regulations or the organisation of service provisioning.

Our first task was to contact the Agency for Planning and Building Services in Oslo Municipality. Oslo being the capital, and due to its size, should also have an organisation able to handle our inquiry. Based on initial semi-structured phone interviews we where briefed on important aspects of the domain and where provided background information for document studies. We discovered at this point that a new law had been passed for this domain in particular, and that preparations were being made in order to support the new regulations. This meant that the timing of our study was optimal with respect to government transformation and that anyone we wanted to speak to would be busy.

The National Office of Building Technology and Administration was also discovered through document studies and available information online. Being responsible for both the development of core components, translating laws to regulations and monitoring the market's reactions to regulations. A similar approach was used as for the municipal level. Initial phone contact was followed up for questions that could not be answered from our initial studies. We found that most material was available online but that locating the right information needed some help. Further, questions related to current or future activities were answered directly.

In the next section we will give an overview of the building application approval process and the different stakeholders. This is followed by a discussion of the case.

4 THE BUILDING PERMIT APPLICATION PROCESS

In the following section we will first give an overview of the application process for building constitutions. This is followed by an overview of the different stakeholders involved in the process and systems supporting it.

4.1 Overview of the case

Norway has 429 autonomous municipalities responsible for processing of building constitutions within their domain. In 2008, 326 of these municipalities had less than 10.000 inhabitants and the single largest had more than 575.000. Due to this, the required staff and infrastructure to handle building permits vary extensively. But the approval process will in any case have to be in accordance to the Planning and Building Act.

The duration of the approval process depends on the complexity of the building project. The Planning and Building Act determines what projects that require approval. Less complex projects can be processed directly or through simple notification over the counter, while other projects will require a more comprehensive consideration. Larger applications normally go through four phases: *The Initial Framework Meeting*, an application for a *General Permit*, an application for *Project Start-Up Permission*, and a request for *Permit of Us*e or a *Statement of Completion*.

The *Initial Framework Meeting* can be requested for projects of all sizes. It is held so that the general conditions and possible obstacles for completing the process can be identified and communicated to the liable applicant and developer. Even though the municipal representative is required to take minutes from this meeting, these minutes are not taken into the processing of the application itself.

An application for a *General Permit* is submitted, which will determine whether the project can be accomplished within the existing local plan and within the scope of initial framework meeting. The project can be granted a *General Permit* despite having some unresolved technical conditions.

Before the *Project Start-Up Permission* is given, a detailed planning for the project must be completed and controlled, and documentation must be sent to the Agency for Planning and Building Services. *General Permits* and *Project Start-Up Permissions* can be given simultaneously when applicable, and less complex projects can be processed directly in one-stop shops.

The *Permit of Use* or *Statement of Completion* is issued when the project is documented to be complete. Provisional permissions can be provided prior to completion given that there are no shortcomings that are a danger to life, health or safety. *The Permit of Use* is limited to the intended use stated in the project framework with respect to residential or commercial activity or other factors in which the initial permit was based on.

Figure 1 Steps in the building plan application process

Everyone has the right to file a formal appeal according to the Public Administration Act. External stakeholders such as neighbours, residents associations etc., have the right to make complaints regarding decisions made by the Agency for Planning and Building Services in a building application. The purpose of the system for formal appeals is primarily to secure the interests of private parties. The County Governor is the top-end authority to rule on appeal cases. The responsible applicant is responsible for informing external stakeholders affected by the project prior to sending the application. Proof of what information that has been provided and to whom should be attached to the application together with any protests received. Any irregularities with the building application with respect to

regulation plans for the given area should be enclosed with the information provided to the external stakeholders.

4.2 Stakeholders

Stakeholders within the building application approval process are found at the state/national and local/municipal level according to Figure 2. On the national level we find The National Office of Building Technology and Administration as a central authority. The software and construction industry also operate nation wide. At the local/municipal level we find the local authority represented through the Agency for Planning and Building Services (or a local building office), the projects owners and the external stakeholders, who are involved based on how their interests are potentially affected by the project.

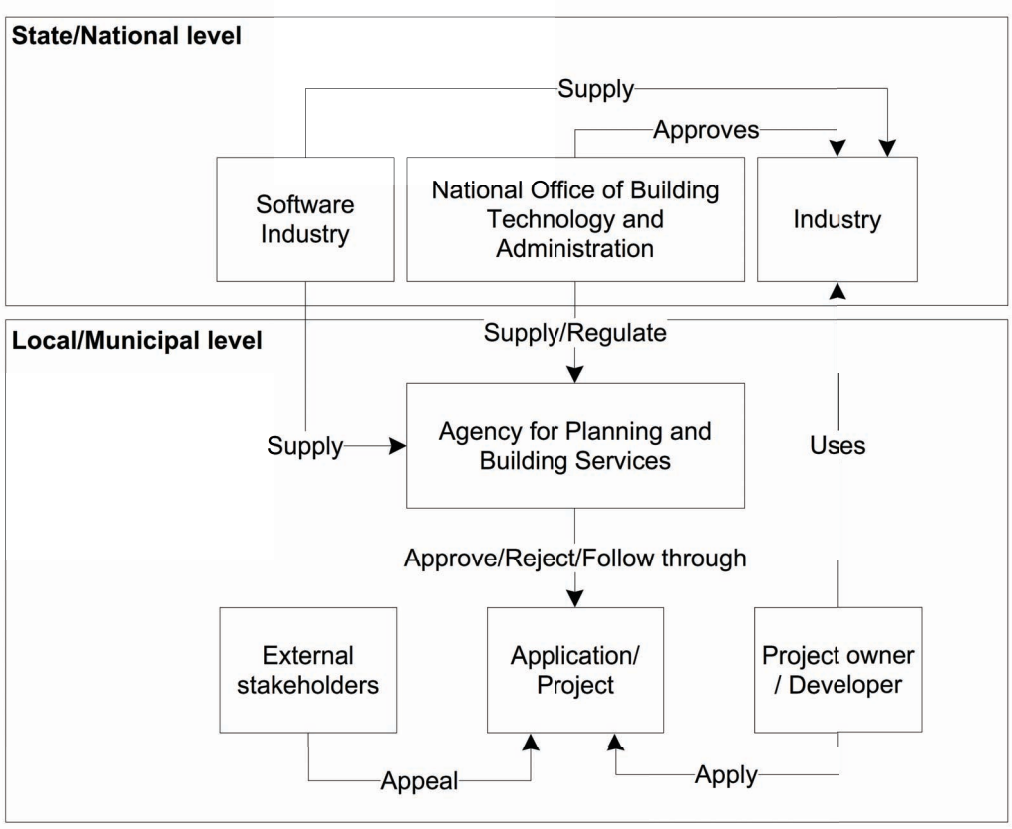

Figure 2 Relevant stakeholders and interactions with respect to building constitutions

4.2.1 National office of building technology and administration

The National Office of Building Technology and Administration is the central authority for technical regulations regarding construction. Publications created by The National Office of Building Technology and Administration in collaboration with the Ministry of Local Government and Regional Development includes the Planning- and Building Act with corresponding regulations and guidelines. The regulations are monitored and validated with respect to their intended purpose, which requires collaboration with local authorities and corresponding revisions when necessary.

The National Office of Building Technology and Administration is the supervising authority for regulations on documentation for properties of construction material. It should oversee that documentation of capabilities for construction material exists and supports the overall goals of the building. It is further in charge for the authorisation of construction companies in according to the Planning- and Building Act. It is a goal that all constructions should be beneficial for individuals and

the society at large. Health, safety and usability are as of that priority areas for all work on existing or new constructions.

Increasing the competence level within the industry and in public administration is a separate focus area. This includes supporting measures to increase knowledge sharing, education, methods and tool development. This also includes promoting innovation and product development in the industry, and thus stimulating the Norwegian exports of construction products and services. Which again contributes to increased employment.

The National Office of Building Technology and Administration collaborates with the authorities, the construction industry, users and organisations as well as the Nordic governments and with groups within the EEA.

4.2.2 Agency for planning and building services

The size of the organisation that takes on the role of the Agency for Planning and Building Services varies with the size of the municipality. Main task involves zoning and planning as well as services related to case handling for building constitutions within the policy area. In Oslo municipality, in addition to the case handling itself, this involves providing:

- Maps and neighbour information to applicants.
- Document and case information for all public documents. Actual document content can be accessed at service terminals or by request.
- Process descriptions and support for applications of different complexity.

4.2.3 Project owner

The project owner is the initiator and one who benefits from the project. He is responsible for safety during construction, that the construction is in accordance to regulations, and that the process is conducted formally correct.

It is important that information is easily made available to the project owner and that the construction process is hassle free from idea to completion. This counts both for professional developers and individuals seeking to complete a single project. Project owners depend on close collaboration with the Agency for Planning and Building Services and any industry actor doing the actual work.

4.2.4 Construction industry

It is possible for the performing engineer to take on the role of responsible on behalf of the project owner. Professional developers can also take both the role of the owner and the performing part in a construction project.

Industry actors are allowed access to the market through the approval granted by The National Office of Building Technology and Administration. For the industry it is important to document the projects to show that they are according to regulations. It is further important that they have effective project management tools in order to streamline their activities.

4.2.5 External stakeholders

External stakeholders are normally involved prior to the project application through the project description made by the project owner. The Agency for Planning and Building Services can provide a list of affected external stakeholders on request. These are normally neighbours, but other authorities can also be involved if (by example) existing structures are of historical value.

The external stakeholders is the first controlling part, as their objections should be brought on to the Agency for Planning and Building Services with the initial building application.

External stakeholders are provided access to documents related to a case through the Agency for Planning and Building Services. The county governor handles appeals to decisions made by the Agency for Planning and Building Services.

4.2.6 Software industry

Actors in the software industry are already providers of case handling systems in accordance to the Norwegian records management standard (NOARK) to municipalities. Separate modules for handling building permit applications are available and are used on the municipal level. The software industry also delivers software packages to various parts of the construction industry.

4.3 Information infrastructure components

The information infrastructure (Hanseth and Ciborra, 2007) for a given domain goes beyond the installed base of servers, databases and applications. The information infrastructure is a sociotechnical system comprised by technical and human actors, as well as the methods, processes and the interaction of these.

We will present two components related to the building application approval process. The first is a component for validation and re-use of data, developed and maintained by the National Office of Building Technology and Administration. The second is a process knowledge management and support platform, used by municipalities to document and communicate routines and templates.

4.3.1 Data validation and re-use

The National Office of Building Technology and Administration initiated the project *ByggSøk* in 2000 on request by the Ministry of Local Government and Regional Development and the Ministry of the Environment. Launched as one of three components in 2003, *ByggSøk Building* is a service for registering building applications online. It enables the applicant to register its building application and to get customised support and guidance through the process. When the application is completed, the content is validated before it can be passed on to the local authority responsible for the case handling.

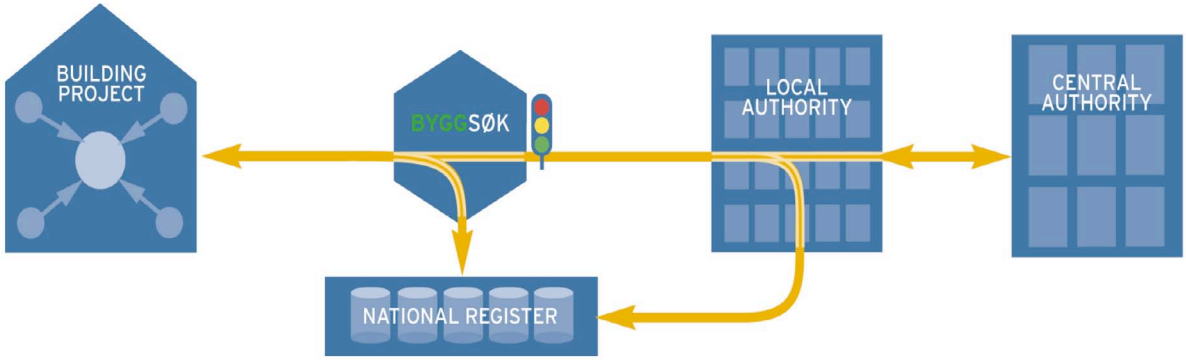

Figure 3 Data flow between building project, ByggSøk, local and central authorities and national registers (http://www.be.no/)

By using *ByggSøk Building*, the local authorities offer electronic services 24/7 on building matters. This facilitates more efficient case handling processes, as application content is validated before they are handled. It further reduces costs for both industry and the government agencies. The online interface can be used even if the local authority in the given area does not support *ByggSøk*. The building application can be completed online before it is printed and manually submitted.

It is also possible to access *ByggSøk* Building through a web service, enabling professional developers to validate building applications from their own applications. This opens up for a type-once policy where no data has to be entered into systems more than once. When the local authorities are through

with their case handling, the BIM (Building Information Modelling) files are returned to the developer for documentation and further work.

By establishing the *ByggSøk* application, a central control of standards has been established. It is further the same authority that is responsible for regulations within the domain that is in control of the control mechanisms of applications. By providing integration with map systems, and through also being used for automatic checking against zoning rules and regulations, *ByggSøk* can act as an interface to various sources of public data. The quality of the industry and government databases is crucial for the success of this approach, but will on the other hand provide more comprehensible and accountable services based on an open and transparent public sector.

A full-scale implementation of *ByggSøk* Building would require changing the organisation of 429 municipalities and approximately 2.000 public offices. In addition, 30.000 private companies in would have to change they way they work. It must be said that *ByggSøk* can be used in all municipalities as long as there is an email address available to send the applications to. But in order to benefit from the solution beyond receiving valid applications, it is necessary to enable electronic case handling. This requires the proper IT-infrastructure and processes to transform the entire service organisation and not only electronic case handling related to building applications.

In 2009, approximately 40% of all building plan applications were created through *ByggSøk* Building. Whether there will be 100% take-up by municipalities directly is uncertain. Smaller municipalities have a just a few cases each year and will have a minimum of benefits through its use. An important point is however that this service can be provided to the citizens regardless of the usefulness to the local authorities. It is estimated that over 80% of the population live in a municipality where building plan applications can be handled electronically. The trend in the latest years has been organisation of shared service networks (Becker et al., 2009), which should enable building application approvals for a collection of smaller municipalities.

4.3.2 Process knowledge management and support

The service byggesak.com was an initiated by Oslo municipality prior to the development of *ByggSøk*. It enables each municipality to publish documentation of routines, regulations, guidelines, checklists, templates, examples and general information. This provides increased transparency towards the public and facilitates unanimous case handling across different municipalities. As of today, 202 municipalities are listed as using byggesak.com, but the amount of information published at each municipality varies greatly.

In addition to byggesak.com, the National Office of Building Technology and Administration hosts the forum BE Interactive, as a discussion board for general matters related to case handling and technical issues for both planning and zoning. It is an active forum having more than 3000 registered users since 2003.

One of the planned services when establishing *ByggSøk*, was a separate information portal, providing the basically the same functionality as byggesak.com. It later turned out to be more appropriate for the municipalities to publish this information within the context of their own websites rather than using and external solution. Today, much of the knowledge management and collaboration occur in virtual organisations of shared service networks.

5 DISCUSSION

Our investigation of the building plan application process is in the perspective of a next generation government infrastructure. Based on that, our interest is to identify structures and experiences from the case that can be applied as guidelines for best practice in establishing such an infrastructure.

What we have observed is that the strong central authority, through the role of the National Office of Building Technology and Administration, has been an important to the success of this part of

government as we see it today. Through providing *ByggSøk Building* as both an application and a web service, it has been possible to provide a single channel for submitting and validating data. Having the central data validation service close to the authority responsible for establishing regulations it additionally enables timely coordination of regulatory changes. Changing the technical interpretation of new regulations is a one-time job.

The role of the software industry is also important in this case. As of today, Norway has four providers delivering case handling systems to municipalities. These systems additionally provide modules for handling building plan applications. Through central standardisation it has been possible to guide both the software and construction industry by deciding what document formats to use for collaboration. This has increased the competitiveness and effectiveness within the domain. It is a priority area that the National Office of Building Technology and Administration take a key role in the standardisation of communication between relevant stakeholders. Proactive involvement in standardisation work is an important task for governments.

When it comes to the potential promoting of certain stakeholders, the single citizen is not found to be the primary user of *ByggSøk Building*. One could further say that online building plan applications is more fitted to the B2G rather than the C2G domain. We see that focusing on efficiency towards business users before taking on the needs of the citizens is a possible strategy. How online applications can be made easier accessible for citizens is a topic that needs more attention. Given the existence of national information infrastructure with messaging capabilities, providing automated notice of building plans to external stakeholders might be a service that can attract citizens to the online gateway.

An aspect of the case that was less successful from the ByggSøk project point of view would have to be the information portal. This is a special situation, since the designed portal would compete with already existing similar functionality. If a new attempt to reorganise information on a local, regional or central level were to be made. It would most probably be based on mining the information from the different municipalities, rather than having the municipalities publishing their information onto ByggSøk as originally planned.

6 CONCLUSION

In this paper we have investigated the processing of building application approvals in Norway. Through describing stakeholders and supporting information infrastructure components we have established some understanding of a single e-government domain. The separate components of the case can be identified as outcomes of more or less classic e-government initiatives as described elsewhere. From a holistic point of view the case can be used as input to a successful approach to a dynamic and evolving government domain. Properties identified in our discussion will be used as input to our research related to next generation government infrastructures.

The material used on this study is based on qualitative data from primary sources and quantitative data from secondary sources. Even though it is not within our current scope, further studies could be conducted within municipalities, the industry, and towards citizens directly.

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Paper 6

Service development for national government information infrastructures – The case of Norway

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SERVICE DEVELOPMENT FOR NATIONAL GOVERNMENT INFORMATION INFRASTRUCTURES – THE CASE OF NORWAY

Gustav Aagesen and John Krogstie

Abstract

There is an ongoing technological transformation as a result of e-government initiatives and the establishment of national government information infrastructures. The central standardisation and flexibility of national enterprise systems shape the overall capabilities of the governmental agencies to evolve. This paper presents a case study on the current transition and plans for deployment of the national information infrastructure of Norway, Altinn. Aspects important to service development are described, and challenges related to adoption by stakeholders are discussed. We see that important parts of the transformation strategy include both making available tools and methods for building services on a common information infrastructure and applying political pressure on organisations to adhere to what one centrally has defined as best practice.

Keywords: e-governance, enterprise architecture, information infrastructure, information systems, e-service development

1 INTRODUCTION

From an e-government perspective, rational choice inspired management reforms like New Public Management (NPM), which break down large organisations into networks of relatively autonomous organisational units to create economic incentives, means that many processes are now fragmented over several administrative organisations in "silos" (Hjort-Madsen, 2006). Early adopters of e-government are at point where access to secondary data and remote processing is a necessary aspect of further e-government development. Access to central resources and service interaction patterns are type-wise identical across a great landscape of autonomous governmental agencies. National enterprise architectures are aimed at ensuring interoperability, avoiding duplication of efforts and enable government-wide reuse (Janssen and Hjort-Madsen, 2007).

The 2009 *Ministerial Declaration on eGovernment* (EU, 2009) promotes shared European objectives by 2015. This involves the development of user-centric services that provide flexible and personalised ways of interacting with the public administration. It further actively seeks to collaborate with businesses, civil society, and individual citizens in developing user-driven e-government services. This enables a collaborative development effort across nations, and a further co-evolution of systems, knowledge and methods towards transformational government (Janssen and Shu, 2008).

The future strategy and directions for the development of e-government in Norway (FAD 2006a; FAD 2006b; FAD 2007) includes identification and standardisation of services, use of central registries, as well as access to centrally developed components as common platforms, and the use of e-signatures and electronic identification management. As of now, Altinn, being one of several government portals in Norway, provides a single front-end for transaction-based data delivery.

The next generation Altinn, Altinn II, will be launched in 2010 after 4 years planning and development. It will, among other things, support service collaboration between several process owners for cross-organisational processes presented as one integrated process for the users.

In this paper we will look at the planned transition from Altinn to Altinn II, new features provided by the upgrade, and the means used to achieve successful adoption of the new national information

infrastructure. The motivation for our study is based on our ongoing research on Next Generation of Digital Government Infrastructures (NGI) (Janssen and Chun, 2009). Our reference architecture is an architecture that supports the transformational government scenario and the objectives outlined by the 2009 Ministerial Declaration on eGovernment. This involves investigating whether the provided infrastructure is able to support a demand-driven and citizen-centric government. The case description and discussion is related to how the planned national infrastructure in Norway facilitates service development, and the potential challenges to its success.

The next section will provide a description of the national infrastructure development in Norway, represented by the Altinn solution. The case description is based on presentations at the Norwegian conference of ICT in public sector 2009 (NOKIOS), document studies of both public and internal documents, and follow-up discussions with members of the Altinn project group and employees in the Agency for Public Management and eGovernment. We discuss challenges of the case by looking the different stakeholders involved in service production and through an existing stage model for dynamic capabilities of joined-up government. This if followed by our conclusion and discussion of further work.

2 NATIONAL INFRASTRUCTURE DEVELOPMENT IN NORWAY

Altinn is not a service itself, but a professionally hosted service platform, a web portal for publishing online services to end-users, and a centralised integration point for end-user systems. It can also act as a front-end for legacy systems, providing loose couplings and clean interfaces. This allows back-end systems to be upgraded independently while providing online services to users, and prevents the need for legacy systems to be online at all times. It has its own security layer, handling authentication of users on behalf of back-end systems and acts as a centralised user database.

The Altinn II framework will be launched in two stages using a replacement approach (Armour and Kaisler, 2001). The first stage is a replication of the existing solution on a new technical infrastructure, while the second stage involves providing new functionality. The two versions will, however, co-exist for some time before the initial version is discontinued.

The following is a description of the types of services supported by Altinn II, the architecture and reference model, and the service development platform. We have also accounted for the initiated political pressure to promote adoption for government agencies.

2.1 Service types

Submission services are provided as online forms presented within the end-user interface. Form fields can be completed within the interface or pre-populated from connected third- party applications. Forms can be completed collaboratively, and actors can alert each other about forms ready for contribution. The form owner can publish forms with their respective deadlines onto the task list of users, and single forms can have multiple receiving actors and can be grouped or nested prior to submission. The tax declaration service is a submission service for both citizens and businesses and is the most commonly used service. Messaging services is close to what one can define as an internal email bus, enabling government agencies to send html-formatted messages (with attachments) to the inbox of a registered user. The service features confirmation of received messages and it is also possible for the user to forward messages to a regular email account. Information services provide information stored in central registries to a particular user or user's representative. The user can also pass on this information, given that the service owner grants this. Link or authorization services are provided when the service itself is located outside Altinn. Altinn acts as a proxy for authorization before passing the user on to the service. Distribution services are provided in order to transfer data between government organisations or between private and public organisations. These services rely solely on an API and are capable of distributing data to multiple receivers. Compound services allow

single services to be linked together within a process and combine several actors from both public and private organisations or citizens. These can be long running processes, and actors can perform multiple steps at different stages of the process. A compound service has one overall process responsible, while different actors can be responsible for separate process stubs.

2.2 Architecture and reference models

The overall architecture of the national infrastructure is a three-layered model as shown in Figure 1. The bottom layer is the business layer and the back office and physical front office of the government agencies. These are supported through access to the core component layer and the Altinn services. In the presentation layer we find the Altinn portal, services provided by Altinn with customised user interfaces, or state or municipal portals built on elements from the core component layer. The online government front office is found in the presentation layer. Services that are produced or provided by Altinn cannot be hardwired to presentation in order to be reusable, and the Altinn framework will have to support information about customised presentation of services. There are two different service concepts found within the reference model, both end-user services provided externally and as internal SOA-services provided by the core component layer.

The Altinn framework is developed using established open standards and available standard tools for its development environment. To prevent the framework from being outdated soon after deployment, it has to be created so that both tools and components can be replaced without having to redesign the entire architecture. The risk of having components diverging from a given technology roadmap when upgrading is reduced when using tools from the portfolio of a single provider. In the case of Altinn II, this provider is Microsoft. Adding new services should also be possible without affecting central system components or already deployed services. These are factors that intend to contribute to the attractiveness of the framework for software developers and an increased competition and potential providers to e- government projects.

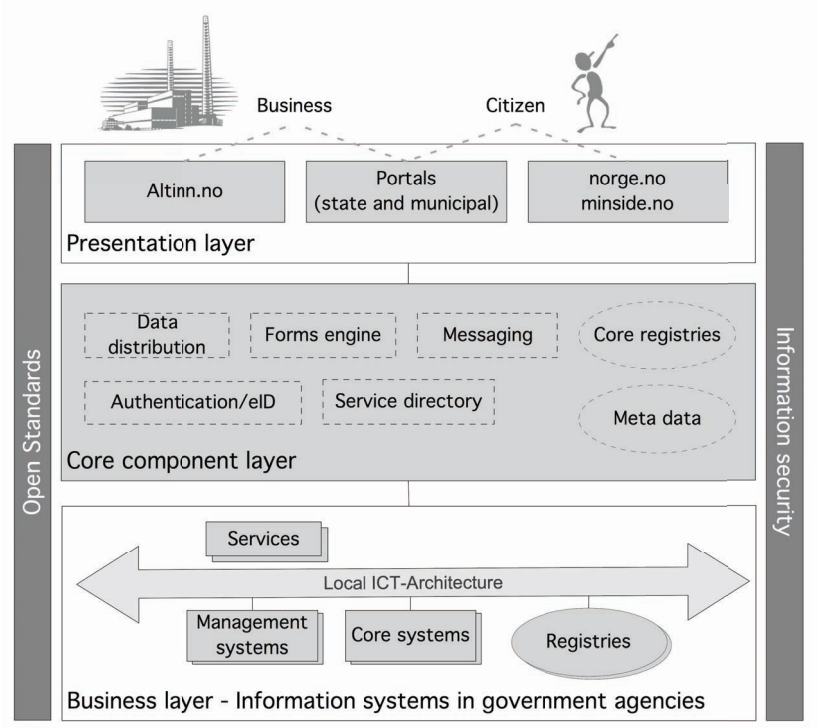

Figure 1 National infrastruture, adapted from FAD (2006b).

2.3 Service development platform

Separated from the infrastructure and interfaces supporting end-user services, is the service development platform. It supports the service owner in developing and testing services before they are made available on the end-user platform. Functionality within the service development platform include:

- *Service versions*: Information about existing services and versions. Tasks include opening, deleting and creating new versions of services.
- *Documents and collaboration*: Document library, version control and other collaboration functionality including service design.
- *Publish/information portal*: Enables posting information regarding available services to the information portal within the development platform.
- *Migration and testing*: Moving services from the development, test and production environment. Facilitating test and deployment of services.
- *Service metadata*: Maintenance of metadata descriptions for service definitions, workflow, links, task-lists, authorisation, bootstraps and data sources.
- *Service content*: InfoPath documents with attached contents collections required for rendering the actual forms (Graphics, layout, style sheets, navigation, control routines, ELMER (2006) user interface guidelines).
- *Language*: Translate descriptions, labels, confirmations and other locale-specific information within a service.
- *Toolkit*: Developing and making available components and templates for reuse when developing new services. This can include parts of forms or workflow.
- *Service ontology*: Definition of categories for organising services. Categories are defines by the service developer and controls how the service is displayed to the end user.
- *User support*: Information about the service development process available to the service developer throughout the service development life cycle.
- *Access control*: Maintenance of access and roles for the different users of the service development platform.

Access to the service development platform is web-based. By using Citrix add-ons, richer applications can be accessed for designing forms and service workflow.

2.4 Political pressure on planning and reuse

While a too strict governance may lead into diminishing of innovativeness and initiatives, which may reduce modernization of public services and government's structures (Isomäki and Liimatainen, 2007), providing the right support and guidance can foster service development in government agencies. The central instrument of control the ministries have on state-level government agencies is the annual allocation letter (*tildelingsbrev*). It passes on economic boundaries, priorities, goals and means of reporting results for the given organisational unit.

With the launch of Altinn II and given the current maturity of core components, national infrastructure and electronic ID in Norway, the allocation letter for 2010 is quite specific on ICT and issues related to e-government development. Norway has seven architectural principles for e-government defined by the Ministry of Government Administration and Reform: service orientation, interoperability, universal availability, security, openness, flexibility and scalability. All state agencies must consider these principles when developing new or when taking on significant modifications on existing information systems. They should further utilise core components for electronic ID and use Altinn

when creating new services or making services available online. In addition, all existing solutions for electronic identification will be replaced by the central solution. Agencies that wish to continue using existing solutions for electronic identification will have to explain their reasons for doing so. This also counts for any services developed outside the framework provided by Altinn.

In order to follow up and to ensure that state agencies are doing sufficient architectural planning, a self-declaration form is to be sent to the Ministry of Finance and the Ministry of Government Administration and Reform. Completing the form is required for projects that require cross-organisation or sector integrations, projects with investments over 50MNOK ($8.5M) or e-government service initiatives that require special funding through the fiscal budget.

3 DISCUSSION

The Next Generation Digital Government Information Infrastructures aim to deliver application-layer functionality that enables the developers to disregard many of the deeper technical issues related to interoperability. Altinn is an example of an infrastructure that attempts to deliver just this. It provides a standardization of interfaces, tools, and methods available for creating services using predefined service-types. Previously identified changes required to meet the challenges of interoperability in e-government include componentization, establishing a global-local architecture and a meta-level object definition for a single source of truth (Wu, 2007). These are all aspects of the infrastructure provided by Altinn. But Altinn does not provide any services itself, it is just a service infrastructure in a complex socio-technical system. Crucial for its success are among other the necessary top-down policies required for initial adoption, the pragmatics of service development and maintenance, the organisational changes required for service transformation, and the agility of the infrastructure and its deployed services. We divide our discussion into three levels with respect to the current infrastructure: the public administration, and the private and public stakeholders.

Within the public administration at state and municipal level it is clear that the focus area and short-term gains are anticipated at the state-level. State-level initiatives have a broader reach and are more manageable. The allocation letters and top-down policies are also directed toward agencies at the state-level. The self-declaration forms are not required for government agencies at the municipal level, but their use is encouraged as a desktop exercise. A possible origin to the problem of the low pressure on municipal agencies is that of the coordination between the Ministries. While the Ministry of Local Government and Regional Development is responsible for regional and local development, all matters related to ICT are left to the Ministry of Government Administration and Reform. The problem is that these areas are close to inseparable as there is no likely ICT innovation without organisational change or vice versa. It is further not possible to impose the use of core components or self-declarations on municipalities without the support through laws or regulations, which is a separate process all together. A further issue with the self-declaration forms is that they follow a comply-or- explain policy, so a project is practically free to ignore the established standard. Enforcing use of a single framework is further both a matter of high cost and possible high risk due to complexity in an early stage of development. An alternative strategy to increase awareness and spread knowledge on important e-government issues are efforts similar to the online project portal for government ICT projects (http://www.prosjektveiviseren.no/), maintained by the Agency for Public Management and eGovernment. The portal hosts e-rooms, guidelines, and experiences for various aspects related to running e-government projects. We see that the need for competence to develop services that allow free moving between services in different municipalities is one particular area that needs coordination.

Successful adoption of the national infrastructure requires a strong IT industry as providers and service developers. The IT industry needs sufficient domain knowledge to work with government agencies, and an extensive effort must be made to apply principles of service oriented architecture when designing globally accessible and reusable services. The Altinn framework is designed with the purpose of providing sufficient provider space and to increase competition. The question is whether a commercial involvement by private service developers is sufficiently supported and if the required

collaboration and economic incentives are present. The need for research on private commercial involvement in a building block industry is previously identified by the eGovRTD2020 project (Wimmer et al.,2008).

Mash-ups of government data and open data access based on initiatives similar to http://www.data.gov/ contributes to transparency, involvement and trust in government. Open data access invites a whole new group of service developers through citizens, civil society, and businesses. Providing directions on access and use of data and service design guidelines to this stakeholder group is similar to that of a building block industry and an area that requires attention. Norwegian support for open access to government data has been initiated, but the effort is so far not coordinated through Altinn, which would be a natural framework on which to locate and publish data sources and mash-ups.

As we can see from the discussion, success is very much determined on the ability or willingness of the stakeholders to act according to the planned transition. Our investigation of the case involves investigating whether the provided infrastructure is able to support a demand-driven and citizen-centric government. By using the dynamic capabilities framework of Klievink and Janssen (Klievink and Janssen, 2009), we can identify technology aspects of Altinn with respect to e- government maturity. In addition to technology aspects, the framework separates capabilities into the relational capabilities of stakeholders, transformational capabilities of organisations, and the flexibility and process-oriented capabilities of demand driven service delivery. The sum of capabilities at each level of the 5-stage maturity model qualifies to the given level of maturity. Considering the technology capabilities separately, we see that the generic properties of a nation-wide portal is present as well as the architecture components of integration required to establish service delivery chains required for inter-organisational integration. The framework associates no explicit technology capabilities with demand-driven joined up government. The requirements at this level are related to the organisational and aspects of service delivery on top of the existing infrastructure. There is still a significant gap between these capabilities and those that we observe today. At the technology side, we further support the suggestion (Klievink and Janssen, 2009) that the capabilities required at each stage has to be investigated in more detail. This is generally important for the final stages of e-government maturity models were the tendency is to overload these with utopian features. In our case, we suggest that more work is required for identifying the true meaning of transformational government, capabilities and the ways forward.

We observe the transition strategy for infrastructure in Norway as quiet and harmless opposed to a big-bang (Armour and Kaisler, 2001) approach. The worst-case scenario for the transition is a status quo ante, caused by no changes occurring for better or for worse. The technology capabilities of Altinn is however limited to that of data gathering, validation, and distribution. As we can see, Altinn alone does not make Norway more citizen-centric, but has the potential to unite and simplify existing interactions between citizens, businesses and government and within government agencies. Altinn does not make Norway more demand driven, but given a broad take up of the service development platform there is an overall benefit of increased responsiveness due to the collaborative development of building blocks and the service development framework. The BPMS capabilities of Altinn are limited to the process flow of predefined services and actors. Future work should allow data processing and should investigate the possibilities of integrating and standardising back-office interfaces for individual government agency efforts. This study has brought our attention to the service developer through service development platform. Moving data processing to Altinn will increase the required flexibility of services and possibly move the role of the developer closer to that of the public servant.

4 CONCLUSION

In this paper we have presented the planned transition of the national government infrastructure in Norway, Altinn. It is probably too early to predict the potential e-government maturity based on

technical features of Altinn alone. Our focus has been on Altinn as a service development platform and how government agencies, the IT industry and third party contributors can use this platform to evolve service delivery. We have discussed the policy aspects and other means used to promote adoption. The adoption from a service consumer point of view has not been within the scope of this study. The paper helps document the current state of e-government in Norway. Its timing is important in order to successfully follow up and plan the next moves towards transformational government. Further work should observe the impact of policies, evaluate the success of the service development platform and how services are developed and reused.

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Paper 7

The entanglement of enterprise architecture and IT-governance: The cases of Norway and the Netherlands

Gustav Aagesen, Anne Fleur van Veenstra, Marijn Janssen, and John Krogstie (2011) The entanglement of enterprise architecture and IT-governance: The cases of Norway and the Netherlands, *44th Annual Hawaii International Conference on System Sciences (HICSS'11)*

THE ENTANGLEMENT OF ENTERPRISE ARCHITECTURE AND IT-GOVERNANCE:

The Cases of Norway and the Netherlands

Gustav Aagesen, Anne Fleur van Veenstra, Marijn Janssen and John Krogstie

Abstract

Governments are developing infrastructures to spur e-government development. These e-government infrastructures are based on the notion of ICT as a utility that can be (re-)used by organizations at all levels of government to create their own service provisioning and to facilitate interaction with each other. This paper investigates the development of such infrastructures by looking at regional and national aspects. A cross-country comparative framework is developed and 2 countries are analyzed. We found that infrastructure development in both countries is similar at a global level, yet the governance is different. While Norway aims to enable integration by developing a Business Process Management building block on the national level, in the Netherlands local governments compose and integrate the building blocks with implementation support from the national level. These differences between e-government infrastructure developments of the two countries can be attributed to the degree of centralization of government and the degree of active support given to e-government developments.

1 INTRODUCTION

To spur e-government developments, governments all over the world are creating basic national e-government infrastructures to provide generic functionalities that can be used by government agencies as services (Janssen and Chun, 2009). This concept is based on the idea that basic services are developed and shared among the many governmental users to create services, which is often denoted as Software-as-a-Service (SaaS) (Rappa, 2004). SaaS refers to a sourcing model in which software is made available as services that are provided on a subscription basis and hosted externally. The infrastructure contains these services that are provided by utilizing the SaaS business model. Governments can use the services provided by the infrastructure to create new systems by composing them out of the available services. The main advantages are that organizations do not need to develop, maintain or control software themselves, but instead they can re-use existing building blocks, and at the same time a basic infrastructure stimulates standardization of services, development and interoperability. This promises to reduce control and maintenance costs (Kaplan, 2005) and e-government progress should be given a boost (Janssen et al., 2009).

Development of such e-government infrastructures varies widely in different countries. They are often guided by National Enterprise Architectures (NEA), aimed at aligning business and IT and give direction to e-government developments (Jansen and Hjort-Madsen, 2007;Ebrahim and Irani, 2005). Yet, we lack research on how the design and guidance of such infrastructures should take place. Furthermore, a closer look needs to be taken at how governance of such infrastructures can be set up effectively between the central level, who are primarily in charge of developing these building blocks and the national and regional government agencies, who are the intended users. IT-governance, which is aimed at 'to direct and oversee an organization's IT-related decision and actions such that desired behaviors and actions are realized" (Huang et al., 2010), needs to manage such dependencies.

This paper investigates the development of e- government infrastructure by comparing developments in two countries: Norway and the Netherlands. These countries share the policy aim to establish an e-government infrastructure that can be employed using the SaaS business model. A systematic and structured comparison will be conducted by first developing a framework aimed at understanding and explaining the development of e-government infrastructures and address the tensions between a centralized and a decentralized service development. Nowadays it is argued and recognized that governance is required to assure consistency and timeliness of enterprise architecture (Winter and Schelp, 2008; Perks and Beveridge, 2002). Therefore, we address both governance and architecture aspects. A cross-country analysis allows us to investigate differences in e-government infrastructure development across government organizations. Both countries are similar, but their approaches are different enough to enable mutual learning.

This paper is structured as follows. First, we develop a framework for comparison of e-government infrastructure development. Then, we investigate e- government infrastructure development in Norway and the Netherlands. After a comparison of the developments in the two countries and a discussion on the outcomes of the comparison, we present conclusions and recommendations for further research.

2 COMPARATIVE FRAMEWORK

Policies are formative at several levels. They shape the direction of development both in which research projects are funded and which projects are initiated and supported by the government. But despite this shared vision of the direction e-government (EU, 2009) should take, the actual implementations and organization of government based on a common set of policies may take on different directions at the national and regional level within the different governments. The set-up of generic infrastructures, architectures guiding developments and governance structure are influential in determining the outcome of e-government development. Similarly, the pattern-dependencies caused by previous policies and the order of which policies are enacted, form the capabilities of the different government agencies and the governments as a whole. The infrastructure is influenced by the path dependencies, organizational readiness and implementation of the policies. NEAs are used as an instrument to guide implementation and IT-governance to direct decisions-making processes.

2.1 Architecture

The idea of enterprise architecture in the public sector is that it can be used to guide and constrain decisions and progress towards e-government. The existence of isolated, overlapping in function and content, highly fragmented and unrelated computerized applications has led to ‘isolated islands of technology’ (Peristera and Tarabanis, 2000). Architecture is an instrument to guide e-government progress and ensuring that the single elements are coordinated. Traditionally, the purpose of EA is to effectively align the strategies of enterprises with their business processes and the coordination of their resources (Ebrahim and Irani, 2005; Zachman, 1987). EAs define and interrelate data, hardware, software, and communication resources, as well as the supporting organization required to maintain the overall physical structure required by the architecture (Zachman, 1987; Richardson et al., 1990). Architecture can be viewed at various levels, including hardware, network, system, application, business process and enterprise level (Richardson et al., 1990; Armour et al., 1999). Many governments have embraced architecture as an instrument to progress e-government (Janssen and Hjort-Madsen, 2007; Bellman and Rausch, 2004) and there are many existing frameworks (Lillehagen and Krogstie, 2008).

2.2 IT-governance

Governance represents the framework for decision rights and accountabilities to encourage desirable behavior in the use of resources (Weill, 2004). Information Technology (IT) governance involve the mechanism to direct and guide IT-related decisions by allocating responsibilities, communications and

alignment procedures and processes to manage the dependencies between responsibilities (Huang et al. 2010). IT-Governance mechanisms determine how communication, responsibilities and decision-making structures are formalized (Weill and Ross, 2005).

Ross (2003) criticized enterprise frameworks for taking a technologist view. Frameworks do not highlight the role of institutions and capabilities critical to enabling the adoptions and diffusion of architectures. IT-Governance, or in this context architectural governance, is often viewed as a necessary conditions for ensuring success. The tension between centralization and decentralization of IT is one of the major recurring issues in literature (e.g. King, 1983; Peak and Azadmanesh, 1997; Sambamurthy and Zmud, 1999). With the advent of the Internet, web services technology has become viable to centralize functions that are currently or were formerly performed at a decentralized level. There is some disagreement in the literature about the driving forces behind centralization decisions (e.g. King, 1983; Peak and Azadmanesh, 1997; Sambamurthy and Zmud, 1999). King (1983) found three separate aspects, control, physical location and function that can be either centralized or decentralized. In this research the focus is on the function (infrastructure building blocks) and control (governance).

2.3 Towards a framework for comparison

An important issue in comparative cross-country research is the importance of creating a framework that allows us to compare concepts that are sufficiently equivalent (Gharawi et al, 2009). Janssen and Hjort-Madsen (2007) developed a framework for comparing NEA within the public administration. They used five elements 1) Policies, actors and structures, 2) Governance 3) Architecture model 4) Architecture principles and standards and 5) Implementations. In contrast to this research, the aim of Janssen and Hjort-Madsen (2007) was to investigate infrastructure development and the impact on services. The framework for our comparative study is based on the tensions between central and decentralized actions and the use of architecture to develop the e-government infrastructure. Government strategies towards establishing the government information infrastructures are realized by developing NEAs. At the same time, the governance and support directed at government agencies shape the individual agency's ability to act according to policies and its ability to contribute to both individual and common goals defined by policies.

The framework we present has evolved iteratively together with the investigation and analysis of national policy documents and government initiatives. The framework model in Figure 1 describes (from top to bottom) the policies defined at a national level; these are in some way created by politicians supported by the bureaucrats. The governance measures are further formulated to support policies in the form that they have through laws, regulations or political ambitions.

The governance as an administrative interpretation of policies includes instructions and allocation of tasks and responsibilities for the different public agencies. To support the adherence of tasks and responsibilities, and that actions are in conformance to the objectives, architecture methods, guidelines and standards are defined and made available to the various government agencies. These can be both used to aid adoption, to monitor and measure policy outcomes, or for reference in implementation. In addition to the knowledge-based procedural support provided through methods and guidelines, infrastructure components can be provided centrally with a similar goal of supporting the public agencies ability to deliver their services effectively.

Public agencies operate at a regional (local), or national level. Regional agencies include municipalities and public agencies with a geographically limited policy domain, while national agencies are public agencies with a coordinating function or providing services at a national level. These agencies are both service providers and developers. In a national information infrastructure they can be both producers and consumers of shared services and components.

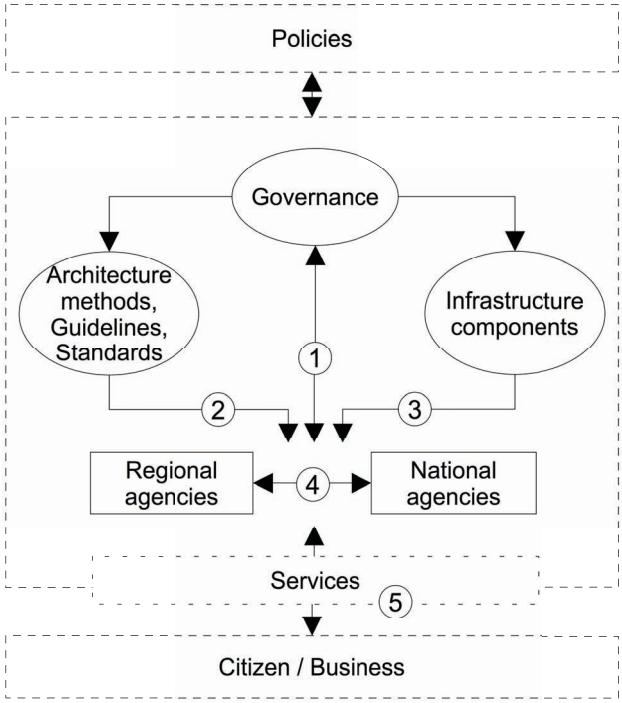

Figure 1 Framework for cross-country comparison

At the bottom of our model the interaction between the citizens and businesses and the government agencies is shown. Given by the numbers (1-5) in the model, our aim is to investigate the following:

1. Organization: What is the organizational readiness? How is the governance of e- government organized? What direct governance exists and what instructions are given to the public agencies?

2. Architectural support: What methods, guidelines and standards are made available centrally to the public agencies as means of support and control in e-government projects?

3. Infrastructure: What infrastructure (software) components are provided centrally to support service delivery?

4. Use and adoption: How is the governance and support different towards national and regional agencies, and what roles do these agencies play towards establishing a national information infrastructure?

5. Services: How is the citizen and business service interaction with respect to the regional and national agencies and the provided infrastructure?

By performing a cross-country comparison of the governance and implementation of e-government initiatives, it is possible to see what parts of the national policies have been given more attention and how the policy implementations are different. We will also be able to see what governance mechanisms that are currently at play and what support mechanisms (methods, tools, and frameworks) are being developed.

3 NATIONAL GOVERNMENT CASE STUDIES

In this study we compare Norway and the Netherlands. The reason for doing a cross-country comparison between those two countries is that they share a number of institutional similarities. Both are constitutional monarchies and parliamentary democracies with around 430 municipalities and around a dozen provinces/counties. Some basic statistics to compare both countries are denoted in Table 1. Data pairs are from 2007 to 2010, depending on availability. This shows that both are small

countries having high Internet and broadband penetration. The main difference is the population density, which is very low in Norway and very high in the Netherlands.

Table 1 Key figures (taken from http://ssb.no/ and http://cbs.nl/)

	Norway	The Netherlands
Citizens (millions)	4.86	16.6
Population dencity pr km^2	14	392
Gross domestic product (GDP) per capita in Purchasing Power Standards (PPS) (EU-27 = 100)	131	119
Unemployment rates [represent unemployed persons as a percentage of the labour force (%)]	3.1	5.9
Gross domestic expenditure on R&D (GERD) as a percentage of GDP (of businesses)	1.57	1.73
Number of ministries (number)	17	14
Households with Internet connectivity / broadband (%)	86/78	90/77
Number of municipalities/provinces	430/19	431/12

3.1 Norway

The Ministry of Government Administration and Reform (FAD) has been responsible for the coordination of government ICT policy since 2004. This includes an overarching coordinating responsibility for the ICT in the municipal sector. This is despite the fact that regional and local development in general is governed by the Ministry of Local Government and Regional Development (KRD). The Ministry of Transport and Communications is responsible for telecom policy. For ICT matters within the administrations, there are a number of coordinating bodies of a more or less formal nature, both between and within sectors.

Being responsible for the policy creation and the future strategy and directions for the development of e- government in Norway, FAD has defined the public sector as the rule maker, the pilot, the service provider, and the developer of public services. At the general level the goal is to have cohesive, safe, user-centered and efficient public ICT. Current focus areas include: better coordination of efforts and project management;

Privacy matters in transfer of data in remits; Transparency in automatic processes; Open user surveys to understand satisfaction, use and needs; and understanding the need for anonymity and pseudonyms in government information systems.

3.1.1 Organization

A separate agency for public management and e-government (DIFI) was established in January 2008 as a merger of three government offices: Norway.no, the eProcurement secretariat, and Statsconsult. Responsibilities for DIFI include better integration of work in areas such as reform, ICT, management, organization, restructuring, information policy and procurement policy. Responsibility for the maintenance and innovation of the national information infrastructure framework is allocated to the Norwegian Register Authority (BRREG).

The central instrument of control the ministries have on national agencies is the allocation letter (Tildelingsbrev). It passes on economic boundaries, priorities, goals and means of reporting results for the given organizational unit.

In order to follow up and to ensure that national agencies are doing sufficient architectural planning in e-government projects, a self-declaration form is to be sent to the Ministry of Finance and FAD. This comply- or-explain principle is mandatory for national agencies and encouraged for regional agencies. Completing the form involves describing potential reuse of existing services, project risk and risk management, the socio- economic value generated through the project, adherence to defined architecture principles, and the use of established core components and electronic ID mechanisms. In

addition to the self-declaration form, procedures for central evaluation of ICT projects have been initiated to prevent duplication of efforts. Separate procedures to evaluate the finance and budgeting of suggested ICT efforts are also initiated. All these initiatives are maintained and overseen by DIFI.

3.1.2 Architectural support

There are three contributing types of initiatives within methods, guidelines and standards that stand out in Norway. The first is the focus on competencies and cross-agency management collaboration. This is achieved through establishing separate websites for procurement and project support for managers. In addition to this, guidelines and support for planning and quality assurance for ICT-projects will be established (DIFI), and guidelines for creating socio-economic analysis as a part of project proposals is provided by the Agency for Financial Management (SSØ).

The second, is the centrally defined architectural principles that act as guidance under information systems planning and development. The principles include service orientation, interoperability, universal availability, security, openness, flexibility and scalability. DIFI is responsible for the management of the principles and will develop models for adoption and compliance.

The third is the reference catalogue defining mandatory and suggested standards for data for government ICT systems. First launched in 2007, the reference catalogue provides public bodies, suppliers and other stakeholders with an overview of recommended and mandatory standards relevant to ICT solutions in the public sector. It is decided by the government that the reference catalogue should be used by all national agencies when planning new solutions. Work is in progress to enforce regulations so that the reference catalogue additionally will apply for the regional agencies.

3.1.3 Infrastructure

The Norwegian government is set out to pursue a cohesive policy to ensure efficient re-use of public information for increased value creation and the development of new services. Large- scale new national ICT projects are to be assessed as to whether they can use the shared ICT components or whether they may have or can develop components that can be made available to all. It is a precondition that these assessments must not result in especially negative consequences for the project and for innovative operating solutions etc. linked to it.

Already existing shared components include: Norwegian personal identification numbers (Treated as privacy sensitive information and used as an integration point in core registers), electronic ID component, the Altinn portal a common Internet portal for public reporting, norway.no/ norge.no as a one-stop public service center for citizens and central citizen and business registries.

A new overarching ICT architecture for the public sector is being developed. Within this architecture is the second-generation national information infrastructure for Norway (Altinn 2). Altinn 2 will also contain a separate service development framework with a workspace for defining process flows comprised by service building blocks, including data submission, messaging, information services, link/authorization services, data distribution services and support for creating cross-silo compound services. The Altinn platform additionally provides interfaces for automated data delivery from businesses, acts as a centralized third party intermediary for data integration, provides multi-actor process support and allows task allocation and task sharing. All Altinn services should be created to allow web-service access as providing a web-based user interface is not required for all services.

For future service development, there are ambitions for examining how legal protection can be catered for satisfactorily in relation to fully or partially automated decision-making solutions. The government set out to review the division of labor between supervisory authorities, in processing of personal privacy data, with in the interests of facilitating closer cooperation and coordination (FAD, 2006).

3.1.4 Use and adoption

The regional agencies in Norway are highly autonomous and act independently. Given this, there is currently no direct authority in e- government matters that can enforce best practice or measures for increased consolidation of services. Due to this, the comply-or-explain principle is only mandatory for national agencies, but is advised as a desktop exercise where appropriate for regional agencies. Similarly the planned national information infrastructure is not customized in favor of the regional agencies. DIFI/FAD have been criticized for not supporting regional agency requirements sufficiently, and separate projects have been announced to address this problem in particular. One example of this is the need to establish shared components that can act in accordance to archiving laws in order to enable regional agencies to take full use of the Altinn framework.

Shared-service networks regional level exists, and there has been established a separate set of guidelines for municipal collaboration by FAD. Further, The Norwegian Association of Local and Regional Authorities (KS), being the employers' association and interest organization for municipalities, counties and local public agencies have developed separate goals for e-government for the regional agencies.

3.1.5 Services

In establishing electronic self-service solutions, each public agency/sector must make relevant services available via norge.no and Altinn portals. This is in addition to any access to services available directly using the agency websites.

In order to increase transparency, a publishing service for public sector electronic mail records has been established, allowing citizens the same access as journalists to government transactions (http://oep.no/). All national public bodies shall carry out systematic user surveys that shall also include the enterprises' outward-facing ICT services. As a main rule, the results must be published.

3.2 The Netherlands

Responsibility for e-government policy is shared between the Ministry of the Interior and Kingdom Relations (BZK) and the Ministry of Economic Affairs (EZ). There is no single ministry in charge which resulted in critiques concerning the direction and control of e-government (Docters Van Leeuwen, 2009). While BZK is mainly involved in e-government service development, EZ is mainly concerned with innovation and implementation of telecom policies. Most developments to improve service delivery, however, originate within individual government organizations, often at the level of local government.

The main e-government policy currently pursued is to realize a national e-government infrastructure consisting of generic building blocks that function as Software-as-a-Service (SaaS) to be used by all government organizations. This policy, which is the responsibility of BZK, is called the National Implementation Plan (NUP), identifying nineteen generic building blocks to be implemented by all government agencies as well as developing six example projects aimed to show the advantages of e-government.

BZK and EZ are also responsible for a government- wide policy that has many links with e-government: the decrease of the administrative burden for citizens and businesses. Currently, citizens as well as businesses often have to provide the same information twice to different government organizations. By integrating service delivery of public organizations as well as integrate chain processes, the public sector aims to diminish the administrative load with 25% in 2010, which it has claimed to have achieved, as a diminishment of 28% was achieved.

3.2.1 Organization

Besides at the Ministerial level, governance of e-government resides mainly in four public agencies. The most important agency is the ICTU foundation that was set up in 2002 to develop ICT-projects for multiple government organizations. The ICTU foundation was set up to become a 'camping site' for cross-organizational IT-projects. The comparison with a camping site was made to show that a wide array of projects was set up within the organization, which is still a collection of loosely connected e-government development programs.

While the responsibility for the NUP is at the Ministerial level, all generic building blocks and example projects are under development at ICTU. The foundation is also responsible for the implementation of open standards and for the national e-government benchmark. Another governance activity ICTU is involved in is providing local government with guidance and advice to implement the e-government infrastructure building blocks on request.

Other public agencies involved with government e- government development are Logius, which is the organization maintaining all generic building blocks once they have been developed. Furthermore, advisory boards have been established to oversee standardization and to test all new laws and regulations on their administrative load.

3.2.2 Architectural support

To create greater interoperability and more uniformity towards citizens and businesses, a reference architecture was developed in 2002: the Dutch Government Reference Architecture (NORA). NORA has been growing since and its focus is currently shifting more towards realizing interoperability between government agencies. On the basis of NORA, a number of sub- architectures were created for specific groups of government organization, such as the municipalities, provinces and the water boards.

The standardization board holds a list of standards that need to be used, based on the comply-or-explain principle. This means that for all public IT-projects that required procurement at the European level, these standards need to be implemented or a very good explanation needs to be given if they are not. Furthermore, the municipalities have to comply with the objective that they should install a policy for using open standards. By 2009 75% of municipalities should have such a policy. Also, the standardization board will set up an interoperability framework that will be complementary to the reference architecture NORA.

3.2.3 Infrastructure

In the past, government organizations developed their own infrastructure blocks such as authentication mechanisms and electronic forms. As a result of a policy of centralization, now a set of nineteen generic building blocks has been identified to be used by government organizations to maintain their online presence and ensure interoperability. The main e-government building blocks are the Citizens' Service Number (BSN), DigiD, MyGovernment.nl/MijnOverheid.nl, vital record registries, e-forms and the Government Transaction Gate (OTP).

Although implementation of these generic infrastructure blocks is falling behind its objectives, they are considered to be the basis of future e- government development. Furthermore, a separate policy of the NUP is to show the advantages of building services across organizations on the basis of these building blocks by appointing six example projects. Through the identification of these example projects focus is slowly shifting from infrastructure development to the development of (cross-organizational) services.

3.2.4 Use and adoption

Regional agencies are actively stimulated to implement generic building blocks. A program organization was set up at ICTU for the purpose of implementing the infrastructure building blocks in the organizations. Furthermore, an institute for maintaining the quality of e-government in municipalities (an ICTU program) as well as a benchmark that serves this purpose.

Most large semi-autonomous national agencies, such as the Inland Revenue Service and the organizations responsible for unemployment benefits and student loans, are highly autonomous. They are also front-runners in the field of e-government development. They, therefore, are stimulated or targeted by central government policies, but develop most of their activities themselves. Furthermore, they set up a cooperative consortium called the Manifest group that actively develops common e-government projects for these executive organizations, such as the DigiD authentication mechanism.

3.2.5 Services

A generic building block specifically designed to meet citizens' needs is MyGovernment.nl, aimed at integrating all personalized service delivery of public agencies in one portal. Furthermore, a set of guidelines for citizens' interactions, the Citizens' Service Code, was developed including ten guiding principles for governments to comply with when developing and implementing services.

4 CROSS-COUNTRY COMPARISON

We recognize that the complexity of e-government causes a non-discrete transition between different interacting initiatives. Further, the outcomes of the data samples are depending on the timing and current stage of ongoing policy cycles and any diffusion or macro- events occurring. The time from policy and intent to implementation can be long or short, but the observed non-existence of policies or support mechanisms might at the same time give a false impression of differences between the objects of investigation. That is, as long as the measurement of outcomes or needs for policies are left out of the investigation.

Table 2 provides a summary of the national case studies based on our framework. Overall, the studies show a great deal of similarities between the Norway and the Netherlands and we were able to identify similar structures and dynamics between equivalent agencies in both countries.

From the organizational aspect, Norway has a separate ministry for government administration and reform responsible for e-government at the ministerial level, while in the Netherlands there is no equivalent policy maker centrally. The separate e-government agencies, DIFI and ICTU have further taken on different approaches to e-government. ICTU, being established in 2002 has a history for active involvement in e-government projects, while DIFI has focused on its role as a facilitator for increased competency and management collaboration, planning and project management in e-government projects through training and online resources.

Architecture principles for e-government planning and implementation exist in both countries. But while the Norwegian principles are limited to seven principles, The Netherlands has hundreds, most which are technology-oriented and at a different granularity level. Norway has additionally established a reference catalogue for electronic formats and standards available for public agencies. One main difference between the two countries is, that in Norway, support mechanisms are organized more centralized.

Both countries have a few strong semi-autonomous national agencies that are front-runners on e-government development. National agencies in Norway are bound to comply-or-explain principles for e-government development, while in the Netherlands these organizations are more or less self-governed, even though they are accountable at the ministerial level. This allows them to autonomously collaborate within the Manifest Group. Municipal consortiums exist both in Norway and The Netherlands to allow for economics-of-scale. Again, the main difference between the two countries is

that autonomous national agencies are more centrally governed and bound to standards in Norway, compared to the Netherlands. A second difference is that Dutch municipalities are actively supported and funded by the national level, while in Norway there is no direct involvement.

So far, a similar set of core components are established as part of the infrastructure development in both countries. Norway's goal is to provide all services through portals running on this infrastructure. Furthermore, a strong focus on BPM can be found in Norway. Similar efforts are not yet present in The Netherlands.

Table 2 Cross-country comparison

Norway	**The Netherlands**
1. Organization	
- DIFI as the separate e-government agency (established 2008) developing methods and coordinate policy enactment. - Provider of competency support (passive).	- ICTU as the separate e-government agency (established 2002) serving as the main focal point of infrastructure development. - Provider of centrally funded competency support (active).
1. Architectural support	
- Centralized architecture development and translated into domain and organizational architectures at the local level. -7 defined architectural principles for e-government planning and development. - Focus on increased competencies for public agency managers. - Improved planning and reduced project failures. - Reuse of previous efforts and knowledge management. - Reference catalogue for electronic formats and standards. - Procedures for central evaluation of ICT-projects.	- Centralized architecture development and translated into domain and organizational architectures at the local level. - Many principles, no overarching architecture of dependencies among building blocks and centralized/decentralized division of activities - National references architecture, domain architectures guided by models and best practices. - Focus on (Open) standards
3. Infrastructure	
- Several available core components. - Central BPM tool for integrating cross-organizational processes. - Service development framework.	-Several available core components. -No central mechanism for integration. This is kept at the local level. Many bottom-up initiatives, fulfilling an urgent need of local agencies for business process management and orchestration -No service development framework at the central level (although some organizations have a variety of frameworks at the local level).
4. Use and adoption	
- Comply-or-explain principle only mandatory for national agencies. Requires describing use of shared components. - Direct support to regional agencies from the central government on e-government matters is limited to that provided through guidelines and facilitated collaboration environments.	- Comply-or-explain principle for some standards only. Not all shared components and standards are part of this. - Local governments are free to adopt building blocks and architecture
5. Services	
- Services developed by single agencies should additionally be made available on centralized portals.	- Most citizens' interactions are at the local level (around 75%) and with large executive agencies.

5 DISCUSSION

In both countries many of the infrastructure buildings blocks are similar, although they might be different in their implementation. The business process management building block is the exception,

which has been embraced at the national level in Norway, whereas this is left to the local agencies in the Netherlands. When looking for an explanation using the framework, we observe differences in the architectural governance (1) and in the level of active support for (regional) e-government development (2). When it comes to the centralization of governance Norway shows a strong centralization of efforts while in the Netherlands, previously implemented regional initiatives are causing fragmentation making it less likely that it will be possible to pursue the development of a single national e-government information infrastructure. At the same time, the e- government support agency in The Netherlands,

ICTU, was early involved and provided direct active support, while in Norway little direct support for implementing individual projects has been provided.

Governance and architecture are strongly interwoven. The architectures in both countries show great similarities while the governance is different. The differences we observe between e-government infrastructure developments of the two countries can be attributed to the degree of centralization of government and the degree of active support given to e-government developments. While in Norway most attention is given to the national agencies, in the Netherlands great support is given to the regional agencies. One line of investigation is to find which level can benefit most from e-government infrastructures to determine which level can be targeted.

In the Netherlands many developments are driven bottom-up. Only after proven success, they are adopted at a central level. The disadvantage of this approach is the degree of diversity and heterogeneity that is created by employing such an approach. For example, there are many initiatives of creating shared service centers at the local level, which blocks the setting up of a single shared service center. Different working practices using all kinds of applications are developed. The absence of a coordinating ministry in the Netherlands can explain the lack of focus on development of a central BPM component handling cross-organizational processes.

In Norway, central initiatives have focused on establishing portals and facilitating for increased competency for public agencies managers when it comes to procurement and project management, but also awareness of IT-related aspects as principles for architectural planning. Central government initiatives are criticized for not taking the requirements of regional agencies sufficiently into account. Bottom up initiatives through municipal consortiums are however mirroring centrally defined directions for e- government in Norway.

A result of this combination of decentralized governance and active support by ICTU is that the Dutch e-government landscape is fragmented and little collaboration can be observed. Norway, initially not providing direct support to individual agencies, has taken on a different approach: through focusing on centralized architecture development and by providing a service development framework on which individual agencies can create their own services, coherence among the infrastructure building blocks is easier to achieve. Still, e-government development in the Netherlands took off at an earlier stage as local governments could go ahead developing services for their own organization with the support of the central government, spurring adoption.

Looking at the national and regional agencies (number 4 in our framework), we see that based on democratic structure and the autonomous nature of government agencies it is not an option to enforce practices on regional agencies in neither of the countries. National agencies often have less distinct business processes and less different services to deliver than regional agencies, and are, therefore, possibly more manageable. Joining up, and having these agencies to adhere to a defined best practice is a relatively less complex task. Evolving the infrastructure to meet their needs before considering the needs of the local government agencies may be more manageable.

At the same time, the autonomy of the regional agencies in the Netherlands can be used to explain the strong emphasis on motivating them to use the shared infrastructure. Citizens still have most contact with their local governments and harmonization of local government services can, therefore, lead to an increase in e-government development and acceptance. Still, centralized development will remain

necessary to ensure standardization and mitigate fragmentation of developments leading to duplication of efforts and redundancy. There are no formal mechanisms to force the use and for infrastructure building blocks the complain-or- explain principle is not used (although it is used for standards and open source). One way to drive developments further ensuring standardization as well as spurring adoption on the level of individual organizations may be to centralize architecture development, but decentralize governance.

6 CONCLUSIONS

In this paper a framework for analyzing the development of national infrastructures was presented and used to conduct a cross-country comparative study. Our framework for conducting the case study consists of five main elements: (1) governance through direct instructions, budgets, and regulations, (2) architectural methods, guidelines, and standards, (3) information infrastructure (4) the roles of regional and national agencies and (5) the service interactions between citizens businesses and public agencies. Using this framework Norway and the Netherlands was compared.

The comparison shows that governance and architecture are strongly interwoven. The architectures in both countries show great similarities while the governance is different. The differences we observe between e-government infrastructure developments of the two countries can be attributed to the degree of centralization of government and the degree of active support given to e-government developments. Norway has centralized IT-Governance, whereas in the Netherlands this is decentralized. As a result in Norway most attention is given to the national agencies, in the Netherlands much support is given to the regional agencies. The form of governance adopted can also explain the differences between one of the infrastructure components. While Norway enables integration by developing a centrally provided Business Process Management building block, in the Netherlands regional governments compose and integrate the building blocks. In the Netherlands this has resulted in a large number of different approaches to integration of developments originating within single organizations and generic building blocks.

The findings suggest a high level of entanglement of governance and architecture aspects as they influence the development of the infrastructure. Further research should be looking at the advantages and disadvantages of and interdependencies among centralized and decentralized development and governance. While centralized development suggest more standardization, decentralized development suggest a faster development and acceptation of e-government at the local level. This may be investigated by comparing additional countries.

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Paper 8

Citizen centric public service provisioning - A conceptual approach for next generation information infrastructures

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CITIZEN CENTRIC PUBLIC SERVICE PROVISIONING – A CONCEPTUAL APPROACH FOR NEXT GENERATION INFORMATION INFRASTRUCTURES

Gustav Aagesen and John Krogstie

Abstract

The provisioning of holistic public services requires the coordination of various government agencies, a responsibility often taken on by the service receiver. To compensate for a fragmented and complex range of government service providers, one-stop shops, online portals, and compound services are established for the most frequent patterns of interaction. National information infrastructures are being developed to act as a unified front-end towards the public, and as a point of integration between collaborating agencies. This paper describes a conceptual approach for organizing delivery of citizen-centric and demand driven public services in a multi-agency setting. It is evaluated through the presentation and discussion of the case of the Norwegian Individual Plan (I-Plan), a law-given opportunity for receivers of long-term complex health and social services, aiming to provide coordinated and individually fitted services. We find that our approach support current requirements of virtual service organizations, and we see a potential use also within other government domains.

Keywords: information infrastructure, socio-technical system, citizen-centric, e- government, design science

1 INTRODUCTION

E-government has the potential to improve the delivery of demand driven and citizen-centric services. Demand driven implies that the need for new services is satisfied upon request, and citizen centric implies that the needs of the service receivers affect the contents and reach of the services provided. User centricity also involves facilitating for the needs of the individual user in terms of customising the services offered to that particular user, and taking action to improve the service delivery to all users (FAD, 2009). To support this, flexibility is required both within public agencies and in how services are provided, and necessary tools must be made available for public agencies in order to effectively provide holistic services with a unified front-end.

Infrastructure frameworks supporting the requirements given by the electronic collaboration of government agencies are referred to as Next Generation of Digital Government Infrastructures (NGI) (Janssen et al., 2009), as the further evolvement of the current Government Information Infrastructures (GII) (Hornnes et al., 2010), providing global functionality. Current technical challenges involve, among other, establishing global standards while supporting local solutions and practices (Ciborra, 2002); establishing gateway devices between new systems and the currently installed base, and within (and between) policy networks (Bekkers, 2006); and supporting the required organizational flexibility for providing citizen-centric, demand-driven, adaptive and evolving services (Aagesen and Krogstie, 2010).

A study on the practice of Individual Plan (I-Plan) (Vold Hansen, 2007) distinguish levels of user involvement in service delivery scenarios as user centric, user influence, user participation, and user control. In a user centric (citizen-centric) scenario there is no actual user influence, services can be customized to the individual while the appropriate services are selected based on logic of appropriateness (March and Olsen, 2004). In the user influence scenario, provided services are the result of a negotiation between the provider and the receiver based on a catalogue of services and measures. In the user participation scenario, the services are provided and selected based on rules and standards, there is a low degree of customization and the service receiver and provider collaborate in

finding the best fit services and measures to the individual. In the user control scenario, the provider performs a production of services as requested by the receiver.

We argue that an information infrastructure supporting all service delivery scenarios and levels of user involvement are covered by the citizen centric approach, and that the organization of public services based on a citizen centric model is the lowest common denominator for the organization of public services in a global delivery scenario.

This paper acts as an analytical demonstrator for a conceptual design for the next generation information infrastructure for public service provisioning. We introduce the conceptual design and discuss a case study on the provisioning of symphonic public services provided in a multi-agency setting, here known as the Individual Plan. The case is based on services related to health and social work, although we believe that the demonstrator and underlying concepts and design principles are applicable to other areas as well. Much of this is based on what we see as a gap in process and data ownership in inter-agency service provisioning, where ownership and accountability of shared data (e.g. data about the service or service receiver) are not clear, and where an intermediary function has to be established.

The next chapter provides background on the methodological aspects of the study as a whole and the background for this paper in particular, following the design science research method. This is followed by an introduction to the design artefact, including problem statement, objectives of a solution, and a brief description of the conceptual design, referred to as the citizen-centric process views. Background and goals of the I-Plan is provided together with a description of participating stakeholders. The analytical evaluation of the demonstrator is conducted through the discussion of the case in light of the design artefact. We conclude the paper after a discussion of related work.

2 METHODOOGICAL ASPECTS

The growing use of information technology in everyday life, with additional channels of interaction and an abundant offering of end-user devices, pose new requirements to the general infrastructure. It further increases expectations on how the public interact with government and how services are provided. Existing infrastructures supporting content and services can however only be extended to a certain point before saturating, and there is a need for design efforts focusing on infrastructures supporting the government domain.

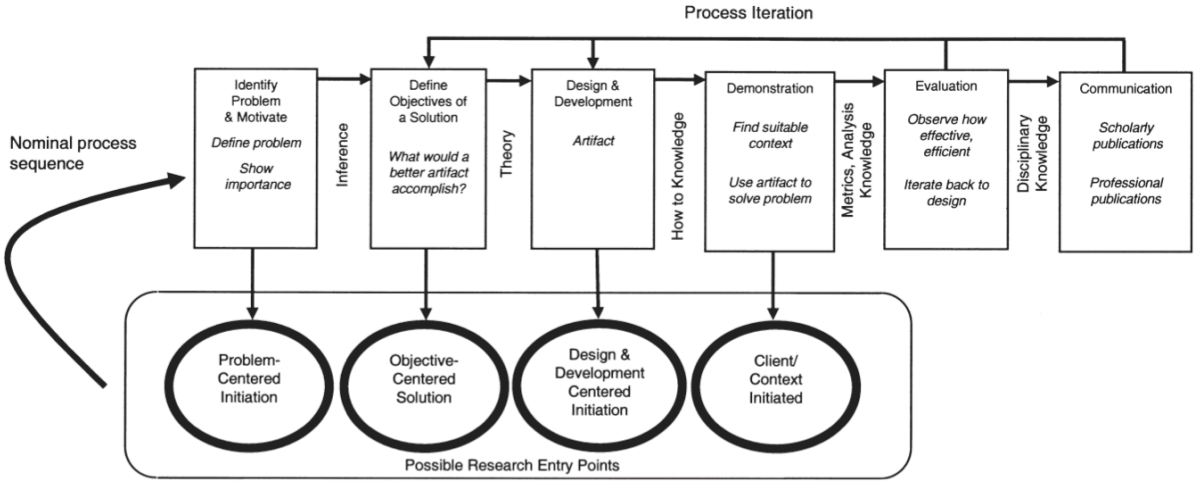

Figure 1 Design science research method process model (Peffers et al., 2006)

We describe our work using the suggested design science research methodology process of Peffers et al. (2006), an approach with four entry points depending on the knowledge of the problem, goal and artefact before commencing the research (figure 1). In a problem-centred initiation, the problem is not

known, and knowledge about the domain must be accumulated so that the problem and motivation for solving the problem can be established. In an objective-centred solution the problem is known and articulated, and objectives of a solution must be made clear, and thus suggest goals and requirements for the artefact. In a design and development-centred initiation the artefact is developed based on already existing goals and requirements. While in a case where the research is client or context initiated, the artefact already exists and the research task is to demonstrate its utility in a given context.

Following the problem-centred initiation, we briefly describe the different phases of our work including the design, demonstrator and evaluation, which are additionally covered by the remaining parts of the paper.

2.1 Problem formulation and motivation

Based on the concept of multi-channel delivery of public services and the existing My Page citizen portal in Norway, the research problem is grounded in taking the current mostly static My Page to a more dynamic My Processes offering. More specifically investigate how it is possible to easily implement multi-channel process support systems for public services having dynamic and interactive capabilities.

2.2 Objectives of the solution

The solution will act as a reasoning tool for design requirements, capabilities, data models, governance models, necessary support mechanisms, and other problem areas related to providing citizen-centric services. This involves both investigating the current situation (AS-IS) and features of a possible optimal situation (TO-BE). The design artefact is a conceptual design for an information infrastructure supporting the provisioning of demand driven and citizen-centric services, referred to as the citizen-centric process views (CCPV).

2.3 Design and development

Leading to the initial design, an investigation of the state of the art within process modelling approaches as well as a wide investigation of the e-government field was conducted. This would facilitate an understanding of the dynamics and challenges related to e-government service provisioning and the current capabilities provided for supporting process work. A description of scenarios for use was created together with a model for the dynamics of transformational government (Aagesen and Krogstie, 2011). This was followed by a series of designs for the CCPV concept, evolved through case studies within a policy domain, on the GII level, and through comparing current infrastructure, governance, and support in Norway and The Netherlands.

2.4 Demonstration

The use of the I-Plan as a demonstrator was suggested by researchers in the e-health. E-health and e-government as research domains share several concerns. The I-Plan case in particular, can be looked at from an e-government point of view. The goal of the I-Plan is to coordinate and deliver health and social services from several agencies to individual citizens. CCPV has a similar goal at a general level, providing coordination and process support for all public service interactions for a single citizen.

2.5 Evaluation

Evaluating the benefits of enterprise architectures is challenging (Liimatainen, 2008). Evaluating a conceptual design of GII is similarly difficult, since the impact and dependent variables are hard to determine or the underlying technologies of the design are not yet available. The designed artefact (object design) would further require corresponding governance and support (i.e. the realization design) to trigger the required diffusion. The analytical evaluation provided in this paper is based on

discussion of I-Plan, and how the availability of an implementation based on the citizen-centric process views could support the design goals of the I-Plan and its stakeholders. As the conceptual design is created prior to investigating the case, we are interested in bringing forward any new learning on how to improve the design based on the analytical implementation of the I-Plan using CCPV.

3 CONCEPTUAL DESIGN FOR CITIZEN CENTRIC PROCESS VIEWS

3.1 Service layer

The conceptual design of the citizen-centric process views (CCPV) (Fig. 2) is organized around the delivery of a service to a single citizen. The service comprises of a single or multiple process instances, which contribute to the completion of the service. That is, the process can be the partial delivery of a service, the delivery of a single service, or a service delivery in a chain of subsequently provided services. The service defines and organizes the processes where all work is done.

Each service has a set of actors, which have defined roles in the process. The citizen is the subject who is the receiver of the service produced by the process. There can be several contributors from government and non-government organizations as well as caretakers acting in the interest of the citizen. These actors together form a virtual organization for the service in which the processes are defined.

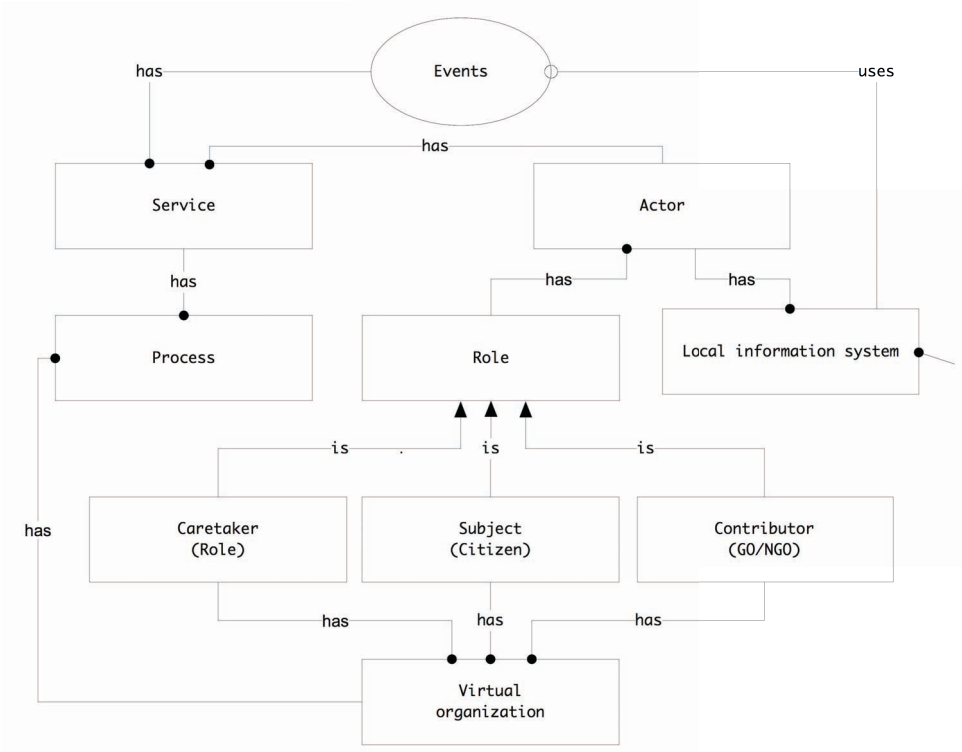

Figure 2 Citizen Centric Process View conceptual model (adapted from Aagesen and Krogstie, 2010)

The events contribute to synchronize the current state of the process between all involved actors in the virtual organization. This allows local information systems connected through the system interface to subscribe to events within processes or they can request information about the process. Capabilities defined in the process can be implemented through actors connected to the system interface. This can typically be core components in the national information infrastructure or locally defined functionality in the given municipality or public agency. This means that the actors interact with the process

through a defined system interface, which can be extended to local information systems at the contributors, or to various user devices for caretakers and subjects. The system interface can allow access to custom defined resources connected through the interface. These can provide various views of the process and process-relevant data separately or combined for the different actors. Examples of these are alerts on spending, deadlines, regulations; lookups in central registries for explanations or references; support for running what-if scenarios on process changes; process documentation, central reporting, benchmarking or locating cases similar to the given process instance; translation services, or other utilities that prove useful for single actors or the virtual organization as a whole.

3.2 Network layer

The physical construction of the network layer of CCPV is considered as a black box, and the scope of this study is limited to the logical construction and functional capabilities. Figure 3 illustrates the positioning of CCPV as a distributed network. A CCPV node can provide functionality based on the presence of connected resources to that node, or resources connected to other connected nodes within the scope of each node. A CCPV node can be installed within a policy network or government agency and provide the gateway functionality to other nodes in the network. Connecting additional nodes increases the reach of the CCPV network and the amount of agencies that can collaborate and access shared resources electronically. Service information not shared outside a node will not leave that node.

A resource provides a function identified by the process layer. Resources can be data stores, data processors (manual or automatic processes), or actors with defined roles. Examples of resources include: a citizen identification registry, case handling system for car registration, a medical test lab, an unemployment benefits office, a government procurement office, a building permits office, or a private building contractor.

The resource is defined by an internal and external presentation. The internal presentation is the necessary input and outputs to handle a given request from the CCPV. The external interface is the necessary information to exchange data with the installed base, requiring development efforts to add that all existing systems as resources to the CCPV. In this sense, CCPV should be extensible and channel independent. Once a resource is developed, it should be reusable.

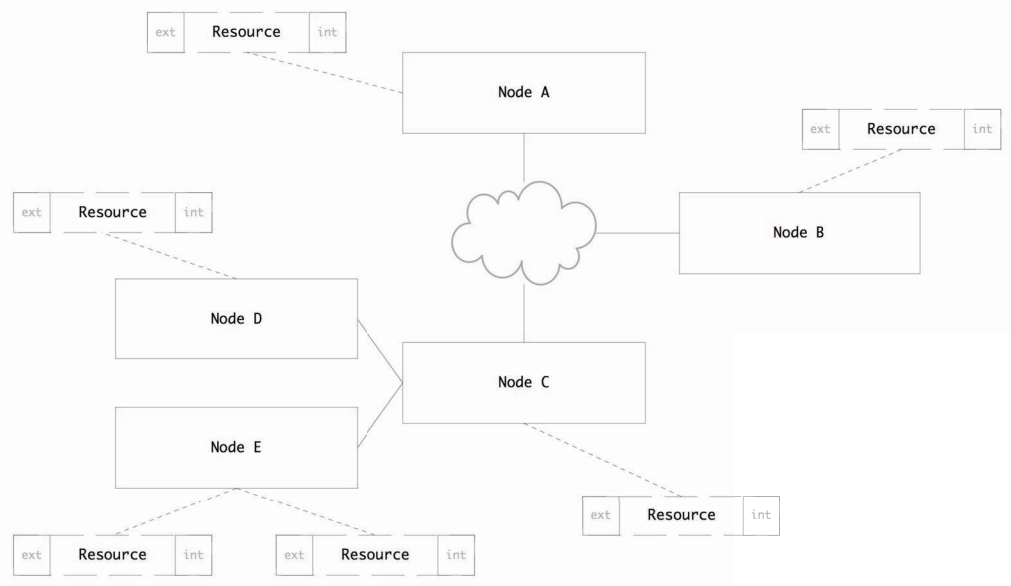

Figure 3 Conceptual distributed architecture model for citizen centric process views.

The nodes should be able to connect from geographically disperse locations as a distributed network or can be part of a virtualization or cloud cluster. It should be possible to access resources by type, name, or by location. It should be possible to get data for a local or central registry based on the

process context. Specific resource instances required need not be defined during design but can be decided through just in time orchestration.

Generic overloaded local resources should be able to re-route requests by reference and thereby outsource service delivery in local context when possible. Actors participating at a later stage in a policy chain will be able to see the estimated time of involvement in the process, but cannot access process details.

As events occur during the process, connected resources will be alerted. Process instance information not shared with a given actor or outside the scope of that actor will however not be available to that actor.

Services within the CCPV can be defined through what information should be stored, what resources that should be used, and with a possible overall process description. This enables the CCPV to provide orchestration between actors and act as an integration point for compound services. It should further buffer and store transactions for resources as to allow asynchronous process execution not requiring nodes and resources to be connected at all times.

Citizens can access the CCPV through defined public portals, electronic channels defined as resources, or through service providers accessing information on behalf of the citizen.

4 THE CASE OF INDIVIDUAL PLANS FOR HEALTH AND SOCIAL SERVICES

Individual plan (I-Plan) was first introduced in 2001; and has since then been through several revisions, mostly caused by a consolidation of various I-Plan initiatives. The goal of I-Plan is to compensate for the inconvenience suffered by citizens from the consequences of a fragmented public sector when supporting individuals with complex and long term needs for services provided by the public. Through I-Plan, the service providers can improve the coordination of services delivered to the individual citizen.

Receivers of long term, coordinated health or social services are eligible to an I-Plan by law (FOR, 2004). Services leading to the need for an I-Plan stem from health and social services, services provided to citizens with physical disabilities or who are mentally retarded, those suffering from mental illnesses or with various addictions, elderly with complex health situations, citizens in need of long term economic support related to health issues, or unemployment.

The individual plan provides orchestration of existing available services and details on the execution of individual services. The I-Plan succeeds any existing plans for treatment or training, thus requiring that subordinate plans are adapted to fit with the goals of the I-Plan and the measures that it describes. In this sense, the I-Plan acts as a master process and a process variant description for services rendered to an individual service receiver.

An I-Plan is not to be created without the service receivers' consent. The service receiver has the right to be included in developing the I-Plan, and any next of kin can be involved in the development process.

Only a single I-Plan should exist for each service receiver. It should cover all involved public agencies across municipalities and other organizational boundaries within the policy domain.

4.1 I-Plan scope and contents

Pragmatic quality is a priority for I-Plan, it should be complete without being complex, and it should be understandable to its intended users. The I-Plan should function as a high-level plan, leaving details to separate professional systems of the separate process owners where applicable.

The I-Plan should cover the overall goals of services rendered (i.e. reasons for providing services), resources available, and need for services. In addition to a named coordinator responsible for coordination and progress, involved stakeholders partaking in the I-Plan should be added with names and contact information. A list of necessary or preferred collaborating agencies for service delivery should also be added, even when these are not available for providing services at the time of establishing the plan. A list of measures and contributions by different stakeholders, both from public agencies, the service receiver and next of kin, a summary of how the different measures should be conducted, and an indication of the timeline and scope of the currently described I-Plan. Consent is needed from the service receiver so that personal information related to the services provided can be shared between the different service providers of the I-Plan

4.2 Stakeholders

The service receiver is defined as the patient in a health care situation or an individual receiving social services. Work related to an I-Plan is not to be commenced without the consent of the service receiver. In cases where the service receiver is not capable of providing consent, the next of kin or guardian can initiate and participate in the development of the individual plan. Kin, or other stakeholders not considered as service providers (e.g. friends or other relatives), can further be crucial as contributors to the success of planned measures if involved correctly. Figure 4 provides a stakeholder overview for the I-Plan.

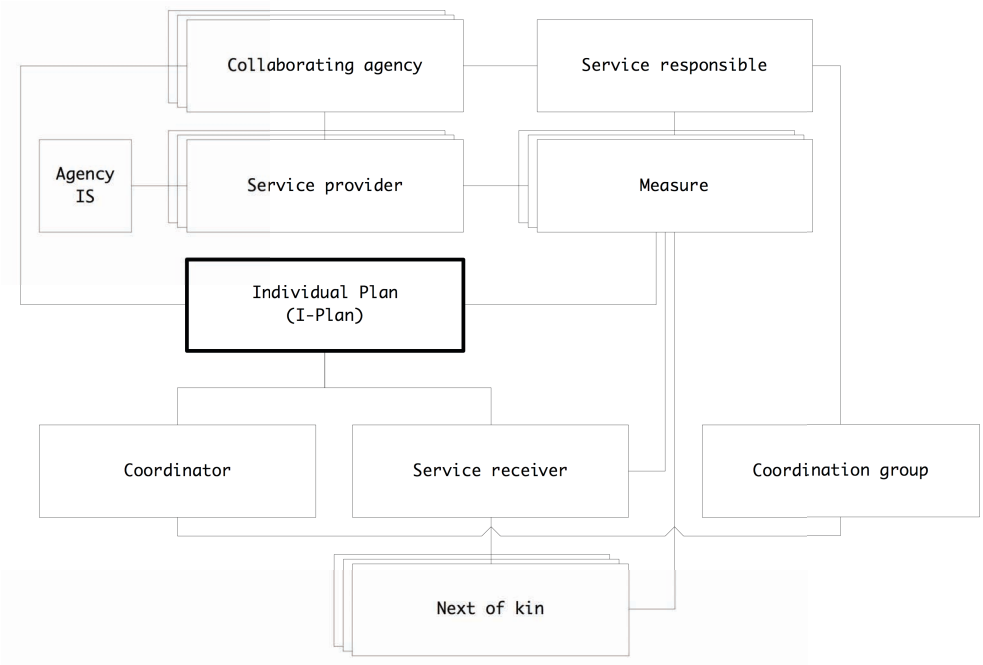

Figure 4 I-Plan conceptual model and stakeholder overview

The public agencies responsible for health- and social services are obliged to coordinate and establish an I-Plan based on the request of any service receiver. The agency in which the I- Plan request is directed is by law required to initiate the I-Plan process, also in situations where previous services are provided by different agencies. The coordinating agency is further responsible for the coordination between service providing agencies of the individual service receiver. It might however be that the initiating and coordinating agency is not the same, as the coordination role can be decided to be held outside the initiating agency.

The person given the role as the coordinator for an I-Plan is expected to act as a motivator for the service receiver. It is in the responsibility of the coordinator to ensure that all involved stakeholders have a clear understanding of the task at hand. The coordinator should act as an advocate for the

service receiver and have extensive knowledge of the service domain and possible measures. Service providers are public agencies defined by the I-Plan as contributing to the goal through the delivery of formally defined or emerging ad-hoc services. The service responsible is located with the service provider and act out their role based on their professional background. Any internal reorganization within the service provider will ensure continuity through a role-based replacement of the service responsible. The collaborating agency can be analogous to the service provider, but different service providers can also be found within the same agency, within the same organizational context, organizational culture, and supporting information systems. That being said, different information systems can be found supporting different service providers within the same agencies. The coordination group is a function for a given I-Plan, which is not prescribed by the law but has emerged out of the natural need for coordination between service providers. The purpose of the group is to ensure progress and that stakeholders are involved, even when not contacted directly as part of the normal service flow. Tasks involve milestone review, status and progress reporting, as well as determining new directions for the I-Plan.

5 EVALUATION

The role of a demonstrator is to show that there exist cases of use that benefit from the suggested design, and in that sense justifies the need of the designed artefact. Once the demonstrator case is established, it can facilitate reflection on use scenarios outside that of the demonstrator, and further act as a tool for the analytical evaluation of the design. First, we will discuss experiences with the current I-Plan. This is followed by a discussion how I-Plan work can be supported by CCPV and whether the I-Plan scenario can be generalized.

5.1 Experiences from using I-Plan

Experiences from I-Plan work show (Thommesen et al., 2008) that the I-Plan process is by no means linear, and that the goals of the service receiver emerge over time, rather than being clearly defined through a formal analysis up front. This entails that the I-Plan process must support flexibility and that there are periods where service providers enter and leave a given the I-Plan. The I- Plan is subject to this dynamics also at later stages as the treatment and nature of the measures evolve with the life of the service receiver.

The existence of an I-Plan is not a quality measure itself, and the I-Plan does further not guarantee a set of rights or provided services to the service receiver. The I-Plan can act as a motivation tool and show improvement, and foster active participation from the individual. It further reduces the need for the service receiver in having to update service providers regarding past occurrences and act as a translator between different service professional groups. Acquiring these benefits from the I-Plan is however highly dependent on the involvement of the coordinator.

Electronic collaboration of the I-Plan simplifies the coordination between the different actors. Electronic tools supporting I-Plan work are provided commercially, but are not widely adopted. Tool support for cross-platform collaboration is low, thus defeating the purpose of electronic collaboration for agencies bound to different vendors.

5.2 CCPV as process collaboration and support for I-Plan work

We evaluate the use of CCPV with I-Plan work based on the ideal scenario of full adoption and consider added value to each stakeholder group separately.

If the I-Plan is to function well, coordination at the system level is vital, and the municipalities need to be organized in a fashion that promotes cooperation and a holistic view on service delivery (Thommesen et al., 2008). The distributed network functionality of CCPV would simplify the creation of temporal virtual organizations with dynamic membership.

The fact that the receiving agency is in charge of storing and updating the I-Plan makes system level coordination and monitoring problematic. The lack of networked control makes the professionalization of the coordinator role more difficult from a system perspective. With the use of CCPV, real-time benchmark reporting of events within or between policy networks would be possible.

The role of the coordinator is important and is widely discussed. The fact that the coordinator role is not a professional one, receiving electronic process support would prove useful for the coordinator in establishing and maintaining a given I-Plan. Provided task support could include locating appropriate service providers in the area, keeping plans updated and shared between stakeholders, and checking resource availability on the fly.

Having online access to the I-Plan with possible views within professional systems would enable the service providers to provide holistic multi-channel support to the service receivers. Professional systems could additionally share information with the I-Plan to provide updates that normally would not be shared, but that potentially could change the I-Plan of the service receiver. This could include daily logs for home care services or other interactions from service delivery that would alert other professional groups with a different understanding of the status quo. The CCPV would further allow coordination of activities, and aid the discovery of other coordinating groups or I-Plans with similar configurations through access to reporting and a global knowledge base.

From a service receiver point of view, the greatest benefit is received through having a highly functional coordination group, a motivated coordinator and informed service providers. CCPV would however in addition prove useful through providing increased mobility, and through extending and overlapping the virtual organization in a service hand-over situation when moving from one geographic policy domain to another.

Having access to CCPV as a next of kin or caretaker provides updated information and the possibility to give feedback on the effect of current measures more frequently. Access to updated contact information for the coordination group and asynchronous messaging would further improve the interaction between the I-Plan and the non-professional service provider.

5.3 Discussion and summary

As we can see from the described conceptual architecture, the citizen-centric process view is a single point of access for the citizen where it can interact with the government on currently provided services. It provides a platform for service collaboration, knowledge management and process support in the provisioning of evolving services. It supports flexible organization of providers and the different government information systems, and with that supports continuous transformation of government services.

The possibility to support a virtual organization of providers and receivers is probably the most beneficial feature of CCPV to I-Plan as it is described today. Few formal processes are defined and process support is mostly focused on the meta-process of establishing a plan, and conducting coordination group meetings. As process work is mostly emergent and ad-hoc, producing data for reporting would possibly be considered as a burden, which calls for process mining (van der Aalst, 2010) or similar approaches for global knowledge generation and management.

Once the information infrastructure is established, it is however possible to add business process management functionality for supporting various process configurations and types. Process descriptions for customized services provided by different service providers would need to be stored within the CCPV or within the connected information systems, and need to share information between the different systems would be needed. One of the benefits crucial from the I-Plan supported by the CCPV is the fact that the virtual organization can have knowledge that can improve service delivery not available in existing systems.

Looking back to the original research goal of establishing My Processes capabilities for citizens, the I-Plan as seen through CCPV is a good demonstration of the possibilities that are found within the

approach. The I-Plan is however a special and resource intensive case, and similar service configurations for single citizens are less likely. The citizen-centric organization of the information infrastructure would allow citizens not covered by an I-Plan to share information across different service providers. An enterprise architecture where the citizen is conceptualised as a separate entity, similar to that of the I-Plan would further be beneficial. A development in this direction can already be seen in the current Norwegian GII, where an electronic message box for all citizens has been defined as part of the framework.

In addition to the citizen entity and the possibility to create mash-ups of different services available for a single citizen, the next of kin as defined in the I-Plan and the caretaker role of the CCPV is important. In CCPV this role involves not only sharing information with a non- service provider, but formally recognising this individual as a trusted person who is able to act and request services on behalf of the citizen.

We see that our design artefact, however being a conceptual and quite technical artefact, take a few environmental requirements (both political, juridical, technical, and organizational) for granted. But as it is a design artefact for the next generation information infrastructures it also provides a mental model for how we want public services to be provided, and if the technical capabilities are those that we should aim to implement. Government information infrastructures can provide much more than just public service catalogues. They can provide a neutral and trusted arena for sharing both open and protected data, where sufficient government reporting is handled in addition. Such a scenario is related to that of, trust, Internet governance, the role of dominating corporations and the effect global solutions and providers have on local practices, legislation, privacy, and the rights provided to us by our governments.

6 RELATED WORK

Citizen-centric service provisioning is not a new concept, it is considered to be one of the cornerstones of e-government and a key driver of transformational government. The I-Plan initiative is one example of a shift towards a holistic service delivery where features in the supporting information infrastructure go towards a process-aware CRM (King and Cotterill, 2007). Various initiatives towards enabling citizen-centric service provisioning can be observed (Blakemore and Undheim, 2007). Additionally, national variations of e-government interoperability frameworks have been established. These frameworks act as reference catalogues for EDI and acceptable document formats. This level of standardization is an important part of implementing joined up government and facilitates a base interoperability between agency information systems.

Once integrated, current e-service implementations are capable of supporting cross-agency collaboration for predefined services, but we see that they do not scale to support provisioning of public services based on a dynamic composition (Aagesen and Krogstie, 2010). In addition to the constraining factors identified by (Scholl and Klischewski, 2007), the pragmatics of use declines as the complexity of the process environment increases with additional actors and process variants.

An approach similar to the CCPV is the Configurable Services for Local Governments project (van der Aalst, 2010). It combines a cloud infrastructure with a configurable service environment for facilitating public services. The project involves 10 Dutch municipalities to create a test bed for developing and analysis of configurable services. One of the project goals is to build evidence for best practice processes based on cross-organizational process mining.

7 CONCLUSION

We have demonstrated the utility of the conceptual design of a citizen centric approach for organizing a government information infrastructure for public service provisioning, referred to as the citizen centric process views. We have done this through the description of Individual Plan for health and

social services (I-Plan), which is an existing cross-agency offering, aiming to provide a holistic delivery of service to receivers with complex and long- term needs. The use case scenarios for I-Plan are similar to other cross-agency services provided in public/private service networks. We further suggest our design as mental model for reasoning and designing the next generation information infrastructures. This includes providing orchestration support for compound services; treating the service receiver as a global entity and thus supporting increased mobility; providing delegation capabilities to allow for access to privacy protected information in order to increase service quality; and granting access to family or friends to act on behalf of the service receiver. The presented work is conceptual, and describes solutions not fit for implementation in the near future. Further work would include creating additional demonstrators or small-scale pilots as proof of concept. Various scenarios should be elaborated and communicated to policy makers and researchers.

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Paper 9

Public service provisioning and ICT development. Synchronising the flexibility of organisations and ICT

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PUBLIC SERVICE PROVISIONING AND ICT DEVELOPMENT. SYNCHRONISING THE FLEXIBILITY OF ORGANISATIONS AND ICT

Gustav Aagesen and John Krogstie

Abstract

In this paper we investigate the design, development and maintenance of ICT process support for government services. The motivation is based on the political ambitions for government service provisioning and the required information infrastructure to implement demand driven service provisioning. We introduce the different types of flexibility from literature, and look at approaches to achieving flexibility in process aware information systems (PAIS). Our study shows that synchronizing flexibility of organizations and the supporting ICT has consequences for the agencies partaking in the delivery of services, and the organization of service delivery itself. We highlight current challenges and suggest further directions in order to support development towards service flexibility for government agencies.

Keywords: e-government, services, process integration, business process management, flexibility.

1 INTRODUCTION

E-government is about the continuous improvement of public administration and service delivery. It is supported through the use of information technology, facilitating the reorganisation and development of new services, and with the potential of reorganising the service administration as well. E-government has until now mainly contributed to information sharing and transaction support through web portals and electronic schemas, but it is thought of as tool to improve the delivery of demand driven and citizen-centric services. To support this, flexibility is required both within public agencies and in how services are provided. Demand driven implies that the need for new services is satisfied upon request, and citizen centric implies that the needs of the different users affect the contents and reach of the services provided. User centricity also involves facilitating for the needs of the individual user in terms of customising the services offered to that particular user, and taking action to improve the service delivery to all users (FAD, 2009).

Examples of improved service delivery for common good involve extending opening hours and reducing the time spent waiting to be served. Through active collaboration between the central and local government agencies, various approaches to resource sharing are being developed (e.g. shared service centres, shared service networks, virtual organisations, portals, and electronic intermediaries). This promotes a single point of contact for citizens or what also is known as a one-stop government. To support current and future needs for interoperability required by the vertical and horizontal integration of government agencies at the local, national and cross-national level, concepts as joined- up government, seamless government, and whole of government (Christensen and Lægreid, 2007) have been spurred. These concepts describe the idea of having interoperable national public infrastructures that facilitate sharing of resources based on a unified set of standards while at the same time supporting needs and required flexibility of the highly autonomous individual agencies. Infrastructure frameworks supporting these requirements are referred to as next generation infrastructures (NGI) or cyber infrastructures (Janssen et al., 2009).

Duncan (1995) defines an IT infrastructure as a set of shared, tangible, IT resources that provide a foundation to enable present and future business applications. The primary tangible resources include: "Platform technology", network and telecommunications technology, key data, and core data processing applications, as well as design and implementation affecting flexibility. In addition to the installed base of technical components come the human factors and skills (Henderson and Venkataraman, 1993). This includes the acquisition, training, and development of the knowledge and capabilities of the individuals required to effectively execute a given strategy. The combination of technical and human actors as well as the methods, processes and the interactions of these forms the information infrastructure (Hanseth and Ciborra, 2007) for a given domain.

Process-aware information systems (PAIS) have the advantage over the previous data-aware information systems of allowing the modification/reconfiguration of the process without changing the system itself. PAIS can be classified into human-oriented and system-oriented and support person-to-person (P2P), Person-to-Application (P2A), and Application-to-Application (A2A) processes. Traditionally, PAIS are based on formal graphical process models allowing for a selection of predefined variations (van der Aalst et al., 2007).

Even though if PAIS can provide a possible approach for delivering cross agency public services, there are currently no commercially available PAIS that can sufficiently satisfy required flexibility depicted by a demand driven government based providing adaptable individually customised services by a network of autonomous actors (Hallerbach et al., 2010). There is a need to holistically address the support for distributed process-based delivery of public services.

In this paper we will give account for existing approaches to achieving process flexibility and discuss challenges for providing public services in public/private networks. First, we will provide a brief background on previous case studies on the development of national enterprise architectures for public service provisioning. Then we will provide an overview of different perceptions of flexibility related to service provisioning and information systems. Following that, we will discuss the process life cycle, and approaches to achieving process flexibility through the use of PAIS. As part of that we discuss challenges related to PAIS in general, and for an e-government setting in particular. We provide a set of recommendations for further directions in order to support development towards service flexibility for government agencies.

2 NATIONAL ENTERPRISE ARCHITECTURES SUPPORTING CROSS AGENCY SERVICE PROVISIONING

From a recent study comparing enterprise architecture development in Norway and the Netherlands (Aagesen et al., 2011) we see different strategies for developing national e-government information infrastructures for public service provisioning. In Norway, initiatives for cross-agency collaboration are being centred on the Altinn framework, acting as an intermediary for integration, access to shared components and service publishing. In the Netherlands, several projects have been initiated independently, providing various interfaces and loose coupling between actors. While both countries provide core components for information integration, the core components offering in Norway is taking its first step towards process integration for predefined processes.

While process integration based on a stable group of partnering agencies provides a rewarding setting for the integration of core cross-agency processes, process integration based on global partnerships usually does not pay off (Klischewski, 2004). In a global setting, as found in a national information infrastructure, it is advised to approach process integration through establishing open process interfaces and applying global standards for process descriptions (ibid).

Bekkers (2006) uses policy chains and policy networks to describe public service provisioning. These are semi-permanent collaboration arrangements between organisations in order to produce a given service or outcome. The collaboration arrangements are based on political and administrative agreements, technological agreements, economic agreements and legal arrangements. Being part of the

technological agreements, the information systems supporting any collaboration bare the risk of imposing pattern dependencies onto the arrangements between the actors and act as a barrier (or have a dampening effect) to flexibility.

However theoretical, the scenarios related to the scope of this paper are limited to that of the demand driven and citizen centric provisioning of public services. Flexibility requirements caused by a demand driven government scenario include providing information system design fit to support the change of agreements and arrangements of existing policy chains, and the introduction of new policy chains. Flexibility requirements caused by the citizen centric government scenario include providing information system design fit to support the interaction of processes and information sharing within and across policy chains, replacing of one or several service providing actors, and customised individual processes in policy networks.

3 FLEXIBILITY IN PROVISIONING OF PUBLIC SERVICES

In the following section we will give an introduction to terms describing flexibility related to provisioning of public services, going from the dynamic capabilities of organisations, to the flexibility of information system design and development, and the flexibility of services provided on top of a stable information infrastructure. In general, the terms describe how organisations are able to deal with new environmental conditions. The existing terms overlap, and different terms depend on the scope and the nature of the disruption. We also observe that the terms evolve (Turner and Lankford, 2005) as new technology affordances are introduced and depending on the scope and viewpoint (organisation, system, process) for the change at hand.

3.1 Dynamic capabilities of organisations

The dynamic capabilities of an organisation are the strategic actions that take place to gain short or long-term competitive advantage. Their value for competitive advantage lies in their ability to alter the resource base: create, integrate, recombine and release resources (Eisenhardt and Martin, 2000). Dynamic capabilities support the evolution of the business to adapt to external changes at the macro, meso, and micro level. They can additionally be disruptive by creating new markets or through innovative approaches on how the market is served.

Dynamic capabilities have been criticised for being described at an abstract level, but by investigating organisational processes from a functional perspective it is possible to identify the processes that contribute to the dynamic capabilities of an organisation. These are typically strategic change processes, processes related to resource reconfiguration, and processes that integrate resources to support knowledge creation in the organisation.

Within e-government, gaining competitive advantage is replaced with the continuous strive for improved efficiency and efficacy of provided services. The dynamic nature of transformational government requires creating and adapting services to support changes in laws and regulations, changing organisational structures, access to resources, technology affordances and demands from citizens and businesses (Aagesen and Krogstie, 2011). These are all aspects of demand driven citizen-centric government.

3.2 Agility of businesses and methods

Business agility is being able to swiftly and easily change businesses and business processes outside the normal level of flexibility to effectively deal with highly unpredictable external and internal changes (van Oosterhout et al., 2005). Later, the term “agile methods for information systems development” was introduced through the agile manifesto (Fowler and Highsmith, 2001). Convoy et al. (2005) provides a broad classification of agile activities from the field information system development. The classification is very much aligned the functional commonalities of the dynamic capabilities as described by Eisenhardt and Martin (2000). The agile activities are classified within

change creation, pro-action, reaction, and learning. They are passive and active strategies to embrace change and to strengthen the dynamic capabilities of the organisation through learning. This classification of agile activities into passive and active additionally indicates the timing of activities with respect to the changes that occur.

Robustness or resilience is the ability to endure all transitions caused by foreseen or unforeseen changes, or the degree of change tolerated before deterioration in performance occurs without any corrective action (Hashitnoto, 1980). As robustness is a result of non-action it is not classified as an agile activity itself, but it is rather the result of a given configuration of dynamic capabilities.

3.3 Resource flexibility and flexibility in an information systems perspective

Resource flexibility is defined as the ability of a resource to be used for more than one end product (Duncan, 1995). The greater the flexibility of the resource, the more options the firm has for diversifying into less related end products. IT-Infrastructure flexibility can be understood as the degree to which its resources are shareable and reusable, and is described through connectivity, the ability of any technology component to attach to any other component; compatibility, the ability to share any type of information across any technology component; and modularity, the ability to add, modify and remove any component with ease and with no major overall effect (ibid). The first capabilities are strongly related to that of interoperability.

Flexibility within computer science and information systems development is different from that of a common (interpretative) understanding of the term: It denotes either flexibility for further changes, or flexibility in the pattern of use (Hanseth et al., 1996). This means that the processes, methods and technologies through which the information system components have been developed affect the irreversibility and the interpretative flexibility of these components, and that these processes may support flexibility of use and further changes as well. This might be called anticipated and alternating flexibility (ibid).

In an inter-enterprise setting, Gosain et al. (2005) propose that coordination outcomes, allowing for flexibility goals to be attained, can be achieved through advance structuring (Appropriately structuring inter-organisational information flows and interconnected processes in order to reduce the effort involved in adjusting to changing business environment) and dynamic adjustment (Using IT-supported learning and adaptation to effectively and quickly reconfigure a set of inter-organisational processes supporting the changed business environment) (ibid).

3.4 Service and process flexibility

Gong et al. (2009) defines service flexibility as the ability to allow outsourcing or in-house handling of single services. In BPM systems, the process itself can be static, predefined, based on knowledge or business rules (ibid), or dynamic or ad hoc. It is common to distinguish between straight through processing, where the goal is to achieve full process automation, and case handling, where the process is too variable or complex to model in a single diagram (van der Aalst et al., 2003). Process models for public service provisioning can additionally be descriptive, acting as guidelines for physical services rendered, or as support for knowledge workers in case handling. In those situations, the process can be data or context-driven, providing support for alternative routes depending on the status of the current process. Interactive process models/active models are processes that can be partially automated and partially manually executed. (Krogstie and Jørgensen, 2004). The model diagram and the supporting information system are connected so that changes in the model are reflected within the information system (Lillehagen and Krogstie, 2008).

Schonenberg et al. (2008) suggests a taxonomy for process flexibility involving flexibility by design (incorporate alternate execution paths within a process model at design time); flexibility by deviation (the run-time deviation from the prescribed execution of a process instance); flexibility by underspecification (enabling an incomplete process, similar to that of an interactive process model, to

be completed through supplying information for undefined/ambiguous parts at run-time); and flexibility by change (run-time modification of process model so that one or more executing instances are migrated to the new model).

4 FLEXIBILITY IN PROCESS AWARE INFORMATION SYSTEMS

In this section we will look at approaches to achieving flexibility for process-oriented service provisioning using process aware information systems.

4.1 Why process flexibility

Gortmaker et al. (2004) provides an extensive overview of benefits of cross-agency automation of services, both from organisational, managerial, strategic, technical and operational point of view. In Norway, there are ambitions for examining how legal protection can be catered for satisfactorily in relation to fully or partially automated decision-making solutions (FAD, 2009). Important aspects involve transparency, traceability, and the sharing of data between supervisory authorities. From a single agency point of view, process-orientation provides support and documentation of activities for monitoring and reporting. Additionally, the process-oriented approach provides relative increased business agility and flexibility of service offerings compared to what achieved through previously available approaches.

4.2 Flexibility provided by PAIS

It is common to differentiate between imperative and declarative process modelling. While imperative process modelling is explicit about both what and how any action should be completed, declarative process modelling focuses only on what should be done. Declarative (constraint-based) process modelling has limited potential for automation, and is limited to describing tasks and interactions of tasks. One example using declarative process models for public services is that of the person-centric flows, providing updated tasks lists for health workers (Unger et al., 2010).

The support for constraints and flexibility in process-oriented environments depends on how the activities are bound to the human and system actors within the models. Declarative P2P processes can be remodelled with ease provided that the actors with the required competencies are available. P2A and A2A processes are however, bound to the flexibility of the information infrastructure or components supporting the PAIS, thus requiring configuration of interfaces of any new application resource.

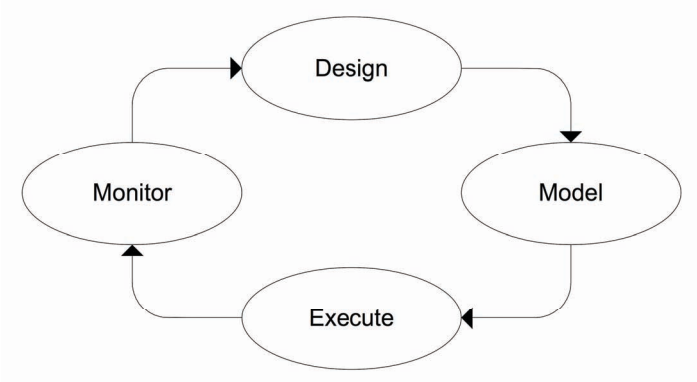

Figure 1 The process life cycle

Figure 1 shows the traditional life-cycle model for process development, going from design, modelling, execution of processes, and monitoring. The design phase requires transforming business goals to services and process models, adding modularity, and defining interfaces. The anticipated flexibility of the model is decided in the design phase, and modelled in the modelling phase. When

developing a dynamic process model, the aim is a model that can be adapted with few modelling efforts at run-time (Gottschalk and La Rosa, 2010). At run-time, it is not possible to add behaviour that has not been modelled or prepared beforehand (i.e. adaptive workflow, as opposed to emergent workflow). The execution phase, can however, in addition to allowing for the designed flexibility of the model, support exception handling and flexibility by changes to the process instance. Weber et al. (2009) provides a structured overview of different approaches to flexibility on a PAIS, a summary of the approach types is provided in Table 1. An important aspect of the execution phase is to provide execution and change logs to monitor performance and to support process evolution. One output of monitoring is redesign and remodelling for improved process execution.

On the design side, distributed processes designed using an event driven approach have the potential of higher flexibility than that of the traditional SOA. This is due to lightweight nature of the requests not carrying the payload data itself. In an event driven environment, actors subscribing to events will be notified and are responsible for collecting data based on occurring events (Klievink et al., 2008).

Approach	**Description**	**Risk**
Modelling phase		
Granularity control	Ignoring details of modelling and creating black boxes.	Reduced transparency, monitoring and automation.
Flexibility by enumeration	Creating models of all possible flows.	Model redundancy, increased complexity and maintenance
Process configuration	Adding alternative flows into the model using conditional branches and external variables. Flow is further decided by context or user interaction (questions).	
Late binding	Leaving the resource allocation or service instance of a given activity undecided in the process schema.	Making sure that the selected resource for the activity is fit for the process at hand.
Late modelling/ *Pocket flexibility*	Leaving parts of the model open for runtime modelling.	Limited control depending on constraints.
Execution phase		
Dealing with expected exceptions	Adding exception-handling patterns as part of modelling.	Adds complexity.
Dealing with unanticipated changes	Structural remodelling of process instance.	Making sure that the modifications does not affect later process flow.

Table 1 Approaches to process flexibility adapted from Weber et al. (2009)

4.3 Challenges and requirements

Switching to a process-oriented approach for service provisioning requires at least an investment in IT-infrastructure and competencies, in addition to the potential reorganisation of the service providing agencies. A PAIS requires support from the information infrastructure with databases and existing legacy applications to function, this requires that the existing operation be transformed to support a SOA approach. Today, most COTS applications come with predefined web-service interfaces. But still, the help of consultants to configure custom interfaces to match the institutional facts (Iannacci, 2010) for the given agency is required. Strategy definitions or process design should also be related to documented patterns, and business and knowledge rules should be formulated. Due to the nature of process design documents that result from business strategic planning and articulation, achieving a fit (lossless transition) is a task requiring great expertise (Weber et al., 2009) not likely to be found within government agencies. This being said, the first challenges to catering for a dynamic process environment are found within establishing the first working representation, or base process (Hallerbach et al., 2010), for the process-oriented service organisation. It is further expected that the process instances will be monitored and that the base process will evolve continuously. A dynamic process environment requires that new roles and responsibilities be established (Janssen et al., 2006).

This ensures that that expertise for maintenance of the PAIS is built so that the process models can evolve together with the organisation.

Given a public service delivery provided through a public/private service network, the scope and the requirements of the PAIS is no longer limited to that of a single organisation. The service flow is defined at a cross-agency level (Figure 2) and service stubs provided by separate agencies can be declarative or imperative depending on the service.

Janssen (2007) depicts different challenges to cross-agency process integration: First, the entire service has to be modelled and maintained, not only the separate agency stubs. Second, the process state has to be made available to the actors partaking in the process instance. Third, as the process flow can be a result of both vertical and horizontal integration, traditional accountability principles for hierarchical organisations (vertical accountability) do not apply.

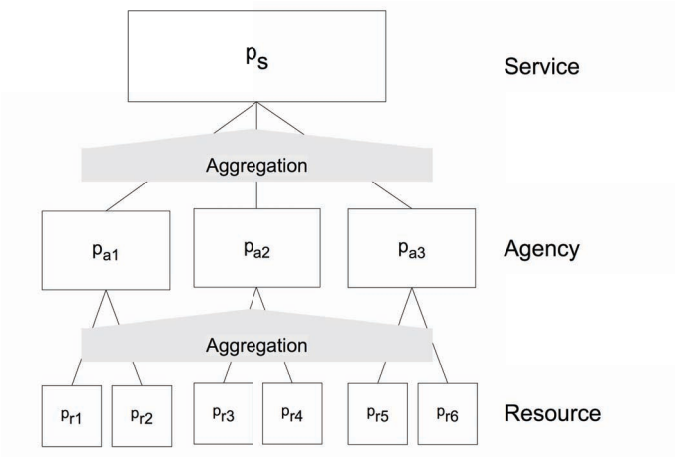

Figure 2 Process model aggregation for cross-agency service provisioning

Jørgensen (2001) and Weber et al. (2009) identify a range of issues related to service provisioning using a PAIS and in a cross-agency setting both for the involved organisations and on level of the user and in the pragmatics of use. This involves:

- Resolving access control to different parts of the model, handling concurrency control for conflicting changes performed by different users, as well as resolving ambiguities and exception handling.
- Orchestration of multi-threaded cross-agency process instances.
- Providing coordination support (enactment, awareness).
- Allowing for local variants and domain specific models at the agency-level synchronised to the service process.
- Supporting communication between actors in virtual organisations.
- Providing good usability and pragmatic quality of models and user interfaces
- Enterprise resource management, and horizontal resource allocation.
- Support for changes at a high-abstraction level and creating change patterns updating several parts of the model.
- Validation and activation of ad-hoc changes to model.
- Making changes made to process instances reusable.
- Model maintenance and administration of model repositories.
- Diagnosing and mining based on process instance variants.

- Traceability of changes and monitoring of dynamic processes (transparency and trust).
- Process schema evolution, version control and migrating process instances.
- Accounting in public/private networks.

Unger et al. (2010) additionally identifies the need to support personal work organisation and person-centric flows, this can both be to support the user as a provider of public services and as service receiver.

5 DISCUSSION

A key characteristic of dynamic processes is that they are knowledge intensive. Thus the process flow is governed by knowledge rather than well-defined control flow (Weber et al., 2009). Having a dynamic process environment does not only support knowledge intensive and ad-hoc processes, but provides an improved business agility when providing services that are seemingly static. A service-oriented approach facilitates for increased trust and transparency through logging activities, as well as supporting public servants with guidance in routine work. A goal should be that the system representation of work (model) is as close to reality as possible, both for real-time support and to facilitate post-process learning and improvement.

With the establishing of Next Generation Public Information Infrastructures, BPM is expected to support cross agency integrations, access to key registries, and handle citizen transactions. PAIS is a key player in supporting a demand driven citizen-centric service provisioning. But even if process-aware information systems have introduced a paradigm shift with respect to traditional data-driven computing by eliminating hard-coded routines and enabling flexibility, there are challenges that prevent them from being used. We se challenges in the areas of establishing the base process; monitoring, evaluation and change management; complexity of tools and concepts; control in multi-actor networks; and the role of the process worker.

5.1 Establishing the base process

Challenges to establishing the base process are mostly related to the resources involved in the development project and the initial design and modelling. This is a task requiring great expertise (Weber et al., 2009), as well as it is a task requiring a high level of involvement from the users. Knowledge must be transferred so that the initial design provides a sufficient starting point; as well as sufficient know-how is transferred to the organisation responsible for maintaining the service support system. In a global setting of actors, like in a public/private service network, the search for reusable components and creating sufficient process modularity is an important part of establishing the base process. Coordination between unrelated policy networks using the same information infrastructure adds an additional level of complexity.

5.2 Monitoring, evaluation and change management

Solutions for managing process variants in existing BPM tools can be divided into a multi-model or a single-model approach (Hallerbach et al. 2010). A multi-model approach is feasible for processes with few variants, creating a single process schema for each variant. Maintenance of such an approach requires that the process designer update all variants when the model is updated. The single-model approach involves adding control-flow so that all variations are contained within a single model. This approach creates large and complex models, and separating the variants from default process flow is not hassle-free.

Monitoring of process instances is a necessary part of business performance management (Vitharana et al., 2007). The purpose and outputs of the monitoring must be decided and can vary between performance in view of the service, agency or tasks of the individual worker. Optimising best practice

in a multi-actor service network can be complex, as the necessary context information from all partaking agencies might not be available. Further, the goals of the various actors might not coincide.

A part of the process instance monitoring involves discovering possible process improvements, improving exception handling and evolving best practice. Based on the changes made to the process instance by the process worker, the process designer must decide whether the change patterns should be included to the process schema for later instances, or if running instances should be migrated to the new schema version. Changes the both the type and instance level process model requires validation and consistency checks both for the process model and against any service agreements related to service provisioning.

5.3 Complexity of tools and concepts

The modelling and process-oriented way of thinking is not necessarily intuitive for the users involved in the service production (both providers and receivers). Monitoring of process state and possible process paths should be communicated based on the skill and needs of the user. This involves producing task-lists or interfaces fit the context or the task at hand. Additionally, unnecessary complexity due to the explicit formalisation of all defined process paths should be filtered out.

The process support should not restrict the actual process from moving forward. This is a risk for emergent workflows, or late modelling, especially if the required skill to operate the tool does not match the skill of the process worker. In late modelling scenarios, it is important that sufficient tool support to communicate consequences of any changes to the model is available.

5.4 Control in multi actor networks

Case studies show (Janssen, 2007) that the even though information system flexibility is provided through loose coupling between actors, it does not enable adaptability at an organisational level and that long negotiation processes are necessary to adapt to new circumstances.

For process support in emergent workflows or in late-modelling scenarios, orchestration might prove difficult if agreement on process direction cannot be made, and there are no means of applying pressure on the partaking actors. Also, the handling of wicked issues can be problematic for reasons different from those related to technology.

5.5 Increased pressure on the process worker

With the use of dynamic process support, ad-hoc decisions are made explicit and logged, causing a potential resistance to use. This can also be related to the privacy of process workers perceivably being under surveillance. An other issue is related to exposing the single process worker to a virtual organisation in which the safety and protection of ones own agency seemingly might not apply, is also a risk that should be accounted for. While up until now, flexibility has mainly been a management issue. For process flexibility of cross-organisational processes, there is a risk of moving the risk of the flexibility on to the process workers if the service design is at run-time.

5.6 Summary and recommendations for further directions

Process aware information systems might seem like one approach to paving the way for a technology-first transformation of government service provisioning, and the answer to the political ambition of realising demand driven and citizen-centric services. The behaviour of such a network of service providers is similar to that of a complex adaptive system (Sutherland and van den Heuvel, 2002).

Our analysis show that that the currently observed challenges for the realisation of such a scenario is mainly related to that of the complexity of making the behaviour of current processes explicit, and the limitations of the organisations involved in the service provisioning. That is, the flexibility provided by the PAIS is improved relative to the hard-coded workflows, and the fixed internal models of

integrated applications. We suggest that the complexity of this reality is currently not manageable, and the organisational readiness to support the possible transformation of services is at the moment not present. We do however see that coordinated efforts at the national level can potentially provide the required support and facilitate for this service transformation.

In order to support the adoption of cross-agency process oriented service delivery we recommend that collaborative efforts be made to allow for economics of scale and to support the transformation of individual agencies. This involves providing standardisation and support of infrastructure, development methods, service interactions, and agreements for establishing policy networks and public/private service partnerships. This can involve:

- Establish core component offerings providing execution platform for service level process definitions and support keeping process state as third party intermediary.
- Establish templates and guidelines for service level agreements for establishing public/private service networks.
- Defining process interaction patterns for: scheduling, resource allocation, request, and confirmations; providing for loose couplings between service organisations; adding new application resources to the service network; and adding data to existing service flow.
- Provide for domain specific modelling, aggregated reference process building blocks, and change patterns for standard services.
- Case management and archive standards should evolve to reflect a process-oriented reality.

6 CONCLUSION

In this paper we have looked at information infrastructure as a socio-technical system and aspects related to process flexibility, given flexibility as means to adapt to a required transformation of government service provisioning to provide demand driven and citizen-centric services.

The paper is based on previous case studies on national enterprise architectures and the next generation information infrastructures for e-government service provisioning. Based on the idea that process aware information systems (PAIS) can support a required flexibility in public service provisioning, we have performed a literature-based investigation of challenges and ways forward. We see that even though flexibility definitions depend of different viewpoints (resources, management of information systems, system development, processes, and services), they are highly interwoven and complimentary.

Our main concern has been that of the PAIS, and different approaches to flexibility provided by such an infrastructure affordance. Our analysis show that the flexibility provided succeeds the flexibility of the organisations, but is potentially limited through the added complexity of the approach and the structural organisation of government hierarchies. As a response to this, we have provided suggestions for further directions that can aid the establishment of public/private service networks. These suggestions are related to that of providing core component offerings, guidelines, templates and support for agreements between the public and private agencies partaking in a public service provisioning.

We have not investigated process flexibility based on a specific case, but rather addressed flexibility within and across policy chains. Investigating specific cases would provide knowledge about the relevance of specific identified challenges. It would also identify to what degree the PAIS approach, as means to support public service provisioning, is appropriate. We suggest that work is done to classify existing public services in means to where flexibility is needed. Further, to investigate what kinds of capabilities are expected for different services, both from a technical and organisational point of view.

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Appendix C: Additional publications

The following publications were written after the thesis publications were already decided. These are based on extended versions of conference papers P7, P8, and P9.

SP1 Anne Fleur van Veenstra, and Gustav Aagesen, and Marijn Janssen, and John Krogstie (2012) Infrastructures for public service delivery: Aligning IT governance and architecture in infrastructure development, to appear in: eService Journal, special issue on E-government Services and Information.

SP2 Gustav Aagesen, and John Krogstie *A national e-service infrastructure approach to citizen-centric and demand driven public service provisioning*, prepared manuscript.