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Working Paper

Network e-Volution

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Foreword: Uncertainty, Evolution and the Network – Impacts of Information Systems on the Network Society

Modern society is a network society permeated by information technology (IT). Networks, perceived as a group of organisations and people (vertices) connected on several layers of interaction (edges) who exchange information, contacts, and experience for professional or social purposes, leave their mark on almost every area of our society and promise diverse advantages to those involved. As a result of innovations in IT, enormous amounts of information can be communicated to a larger number of recipients faster than ever before. The evolution of networks is heavily influenced by the extensive use of IT, which has enabled co-evolving advanced quantitative and qualitative forms of networking. This, in turn, has, for example, facilitated the development of global value networks with significantly increased production efficiency. This high degree of networking has led to business networks, administration networks, and social networks intensifying their interaction.

Although several networks have been formed with the aim to reduce or deal with uncertainty through faster and broader access to information, it is in fact IT that has created new kinds of uncertainty. For instance, although digital information integration in supply chains has made production planning more robust, it has at the same time intensified mutual dependencies, thereby actually increasing the level of uncertainty. We call this phenomenon information-uncertainty-paradox.

Information technology is affecting communication and trust, governance, and (business) processes and is broadening their interdependencies. For instance, “prosumers” – organised in social networks of the “interactive society” – have an escalating impact on product design and therefore on processes and governance in e-Business.

The objective of this working report is to provide an overview of the drivers and the development of uncertainty in different types of hybrid, IT-supported networks. The drivers, development, and management of network uncertainty are investigated in the following areas:

- Increasingly interacting and/or overlapping IT-supported business networks, networks of public administrations, and social networks;

- Interdependent layers of interaction of communication and trust, governance, processes and information technology in IT-supported networks;
- Structure, behaviour and evolution of IT-supported networks.

The following figure 0.1 exhibits the overall structure of the research field.

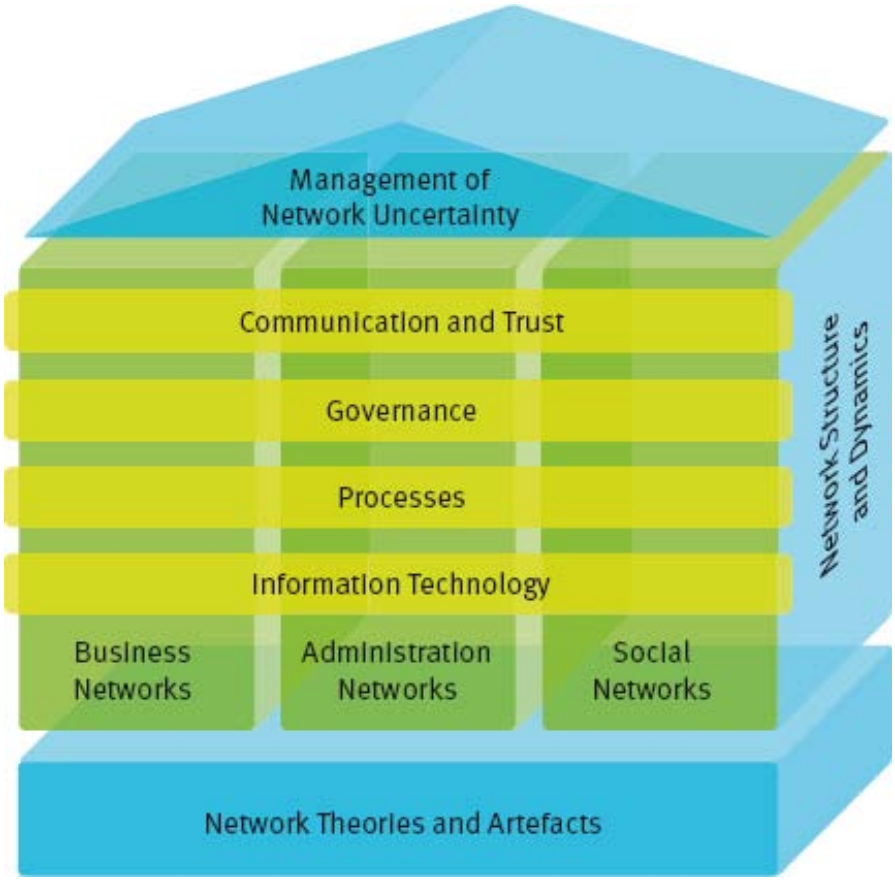

Figure 0.1: Conceptual Framework for Network Research

The papers included in this report are the outcome of a Master's Seminar which was held at the Institute for Information Systems, University of Münster in the Winter Term 2010/11. The objective of this Seminar was to explore some core research areas related to the information-uncertainty-paradox in networks as systematized in the conceptual framework.

After a short introduction and some basic definitions of the central terms explored in this report, sections 2 to 5 focus on the central construct of uncertainty. In section two Alexander Kirchner discusses "A Business Process Perspective on Uncertainty in Facility Management Networks" introducing a reference model for the planning phase of construction projects. Sanja Tumbas goes on by providing an overview of "Business Process Governance for Managing Uncertainty in Administration Networks" in section three. We move from public administration networks to networks of practice in section four with Adriana Lopez elaborating on

“Communication and Trust in Networks of Practice”. In section five, “Cloud Computing – Governing Uncertainty in Distributed Electronic Business Networks”, Nils Labusch reports on cloud computing as situated in a business network and discusses its relations to uncertainty.

The subsequent sections deal with evolution as a major factor that impacts on the future structure and behaviour of a network. In section six Sebastian Wiethoff focused on “The Evolution of Digital Business Processes in e-Government” and their impact on the interoperability in business networks. In section seven Sebastian Sartor analyses aspects of the “Evolution of Communication and Trust in Social Networks”. Enrique Villalon concludes with “An Evolution Perspective on Service Oriented Architectures in Business Networks“ in section eight.

We as the supervisors and mentors of the seminar would like to thank the students for participating in the seminar as well as for making their own results available to the public by means of this report.

Münster, August 2011

Prof. Dr. Jörg Becker, Dr. Daniel Beverungen,
PD Dr. Patrick Delfmann, Dr. Michael Räckers

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Abbreviations

A	Architect
BP	Business Process
BPEL	Business Process Execution Language
BPG	Business Process Governance
BPM	Business Process Management
BPMN	Business Process Modeling Notation
BRMS	Business Rules Management System
CaaS	Communication as a Service
CAFM	Computer Aided Facility Management
CC	Construction Company
CMC	Computer-mediated communication
CMMI	Capability Maturity Model Integration
COBIT	Controlled Objectives for Information and related Technology
DaaS	Data-Storage as a Service
EPC	Event Driven Process Chain
ERCIS	European Research Center for Information Systems
ESB	Enterprise Service Bus
FM	Facility Management
FMC	Facility Management Consultant
HaaS	Hardware as a Service
HTTP	Hypertext Transfer Protocol
HW	Hardware
i	iterative
IaaS	Infrastructure as a Service
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
IS	Information Systems
IT	Information Technology
ITAIDE	Information Technology for Administration and Intelligent Design of E-Government
J2EE	Java 2 Enterprise Edition
NAO	Network Administrative Organization
NIST	National Institute of Standards and Technology
NPM	New Public Management
OIPT	Organizational Information Processing Theory
OSS	Open Source Software
OSSD	Open Source Software Development
p	periodic
PaaS	Platform as a Service
PAN	Public Administration Network
PC	Principal/Control
REST	Representational State Transfer
SaaS	Software as a Service
SNS	Social Network Sites
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SW	Software
T	Type
TCP/IP	Transmission Control Protocol / Internet Protocol
UDDI	Universal Description, Discovery and Integration
VM	Virtual Machine
WSDL	Web Services Description Language
XML	Extensible Markup Language

Working Paper Sketch

Type

Research Report

Title

Network e-Volution

Editors

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The authors of the Report are Alexander Kirchner, Nils Labusch, Adriana Lopez Cordoba, Sebastian Sartor, Sanja Tumbas, Enrique Villalon, and Sebastian Wiethoff. They are all Master Students in Information Systems at the University of Münster.

Abstract

Modern society is a network society permeated by information technology (IT). As a result of innovations in IT, enormous amounts of information can be communicated to a larger number of recipients faster than ever before. The evolution of networks is heavily influenced by the extensive use of IT, which has enabled co-evolving advanced quantitative and qualitative forms of networking. Although several networks have been formed with the aim to reduce or deal with uncertainty through faster and broader access to information, it is in fact IT that has created new kinds of uncertainty. For instance, although digital information integration in supply chains has made production planning more robust, it has at the same time intensified mutual dependencies, thereby actually increasing the level of uncertainty. The aim of this working paper is to investigate the aspects of evolving networks and uncertainty in networks at the cutting edges of different types of networks and from the perspective of different layers defining these networks.

Keywords

Network Uncertainty, Network Evolution, Communication and Trust, Governance, Processes, Information Technology, Network Structure, Network Dynamics, Business Networks, Administration Networks, Social Networks

1 Introduction

Alexander Kirchner, Nils Labusch, Adriana Lopez Cordoba, Sebastian Sartor, Sanja Tumbas, Enrique Villalon, Sebastian Wiethoff

1.1 Structure of the Working Report

In general we use the structure as introduced in figure 0.1. In this report we especially focus on the intersections of communications and trust, governance, processes and information technology with business networks, administration networks and social networks. We further relate these to either the concept of uncertainty or evolution.

In order to provide an overview about the relevant concepts in each part, we integrate a navigation figure within each section. This figure as introduced in figure 1.1 provides a brief overview of the used concepts and the outline of the section.

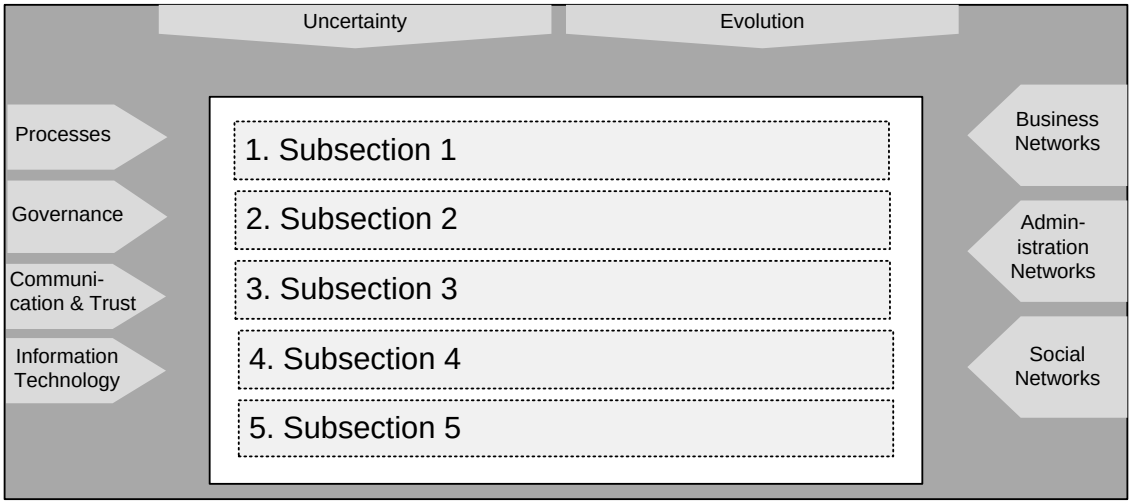


Figure 1.1: Section Navigator

1.2 Research Methodology

The research approach is mostly related to literature survey and investigation. We followed ideas given by vom Brocke et al. (2009) in order to conduct the search process rigorously. We applied a search process as outlined in figure 1.2.

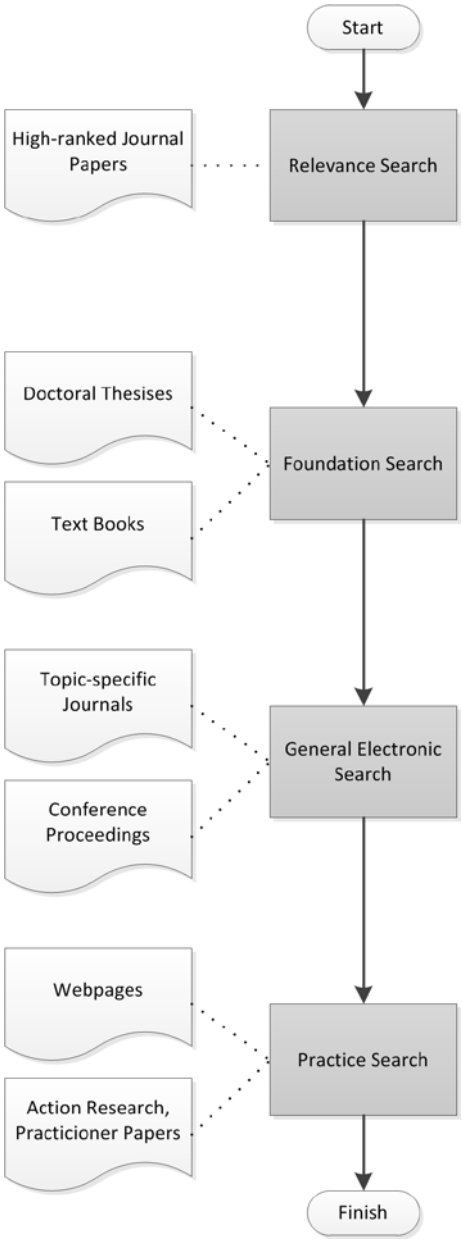


Figure 1.2: Literature Search Process

In general we surveyed different sources emphasizing on different perspectives of the topic. Within the first phase, the relevance search, we used e.g. A+ rated journals out of the Jourqual 2[1] index to get a general impression of the topic in management science. We further surveyed the information systems journals from the AIS senior scholars' basket of journals[2]. Depending on the specific topic we also included additional top journals from other disciplines (e.g. the "Nature" journal). Usually we applied search string combinations containing the major key words given in the title of each section combined with "uncertainty" or

1 http://vhbonline.org/service/jourqual/jq2/
2 http://home.aisnet.org/displaycommon.cfm?an=1&subarticlenbr=346

“evolution”. For example in the cloud computing section we applied search terms like “governing cloud computing”, “governance AND uncertainty”, etc. We further investigated the foundations of the later discussed topics within the journals.

In cases where the research topics were rather new and not yet heavily discussed in top-ranked journals, we include additional sources as well. In the second phase, the foundation search, we added textbooks and doctoral theses dealing with the topics and sub-topics of the sections in general into the literature survey – mostly by surveying the local library catalog for relevant search terms in German and English language. Our objective by doing this was to get some ideas about characteristics and different definitions of the topics. We further used these sources in order to investigate some more sophisticated concepts. If these sources contributed to finding interesting insights regarding the research questions we further used them to enhance our results.

In phase three, we conducted a general electronic search. We surveyed more specific magazines that deal with research on the specific topics (e.g. by conducting a search for “cloud computing” using EBSCO search and including the high relevancy papers into the survey). Other electronic resources we used are Springerlink, AbiInform, Science Direct or Google Scholar. We also included proceedings of conferences that dealt with the specific topics or their surrounding. Further we did reverse searches by surveying the references of articles we found during the first search steps and ordered some of the promising sources via interlending services.

In the last phase we concentrated on practice-related result contributions. We searched for examples on practitioner’s websites, publications authored by enterprise consultants or action research contributions.

We mostly concentrated on sources that were published during the last ten years (2000 – 2010). However, we think that in some cases the historic emergence is important nevertheless and therefore also included sources outside the predefined time span.

1.3 Common Concepts

1.3.1 Network

Business Networks

Business networks can be described as “cooperative arrangements between independent business organisations that vary from contractual joint ventures to informal exchanges of information” (Lynch et al. 2009, p.163). Additionally, we are interested in the relationships connecting the participants, and the definition provided by ANDERSON et al. (1994, p.2) reflects on this perspective perceiving business networks “as a set of two or more connected relationships, in which each exchange relation is between business firms that are conceptualized as collective actors. In this context, the term “connected” refers to the extent to which exchange in one relation is contingent upon exchange (or non-exchange) in the other relation. This definition is widely accepted among many scholars (e.g. Sanzo et al. 2003, p.76; Johanson & Vahlne 2010, p.2; Björkman & Kock 1995, p.520).

Moreover, the connected relationships can be under the direct or indirect influence of other relationships of the larger business network and the function of a relationship is characterised by three components: actors, activities and resources (Anderson et al. 1994, p.2f.). One can differentiate between primary functions and secondary functions of a relationship: Primary functions are defined as “the positive and negative effects on [...] two partner firms of their interaction in a focal dyadic relationship. The secondary functions, also called network functions, capture the indirect positive and negative effects of a relationship because it is directly or indirectly connected to other relationships” (Anderson et al. 1994, p.3).

The development of business relationships “can fruitfully be explained as a social exchange process in which two parties gradually and interactively learn about each other, built trust in each other and commit themselves to exchange with each other” (Johanson & Vahlne 2010, p.2). Thereby, the development of a relationship depends on past interactions, the learning effort of both organisations, the current interactions of the relationships and connected relationships, the expectations towards future interactions and the expectations towards relationships of the wider business network context (Håkansson & Ford 2002, p.134). The interactions of the actors can be described as to include social exchanges, information exchanges and business exchanges (Björkman &

Kock 1995, p.520f.). Moreover, it can be stated that the organisation's "network position consists of its portfolio of relationships and the activities links, resource ties and actor bonds that arise from them" (Sanzo et al. 2003, p.76).

Administration Networks

Administration networks, also known as public networks, appear in numerous classifications and contexts. Here, we reflect on those administration networks which are within the scope of our research. Hence, we address: 1. networks as a form of collaborative public management and 2. governance networks.

The study on networks in a role of collaborative management in the public sector "goes beyond studies of informal and intraorganizational networking among individuals to include interorganizational – in this case, intergovernmental – entities that emerge from interactions among formal organizations" (Agranoff 2006, p.56). Many scholars suggest that network management includes much more than hierarchical coordination (Kettl 2002; O'Toole 1997; Agranoff & M. McGuire 2001). Consequently, that is the area of our research as well.

Another perspective we take on networks, places governance to spotlight. The approach builds on the "Provan's school" with a special emphasis on the networks as the unit of analysis. This means that we want to take a closer look at the network as a whole, but also study their relation to governance. We argue that it is important to make this differentiation as the literature often uses very varied terms, even when describing the same constructs (Provan et al. 2007; Isett et al. 2010).

No matter if administrative networks are addressed as means of collaborative value provision or as form which has to be governed, we are also interested in the relation to the enablers of administrative networks. Therefore, we reflect on the relations to information technology, enterprise architectures, business processes as well as the way of managing and governing them. The neccessity has emerged as result of the nature of administrative networks described as "merely complicated, spanning organizational and institutional boundaries and involving many actors simultaneously pursuing multiple agendas, or they may be responses to fundamental uncertainty, designed to account for a lack of information or resources" (Wachhaus 2009, p.71). Networks facilitate interaction among participants, and the main aim is to pursue a common goal by exchanging information and resources.

Social Networks

SCOTT (1988, p.109) links the phrase “social network”, to textiles, webs and grids, and conjures up a strange but surpassingly powerful image of social reality. He sees individuals as “tied to one another by invisible bonds, which are knitted together into a criss-cross mesh of connections, much as a fishing net or a length of cloth is made from intertwined fabrics”. Besides, GULATI (1998, p.295), explicitly mentions that social networks are consisting of nodes which are representing individual persons or groups of persons linked by a set of social relationships (e.g. friendship, transfer of funds, overlapping membership) of a specified type. Some authors enhance the types of relationships by dividing them into directed (e.g. giving advice to someone) or undirected (e.g. being close to each other) ties (Borgatti & Foster 2003, p.992). These relationships can be displayed on social network sites. BOYD & ELLISON (2008, p.2) define social network sites as “[…] web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site.” As mentioned above, the connections between the groups or person can already exists, but it can be observed that new relations between participants are evolving because of social networking site.

Summing up, the nodes in a social network represent persons, teams or groups which are connected by different forms of relationships such as friendship, transfer of funds or overlapping membership. The social networking sites display existing nodes between person, teams or groups as well as enable the member to build up new relationships.

Networks

While elaborating on different types of networks (i.e. business networks, administration networks and social network) it has been revealed that network research has a focus on relations between individuals, work units and organizations. These actors are embedded within networks of interconnected relationships that provide opportunities and constraints on behaviour. The nature of relationships between the different actors change in accordance with various network types. In addition, these relationships can be manifested in directed and undirected forms of relationships. Directed relationships point from

a source participant to target participants, whereas in undirected relationships neither sources nor targets are defined (Brass et al. 2004, p.795).

In the inter-organizational perspective (business and administration networks) the types of relations can be characterized as: information, knowledge, data, communication, cooperation, interdependence, goods and money. In the inter-organizational perspective the term network is not always used. Different phrases for network occur in the literature, e.g. partnerships, strategic alliances, inter-organizational relationship, intergovernmental relationship, coalitions, cooperative arrangements, or collaborative agreements (Grandori & Soda 1995). However, all definitions have in common, that they refer to certain common themes such as social interaction (of individuals acting on behalf of their organization), relationships, connectedness, collaboration, collective action, trust, and cooperation (Provan et al. 2007, p.481f.). In social networks the different forms of relationships are friendship, transfer of funds or overlapping membership.

Concluding, all kinds of networks consist of entities and their relations to each other. As a consequence define networks in accordance with BRASS ET AL. (2004, p.795), who define this term "[...] as a set of nodes and a set of ties representing some relationship, or lack of relationship, between the nodes". In addition, the authors refer to the nodes as actors (like individuals, work units and organizations) and to the relationship as flows of information (communication), affect (friendship), goods and services (work flow) and influence (advice) (Brass et al. 2004, p.795).

1.3.2 Uncertainty

There is no single common understanding of the concept of uncertainty; instead there are as many definitions of the topic as there are treatments of the subject (Argote 1982, p.420). Uncertainty permeates different areas of the social and natural sciences, business and technology. Specific discussions are published for example for projects (Boyle & Guthrie 2003; Nidumolu 1995), politics (Bittlingmayer 1998), finance (Morgan 2002), production (Hitsch 2006), change (Carrillo & Gaimon 2004) or entrepreneurship (McMullen & Shepherd 2006). However, some authors provide rather general definitions of the term. MILIKEN (1987, p.136) defines uncertainty as an "individual's perceived inability to predict something accurately". SOMMER & LOCH (2004, p.1334) define unforeseeable uncertainty as "the inability to recognize and articulate relevant variables and their functional relationships" based on a discussion given by

SCHRADER ET AL. (1993). However, we will not distinguish between unforeseeable and foreseeable uncertainty.

MILIKEN (1987, p.136) emphasizes on environmental uncertainty by stating “the label ‘environmental’, when attached to the term uncertainty, suggests that the source of the uncertainty is the organization's external environment”. This environmental uncertainty is further distinguished into state, effect and response uncertainty:

- *State Uncertainty*: Administrators experience state uncertainty when they perceive the organizational environment (or a particular component of that environment) to be unpredictable. Uncertainty about the state of the environment includes that one does not understand how components of the environment might change. Examples are an inability to predict the future behavior of a key competitor or the inability to predict whether congress will deregulate the organization’s industry (Milliken 1987, p.136).

- *Effect Uncertainty*: Effect uncertainty relates to an individual's ability to predict how environmental events or changes will influence their organization. The experience of effect uncertainty may involve uncertainty about whether an event or change in the environment will impact on the organization at all but also uncertainty about the nature, severity, and timing of this impact. If state uncertainty involves uncertainty about the future state of the world, then effect uncertainty involves uncertainty about the implications of a given state (Milliken 1987, p.137).

- *Response Uncertainty*: This type of uncertainty is associated with attempts to understand what response options are available to the organization and what the value or utility of each might be (Milliken 1987, p.137f).

Additionally, ARGOTE (1982, p.420) as much as (2006, p.105) identify incomplete information as a main characteristic properties of uncertainty. This lack of information makes it difficult to predict the future states of factors connected to an organization´s environment or tasks. In management science this lack of information often refers to different decision alternatives. Following the argumentation of ADAM (1996, p.215), uncertainty is connected to risks. Consider a situation with different strategies and data situations like illustrated in table 1.1 where an actor has to decide upon.

Data Situation	A	B
Strategy 1	10	5
Strategy 2	4	8

Source: See (Adam 1996, p.215)

Table 1.1: Uncertainty Example

A company follows strategy one that is optimal if data situation A is valid. If data situation B would be true, strategy two would be the optimum. Consider that someone assumes that data situation A will come up and thus chooses strategy one. If the other situation occurs, the company will not have a margin of 10 but only 5 if the company cannot revoke the decision and change it (and thus has no loss). The missing flexibility is considered as the risk of the decision; uncertainty is only relevant for a decision if it comes along with a risk (Adam 1996, p.215).

Connected to such scenarios are different kinds of uncertainty. Consider an example with different possible strategies and environmental situations. For each combination a possible margin is assigned (that could also be negative). In this situation there could be uncertainty about the entrance probabilities of the different scenarios. Different assumptions and criteria could be taken to deal with this (MiniMax, MaxiMax, Laplace, etc.). Different mechanisms are relevant when the probabilities are known (but of course still contain uncertainty by themselves). The calculation of the expected value is one possible tool to deal with this challange (Adam 1996, pp.231-241).

Even if environmental uncertainty is of a major interest for organizations, since it can facilitate major failures by single decision errors (Karimi et al. 2004, p.175), additional types of uncertainty do exist. PREMKUMAR ET AL. (2005, p.265) describe the concept of partnership uncertainty as the uncertainty that exists in the relationship with trading partners. This type of uncertainty relates to opportunism (lock-in risk) and operations risks (risk of underperforming partner) and it is not only observed in the context of business but also in social relations. BERGER AND CALABRESE (1975, p.100) in their study of uncertainty in interpersonal relations describe uncertainty as the high number of alternative ways in which each interactant in the communication process might behave and the retroactive explanation of this behavior. In their view, uncertainty involves the components of explanation and prediction (Berger & Calabrese 1975, p.101). To reduce uncertainty individuals must narrow the range of alternatives about the other´s probable future behavior and attempt to develop predictions

about his/her actions (Berger & Calabrese 1975, p.101). Additionally, the explaining component describes the existence of a high number of plausible alternative attributions that a person might make for a particular communicative act; therefore, individuals must try to reduce the number of alternative explanations for the other person´s behavior (Berger & Calabrese 1975, p.100f).

In the area of networks, the uncertainty about information is affected by social phenomena as well (Koppenjan & Klijn 2004, p.6). Interpersonal relations carry an inherent element of uncertainty. Especially in large social structures and networks, the asymmetries of information and the imperfect knowledge of the self and others result in perceptions of uncertainty (Berger & Calabrese 1975, p.101). Individuals engage on a constant strive to make their own behavior and the behavior of others predictable. In this sense, interpersonal communication acts as a tool to develop predictions and explanations for our own and others´ communication behavior (Berger & Calabrese 1975, pp.101-106).

Further sources of uncertainty in interpersonal relations relate to concepts such as the level of dissimilarity among individuals in terms of their attitudes and conceptual structure (Berger & Calabrese 1975, p.105) and to the cognitive distance (van Baalen et al. 2005, p.303) that exists between them. Cognitive distance is understood as the alignment of their values and perceptions (van Baalen et al. 2005, p.303). Additionally, aspects such as the risk of free-riding behavior (Faraj & McLure Wasko 2005, p.37) in group formations that produce value and the lack of information on the other participants in the relation (Goldsmith 2001, p.515) especially in large groups and networks are also studied as constant causes of uncertainty in social endeavors.

Networks and social groups require the existence of smooth and harmonized social relationships. Therefore, the reduction of uncertainty to an acceptable level becomes crucial for “smooth, coordinated and understandable interactions to occur and for individuals to have a sense of control over their environment and outcomes” (Goldsmith 2001, p.515). In order to achieve this, individuals in social relations engage in different strategies such as information seeking. “High levels of uncertainty cause increases in information seeking behavior” (Berger & Calabrese 1975, p.103). Additionally, the rate of reciprocity in the communication, the intimacy level in the communication content and the use of nonverbal cues for affiliative expressiveness are all further elements used by individuals when engaging in interpersonal relations (Berger & Calabrese 1975, pp.100-109). These elements will determine the level of uncertainty participants

in social groups are phased with and the strategies that they will develop to cope with it.

In summary, the concept of uncertainty is widely employed and studied in the literature. “Uncertainty is a fundamental human experience and uncertainty management is a basic human activity” (Goldsmith 2001, p.516). Its application expands to all fields of science and it will play an important role in our current study of networks. On the field of business management, uncertainty impacts decision alternatives and strategies adopted by organizations. On the field of social sciences, uncertainty will have a high effect on the nature and development of social relations and the way individuals interact with each other and with their environment. Both of these perspectives will be further detailed in this work and will serve as a basis for our current study.

We summarize these aspects in the following working definition: *Uncertainty is a phenomenon that emerges when individuals or organizations are not able to collect all relevant information about the intentions, strategies and actions of their environment or relationships.*

1.3.3 Evolution

The concept of evolution is mainly discussed in the context of biology. The importance of this concept to biology is stated by DOBZHANSKY (1973, p.125): "nothing in biology makes sense except in the light of evolution." One of the most popular and most cited works published in this context is the book “*On the Origin of Species by Means of Natural Selection*” by the English biologist DARWIN (1859). In this work he published his perception of the evolution of species, arguing that all organisms, also including humans, passed through an evolutionary process. As more organisms are born than can survive, there is a battle for existence. DARWIN argues that the organisms which win this battle are able to survive because of their individual characteristics. This mechanism, called natural selection or survival of the fittest, causes the changes in the evolutionary process.

In a literature review we identified six evolutionary principles. The *principle of co-evolution* explains the reciprocal effects of evolving organisms. “The structure of every organic being is related, in the most essential yet often hidden manner, to that of all the other organic beings, with which it comes into competition for food or residence, or from which it has to escape, or on which it

preys” (Darwin 1859, p.98). According to KAUFFMAN (1993, p.237) also the abiotic environment influences the evolution of an organisms.

The *handicap principle* is based on the sexual selection processes where male signals attract females (Iwasa & Pomiankowski 1999, p.97) and strategic signals could provide an honest indicator of quality (Grafen 1990, p.517). It suggests that in sexual selection, a certain handicap of a male that is generally costly to afford becomes a signal of fitness for a selection criteria for females. ZAHAVI (1975, p.205) proposed that all males express the handicap despite their level of quality. However, high quality males pay a lesser cost in order to do this than low quality males. Thus the cost of such characters is an essential feature of an honest signaling system and therefore a higher fraction of high quality males survive despite the handicap than low quality males. Thus, high quality males survive longest and mate with more females, increasing the spread of their genes. The traditional example of the handicap principle is the peacock’s tail since it is difficult to posses for males as they are more susceptible to predators (they are more visible, cannot run faster, etc). However, those peacocks that survive will be selected by females who mate with these handicapped males.

Kin selection refers to the evolution of characteristics of individuals which favor the survival of their close relatives (J. M. Smith 1964, p.1145), whereby no discontinuities in the population breeding structure occur. The principle plays a key role in the evolution of specialized cooperative societies, where breeding individuals rely on the assistance of non-breeding helpers to raise their young (Clutton-Brock 2002, p.69). Among others, it explains how aid that is self-sacrificing (in terms of classical individual fitness), or "altruism” can evolve if sufficiently beneficial to relatives (Eberhard 1975, p.1). The basic logic of kin selection is that a gen can be reproduced either by the familiar route of increasing the fitness of its bearer or by increasing the fitness of the relatives who share copies of the same gene. Thus, kin selection formalizes the obvious point that helping relatives is advantageous, where harming them is not (Queller & Strassmann 1998, p.165). The classical example is seen in a eusocial insect colony, in which sterile females act as workers to assist their mother in the production of additional offspring. In the organizational/network evolutionary context it can be seen as the way in which organizations support key players in the network (contributing with their own resources) for the survival and growth of the network.

Genetic recombination is a process crucial to evolution in which the variation in the population upon which natural selection occurs, is generated in new genetic variants coming from mutation and the novel combination of existing alleles. A mutation is a heritable change in the genetic material of an organism and can alter a gene thereby creating a new allele or affect the structure or expression profile (Evolutionary analyses of genetic Recombination (Lewis-Rogers et al. 2004, p.50)). Genetic recombination happens during meiosis, a special type of cell division that occurs during formation of sperm and egg cells and gives them the correct number of chromosomes. Since a sperm and egg unite during fertilization, each must have only half the number of chromosomes other body cells have. Otherwise, the fertilized cell would have too many (Access Excellence 1992). Thus a molecule of DNA, is broken and then joined to a different one. Recombination can occur between similar molecules of DNA (homologous recombination), or dissimilar molecules (non-homologous end joining). In organizations and networks, recombination happens usually when companies go through mergers and acquisitions or form networks in which new identities and capabilities are created, based on a combination of the ones conforming the merge, acquisition or merge.

The *principle of modularity* bases on the inherent modularity of biological networks that form organisms that can be separated into units (both anatomically and in their metabolism). The units perform almost independently and reuse some network patterns (Kashtan & Alon 2005, p.13773). The units can be considered as modular parts of a body which integrate characters that are functionally related into units of evolutionary transformation. The units may either emerge by spontaneous self organization or may be a result of natural selection (Wagner 1996, p.36). Modularity helps to understand the origins of variation not just in natural selection process but also in the variability of the developmental process in morphological change (Von Dassow & others 1999, p.307f) i.e. modularity enables some degree of evolution in a system where modules undergo changes without substantially altering the functionality of the entire system. Thus each module evolves freely while the interfaces between modules remain consistent. *Directed evolution* is a “powerful method for enhancing the stability, activity and selectivity” (Reetz & Carballeira 2007, p.891) of proteins. This method includes the creation of different mutations, the selection of the “most improved variant (best hit)” (Reetz & Carballeira 2007, p.891) and the iteration of this procedure.

Beside the field of biology, the concept of evolution has e. g. also become a relevant topic for the investigation of business organizations. In the environment of organizations there occur evolutionary processes which the organizations have to adapt to (Terreberry 1968, p.590). AUGIER & TEECE (2008, p.1187) speak of dynamic capabilities in this context and furthermore connect evolution to organizational structures, and business strategies. Also the evolution of different network types, such as business networks (Provan et al. 2007), social networks (M. O. Jackson & Watts 2002), or administration networks (O'Toole 1997) have been investigated.

However, we argue that the definition of evolution by DARWIN is too narrow for the context of networks and business organizations. Especially the concept of the survival of the fittest seems to be not always applicable. GIMENO ET AL. (1997, p.750) state that the survival of organizations is not strictly connected to their economic performance as there exist different predictors or determinants for survival and economic performance. Evolution will play an important role in our studies. Especially the evolution of networks or the evolution of concepts in networks is investigated.

Thus we outline the following working definition: *Evolution is a process of constant change, constantly bringing something new forth, and is directed towards growth and optimization. Social organizations, too, are exposed to such processes. They, too, are able to change, to arrange themselves and to bring forth something new.*

2 A Business Process Perspective on Uncertainty in Facility Management Networks

Alexander Kirchner

2.1 Motivation for a Process View on Uncertainty in Business Networks

Business networks "help firms create value by combining resources, sharing knowledge, increasing speed to market, and gaining access to foreign markets" (Barringer & Harrison 2000, p.367) and are today a phenomenon that can be found everywhere (Gulati 1998, p.293). Recent research has focused on the inter-organisational context in terms of inter-organisational relationships, governance structure, power, trust, competitive pressure, dependence and other factors (Premkumar et al. 2005, p.259). Hereby "recognition of some of the dynamics at both the dyadic and network levels that influence the evolution and eventual performance of [business networks] can be extremely beneficial" (Gulati 1998, p.313) as the coordination and collaboration between business partners is considered to be particular important (Braha & Bar-Yam 2004, p.244). Moreover, the "link between uncertainty reduction and formal inter-organisational networks has a noteworthy foundation" (Beckman et al. 2004, p.259) and further research of how uncertainty affects business networks is of interest (Beckman et al. 2004, p.272). Lately, business networks are also described as streams of network processes (Nøkkentved & Hedaa 2000, p.34). However there are only a few studies that feature an information processing perspective on business networks (Premkumar et al. 2005, p.259).

Thus, the goal of this paper is to derive an understanding of how uncertainty affects business networks and which processes are conducted to cope with uncertainty by analysing the processes and information flows of a facility management network. Thereby the goal is to identify which information is exchanged and important in the effort of coping with uncertainty and to provide new insights to the topic, generated on a process level.

Facility Management (FM) represents a life-cycle oriented perspective on a facility. It is a generic term for different person- and especially object-related (technical equipment, facilities) services, that range over the whole life-cycle of a facility (conventionalising, planning, construction, operation as well as revitalization/reuse) (Bernhold et al. 2008, p.1625). Facility Management Consulting comprehends the supplier- and manufacturer-independent

consulting of the orderer during the construction or modification of an existing FM. This includes the introduction of FM during construction projects as well as the improvement of FM in existing facilities (Diederichs 2006, p.559). Optimal target achievement (optimised operation processes) implies that FM Consulting is included already in the project initiation and planning phase of a construction project (Diederichs 2006, p.557), because a bigger part of the utilisation costs is already irreversibly set due to choices in the planning phase (Bernhold et al. 2008, p.1625). The business network of planners, building contractors, principal, consultants and several other companies conduct a construction project that "[requires] a unique combination of labour and material inputs" (Eccles 1981, p.337), which has several implications regarding uncertainty and will be discussed in the remainder. The focus of this paper lies on the planning an execution phase of a construction project.

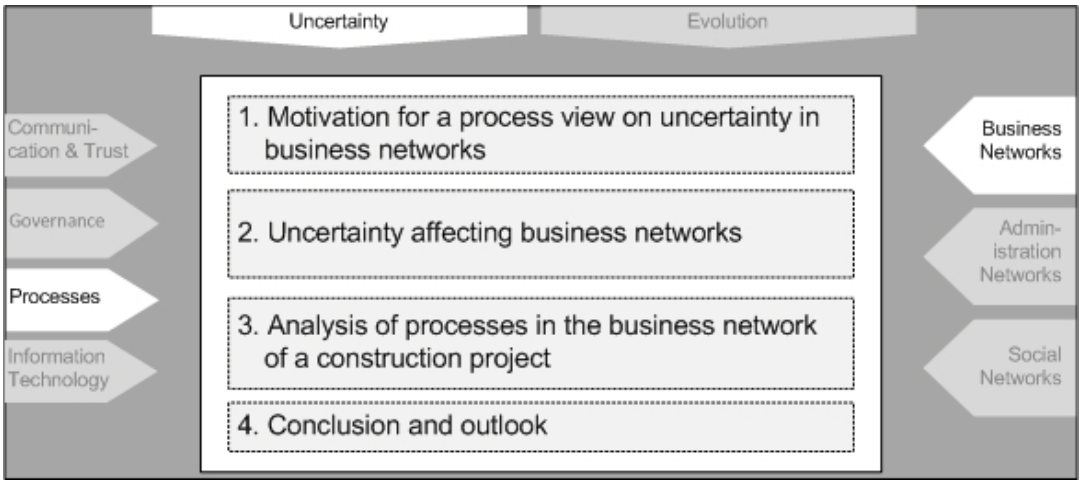


Figure 2.1: Structure of the Section

To meet the goals of this work, section two gives an introduction into the topic of uncertainty affecting business networks. Thereby the influence of uncertainty on business network and the collaborative processes are highlighted as well as the introduction of an information processing perspective on business networks. In section three follows the analysis of the processes and information flows in a business network of a construction project, whereat in the beginning the different actors are introduced and analysed, after which the effect of uncertainty on the collaborative processes and information flows is elucidated. In section four, a conclusion and outlook completes this paper (Figure 2.1).

2.2 Uncertainty affecting Business Networks

In the first part of this section, the influence of uncertainty on business networks is pointed out, after which the collaboration in business network in the context of

uncertainty is analysed and an information processing perspective on business networks is explored.

2.2.1 Business Networks under the Influence of Uncertainty

Business networks arise, because organisations see industry-level factors like competitive uncertainty, demand uncertainty, extent of competition and the development stage of the market frequently as critical factors for joining or forming business networks. Thereby, “competitive uncertainty is created when the competitive actions of a rival influence a firm [and] demand uncertainty comes from the general level of demand for an industry’s products (e.g., semiconductors)” (Beckman et al. 2004, p.262). In response to such industry-level factors, organisations with dissimilar but complementary strategic capabilities strive to form business networks to stay competitive on a global basis. The forming of a business network therefore, is an attempt to reduce uncertainty, to assess complex resources and skills, as well as to exploit the resulting power (Goerzen 2007, p.489). Networks in the form of joint ventures can even be seen as both buffering and exploring uncertainty, when e. g. utilizing the joint venture to determine expansion possibilities (Gulati 1998, p.294). GULATI et al. (2009, p.1228) also find evidence that uncertainty motivates the formation of business networks. Though there is a rapid growth in the forming of business networks, being part of such a network is considered to be risky and for engaging in network ties, which are effective and risk-minimizing, organisations “must be aware of the existence of their potential partners and have an idea of their needs and requirements. Organisations also need information about the reliability of those partners” (Gulati 1998, p.300). Thus, organisations face uncertainty about their partners, before and when entering business networks.

Transaction cost economics see this kind of behavioural uncertainty and contracting hazards at the point of alliance formation as causes for appropriation concerns of the partners. As a countermeasure, hierarchical controls can be an effective tool, as they enable to ensure control by authorization, set incentives and enable monitoring. It can be stated that the greater the concerns related to appropriation are at the formation time of an alliance, the more hierarchical the control structures are likely to be. In another perspective, “considerations associated with managing coordination costs resulting from the anticipated ongoing coordination of tasks across partners” (Gulati 1998, p.304) strongly influence the choice of the alliance structure.

Hereby the task of designing a structure while anticipating coordination costs can be considered as a means to deal with work-related uncertainty (Tushman & Nadler 1978, p.619). Prior ties and ongoing interactions with other organisations can help in learning about each other but also to build (knowledge based) trust between partners and thereby mitigate the appropriation concerns and address the anticipated coordination costs, which in turn leads to less hierarchical forms of control (Gulati 1998, pp.302-304). Lower monitoring costs due to reduced risk that the partner acts opportunistic as well as the fact that the partner's capabilities are already identified and therefore uncertainty and information asymmetries are reduced, lead to reduced transaction costs (Li et al. 2010, p.146). Moreover, trust can enable a fluctuating information exchange, an uncomplicated interaction and a flexible orientation related to the distinct working areas of the participants.

Thereby, already established "tie relationships [perform] better than alternative sourcing arrangements, but [are] particularly effective in situations of high uncertainty" (Gulati 1998, p.308), which is based to some extent on the fact, that organisations develop cooperative capabilities when gaining experience while participating in a business network. Furthermore, tie relationships that exhibit rich information flows and long-term commitments between organisations can result in concrete performance benefits, due to enabling more cooperation and joint activities as well as higher levels of asset-specific investments (Gulati 1998, pp.308-310). Additionally, prior research found "that more tightly integrated inter-organisational networks outperform those that are loosely organized" (Goerzen 2007, p.491). Overall it can be stated, that, if an organisation has a set of effective and efficient network relationships, three particular economic benefits arise: Access to information processing capabilities of the network, access to early information and the involved referral activities of partners to third-party organisations, which leads to a net of contacts or sources for even more information (Goerzen 2007, p.491).

Firm-Specific Uncertainty, Market Uncertainty and Network Partner Selection and Alliance-specific uncertainty

In an effort to control uncertainty, organisations form business networks as described above, but these decisions can be seen from the perspective of *firm-specific* and *market uncertainty.* "Firm-specific uncertainty can stem from a variety of sources, but the key underlying dimension is that these sources produce uncertainty that is unique and often internal to the firm" (Beckman et al.

2004, p.260). Thereby, this kind of uncertainty can stem e. g. from internal changes, concerns about technical success and the costs associated with it as well as external sources like network relations with business partners. Facing firm-specific uncertainty, organisations try to countervail the effects by broadening their business network and access sources of unique and new information to broaden their knowledge base. This is a so called *exploration* response of gaining new information through added relationships in an organisation's business network, as added value can be reached through diversification (Beckman et al. 2004, p.260f.).

"If firm-specific uncertainty is largely internal, controllable, and unique, market uncertainty is external and shared across a set of firms" (Beckman et al. 2004, p.262). Moreover, "high market uncertainty increases costs of specifying circumstances surrounding an exchange, allows negative information asymmetries to develop and provides the potential for partners to behave opportunistically" (Li et al. 2010, p.144). Market uncertainty affects the whole economy and is neither controllable nor dependent on choices at firm-level. Besides market and demand uncertainty, input cost uncertainty (related to the inability to influence prices of input products) is an example of a source of market uncertainty. Too reduce market uncertainty, firms respond with an *exploitation* response: Reinforcing and adding to existing relationship ties with already known business network partners and thereby creating strong ties with considerable levels of trust. This is a way to gain stability and trust, without engaging in new (and uncertain) network ties. Thus, an exploitation strategy means a reinvestment in the existing network structure, while an exploration strategy is an attempt to alter the existing structure (Beckman et al. 2004, p. 262f.).

Examining both strategies, it can be stated that if a business network is considered to be a knowledge base, firms either exploit that knowledge (by reinforcing or adding to existing network ties) and are able to process it more effectively or explore on that basis and access new knowledge (by adding new network ties with new partners). BECKMAN et al. (2004, p.273) found that opposed to the exploitation strategy being a common one, it does not lead to a reduction of market uncertainty, while an exploration of new and network ties seems to be an effective way to reduce firm-specific uncertainty (Beckman et al. 2004, p.273). The notion, that learning from diverse and new relations results in significant benefits is also supported by GOERZEN (2007, p.503). The problem with reinforcing and adding to already existing relationship ties is that they

“often do not truly improve the quality of the network so much as simply enlarge it, lessening its efficiency and weakening its effectiveness over time, since fewer new ideas flow into the group through these already familiar contacts. Particularly in turbulent environments the issue of knowledge creation and learning [(development of new products and processes)] has an important bearing on the firm’s economic performance” (Goerzen 2007, p.492). Reasons for this behaviour might be the lock-out of newcomer organisations that come with cutting-edge technologies and the replacement of the desire to acquire new knowledge by a desire to improve business network coordination. GOERZEN (2007, p.503) states that the discontinuity with previous insights might be given through an overemphasizing of facilitating management efficiency (Goerzen 2007, p.503) through reinforcement and addition to existing network ties. In the most recent study that was found related to that matter, GULATI et al. (2009, p.1227) “distinguish between partners’ distinctiveness and the [organisations’ partner-specific experience and] suggest that the negative performance implications of redundancy observed by Goerzen may be related to low partner distinctiveness rather than to [partner-specific experience]”. Their study shows that organisations can maximize their expected gains by following both strategies (exploiting and exploring business networks) simultaneously (Gulati et al. 2009, p.1227).

Following the concept of alliance-specific uncertainty from LI et al. (2010, p.145) business network specific uncertainty can be based either on cultural distance between business partners or on geographic scope of the market served by the business network. Organisations “often perceive a significant amount of uncertainty caused by the cultural distance between [business network] partners’ originating countries” (Li et al. 2010, p.145). This kind of distance can lead to different market and product perceptions in the different organisations and to difficulties with accessing the desired resources while exploring the actual capabilities of a partner. On the other side, a broad geographic scope (related to the different markets a business network covers) can lead “to greater uncertainty as a result of consumer taste changes, unpredictable government policies, etc.” (Li et al. 2010, p.146). This kind of uncertainty is, opposed to market uncertainty, controllable, as business networks can increase or decrease their geographic scope and thereby the complexity. A broad geographic scope leads to increased information asymmetry, increased monitoring costs, problems with service quality and product control and therefore, to increased transaction costs. In business networks, the arising transaction costs typically include negotiation costs (related to contingent

contracts), costs asserting contractual agreements and monitoring costs (Goerzen 2007, p.490). Furthermore, it can be stated that “uncertainty in inter-organisational relationships is greater, since two organisations that have different business objectives and stakeholders are involved in a transaction (...) [and can even] engage in opportunistic behaviour to exploit the uncertainty (lack of information) to their benefit” (Premkumar et al. 2005, p.260).

Uncertainty affecting Facility Management Networks

The focus of this of this paper is the planning and construction phase of a facility, referred to here as a construction project. Kochendörfer & Liebchen (2007, p.4) find that a construction project is an endeavour characterised through the uniqueness of its conditions, like for example: Its set target, time-, financial-, personal- or other constraints, boundaries to other endeavours, project specific organisation, uniqueness, novelty, complexity and interdisciplinary. The uniqueness of a construction process thereby, is given by: The individuality in terms of topographic, geological, traffic and adjacent factors (through construction at the place of utilisation), individual architecture and combination of building materials, regional construction- and environment laws, individual contracting, principal organisation and form of project execution. These unique characteristics influence the construction process, because it has to be planned individually for every facility, differentiating the construction process from other production processes in terms of the high degree of interactivity, interaction, individuality and immateriality (Girmscheid 2006, p.581). “The complexity of construction projects stems not only from the complexity of the built environment, but also from the multi-cultural, multi-location, multi-disciplinary, multi-organisational nature of the project participants. [...] As a result, the execution of a construction project includes a complex network of service providers” (Pekericli et al. 2003, p.2).

A construction project thus involves an inherently uncertain development and building process (Winch 2002, p.266). “The information needs of facility-planning decisions require a strategic perspective. [...] It is the uncertainty associated with forecasting future conditions that is the fundamental problem of planning” (Schilling 1982, p.1). Basically all decisions in a construction project are directed to the future and therefore, decisions under uncertainty, because the decision maker has only imperfect information. The decision maker can counteract this problem by information procurement and planning (Girmscheid 2006, p.651). This is done by outsourcing the majority of the paper to external

service providers (planners, consultants, building contractors), which adds to the complexity of the construction project.

2.2.2 Collaboration in Business Networks

Collaboration can be defined as “a negotiated cooperation between independent [organisations], exchanging capabilities and constraints to improve collective responsiveness and profitability” (Nøkkentved & Hedaa 2000, p.14). It can be stated that organisations operating in a business network have to collaborate with their network partners to achieve their own as well as the network’s goals (Batt & Purchase 2004, p.169). Inter-organisational collaboration can be defined as “a process in which organisation exchange information, alter activities, share resources and enhance each other’s capacity for mutual benefit and a common purpose by sharing risks, responsibilities and rewards” (Huxham 1996, p.22). The collaboration within a business network can on the one hand move the decision making process from organisation level to inter-organisational level (Nøkkentved & Hedaa 2000, p.34) and also lead to not only transmitted, but jointly developed, new information (Nøkkentved & Hedaa 2000, p.16).

Collaboration obviously involves communication through which “any uncertainty about a [network partner’s] organisational structure, viability, methods of operation, technical expertise, or competence can be resolved (...) [and] adaptions by [network partners] to the design or application of a product, or the modification of production, distribution, and administrative systems” (Batt & Purchase 2004, p.171) may be facilitated. Thereby, organisations have to recognize that they are taking part in a self-organizing process through interaction within a business network, which cannot be centrally controlled or directed and that they have to manage these interactions rather than the whole business network (Batt & Purchase 2004, p.171). In fact, it can be stated, that business networks inherit a knowledge base and that the collaboration in a business network is a mechanism to maximise this knowledge base and the individual processes of organisations (Batt & Purchase 2004, p.169).

The development of partner-specific experience and knowledge sharing routines

Partner-specific experience accumulated during the collaboration can be seen as an important knowledge body. As the organisations “work through the operational details of the collaborative agreement, both partners develop a

more refined understanding of each other's cultures, management systems, capabilities, weaknesses, and so forth" (Zollo et al. 2002, p.703). The more the partners collaborate, the more sophisticated and smooth these inter-organisational routines become. This in turn, leads to reduced coordination conflicts and reduced information-gathering issues and thus to the facilitation of an iterative learning and adjustment process (Zollo et al. 2002, p.704). Thereby, the "collaborators' development of inter-organisational routines through [diverse business networks and] the development of interpersonal trust among the members of the (...) organisations" (Zollo et al. 2002, p.704) is important. Furthermore, the interdependence of every single partner interaction to the whole network has to be mentioned, as the "collaboration within one relationship will affect relationships with other closely connected actors, making the collaboration process and its outcomes contingent on the goals of the network rather than the dyad" (Batt & Purchase 2004, p.170).

Zollo et al. (2002, p.709) found that "partner-specific experience facilitates the development of inter-organisational routines, or stable patterns of behaviour aimed at the interaction and cooperation across (...) organisations. These routines may contribute to the performance of the [business network] by facilitating the information gathering, communication, decision making conflict resolution, and the overall governance of the collaborative process." Moreover, Barringer & Harrison (2000, p.378) see inter-organisational relationships as a particular effective way to transfer knowledge across organisation boarders.

Inter-organisational learning while collaborating with other organisations is a critical success factor for organisations. Thus, "a production network with superior knowledge transfer mechanisms among users, suppliers and manufactures will be able to 'out innovate' production networks with less effective knowledge sharing routines" (Dyer & Singh 1998, p.664). Similar results stem from the biotechnology sector, where the actual innovation is based on the collaboration in the network and not on an individual organisation. This kind of inter-organisational knowledge sharing routine can be defined "as a regular pattern of [inter-organisational] interactions that permits the transfer, recombination, or creation of specialised knowledge. These are institutionalized [inter-organisational] processes that are purposefully designed to facilitate knowledge exchanges between [business network] partners" (Dyer & Singh 1998, p.665). Hereby, 'knowledge' can be of the type 'information' or of the type 'know-how'. Information can be defined "as easily codifiable knowledge that can be transmitted without loss of integrity once the syntactical rules required for

deciphering are known. Information includes facts, axiomatic propositions and symbols" (Dyer & Singh 1998, p.665). Know-how, on the other hand, can be defined as "knowledge that is tacit, 'sticky', complex and difficult to codify [and therefore] difficult to imitate and transfer, [but also] more likely to result in advantages that are sustainable" (Dyer & Singh 1998, p.665). Furthermore, the concept of partner-specific absorptive capacity "refers to the idea that a firm has developed the ability to recognize and assimilate valuable knowledge from a particular [business network] partner. This capacity would entail implementing a set of inter-organisational processes that allows collaborating firms to systematically identify valuable know-how and then transfer it across organisational boundaries" (Dyer & Singh 1998, p.605). The partner-specific absorptive capacity within a business network can be increased, when knowledge sharing routines that ensure socio-technical interactions and facilitate information sharing are established. The success of such knowledge exchange processes is based on an iterative character and direct and extensive face-to-face collaboration (Dyer & Singh 1998, pp.664-666). As business network must enable the creation of rents through a transparent transfer of knowledge during which the partners utilize their resources to provide and receive knowledge (Dyer & Singh 1998, p.666). Another aspect of collaboration in a business network are complementary resource endowments, where the distinctive resources of the partners, "when combined (...) [result] in a synergistic effect whereby the combined resource endowments [are] more valuable, rare and difficult to imitate than they had been before they were combined" (Dyer & Singh 1998, p.666).

Collaboration in facility management networks

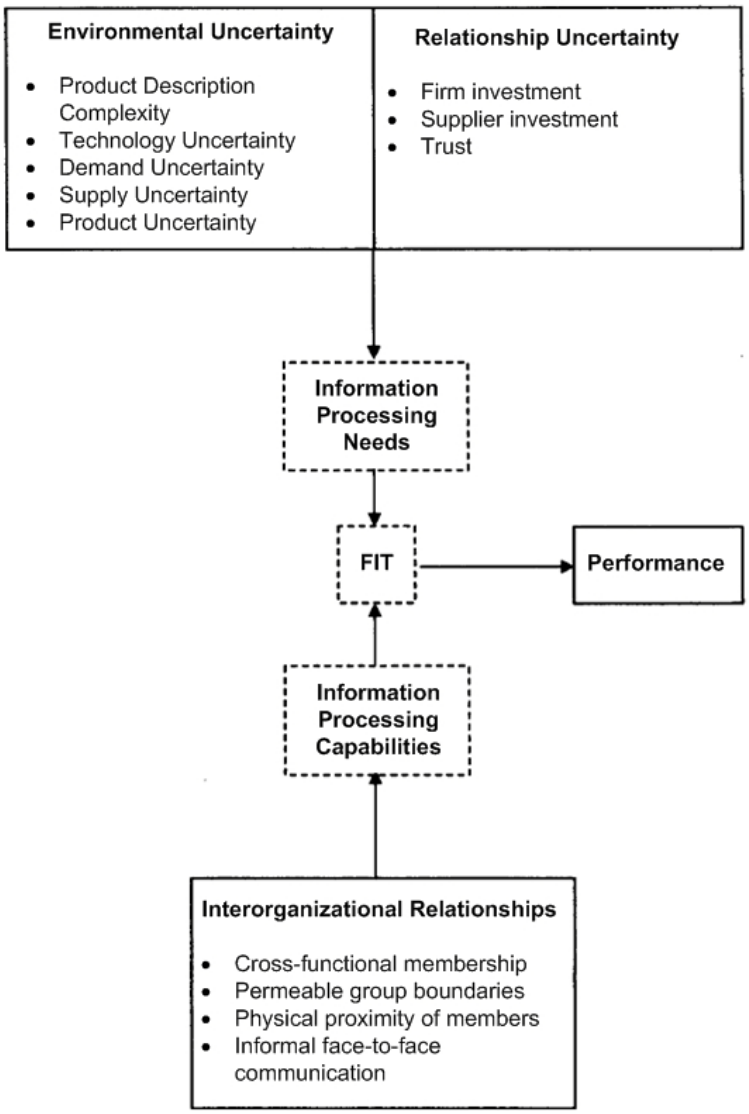
"Construction clients represent an infinite range of choices, since their requirements are a combination of functionality, aesthetics, culture and technology" (Pekericli et al. 2003, p.4). PEKERICLI et al. (2003, p.4) hereby describe that although there are different objectives and responsibilities for the network partners, the ultimate goal of the network is to form 'one body' with complementing parts respectively resources. The progress of the construction project is characterised through the progressively decreasing uncertainty (Winch 2010, p.101), as more and more information is created during collaboration respectively the planning process. An integral planning with involvement of a facility management consultant (FMC) for example can minimize investment risks and therefore, improve ways of funding. The collaboration processes in the business network of a construction process often

have an iterative character, include feedback loops (Pekericli et al. 2003, p.8) and especially in the later phases of the development process require a considerable amount of meetings and face-to-face collaboration (Kochendörfer & Liebchen 2007, p.228). The activities in a construction project “require an ongoing interaction of knowledge and information transfer among many parties. This information can be the coordination orders, legal reference, the status of previous work done, or missing project information that is required to perform the job. Add the uncertain nature of the processes; construction work becomes an intricate entangled web of information transfer between various parties” (Pekericli et al. 2003, p.4).

2.2.3 Information Processing View on Inter-Organisational Relationships

PREMKUMAR et al. (2005, p.259) examine the concept of ‘fit’ between information processing needs and information processing capabilities in an inter-organisational context. The theoretical foundation for their analysis lies in the information processing theory which assumes that an organisation needs quality information to cope with environmental uncertainty. One way to cope with environmental uncertainty is the establishment of inter-organisational information flows since a lack of information leads to uncertainty. Thus, information processing refers to a way to reduce or cope with uncertainty (Keller 1994, p.168). “Information processing needs are defined as the communication requirements for inter-organisational interactions in the context of a [business network and are] captured by (...) environmental and partnership uncertainty” (Premkumar et al. 2005, p.264). “Environmental uncertainty is captured using product description complexity, technology uncertainty, demand uncertainty, supply uncertainty, and product criticality. Partnership uncertainty is captured using focal firm investment (into the relationship), supplier investment (into the relationship), and trust” (Premkumar et al. 2005, p.269). Accordingly, information processing capabilities are defined as information processing capacities for inter-organisational interactions in the context of a business network. Keller (1994, p.177) states that “project group designs that increase information-processing capabilities include such characteristics as cross-functional membership, permeable group boundaries, physical proximity of members, and the opportunity for informal, face-to-face interactions among members.” The fit between needs and capabilities (Figure 2.2), meaning the optimal match of both has a positive effect on business network performance (Premkumar et al. 2005, p.268). Hereby, “fit is a complex construct that

captures the interaction between needs and capabilities" (Premkumar et al. 2005, p.262).



Source: (Premkumar et al. 2005, p.263)

Figure 2.2: Fit between information processing needs and capabilities

The design process of a facility, as it requires "extensive discussion of product requirements, frequent interactions and long-term collaboration, [leads to] a higher information processing need" (Premkumar et al. 2005, p.281).

Information Flows in a business network

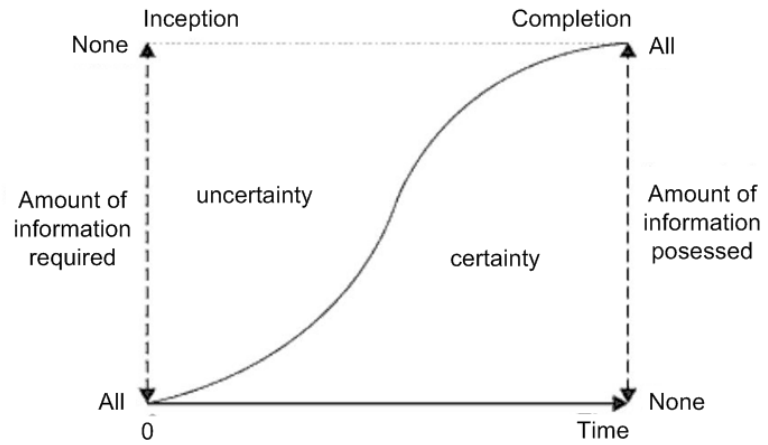
In a product development process carried out in a business network, several interdependent information flows lead to an iterative exchange of knowledge. The structure of the information flows "[constitutes] the infrastructure for exchanging knowledge that is important to the achievement of work by individual agents" (Braha & Bar-Yam 2004, p.245). New or updated information

leads to a repetition (iteration) of specific tasks, because the predecessor information was missing or incomplete (uncertain). With every iteration step, the product comes closer to its final specification and the process ends when an agreement is achieved. The design iterations have an effect on the effectiveness and efficiency of the development process and might slow it down, thus resulting in lost profits due to delayed development (Braha & Bar-Yam 2004, p.245). BRAHA & BAR-YAM (2004, p.247) analysed, among other networks, the product design process of two large facilities and identified the iterative character of the project and the involvement of knowledgeable people as important factors for the construction of product development networks, as they reduce the reduce the risk of errors. Thereby, “successful [product development] processes in competitive environments are often characterized by short time-to-market, high product performance, and low development costs, (...) [hereby,] a trade-off exists between the elimination of task dependencies (speeding up the process) and the desire to improve the system’s performance through the incorporation of additional task dependencies” (Braha & Bar-Yam 2004, p.251). In facility design projects, there is a strong relation of the information flows and related tasks to the actual design network (architecture/physical components) of the product (Braha & Bar-Yam 2004, p.252).

“Market uncertainty also inhibits firms from knowing what marketing resources or capabilities they will need long term. Such uncertainty increases the information processing need of firms. Consequently, the costs associated with learning from partners to jointly develop resources/capabilities increase as the uncertainty of the primary market, in which the alliance operates, increases. As market uncertainty makes learning harder, firms may absorb “unwanted baggage” which leads to further learning costs. It is critical to answer to the unique needs of consumers and business partners, which firms are more likely to face in uncertain markets than in stable markets, with minimum ‘unwanted baggage’” (Li et al. 2010, p.144).

Information processing in a facility management network

“Given the fact that missing and bad information are among the major causes of problems in construction, successful completion of a project depends on how well the information is managed within the service network. As the construction projects get more complex and the expectations of the owners increase, the need for efficient and effective information exchanges gets more pronounced” (Pekericli et al. 2003, p.2). The rate between information required and information possessed dynamically changes over time (Figure 2.3), the uncertainty decreases and the certainty increases the more the construction process is progressing to completion.



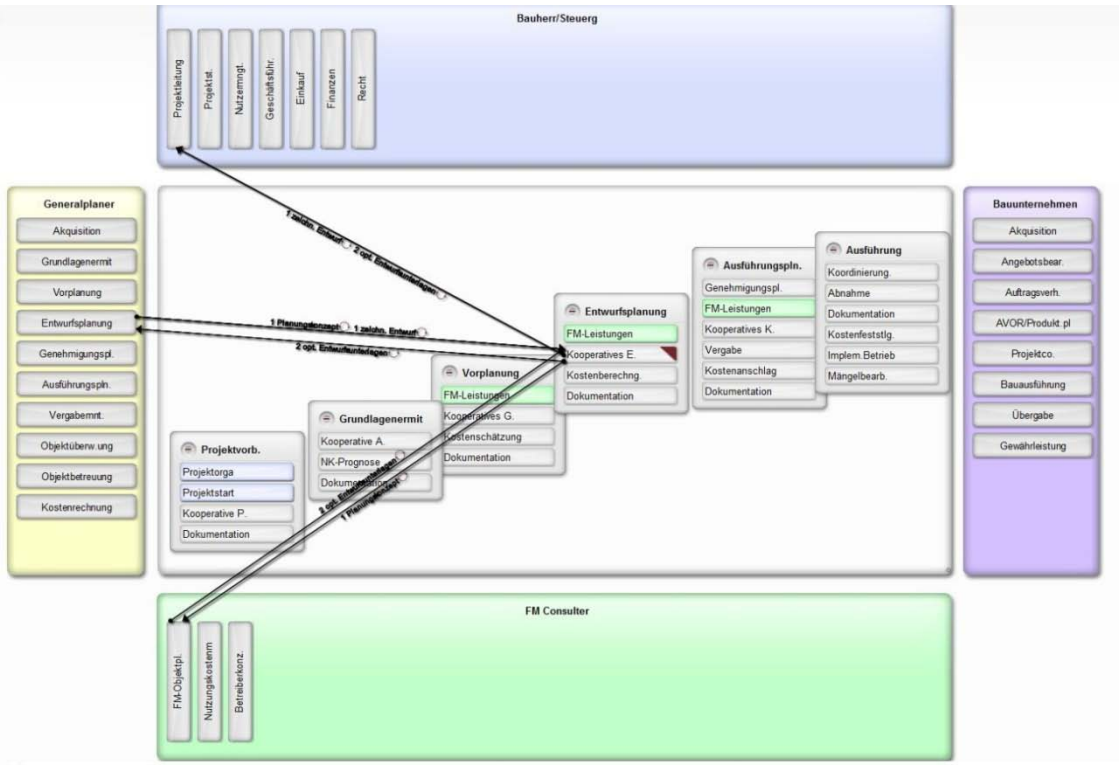
Source: (Winch 2010, p.7)

Figure 2.3: The project process as the dynamic reduction of uncertainty through time

In the planning process, the knowledge body has to be created by information flows in a way that enables interactive planning. Planning errors should be minimised through the recognition of dependencies between information flows and plans should not be revisited too often because important information flows did not yet reach their target and the decision maker cannot act properly (Girmscheid 2006, p.892f.).

In the remainder of this paper, the information flows and processes of a business network in the planning and execution phase of a construction project are analysed. The analysis is conducted on basis of a reference model that was developed at the European Research Center for Information Systems (ERCIS) of the Westfälische Wilhelms- Universität Münster in the context of a bachelor thesis (Figure 2.4). The model features four actors (business partners): The architectural and specialised planners (referred to here as actor *Architect*), the initiating principal as well as his delegate for the project control (referred to here

as actor *Principal/Control*), the building contractors and sub-contractors (referred to here as actor *Construction Company*) and the facility management consultant (referred to here as actor *FM Consultant*). The collaboration of the actors consisting of six phases (*Project Preliminaries*, *Fundamentals Determination*, *Preliminary Planning*, *Concept Planning*, *Execution Planning* and *Execution*) as well as the information flows between the actors is also part of the model (Kirchner 2009).



Source: (Kirchner 2009)

Figure 2.4: Reference Model for the planning phase of a construction project

2.3 Analysis of Processes in the Business Network of a Construction Project

In the part of this section the focus lies on the different actors in the business network of a construction project. It is analysed how they are affected by uncertainty and what processes exist to overcome uncertainty. In the following sub-section, the focus is shifted towards the actual collaboration in the business network in the planning and execution phases of a construction project. The collaboration of the business network is analysed regarding its processes and the most important information flows between the network partners are expounded.

2.3.1 Uncertainty of the Participants

The actor *Principal/Control* initialises the construction project and represents the main client respectively orderer of the facility. His primary targets for the project are cost, time and quality (architecture, functionality, security, etc.), which are exposed to considerable uncertainty and risk (N. J. Smith et al. 2006, p.2). The actor *Principal/Control* strives to cope with the uncertainty with different processes (Table 2.1).

Area	Activity
Project Management	Bring about and make decision
	Assert necessary measures and contractual compliance
	Assert accomplishment of requirements for governmental approval
	Conduct conflict management
	Moderate project meetings
	Conduct project specific or contractual negotiations
	Assert accomplishment of decision/measure catalogue
	Perform representation duties
Project Control	Control organisation, information, coordination and documentation
	Control Quality and Quantities
	Control Costs and Finance
	Control dates, capacities and logistics
User Management	Conduct User Management
Executive	Make Principal related decisions
Procurement	Procure services
Finance	Assure financing
Legal	Assure legal coverage

Source: (Cf. Kirchner 2009, p.36f.)

Table 2.1: Actor Principal/Control: Areas and Activities[3]

The *Project Control* is concerned with the control of a specific construction project (and possibly others) in an attempt to meet those targets. The User Management deals with matters related to the subsequent utilisation of the facility, whereat also a high degree of uncertainty can exist (Tompkins et al. 2010, p.33), as to how the facility will be utilised and who will operate the facility. In *Project Management* the complexities of a construction project are assessed: “Construction projects require a large number of labour specialties such as carpenters, bricklayers, plumbers, pipefitters, electricians, painters, roofers, drywallers, sheet metal workers, glaziers, and labourers. These differ in

3 See appendix App. A.4 for original, German terms.

terms of work activities, training, skill level, and assessed value in the labour market" (Eccles 1981, p.337). This causes the actor *Principal/Control* to bring about and make decisions, and assert different specifications. The principal in a construction project has an interest in passing on execution risks to construction companies; therefore, he wants to detain from the operative planning and execution (Preuß et al. 2006, p.291) and specifies this interest in *project specific or contractual negotiations*. Furthermore, the principal in a construction project often strives to contract partners only for particular phases, as he might face uncertainty related to the realization of the project, due to several not clarified risks (e. g. official approval capability or financing) (Diederichs 2006, p.141).

The actor *Architect* can be seen as a 'general planner', meaning that he conducts architectural as well as specialised (bearing structure, building equipment, etc.) planning activities. This actor is conceptualised based on the facility development process and therefore strongly phase-oriented (Table 2.2).

In most cases, construction projects deal with the development of a product with a high degree of novelty and therefore a planner deals with a high degree of uncertainty about the customer's demand and additionally many stakeholders with different demands often are involved in the project (Kolltveit & Grønhaug 2004, p.545). The early development phase is described as being particularly important for future value generation (Kolltveit & Grønhaug 2004, p.548). Therefore, the *Fundamentals Determination* is conducted where, for example, the scope of the planning task is determined and first insights into the facility's rooms and their functions are gained – to not completely 'start from scratch' and to reduce a considerable amount of uncertainty. The actor *Architect* is exposed to an environment which "can lead to unforeseeable events and substantial uncertainty (the local and regulatory context, geological and climatic contingencies, innovations in the structure and/or the construction process, etc.)" (Mahmoud-Jouini et al. 2004, p.365) and strives to reduce uncertainty by successively planning the facility in more and more detailed steps and by supervising the construction process (execution) with processes related to *Preliminary Planning*, *Concept Planning*, (official) *Approval Planning*, *Execution Planning* and *Facility Supervision*. To continuously monitor the cost uncertainties of the planning tasks (Diederichs 2006, p.375) the actor *Architect* conducts *Cost Accounting* in every phase.

Area	Activity
Acquisition	Order registration
Fundamentals Determination	Clarify scope
	Create Room and Functional program
	Determine Service demand
	Collect and summarize results
Preliminary Planning	Analyse Fundamentals of Architecture and Specialised planning
	Create Preliminary Planning conception of Architecture and Specialised planning
	Clarify and elucidate crucial relations
	Recover expert report
	Conduct preliminary negotiations regarding approval
	Determine Time schedule
Concept Planning	Create Concept Planning of Architecture and Specialised planning
	Create graphical concept
	Conduct negotiations regarding approval
	Collect Concept Planning documents
Approval Planning	Create templates for necessary approvals
	Hand in documents
	Adjust planning documents with respect to demands
Execution Planning	Elaborate Execution conception
	Create detailed graphical depiction
	Collect resulting documents
Contracting Management	Determine and list quantities
	Create and list service descriptions
	Collect Contracting documents
	Pull in offers
	Check and weigh Offers
	Negotiate with vendors
	Take part in order assignment
Facility Supervision	Supervise Execution
	Supervise finished-parts creation
	Set up and supervise Time schedule
	Keep Construction-log
	Supervise and conduct Measurements
	Supervise Approval
	Supervise remedy of defects
	Handover Facility including documentation
Facility Support	Collect Graphical depictions and calculated results
	Conduct Facility inspection
	Remedy defects and monitor remedy of defects
Cost Accounting	Conduct Cost-estimation
	Conduct Cost-calculation
	Conduct Cost-controlling
	Conduct Cost-quotation
	Conduct accounting control
	Conduct Cost-determination

Source: (Cf. Kirchner 2009, p.31f.)

Table 2.2: Actor Architect: Areas and Activities[4]

4 See appendix App. A.1 for original, German terms.

The actor *Construction Company* represents the contractor, the actual ‘builder’ of the facility in the construction project. Construction companies face particular uncertainty, as they take over a relatively high amount of construction risks compared to the orderer (date-, cost-, completion-, functionality-risks, etc.), whereat not recognized or wrongly evaluated risks can threaten the company’s existence (Girmscheid 2006, p.755). Therefore, an actively or passively acquired offer is processed extensively in the *Offer Handling* processes, where for example the liquidity, credit standing, partnering behaviour, management of conflicts and warranty cases, the potential for future offers and marketing benefits of the orderer are checked (Girmscheid 2006, p.535) to reduce uncertainty (Table 2.4).

Physical	Natural, ground conditions, adverse weather, physical obstructions
Construction	Availability of plant and resources, industrial relations, quality, workmanship, damage, construction period, delay, construction programme, construction techniques, milestones, failure to complete, type of construction contracts, cost of construction commissioning, insurances, bonds, access and insolvency
Design	Incomplete design, availability of information, meeting specification and standards, changes in design during construction
Technology	New technology, provisions for change in existing technology, development costs and IPR and need for research and development

Source: (N. J. Smith et al. 2006, p.147)

Table 2.3: Typical Construction Risks

Typical risks that can arise during a construction project and affect the actor *Construction Company* are listed in Table 2.3. “As a result [...], the [construction company] faces a high degree of uncertainty about what resources will be required in the future. Demand volatility exacerbates this uncertainty” (Eccles 1981, p.338f.). To deal with this extensive *Production Planning* with its different processes is necessary (e. g. the *process and construction method planning*). The actor *Construction Company* carries out his own, project specific *Project Controlling* concerning costs, coordination, accounting control and subcontractors. Subcontractors are hired for the duration of one project and their assignment reduces uncertainty, because “the use of subcontractors with fixed price contracts also facilitates cost control and reduces supervision responsibilities” (Eccles 1981, p.340). The execution uncertainties are handled within processes of *Construction Execution,* where e. g. logistics and construction resources are organised and allocated.

Area	Activity
Acquisition	Conduct active Acquisition
	Conduct passive Acquisition
	Conduct preliminary check of tender
Offer Handling	Determine offer strategy and project organisation
	Conduct Budget planning
	Conduct task-planning and time scheduling
	Analyse contractual aspects (legal, economic, technical aspects)
	Prepare analysis and calculation of risks
	Conduct project-specific risk analysis
	Conduct Calculation
	Conduct Offer checking and price configuration
	Make decision regarding offer submission
	Align to service lists and collect necessary documentation
	Submit offer
Offer Negotiations	Negotiate contract with constituent
	Conduct systematic evaluation of tender results
	Finalize contractual agreement
Production Planning	Set up order datasheet
	Assign project controller
	Conduct first construction site inspection
	Create workload calculation and prepare Controlling
	Conduct process- and construction method planning
	Conduct time scheduling and resource planning
	Determine Construction Site organisation
	Conduct quality- and working-safety planning
Project Controlling	Subcontractor assignment
	Accounting control
	Cost-monitoring
	Coordination
	Create Cost appraisals
	Create Measurement
Construction Execution	Arrange construction site
	Plan and determine administration
	Conduct logistics planning
	Conduct construction-procedure organisation
	Conduct construction-method organisation
	Allocate logistics
	Execute Construction Production
Handover	Clear Construction Site
	Attend Approval
	Conduct remedy of scarcities
	Create Approval-protocol

	Conduct Construction Site closing meeting
	Create Measurement
	Create Revisions documents
Warranty	Check Scarcity reports
	Remedy scarcities

Source: (Cf. Kirchner 2009, pp.33-36)

Table 2.4: Actor Construction Company: Areas and Activities[5]

The processes of the actor *Facility Management Consulter* are directed towards a life-cycle oriented perspective on the construction project (Table 2.5). His main concern is thus, the uncertainty related to the future utilisation of the facility. A fundamental problem hereby is the high degree of uncertainty that is related to an incomplete project database in the early phases (Kolltveit & Grønhaug 2004, p.550). Therefore, the consulter conducts *Facility Planning* related tasks and asserts the accomplishment of a *Documentation Guideline* throughout the planning process of the facility and makes sure that all important documents are kept up to date. The actor *Facility Management Consulter* optimizes the planning and develops energetic concepts. The energy management should ensure that energy usage and also polluting emissions are minimised in line with agreed on target values (Diederichs 2006, p.560). Schilling (1982, p.1) states that “the information needs of facility-planning decisions require a strategic perspective. This perspective is characterized by a high degree of uncertainty which is not addressed by traditional, short-term, predictive approaches. It is the uncertainty associated with forecasting future conditions that is the fundamental problem of planning.” Therefore, especially the user costs are of interest and handled respectively given as feedback to the planning in the *User Cost Management*. Further processes to reduce the mentioned uncertainty are conducted in the area Operator Concept, where e. g. an in- and outsourcing concept for the future facility services is developed early on and a computer aided facility management (CAFM) system is implemented to manage facility related information.

Area	Activity
Facility Management - Facility Planning	Introduce and assert accomplishment of Documentation Guideline
	Conduct program optimization
	Optimize economic efficiency of space usage
	Create energetic concepts
	Evaluate Planning regarding operation optimization
	Upgrade and check Inventory- and Revisions documents formally

5 See appendix App. A.2, App. A.3 for original, German terms.

User Costs Management	Define target values
	Conduct UC-Forecast
	Conduct UC-Estimation
	Conduct UC-Calculation
	Conduct UC-Quotation
	Incorporate tender results for FM-services
	Conduct to-be/as-is analyses
	Feedback results into planning
	Conduct UC-determination
	Conduct UC-optimization
Operator Concept	Define Facility specific FM-services
	Model operational processes
	Create Procurement strategy
	Define in- and outsourced services
	Tender outsourced services
	Create Job descriptions for in-sourced services
	Support Implementation
	Implement CAFM-System

Source: (Cf. Kirchner 2009, p.38f.)

Table 2.5: Actor FM Consulter: Areas and Activities[6]

2.3.2 Collaborative Processes to overcome Uncertainty

At the beginning of the construction stage, the network partners are exposed to uncertainty concerning the project execution and organisation (Girmscheid 2007, p.25), the *Project Preliminaries* have to be determined and therefore an Organisation-handbook is generated and sent to the network partners[7] during *Project Organisation* (Table 2.6). In the early stages of a construction project the degree of immateriality is high, but during the continuous value creation respectively goods and services creation process the uncertainty regarding the accomplishment of the principal's targets is reduced, as the materiality of the construction project increases. It can be stated that the intensity of principal/service provider communication decreases while the self-government of the different service providers increases in the further development (Girmscheid 2007, p.25). As described earlier, two of the primary targets of the principal are cost and time related and subjected to risk and uncertainty (N. J. Smith et al. 2006, p.2). Therefore the setting of a budget and time-frame for the partners is important during the *Project Start*.

The planning and execution phase of a construction project is characterised by numerous collaborative activities, involving face-to-face meetings and iterative

6 See appendix App. A.5 for original, German terms.

7 The actor Construction Company is not yet part of the planning and execution process and will augment the network in a later phase.

adjustment processes. As PEKERICLI et al. (2003, p.8) describe, this is an important factor, because “during the design phase of a project, the interactions between [network partners] are critical in achieving a cohesive and constructible design. These interactions are reflected in iterative processes, -feedback loops to achieve a more complete design as a response to the latest constraints.” These processes lead to a reduction of the development-, time-, cost-, financing-, construction ground- and approval-risk (Preuß et al. 2006, p.213). Important processes for the reduction of uncertainty are therefore, the iterative (Type ‘i’) processes of the *Project Preliminary* module: The *Cooperative Planning of User Demand* involves the first, iterative adjustment of the user demand for the facility to narrow down the scope of the project. Hereby, the actors *Architect* and *FM Consulter* together with the actor *Principal/Control* jointly agree upon a *User Demand Program*, to which the previous two give their input/feedback. On the basis of the mentioned uncertainty regarding the future utilisation of the facility, the creation of an optimized (from a facility management perspective) *Documentation Guideline* is important and facilitated during *Documentation* processes by the actor *FM Consulter*.

Building Block	Cooperation Activity	Information Object	Source	Target
Project Organisation	Place order for planner	Planning order	PC – Project Management	A – Acquisition
	Send Organisation-handbook	Organisation-handbook	PC – Project Management	FMC – FM-Facility Planning
		Organisation-handbook		A – Fundamentals Determination
Project Start	Send Functional specification	Functional specification	PC – Project Management	A – Fundamentals Determination
		Functional specification		FMC – FM-Facility Planning
	Determine Budget	Budget	PC – Project Control	A – Fundamentals Determination
		Budget		FMC – User Costs Management
	Send Time schedule	Time schedule	PC – Project Control	A – Fundamentals Determination
Cooperative Planning of User Demand	Transmit User Demand Program	User Demand Program	PC – Project Control	FMC – FM-Facility Planning
	Send optimized User Demand Program	Optimized UD-program	FMC – FM-Facility Planning	A – Fundamentals Determination
		Optimized UD-program		PC – Project Control
	Send detailed User Demand Program	Detailed User Demand Program	A – Fundamentals Determination	PC – Project Control

		Detailed User Demand Program		FMC – FM-Facility Planning
Documen-tation	Send Standard Guideline	Standard Guideline	PC – Project Control	FMC – FM-Facility Planning
	Send optimized Guideline	Optimized Guideline	FMC – FM-Facility Planning	PC – Project Control
		Optimized Guideline		A – Fundamentals Determination

Source: (Cf. Kirchner 2009, p.40)

Table 2.6: Module Project Preliminaries: Cooperation Activities and Information Flows[8]

The subsequent module *Fundamentals Determination* (Table 2.7) strives to (as each of the following modules relative to their predecessors) give a more detailed specification of the facility to increase the materiality and thereby, to reduce the uncertainty. At this early phase, the potential influence of the principal is still high and the cost changes in the planning relatively low and still favourable regarding future value generation (Kolltveit & Grønhaug 2004, p.545). An important iterative process is the *Cooperative Analysis of the User Requirements*. The analysis of requirements is particularly important, because uncertainties regarding the future utilisation of the facility can still exist, because e. g. not all users of the facility are determined yet, therefore a requirements-management in each phase of the planning and execution phase of a construction project should be established (Girmscheid 2007, p.46). Therefore, a room- and functional program is generated by the actor *Principal/Control* and optimized by the actors *Architect* and *FM Consulter* from a planning and a facility management perspective. “Perhaps the most difficult determination in facilities is the amount of space required in the facility. [...] Considerable uncertainty generally exists concerning the impact of technology changing product mix, changing demand levels, and organisational designs for the future. Because numerous uncertainties exist, people in the organisation tend to ‘hedge their bets’ and provide inflated estimates of space requirements” (Tompkins et al. 2010, p.119 f.). Facing this complex problem, the task is to evaluate and use the working space as a resource. The task is to provide working space matching the requirements at lowest costs; to increase the efficiency of space utilisation (Diederichs 2006, p.565). Thereby, a bigger part of the utilisation costs is already determined and set through choices in the planning phase (Bernhold et al. 2008, p.1625). It is therefore important to keep the user costs in mind and generate a *User Costs Forecast* based on the

8 See appendix App. A.6 for original, German terms.

square footage data and construction description which the actor *FM Consulter* receives from the actor *Architect*.

Building Block	Cooperation Activity	Information Object	Source	Target
Cooperative analysis of the User Requirements	Send Room and Functional program	Room and Fun-ctional program	PC – Project Control	FMC – FM-Facility Planning
	Send optimized Room and Functional program	Operation-optimized program		PC – Project Control
		Operations-optimized program	FMC – FM-Facility Planning	A – Fundamentals Determination
	Give planner input regarding Room and Functional program	Planning-optimized program	A – Fundamentals Determination	FMC – FM-Facility Planning
		Planning-optimized program		PC – Project Control
	Send Definition of object-specific FM-services	Definition FM-services	FMC – Operator Concept	PC – User Management
User Costs Forecast	Send square footage data and Construction description	Square footage data	A – Fundamentals Determination	FMC – User Costs Management
		Construction description	A – Fundamentals Determination	FMC – User Costs Management
	Send User Costs-forecast	User Costs-forecast	FMC – User Costs Management	PC – Project Control
Documen-tation	Documentation Fundamentals Determination	Documentatio n	A – Fundamentals Determination	PC – Project Control
	Check of Documentation regarding Guideline	Check regarding Guideline	FMC – FM-Facility Planning	

Source: (Cf. Kirchner 2009, p.42)

Table 2.7: Module Fundamentals Determination: Cooperation Activities and Information Flows[9]

The following two modules, *Preliminary Planning* (Table 2.8) and *Concept Planning* (Table 2.9) are structured similarly and are concerned simultaneously. The degree uncertainty of the early phases of a construction project depends on "factors such as the extent to which the asset is a copy of ones existing; the extent to which standardised components and solutions can be used; and the

9 See appendix App. A.7 for original, German terms.

extent of the requirements for new technologies to solve the particular problems posed by the project. [... As] the project moves through the life cycle, uncertainty is reduced as more information becomes available – ambiguities in design are resolved, geotechnic surveys are completed, regulatory approval is obtained; component suppliers provide their shop drawings, and contractors successfully complete their tasks" (Winch 2002, p.7). As a specific characteristic of the *Architect's Preliminary Planning* the incorporation of alternative solutions can be identified, whereat "the broad uncertainty of a single expected future is replaced with the localized uncertainty of several alternative [...] scenarios" (Schilling 1982, p.2) and communicated to the actor *Principal/Control*. The degree of uncertainty concerning the actual construction costs deceases with advancing iterative processes of *cooperative design of the Preliminary Planning* and the *cooperative development of a Concept*, while the user costs uncertainties decrease slower (Girmscheid 2007, p.99). The uncertainties concerning the user costs are tried to manage by *FM-Services* processes, where early on, in the planning phase, the *operation processes* are modelled and communicated and an *in- and outsourcing concept* on their basis is constructed and aligned between the actors *FM Consulter* and *Principal/Control*.

Building Block	**Cooperation Activity**	**Information Object**	**Source**	**Target**
FM-Services	Send modelled Operation processes	Operation processes	FMC – Operator Concept	PC – User Management
	Send Planning requirements	Planning requirements	FMC – Operator Concept	A – Preliminary Planning
Cooperative design of the Preliminary Planning	Send Preliminary Planning	Fundamentals Architecture/Specialised planning	A – Preliminary Planning	FMC – FM-Facility Planning
	Send optimized Preliminary Planning	Optimized Preliminary Planning documents	FMC – FM-Facility Planning	A – Preliminary Planning
		Optimized Preliminary Planning documents		PC – Project Management

Cost Estimation	Send Investment-costs estimation	Investment-costs estimation	A – Cost Accounting	FMC – User Costs Management
	Send square footage data and Construction description Preliminary Planning	Square footage data Preliminary Planning	A – Preliminary Planning	FMC – User Costs Management
		Construction description Preliminary Planning	A – Preliminary Planning	FMC – User Costs Management
	Send User Costs-estimation results	Investment-costs estimation	FMC – User Costs Management	PC – Project Control
		User Costs-estimation	FMC – User Costs Management	PC – Project Control
	Send Cost optimization	Cost optimization	FMC – User Costs Management	A – Preliminary Planning
Documen-tation	Documentation Preliminary Planning	Documentation	A – Preliminary Planning	PC – Project Control
	Check of Documentation regarding Guideline	Check regarding Guideline	FMC – FM-Facility Planning	

Source: (Cf. Kirchner 2009, p.43 f.)

Table 2.8: Module Preliminary Planning: Cooperation Activities and Information Flows[10]

Furthermore it has to be stated that, at this status of the construction project unfunded decisions, made under the effect of uncertainty can lead to repeated errors, bigger time and cost efforts and unsatisfied clients, thus making it very important to always keep the project documentation up to date and according to the guideline (Girmscheid 2006, p.888) which is facilitated by periodic information flows originating from the actor *FM Consulter*. This information also helps with setting up a computer aided facility management system with the facility data for the future utilisation of the facility without extensive additional effort (Kochendörfer & Liebchen 2007, p.181). Moreover, the information flows regarding user costs and execution costs are made with more and more detailed information based on advancing planning documents and help to reduce cost uncertainties.

10 See appendix App. A.8 for original, German terms.

Building Block	Cooperation Activity	Information Object	Source	Target
FM-Services	Send In- and Outsourcing conception	In- and Outsourcing conception	FMC – Operator Concept	PC – User Management
	Send Planning requirements	Planning requirements	FMC – Operator Concept	A – Concept Planning
Cooperative develop-ment of a Concept	Send Planning conception	Planning conception	A – Concept Planning	FMC – FM-Facility Planning
		Graphical concept	A – Concept Planning	PC – Project Management
	Send optimized Concept	Optimized Concept documents	FMC – FM-Facility Planning	A – Concept Planning
		Optimized Concept documents		PC – Project Management
Cost Calculation	Send Investment-costs calculation	Investment-costs calculation	A – Cost Accounting	FMC – User Costs Management
	Send square footage data and Construction description Concept	Square footage data Concept	A – Concept Planning	FMC – User Costs Management
		Construction description Concept	A – Concept Planning	FMC – User Costs Management
	Send User Costs calculation results	Investment-costs calculation	FMC – User Costs Management	PC – Project Control
		User Costs calculation	FMC – User Costs Management	PC – Project Control
	Send Cost optimization	Cost optimization	FMC – User Costs Management	A – Concept Planning
Documen-tation	Documentation Concept Planning	Documentation	A – Concept Planning	PC – Project Control
	Check of Documentation regarding Guideline	Check regarding Guideline	FMC – FM-Facility Planning	
	Implementation of a CAFM-Systems	Introduction CAFM-System	FMC – Operator Concept	PC – User Management

Source: (Cf. Kirchner 2009, p.45)

Table 2.9: Module Concept Planning: Cooperation Activities and Information flows[11]

The following module, *Execution Planning* (Table 2.10) deals with activities and processes that are aligned towards the actual construction of the building (execution). Hereby, the *Approval Planning* takes an important role, as the actor

11 See appendix App. A.9 for original, German terms.

Architect provides the actor *Principal/Control* with the necessary documents for the official approval of the facility construction. The planner has to inform the project control about possible approval risks, especially with the target to maximise the property utilisation and address this topic, including the chances and risks, in time during the several meetings (Diederichs 2006, p.281) to reduce the aforementioned uncertainty about the approval result. After a solution is fabricated in another iterative process, the construction company augments the business network, which leads to further coordination issues and new relationship uncertainty.

Within the tendering process, the difficulty to fabricate a 'complete' contract comes to the fore, as still a given amount of uncertainty related to the construction tasks exists (Winch 2002, p.22) (e. g. materials to be used for the facility's facade). WINCH (2002, p.22) states that "in upstream design, the process is inherently uncertain as design and regulatory issues are resolved; in downstream execution, site-related uncertainties remain and clients typically wish to retain the option of change." GIRMSCHEID (2007, p.27) adds that a construction service never can be tendered to the last detail, practically and theoretically, due to which the actor *Principal/Control* faces uncertainty, which the service provider has to meet with trust building characteristics and competencies (like e. g. guarantees). Therefore, the *Contracting* processes are particularly important concerning uncertainty within this module, as the *Functional/Service tender offer* is issued towards several construction companies, which then engage in negotiations with the orderer through several information flows. The actor *FM Consulter* provides the actor *Principal/Control* with job descriptions of the future facility services to allow for a reduced uncertainty in the transition to the utilisation phase. Furthermore, the *Cost Quotation* processes are important, as the actual building costs can be included.

Building Block	**Cooperation Activity**	**Information Object**	**Source**	**Target**
Approval Planning	Send Approval documents	Approval documents	A – Approval Planning	PC – Project Management
	Send signed Approval documents	Signed Approval documents	PC – Project Management	A – Approval Planning
FM-Services	Send Job descriptions	Job descriptions	FMC – Operator Concept	PC – User Management
	Send planning requirements	Planning requirements	FMC – Operator Concept	A – Execution Planning
Cooperative fabrication	Send Execution conception	Solution conception	A – Execution Planning	FMC – FM-Facility Planning

of a solution		Graphical solutions	A – Execution Planning	PC – Project Management
	Send optimized Solution conception	Optimized Solution conception	FMC – FM-Facility Planning	A – Execution Planning
		Optimized Solution conception		PC – Project Management
Contracting	Tender offer	Functional/Service tender offer	A – Contracting Management	CC – Acquisition
	Send Offer	Offer	CC – Offer Handling	A – Contracting Management
	Send Contracting result	Contracting result	A – Contracting Management	PC – Project Management
	Placing of Order	Order	PC – Project Management	CC – Offer Negotiations
Cost quotation	Send Investment-costs quotation	Investment-costs quotation	A – Cost Accounting	FMC – User Costs Management
	Send Service descriptions/-catalogues	Service descriptions	A – Execution Planning	FMC – User Costs Management
	Send User Costs quotation results	User Costs quotation	FMC – User Costs Management	PC – Project Control
		Investment-costs quotation	FMC – User Costs Management	PC – Project Control
	Send cost optimization	Cost optimization	FMC – User Costs Management	A – Execution Planning
Documen-tation	Documentation Execution Planning	Documentation	A – Execution Planning	PC – Project Control
	Check of Documentation regarding Guideline	Check regarding Guideline	FMC – FM-Facility Planning	
	Implementation of a CAFM-Systems	Establishment CAFM-System	FMC – Operator Concept	PC – User Management

Source: (Cf. Kirchner 2009, p.47f.)

Table 2.10: Module Execution Planning: Cooperation Activities and Information Flows[12]

The last module, *Execution* (Table 2.11), deals with the building and handover of the facility. The planning process has basically come to an end and activities and processes with other characteristics come to the foreground. The processes “are often associated with high degrees of uncertainty stemming from the unpredictable nature of construction [e. g.] the effect of weather on the productivity and progress of certain activities” (Ahuja et al. 1994, p.314). With

12 See appendix App. A.10 for original, German terms.

the increasing amount of activities, the amount of interfaces as well as the requirement for alignment also increases. Meetings and face-to-face communication now take a bigger part of the information exchange between the network partners that need to have specific participants and information available (Kochendörfer & Liebchen 2007, p.228).

To reduce the level of uncertainty regarding the relation to network partners, the different companies (contractors, sub-contractors, etc.) have to be coordinated in their activities. The actor *Project/Control* therefore, supervises the construction and the actor Architect strives to facilitate the coordination through several information flows and the actor *Construction Company* continuously gives feedback to the development of construction costs. The processes during the *coordination of construction activities* are periodic and therefore conducted repeatedly.

Building Block	Cooperation Activity	Information Object	Source	Target
Coordination of construction activities	Supervise construction	Construction-supervision	PC – Project Control	CC – Construction Execution
	Coordination of Execution	Execution-coordination data	A – Facility Supervision	CC – Construction Execution
	Cost appraisal	Cost appraisals	CC – Project Controlling	A – Facility Supervision
		Cost information	A – Facility Supervision	PC – Project Control
Facility Approval	Facility inspection	Approvals	PC – Project Management	
		Approvals	A – Facility Supervision	CC – Handover
	Exchange of protocols	Handover protocols	A – Facility Supervision	PC – Project Management
		Handover protocols	CC – Handover	
Documen-tation	Send Construction Documentation	Construction Documentation	A – Facility Support	FMC – FM-Facility Planning
	Send Revision-plans	Revision-plans	CC – Handover	FMC – FM-Facility Planning
	Send Operator Handbook	Operator Handbook	FMC – FM-Facility Planning	PC – User Management
	Handover CAFM-system	CAFM-system	FMC – Operator Concept	PC – User Management

Cost Diagnosis	Send Service accounting	Service accounting	CC – Handover	A – Cost Accounting
	Send Cost determination	Cost determination	A – Cost Accounting	PC – Project Control
Implemen-tation	Conduct Orientation Instructions	Orientation Instructions	CC – Handover	PC – User Management
	Support Implementation	Support of Implementation	FMC – Operator Concept	PC – User Management
Defects Handling	Send Scarcity reports	Scarcity reports	PC – User Management	A – Facility Support
	Send Scarcity reports Construction	Scarcity reports Construction	A – Facility Support	CC – Warranty

Source: (Cf. Kirchner 2009, p.49f.)

Table 2.11: Module Execution: Cooperation Activities and Information Flows[13]

The pre-utilisation phase of the facility from the facility management perspective is concluded with the handover of an extensive documentation (physical + digital) to reduce the uncertainty regarding the subsequent phase of the facility life-cycle. Hereby, the actor *FM consulter* provides the actor *Principal/Control* with *Revision-plans*, an *Operator Handbook* and a populated *CAFM-system*. Considerable uncertainty also exists regarding the implementation of the operative processes, as can be concluded from the information flows dealing with *Orientation Instructions* (e. g. for technical facility equipment) originating from the actor *Construction Company* and targeting the actor *Principal/Control.*

2.4 Conclusion and Outlook

This work provided an accentuation of the effects uncertainty can have on business networks, by describing different types of uncertainty and how they affect the network partners and their performance and it was stressed how network partners react on uncertainty. Additionally, the collaborative processes and methods to cope with uncertainty were elucidated. Moreover, the importance of information flows regarding an information processing view of a business network was emphasised. Furthermore, the business network of a construction project in the context of facility management was analysed regarding the areas and processes of each actor as well as the collaboration between the actors regarding the information flows, information objects and collaborative activities. Within this in-depth analysis the focus was particularly set towards the effect of uncertainty on a facility management business network

13 See appendix App. A.11 for original, German terms.

and what information respectively processes are important and conducted to overcome this uncertainty.

Limitations of this work – regarding a business process perspective on uncertainty in facility management networks – are the focus on the planning and execution phase of the facility construction. Furthermore a reference model was used for the analysis and therefore the granularity level was accordingly high. The analysis of a real case scenario would have exceeded the scope of this work, as PEKERICLI et al. (2003, p.2) denote that in a typical medium sized construction project 420 companies and 850 individuals create approximately 56,000 pages of documents and a corresponding amount of information flows.

Interesting for future research could be to analyse the effect of uncertainty on business network processes in more business networks – besides facility management networks –or on a lower granularity level. It could also be interesting to analyse which information flows are suitable for computer aided facility management systems and how these information systems support business networks coping with uncertainty.

3 Business Process Governance for Managing Uncertainty in Administration Networks

Sanja Tumbas

3.1 Introduction

There are certain commonalities that networks intrinsically possess, independently of the discipline which is in the scope. In spite of that, the terminology, definitions and perspectives regarding networks are extremely diversified. That is the main reason why drawing clear boarders between the relevant terms is very important right in the beginning. Consequently, we dive into the research on networks, specifically to the part which is concerned with levels of analysis. Here we have to differentiate: ‘‘network analytical”, ‘‘network as a form of governance” and a combined approach comprising the first two (Provan & Kenis 2008, p.232).

When looking through the lenses of analytical approach, network structural characteristics are described and explained (such as density or centrality). This approach dates back to MORENO (1937) and the main objective can be either to describe, explain, or compare relational configurations or to use these configurations to explain outcomes. The focus is on nodes, relations and “which interactions with interdependent nodes tilt production in one direction or another” (O'Toole & Meier 2006, p.274). The “network as a form of governance” sees the networks as a unit of analysis, and refers to "distinct forms of coordinating economic activity" which stays between hierarchies and markets (W. Powell et al. 2005, p.301). This approach characterizes networks as “social mechanisms rather than authority, bureaucratic rules, standardization, or legal recourse” (Jones et al. 1997, p.925). An important characteristic of “networks as a unit of analysis” is that the organizations which work together in a network are aiming at a common goal and the success of a single organization can effect, but does not have to, the success of the entire network (Provan et al. 2007, p.485). Finally, the third approach combines the previous two - the network governance perspective which allows us to see the networks as a whole while the network analytical view enables seeing the relationships between the participants (Provan & Kenis 2008, p.233). This is the angle which we will usually take in the upcoming sections.

Our special focus will be on networks in the public sector which are not a novelty anymore. In the last 15 years, research was conducted extensively in this area. Some argue that networks emerged as forms which provide solutions for the disadvantages of “New Public Management” (Isett et al. 2010, p.159). At the same time, scientists who addressed the “networks as unit of analysis” are not scarce anymore. However, the majority of these works has a descriptive nature (Agranoff & M. McGuire 2001; Huxham & Vangen 2005; van Bueren et al. 2003). A common assumption is that formal control mechanisms are typically contradicting to the whole point of having a network since networks are built around collaboration (Kenis & Provan 2006, p.228). This assumption inspired us to trigger a new discussion.

Moreover, we believe that governance of administration networks has interesting links to other disciplines. As suggested by BERRY ET AL. (2004) public administration networks need to establish certain relations to other disciplines. The relations towards Information Systems are already drawn, and electronic governance is a common topic in academia. We are interested in the connecting bridge between administration networks and business process governance (BPG).

Two research questions come to light and formulate our main interest. The first one addresses the underlying concepts and reveals what lies beneath, while the second one is more a concretization.

Q1: What are the relations of underlying concepts regarding governance in administration networks?

Q2: How does BPM support the realization of governance in public administration networks?

On this exploratory path, firstly, in section 2, we visit the part of literature which describes and emphasizes on the importance on understanding streams in administration governance. Then we proceed with exploring governance mechanisms in administration networks. Furthermore, we introduce the concept of BPG which directly calls for the explanation of BPM. As we are constantly in the context of networks, we emphasize collaboration in BPM. We introduce the way how uncertainty is understood in this paper, and in section 3 the search for relevant responses is pursued. Moreover, section 3 already provides a promising foundation for further conclusions which are drawn in section 4. Concluding, limitations and further research proposals will follow.

The structure of the section and the related concepts are illustrated in Figure 1. Moreover, all tackled concepts are depicted in the figure providing an overview. The overall discussion within this section takes place in the context of uncertainty, governance and public administration networks.

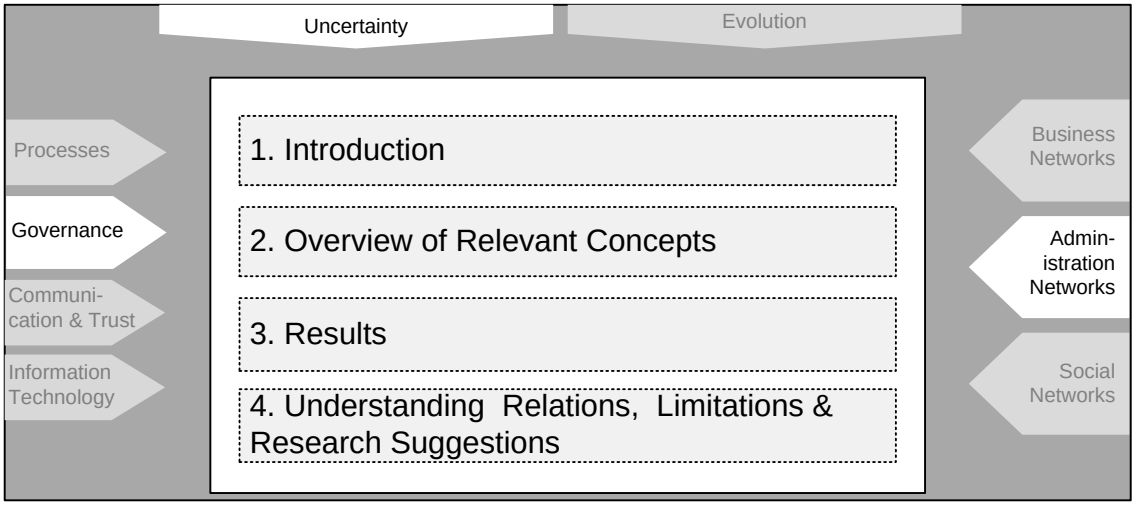


Figure 3.1: Structure of the Section

3.2 Overview of Relevant Concepts

3.2.1 Distinct Paths in the Administration Network Research

Several distinct understandings of administration networks have emerged in the last two decades. It is necessary to get an overview of the context in which "networks" are investigated on the subject of public administrations. The comprehensive article written by ISETT ET AL. (2010, p.158) covers three main directions in the literature. The goal of these networks can be seen as the main criteria for distinction:

- "Policy networks are a set of public agencies, legislative offices, and private sector organizations (including interests groups, corporations, non-profit groups, etc.) that have an interest in public decisions within a particular area of policy because they are interdependent"

- "Collaborative networks are collections of government agencies, nonprofits, and for-profits that work together to provide a public good, service, or value when a single public agency is unable to create the good or service on its own and/or the private sector is unable or unwilling to provide the goods or services in the desired quantities" (Agranoff & M. McGuire 2001; O'Toole 1997)

- “Governance networks are entities that fuse collaborative public goods and service provision with collective policymaking such as business improvement districts or some environmental mitigation efforts” (Bogason & Musso 2006; Klijn & Skelcher 2007; Rhodes 1996; Sørensen & Torfing 2009). These networks coordinate the organizations which share a joint objective. It means that the focus shifts from the policies or jointly offered projects/services to the network itself.

There are other classification criteria in the research of administrative networks. However, for the aim of our research, we would like to focus on networks consisting of actors that are aware and approve operating in them (Meier & O'Toole 2003). Another important way of approaching networks is to understand them as certain means for explaining public services. This research direction can be divided to: networks as a tool for delivering certain services or “Provan’s research direction” and exploring local collaborative governance or “Agranoff’s research direction” (Isett et al. 2010, p.161).

3.2.2 Governance in Administration Networks

The levels of analysis in network research, regardless of the specific scientific field, have been introduced in the first section. We would like to shift the attention to the research in the public administration sector. An important step towards new findings was made by O’Toole (1997) who highlighted several research topics and suggested the following research potentials: shifts in units of analysis, revealing descriptive questions on network agenda, conduct research on dimensions of network structure which effect service delivery results. Several years later Berry Et al. (2004) turned back to these propositions, and analyzed the current state. The dominating tendency which was observed was that “network as unit of analysis” are still not present in the research extensively (Raab & Kenis 2009, p.207).

After getting an insight to administration network literature and its deficiencies, and knowing that seeing networks as “unit of analysis” is a prominent area of research, we would like to place the governance of these networks to the spotlight. Following the line of argumentation, Provan et al. (2007, p.485) identified several network-level properties among which we focus on governance.

Even though there are numerous definitions of governance, we are interested in the ones which originate from public administration researcher. In a rather

broad way, governance may be defined as “regimes of laws, administrative rules, judicial rulings, and practices that constrain, prescribe, and enable government activity, where such activity is broadly defined as the production and delivery of publicly supported goods and services” (Lynn et al. 2000, p.237). HILL & LYNN (2005) describe governance in as funding and control (supervising) role of government agencies, especially regarding the provision of public services. The defined control of networks in public sector can be seen as the “use of mechanisms by actors to monitor the actions and activities of organizational networks to enhance the likelihood that network-level goals can be attained” and suggested that it has to be regard as a broader concept then the “network governance” view of networks (Kenis & Provan 2006, p.228).

The main motivation for analyzing control of networks is the fact that networks are completely different forms which are neither markets nor hierarchies. There is a strong presumption that networks are seen as a solution and response for deficiencies of markets (Williamson 1991). However, networks have to be addressed on their own without applying already existing knowledge from other areas (markets, hierarchies) on them. Networks are usually seen as having a unified form but not as separate entities which have to be governed within their setting. If treating network as a distinctive form of organizing one could also distinguish different forms of networks (Provan et al. 2007, p.504).

AGRANOFF & MCGUIRE (2001, p.309) recognize that there is usually a conflicting interest of organizational and network goals, claiming that in networks “there is no obvious principal or agent, and no exigent authority to steer the activities of the network in harmony with elected officials, the issue of accountability is miscast”. In addition, the PROVAN & MILWARD (2001) conducted a study which showed that governance has a significant impact on the outcomes of four mental health service delivery networks.

3.2.3 Business Process Governance

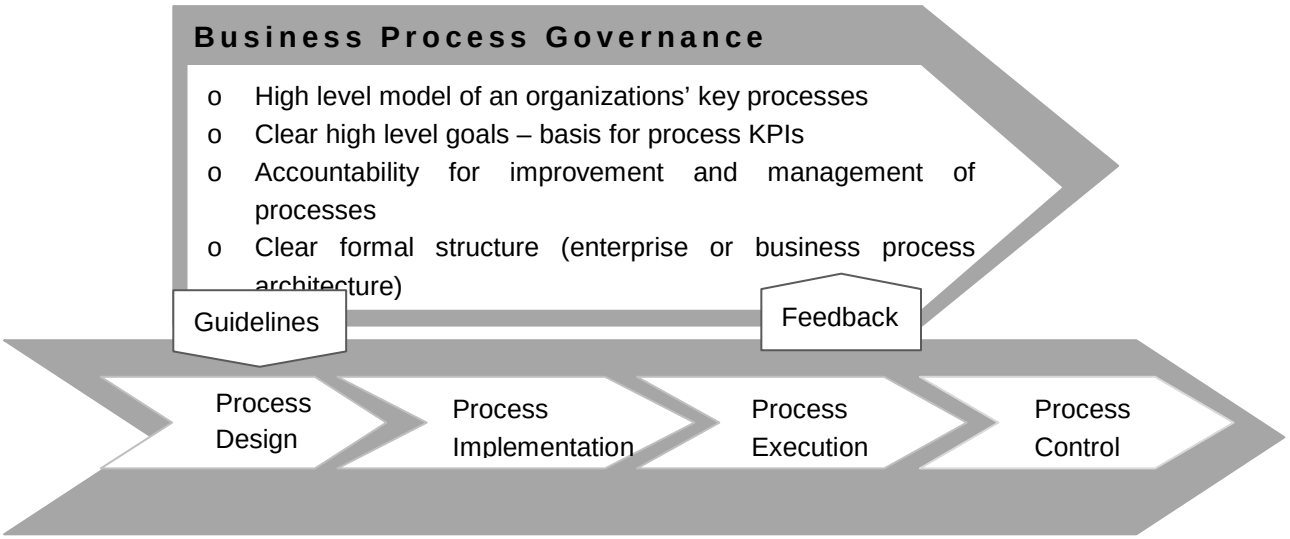
There are two emerging streams in BPG: governance of processes, and governance of BPM (vom Brocke & Rosemann 2010a, p.197). The literature does not provide many evidences and arguments for making a clear distinction. Sometimes, authors use the term BPG referring to BPM governance (Kirchmer 2010, p.51). Hence, we are not attempting to explain the underlying rational for differentiation because our interest is to gain an overview of these concepts and their content.

BPG generally refers to „the direction, coordination, and control of individuals, groups, or organizations that are at least to some extent autonomous“ (Markus & Jacobson 2010, p.201). BPG uses different impersonal and personal mechanisms which are usually providing the most cost-effective governance structure when they are combined. According to JESTON & NELIS (2008, p.133) BPG comprises activities such as risk management, defining formal legal requirements, raising organization's efficiency, measurement, accountability for decision making and alignment between the major components as well as focus on the key stakeholders - internal and external. The necessity for BPG is present for both inter-organizational and intra-organizational processes.

“BPM governance establishes appropriate and transparent accountability in terms of roles and responsibilities for different levels of BPM (portfolio, program, project, and operations” (vom Brocke & Rosemann 2010b, p.113). Also, BPM governance can be determined as “the establishment of process-related responsibility and accountability mechanisms for the purpose of encouraging desirable behaviour in BPM” (Jayaganesh & Shanks 2009, p.1). BPM governance has a task to enable optimization and foster improvements to operational performance, as well as create the fitting structures, metrics, roles, and responsibilities to measure and manage the performance of a organizations' end-to-end business processes.

BPM governance framework represents a roadmap which provides a customized solution for the needs of a particular organization. KHUSIDMAN (2010, p.7) suggests the framework should comply to requirements such as: possibility to coexist and integrate with different governance initiatives across the organization, leverage BPM standards and enable reusability, define a methodology for analyzing BPM Governance outcomes and allow continuous improvement, guidelines for establishing the organizational model and supporting organizations (i.e., Steering Committee, Center of Excellence) and roles (Khusidman 2010, p.2f.). The lack of a strict BPM Governance framework is one of the main reasons for the failing of large-scale BPM initiatives (Spany 2010, p.223).

BPG enables BPM (figure 3.2) which then delivers business results and create value for internal and external actors. As shown in the figure, BPG effects all phases of BPM: design, implementation, execution, controlling (and monitoring) of processes



Source: (Harmon 2010, p.52)

Figure 3.2: Content and Relations between BPG and BPM

3.2.4 Collaborative Business Process Management

A well known definition of BPM is that it can be "considered as: a customer-focused approach to the systematic management, measurement and improvement of all company processes through cross-functional teamwork and employee empowerment" (R. Lee & Dale 1998, p.217). The roots of BPM lie in Business Process Reengineering (BPR) and total quality management (TQM) (Niehaves et al. 2010a, p.3). Business process reengineering is seen as an all-or-nothing redesign of business processes, while total quality management provides continuous improvement, customer orientation, employee involvement, and other benefits (Michael Hammer 1990, p.105; T. C. Powell 1995, p.16). These two streams can be also seen as a constituent part of Business Process Management (Niehaves et al. 2010b, p.4; Kettinger et al. 1997, p.57).

The trend in BPM moves towards collaboration. As a first impulse, integration of stakeholder interests into process management is already well founded in the literature (Rosemann et al. 2006, p.307; Fisher 2004, p.6; M. Hammer 2007, p.116f). NIEHAVES & PLATTFAUT (2011, p.6) moved a step further and identified numerous internal and external actors in BPM. These comprise: top management, middle management and employees, technical specialists, lawmakers, customers, professional organizations, suppliers, distributers, software consultants and BPM consultants.

An important perspective of BPM is governance. It has to be mentioned here as some authors recognize governance as - transparent decision making process, process management standards, process management control, definition of process roles and responsibilities as a part of BPM (Rosemann et al. 2006, p.307). Furthermore, ZAIRI (1997, p.65) suggests that BPM has to be governed to ensure:

- that major activities are documented,
- that BPM is customer focuses and horizontal linkages between key activities exist,
- documented procedures and clearly set rules on which BPM can rely (consistency, quality assurance),
- KPIs for individual processes, target deliverables,
- continuous optimization,
- utilize of best practices for innovation ideas.

3.2.5 Sources of Uncertainty

Interpreted in the context of Organization Information Processing Theory (OIPT) uncertainty represents the difference between the amount of information required to perform a task and the amount of information already possessed. The organization that has to respond to a high level of uncertainty has greater information needs. These have to be resolved by making a choice of strategies in order to prevent a loss of organizational performance. One of the possibilities suggested is the creation of lateral relationships. These comprise direct contact between people who share a problem such as task forces, project groups, or teams (Galbraith 1974).

PREMKUMAR ET AL. (2005) applied OITP to understand the fit between information processing needs and information processing capability in inter-organizational relations. One of the options they suggest is to reduce uncertainty by implementing “structural mechanisms and information processing capability to enhance the information flow” (Premkumar et al. 2005, p.260). The information flow can be improved is by redesigning business processes and implementing an integrated information system.

As we are interested in administration networks, elaborating on network uncertainty is inevitable. There are three identified types of network uncertainty (Koppenjan & Klijn 2004, p.6). Substantive uncertainty is a result of lacking (or different) knowledge about a certain problem or overload of information.

Strategic uncertainty is a consequence of multiple actors involved in the network who have certain decision rights and therefore the uncertainty arises about what choices they make. Institutional uncertainty arises because the actors in the network who have different backgrounds and come from different organizations, naturally have their own goals and perceptions. These categories cover two types of uncertainties – uncertainty contained in the network itself and the task-related uncertainty (Moynihan 2008, p.354f.).

Several standard responses to uncertainty exist: avoiding or delaying action, collecting additional information (research or expert knowledge) or top-down measures. However, the fact is that it is very hard to gather information and steer centrally. Besides, this method would not solve the problem of different perceptions of actors. The top-down measures are not satisfactory because the network is composed of autonomous actors which are out of the reach for hierarchies.

3.3 Results

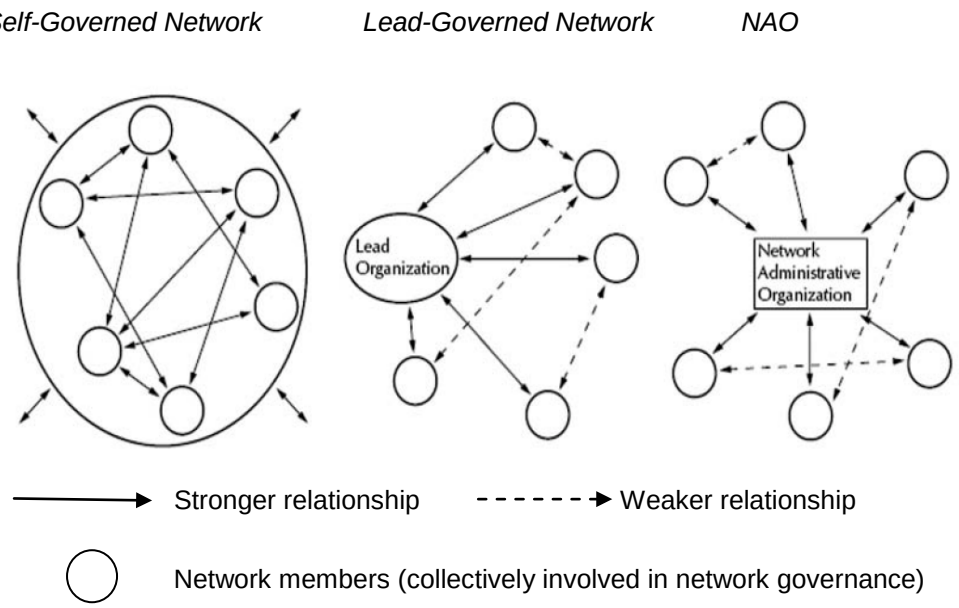
3.3.1 Forms of Governance in Administration Networks

The outcome of the literature research process yields that several specific forms of governance are discussed among administration network scholars. Some authors claim that networks should be governed without applying hierarchy and without considering ownership and taking into account that the accountability of network participants is limited. In this context, governance is understood as a mechanism which is used to govern the overall network. These mechanisms are on the range from “shared” governance, to “hub-firm” (“lead-organization”) governed, to a “network administrative organization” (NAO) model.

The classification proposed by PROVAN & KENIS (2008) serves as the basic ground for the identified forms of governance. There are the two main dimensions used for analysing different forms of network governance. Firstly, if the network is governed by a single organization it is brokered and centralized. In case all the organizations take part in the governance and interact with each other, it leads to a decentralized form which is not brokered. Secondly, the governance can be in hands of the members of the network itself or it can be a responsibility of an external entity.

In the shared governance network model, the members of the network have the responsibility for making decisions collectively, internally and externally, on all

levels (strategic and operational). Governance is conducted formally (meetings, representatives) or informally (ongoing interactions and collaboration). The power on the level of the network as a whole is approximately symmetrical. Furthermore, the lead-organization form (or hub-firm) brings together organizations who share a common goal, while one of them has more power. The leading organization often has more economic influence, specific resources or legitimacy in the eyes of customers (Provan et al. 2007, p.504). It is a highly centralized form, with asymmetrical power, brokered by a single organization which is one of the participants in the network itself. The lead-governed form yields asymmetrical power and the network goals may be really similar to lead organisations' goals. This model occurs for example in the health sector (Provan & Milward 1995) or in public infrastructure projects. Lastly, the NAO model is centralized with an external network broker having a role of coordinating and maintaining the network. It is similar in nature to the lead organization model because all activities and decisions are coordinated through one organization. The NAO may be a government entity, or a non-profit, which is often the case even when the network members are for-profit firms (Milward & Provan 2003) . The NAO may be organized in different ways – it may be an individual or a formal organization with all constituent parts. In some cases the highest body of NAO may include participants from the members of a network in order to keep better focus on strategic concerns. The task of the NAO may be primarily to support (rather than execute) network leadership so that this model of governance may sometimes coexist with one of the other two models.



Source: (Raab & Kenis 2009, p.207)

Figure 3.3: Three Governance Forms of Whole Networks

The NAO model is quite common form used in some European countries (e.g. Germany) because it stimulates public-private sector interactions in networks or clusters[14]. Though not necessarily mandated by the government, some national or regional development programs may specifically recommend the NAO model (Provan et al. 2007, p.505).

MILWARD & PROVAN (2000; 2003) also suggest shifting away from hierarchical bureaucratic organization to the hollow state and government by a third party (non- profit agencies and private firms). They use the term hollow state to "describe the decision by a government, that as a matter of public policy, has decided to contract with third parties – non- profits, firms, other governments – to produce taxpayer funded goods and services" (Milward & Provan 2003, p.3). The main task in the hollow state is to use mechanisms (such as collaboration) to govern networks of organizations from all sectors – public, private and non-profit effectively.

3.3.2 Finding Responses to Uncertainty

The fundamental idea of Information Processing Theory (Galbraith 1974) suggests that when decision-makers are faced with uncertainty they seek to reduce it through the gathering of additional information. This can also include information and knowledge from other sites and represents one of the key advantages of large organization (Trautmann et al. 2009, p.199).

We consider the redesign of business processes and implementation of an integrated information system, as well as knowledge shared between the actors across the boundaries of a single organization or network, as responses to uncertainty. The relation between integration mechanisms and information systems has already been drawn (Levina & Vaast 2005; Lindgren et al. 2008). GRANDORY & SODA (1995) showed that information systems are not considered to be important only for vertical integration mechanisms within single organizations but rather a powerful horizontal integrator for managing interdependencies within and between organizations.

When coming to knowledge sharing, the tree identified uncertainty types (3.2.5 Sources of Uncertainty) have to be considered again. The reason is that KOPPENJAN & KLIJN (2004, p.10) see cooperation which "presupposes learning between the actors, crossing the boundaries of organizations, networks and

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14 For more details see http://www.kompetenznetze.de

coalitions" as a way of overcoming the uncertainties these. More specifically, this means that interaction processes between public and private parties from different organizations, different levels of government and networks should jointly approach problems, discover possibilities of solving them, as well as determine the strategic and institutional context of the problem. Furthermore, they emphasize on horizontal steering mechanisms which encourage supportive behaviour and the better use of knowledge collected from other actors in the network.

The main supportive theory for knowledge sharing and including external actors is the Boundary Spanning Theory. It deals exactly with the importance of exchanging information between actors (crossing borders of a single organization). This means that Boundary spanning Theory is concerned with activities of making sense of peripheral information that is perceived relevant to expand the knowledge at the centre of a given organizational context. Participants in boundary crossing activities can be seen as boundary spanners. Boundary-spanners are "gate-keepers" that are strongly connected to external information areas. (Friedman & Podolny 1992; Tushman & Nadler 1978). They are vital individuals who facilitate the sharing of expertise by linking two or more groups of people separated by location, hierarchy, or function. They should be able to discern relevant information for the related organizations and make decisions concerning the distribution of gathered information. Moreover, they convey influence between the various groups and at the same time represents the perceptions, expectations, and values of their own organizations to those groups (Friedman & Podolny 1992).

3.3.3 Process Transformation and BPM in Public Administrations

Nowadays, the public sector is also facing managerial challenges, dealing with organizational transformations became a strategic goal. Transformation is a necessary step in changing the nature of public institutions. Transformation is often perceived as "uncompromising and uncompetitive", and fostering stakeholder orientation (C. W. Tan & Pan 2003, p.278). It utilizes digital technologies to change the ways of operating and to transform government activities (Foley & Alfonso 2009).

According to the model of the European Commission and the OECD the following development levels of eGovernment[15] projects exist: 1. Information – usually the provision of information at a web; 2. Interaction – two-way digital correspondence; 3. Transaction – usually the digital exchange of money or information and the highest level is 4. Transformation, which targets at the "back-office" reform or reorganization, meaning organizational re-engineering (Foley & Alfonso 2009, p.379).

Therefore, it is crucial for transformation government to address coordination of existing government processes, as well as the way how they are organised (Zahir Irani et al. 2007). NIEHAVES ET AL. (2010b) consider BPM as a solution. Since public sector is also affected by the market environment and has to cope with the changes, they see BPM as a dynamic capability[16] and response to fast changes on the market (Klievink & Marijn Janssen 2009, p.277; Niehaves et al. 2010a, p.2).

Besides considering process transformation, some researchers argue that all the perspectives of different stakeholders have to be taken into account – governmental bodies, citizens and other stakeholders (Zahir Irani et al. 2007, p.333f; C. W. Tan & Pan 2003). This finding directly builds on the Boundary Spanning Theory which was presented in the previous section. External actors have to be included and this reflects also on BPM networks which are "an integral part of the maturization of an organization in its BPM activities" (Rosemann et al. 2006). Networks are a natural complement for BPM while it is important to gain information from both inside and outside of the organizations' boarders and utilize them for BPM action (Niehaves et al. 2010b).

For the purpose of better understanding, we would like to use an example[17] and illustrate the relation between administrative network services and support of BPM. In public administrations change is often triggered by new regulations. The regulations forces the Federal Employment Agency and the municipalities to cooperate regarding the unemployment benefit provided to citizens. The new law allows municipalities to be in charge for providing the citizens with the prescribed compensation. This means, that after paying to the citizens, the municipalities grant the money back from the Federal Employment Agency. In turn, the Federal Employment Agency has to check if the payment of

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[15] See more in the 6.2.3.
[16] More about Dynamic Capability Theory in Teece et al. (1997)
[17] The example is taken from qualitative research conducted in frames of a bigger project

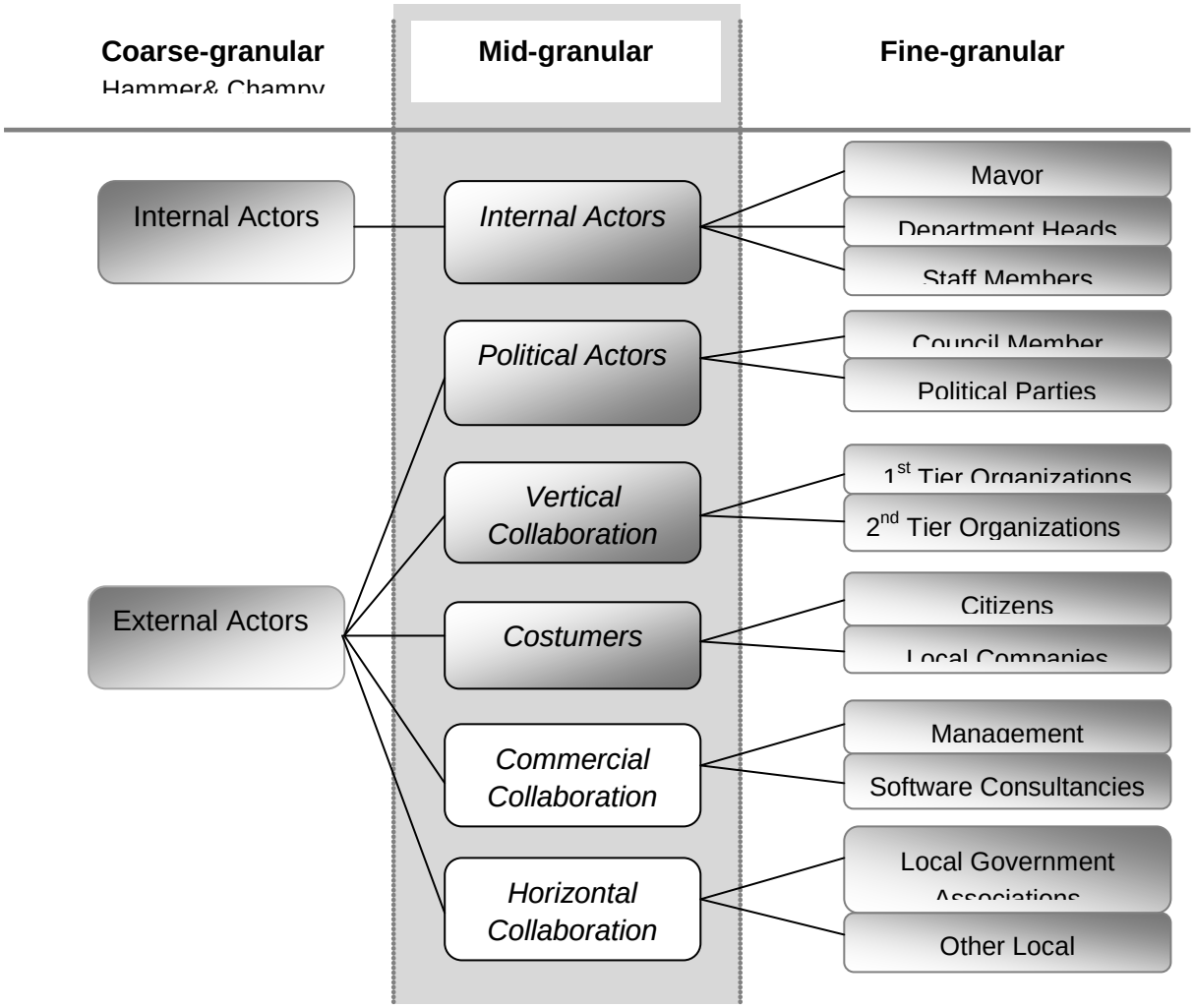
unemployment benefit was correct, so the communication process goes in two ways. BPM can be used to enable communication and minimize the time, effort and costs of these processes.

3.3.4 Identifying BPM Administration Network Actors

Network actors are mentioned in several contexts throughout the literature. When PROVAN & KENIS (2008, p.237) analyzed the forms of governance, they also identified the key concepts which influence the effectives of these forms. The number of participants in the networks was recognized as one of the influencing factors. Naturally, more participants are raising the complexity.

In the context of BPM actors, the literature provides support to the fact that involving internal and external actors organization increases the success and acceptance of BPM initiatives (Niehaves et al. 2010b, p.4). The fact that the actors in BPM networks are usually differentiated very broadly to “internal” and “external” intrigued the research. (Niehaves et al. 2010b, p.2) conducted a quantitative study of BPM networks (357 local government cases in Germany) and identified groups of collaborators which exist in transformation government and public sector BPM. The study reveals different internal and external actors as well as collaboration patterns existing between them – horizontal and vertical. The figure shows that there are several internal (the mayor, the department heads and the staff member) as well as external actors (political actors, vertical collaboration, costumers, commercial collaboration and horizontal collaboration).

All categories of different levels of granularity are depicted in the Figure 2. The interesting relations are especially the ones between: 1sth Tier Organizations and 2nd Tier organizations (federal and central government organizations) and Local governments and Local governments associations. This is an important finding when we further look at the governance mechanisms and the way how they could support networks in public administrations.



Source: (Niehaves et al. 2010b, p.10)

Figure 3.4: 4 Groups of Collaborators in Public Sector BPM Networks

3.3.5 Business Process Governance Mechanisms

The specificity of the public sector lies in the strong emphasis on transparent processes, accountability, rigorous consistency, reliability and security. KETTL (2002, p.128) noted that transformation in governance can be characterized by both horizontal and vertical structures. Service provision by coordination and integration which involves nongovernmental partners requires horizontal, while vertical governance is achieved by hierarchies and bureaucracies. The horizontal relationships offer additional links rather then replace the vertical ones. However, some authors suggest that in public service networks traditional hierarchical mechanisms are replaced by horizontal ones, calling for management of these networks and processes (Marijn Janssen 2010, p.2).

Therefore, we would like to gain an overview of the BPG concepts which are used in inter-organizational settings. Here, our understanding of BPG is depicted by “direction, coordination, and control of individuals, groups, or

organizations that are at least to some extent autonomous“(Markus & Jacobson 2010, p.201)as earlier provided in section 3.2.4.

Especially, our interest was set to BPG in inter-organizational setting. The entities involved are legally independent, they have distinct levels of power and influence. Therefore, these processes rely mostly on impersonal mechanisms of governance (information systems can have this role). If personal governance is used, then often a third party organization is engaged(Markus & Jacobson 2010, p.219). An overview of governance concepts mentioned here and their advantages, disadvantages and proposed usage is shown in Table 1 (only for inter-organizational). However, when the tendency is towards including more and more organizations and organization types, complex combinations of personal and impersonal governance are needed.

An example of such inter-organizational process is the service provision of Emergency Medical Office services in a US county. The actors in this process are both governmental and private businesses, such as police, fire brigade, ambulance, etc. The officials in the Emergency Medical Office were assigned to the responsibility for realizing process improvement. The process of multiple actor inclusion fosters innovative public-private partnership. The process contained no hierarchical authority. The main governance mechanism was impersonal governance. It was realized by using a “performance based” contract. It defined target response times and required 90% compliance from the actors in the process. Besides, the agency enforced process standards for worker trainings, record keeping and communication. Also, a standing committee was established to evaluate the performance of processes and to manage continuous improvement. Concluding, the success of the project relied on a combination of impersonal (contract) and personal governance mechanisms (standing committee and informal interactions) (Markus & Jacobson 2010, p.219)

Governance Concept	Advantages	Disadvantages	When to use
Impersonal Governance	• Clearly specifies roles and responsibilities, compliance requirements, and penalties for non-compliance • Costs of governance can be low • Can avoid conflicts associated with personal governance	• Impossible to specify every contingency in advance • Can be ineffective without expensive monitoring and enforcement	•When certain levels of service are required and can be monitored •When coordination is needed across organizations
Personal Governance	• Has the ability to respond to unforeseen circumstances (flexible).	• May provoke more conflicts than impersonal governance • May result in less consistent application than documented rules	•Always required in some form (to create personal rules)
Horizontal (lateral) relations	• Considering the high relevance of this concept, no specific advantages are mentioned	• Considering the high relevance of this concept, no specific advantages are mentioned	•Always required for business processes (because they cross organizational lines)
Informal Governance	• Execution requires informal governance (it is the way of conducting work) • Facilities	• No way to ensure that informal coordination will happen • No formal method	•Always required •Should be encouraged in addition to other governance concepts

Source: (Markus & Jacobson 2010, p.211)

Table 3.1: Overview of Governance Concepts

3.4 Understanding Relations, Limitations & Research Suggestions

After concluding the literature review process and exposing the results, we reflect on the research questions set in the beginning. Answering the first question and revealing the underlying concepts for governance in administration networks has been a complex discovery journey. It allowed us to link knowledge from different fields and search for more relations.

First of all, when introducing the relevant concepts. The notion of governance has been linked to the understanding of the “network as a unit of analysis”. Then the need for governing networks was clearly emphasized and supported by existing research findings. Investigating existing forms of governance (shared, lead-governed and NAO) followed. That was the starting point for

understanding network participants roles and positions. The topic which additionally fueled the need for binding several disciplines was uncertainty which occurs in networks and also uncertainty in the interpretations of OIPT. That was the main reason for recognizing information systems as horizontal integrators (lateral relations) which aim at reducing uncertainty. Therefore, the question on how BPM supports governance in public administration is implicitly answered. Since BPM networks consist of and help to create lateral relations (Galbraith 1974; Premkumar et al. 2005). We understand them as a strong horizontal integrator.

BPM plays the main role in responding to the research targets while BPM plays several important roles in this paper. BPM supports lateral – horizontal relations which are typical for network settings. If governed properly, BPM is the main means of BPG to deliver its value to the organization. Moreover, by realizing the importance of Boundary Spanning Theory and understanding it in the context of collaborative BPM aims at reducing uncertainty as well. External actors are “boundary spanners”. Moreover, we believe that BPM also has to respond to the fast changing environment in the public sector. Therefore, our focus was on the collaboration perspective of BPM and its role in process transformation tendency.

When public service networks were discussed, the main rationale behind was that public service networks possess characteristics of service networks in general. Service networks comprise “end-to-end service interactions between network partners that embody a succession of business processes typically cutting across organizational boundaries and spanning various geographical locations” (Bitsaki et al. 2009, p.1). The two main features of service networks are: 1. customer centrality to detect the needs and 2. efficient back-office operations (Ahlert & Evanschitzky 2002). These two characteristics are aligned with the trends in public service networks (see 3.3.3 Process Transformation and BPM in Public Administrations).

Certainly, the limitation of this paper is the fact that the conclusions are based on pure theory. Furthermore, this paper has not engaged with the question of network performance. We did not examine the financial impact of identified concepts. The findings are based on articles and conference papers recently published, which could lead to the fact that these sources still do not provide strong theoretical foundation.

This paper was not attempting to provide a comprehensive overview and definite list of related concepts. Rather, the exploratory journey highlighted relevant trends in the literature and their directions. A step further would be to specifically map concepts and by conducting empirical research understand the insights from practitioners. Recently, innovation is identified as a valuable topic in public administration research (Finnegan et al. 2008). The potential for examining this field was captured with BPM as means of realization (Niehaves 2009). Coupling governance and different uncertainty approaches with performance indicators of networks (measurable) would provide more precise information. As research in BPM already recognizes boundary blurring and acknowledges of BPM networks as well as importance of governance (Rosemann et al. 2006; W. Powell et al. 2005), all these directions are potential field for identifying a research gap.

4 Communication and Trust in Networks of Practice

Adriana Lopez

4.1 The Role of Communication and Trust in Networks of Practice

The propagation of networked communication and the Internet as a platform to support virtual groups has drawn attention to the way these voluntary communities create value. Based on the idea that knowledge is distributed and fragmented, the emergence of these networks facilitates the exchange of information to support innovation and the production of knowledge. The knowledge created in these networks is a highly valuable asset not only for its members but also for organizations and society. “The diffusion of innovative knowledge is considered to be one of the main challenges in the emerging knowledge society” (van Baalen et al. 2005, p.301). Several research endeavors have attempted to explain the social complexity within these groups. However, many essential questions associated to collaboration, uncertainty and interaction remain open.

Networks of practice are self-organized groups of individuals that voluntarily engage in collaboration by the use of electronic channels for the fulfillment of a common goal (Wasko et al. 2009, p.255). The electronic nature of their communication processes influences the way interaction takes place and creates high levels of uncertainty among participants. Communication and trust play then a profound role in the dynamics of these networks (Fang & Chiu 2010, p.236). The intrinsic uncertainty forces the development of trust and effective communication processes as only ways for individuals to overcome the unknown and to engage in sharing and creation of knowledge.

The current paper will engage with the question of why do individuals in networks of practice engage in collaboration and which role do communication and trust play in the process of overcoming uncertainty. A framework with the main components of the social phenomena within these networks will be proposed to enlighten its collaboration processes. The model will employ concepts such as Social Capital Theory, Uncertainty Management Theory and Collective Action to analyze in detail the social elements of structure, communication, relationships, uncertainty and collaboration and to define their corresponding dependencies. The main objective is to bring light into the social complexity and phenomena that occur within networks of practice and to analyze the elements that encourage collaboration and that provide individuals

with tools to overcome uncertainty. Figure 4.1 shows the relation of this section in the context of the overall research framework.

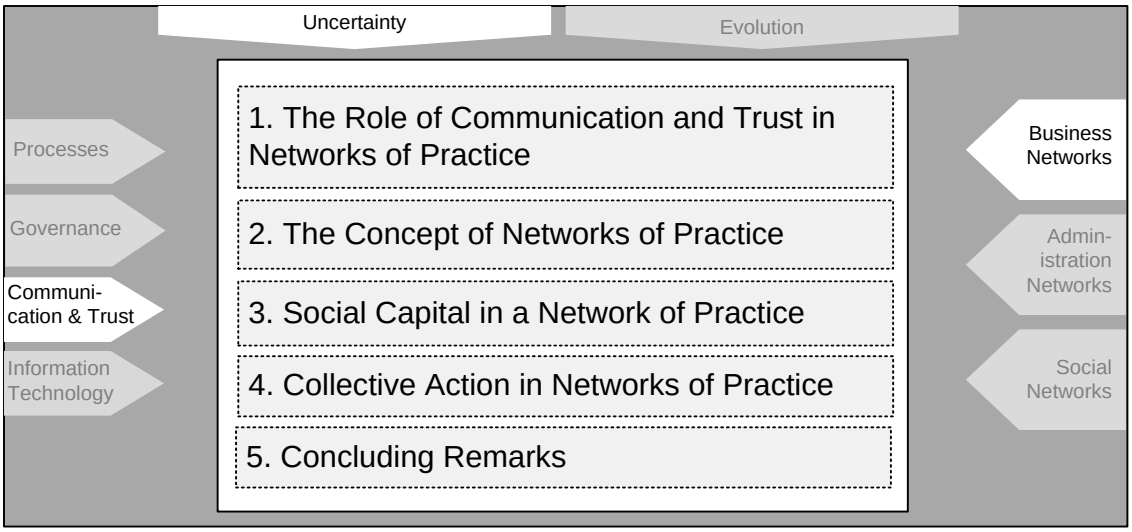


Figure 4.1: Structure of the Section

4.2 The Concept of Networks of Practice

The extensive proliferation in the use of Internet as a portal for virtual groups that engage in knowledge exchange activities had enhanced the spread of networks of practice. “Electronic networks make it possible to share information quickly, globally, and with a large number of individuals” (Faraj & McLure Wasko 2005, p.36). Individuals of widely different backgrounds and locations come together to solve complex problems through cooperative work without ever establishing face-to-face contact. This phenomenon is based on the idea that knowledge, or more precisely, knowing, is a collective activity embodied in a situated practice rather than an abstract codified body of information (McLure Wasko et al. 2004, p.494). Participants share their expertise with the others in order to achieve a common goal which results in the creation of knowledge, relations and social exchange.

4.2.1 Defining Characteristics

There are a variety of definitions for networks of practice. This paper refers to it as a group of individuals that are linked by electronic communication in an attempt to fulfill a specific common objective or task (Faraj & McLure Wasko 2005, p.37). Individuals in this type of networks are geographically dispersed and never undergo any face-to-face interactions. Therefore, ties are restricted to the electronic exchanges of messages and information. Linkages in these

networks are the result of the common pursue of a practice-oriented goal (Hahn et al. 2008, p.370). A formal hierarchy or governance is nonexistent and individuals organize themselves through their virtual interactions (van Baalen et al. 2005, p.302). Knowledge is produced through the sharing and cooperation processes and these interactions result in the creation of relationships between individuals and between individuals and the network as a whole (McLure Wasko et al. 2004, p.502). Affiliation to these networks is voluntary and open.

We can then identify several key aspects that define these networks. Their self-organizing nature allows individuals to participate in a voluntary manner. There is no central governance but an emergent, non-hierarchical and informal one based on cooperation and work. Any person with an interest in the project is allowed to join, to make use of the network and to share his expertise.

Additionally, the electronic nature of communication results in weak-tie relationships based only on knowledge exchange (Wasko et al. 2009, p.257). Without the presence of face-to-face visual cues, the relations that emerge do not possess the strength and density of other social formations like communities of practice. However, a certain degree of closeness and density is achieved through the information exchange. “Sharing one´s knowledge is a good way to develop relationships” (W. W. Ma & Yuen 2011, p.213).

4.2.2 Joining a Network of Practice

There have been different attempts to explain what motivates an individual to join and to actively participate in a network of practice. WASKO & FARAJ (2005, p.40) mention social rewards such as approval, status, respect and reputation as individual motivations for taking part in these networks. “Individuals who perceive that participation will enhance their reputations in the profession will contribute more helpful responses to electronic networks of practice” (Faraj & McLure Wasko 2005, p.40). In this sense, contributing with valuable expertise will enhance the reputation of a participant in terms of his competences and knowledge and it will increase his social acceptance within the network. This reputation will encourage the other members to participate in future joint projects with certain individuals. Participants rely then on status cues because they are motivated to work with those whom they perceive to be successful (Hahn et al. 2008, p.373).

However, other sources of motivation such as participation for the sake of the activity itself are also mentioned in the literature. Individuals might find it

challenging to engage in a complex problem solving activity. Open Source Software Developer Networks are a good example of this. “ Developer participation in OSSD (Open Source Software Development) is driven by motivations ranging from enjoyment and learning from development activities, a sense of obligation toward the OSS community, a belief that code should be open, a need for the software developed, to a desire for reputation” (Hahn et al. 2008, p.373). In this sense, an individual feels part of a challenging project that will create value for others.

Other explanations such as the fact that online contributions are a means of expressing our individual identity or that helping others increases the self-esteem of participants are also studied in the literature (van Baalen et al. 2005, p.304). These electronic platforms provide individuals with a forum to spread not only their knowledge but also to express their personal opinions and views that will be recognized by others.

The need to belong could also be seen as a stimulus for joining networks. The need to belong is defined as a need to form and maintain at least a minimum quantity of interpersonal relationships among human beings (W. W. Ma & Yuen 2011, p.211). This theory explains how individuals are driven to gather interpersonal contacts and to cultivate possible relationships. Networks of practice provide individuals with the possibility to belong to a group. “Group cohesion and the natural drive of human beings to form groups create in individuals a desire for social interaction and for a sense of communion with others” (W. W. Ma & Yuen 2011, p.212).

Finally, relationship commitment and relationship need are also potential individual motivations. “The greater an individual´s need to maintain a relationship, the more that individual will be committed to the relationship, the individual will then spend more time and effort in consistent and continual interaction with the relationship partners” (W. W. Ma & Yuen 2011, p.212). Individuals do not only contribute with their expertise to the network but they also make use of the others’ contributions for their own professional and personal development. Their need for knowledge in a certain area motivates them to participate as well. In this way, members need the others as much as the others need them. This mutual necessity triggers and maintains the membership in the network.

4.2.3 Uncertainty within the Network

The relations between members in networks of practice are constrained to the use of electronic channels and to the exchange of knowledge to achieve a goal. Therefore, there is an inherent uncertainty in the communication and social processes that take place. Lack of information on the other participants, risks of free-riding and opportunistic behavior are some examples of sources of uncertainty in these networks.

Participants in networks of practice are typically strangers. In their Uncertainty Management Theory, BERGER & CALABRESE (1975, p.103) state that when strangers meet, their primary concern is one of uncertainty reduction or increasing predictability about the behavior of both themselves and others in the interaction. In this way, participants of networks of practice will pursue to gain information from the other members in an attempt to reduce uncertainty on the collaboration process. “High levels of uncertainty cause an increase in information-seeking behaviour” (Berger & Calabrese 1975, p.103). This will encourage that participants look for ways to gather information about their team co-workers for example through historical records of collaboration, references and profiles. The objective is to reduce uncertainty to an acceptable level in order to allow smooth, coordinated and understandable interactions to occur and for individuals to have a sense of control over their environment and outcomes (Goldsmith 2001, p.515).

The levels of uncertainty to which the members in these networks are confronted follow a similar development as the phases described in the Uncertainty Management Theory. During the entry phase uncertainty is higher. This uncertainty will be reduced as time and communication increase. “Given a high level of uncertainty present at the onset of the entry phase, as the amount of verbal communication between strangers increases, the level of uncertainty for each interactant in the relationship will decrease. As uncertainty is further reduced, the amount of verbal communication will increase”(Berger & Calabrese 1975, p.102). This implies that in the initial phases when uncertainty is higher, participants will gather all possible information from their team. Once shared work and communication increase over time, uncertainty is reduced to an acceptable level for smooth collaboration.

The open nature of networks of practice results in the participation of individuals of diverse social and demographic backgrounds. Members will have different abilities of perception, interpretation and different views on the world; therefore,

the cognitive distance between them might be high (van Baalen et al. 2005, p.303). Cognitive distance is here understood as the alignment of values and perceptions that allow understandability between individuals. This high cognitive distance between the participants will generate constant uncertainty in the communication processes.

The concept of similarity and its relation to uncertainty is studied in the Uncertainty Management Theory. Similarities along such dimensions as attitudes and conceptual structure produce interpersonal attraction (Berger & Calabrese 1975, p.105). This similarity between individuals reduces the level of uncertainty in a relationship. Similar individuals experience a higher interpersonal attraction and therefore engage into relations in an easier way. On the other hand, dissimilarities in attitudes and views raise uncertainty levels. In networks of practice, the possibility of higher dissimilarities among the participating members is high given the openness and the wide availability of the network. This results in high levels of uncertainty.

On the other hand, the inherent restrictions posed by electronic communication increase the degree of uncertainty experienced in these groups as well. In face-to-face interactions individuals receive social and visual cues and have access to immediate feedback (Wasko et al. 2009, p.257). In electronic networks, communication is done via the exchange of electronic messages. This hinders the possibility of the immediate assessment of reactions, attitudes and emotions in response to a message. Aspects such as eye contact, head nods and arm gestures represent the affiliated behaviour in communication and serve as means to reduce uncertainty in an initial interaction situation (Berger & Calabrese 1975, p.102). These cues are not present in these networks.

In their Media Richness Theory, TREVINO ET AL. (1987, p.557) propose ambiguity of the message as one of the main variables for the choice of media channels. In the presence of ambiguous messages, cues and feedback help interpret the message. “A shared definition of message content is created primarily through language and other social cues” (Linda Klebe Trevino et al. 1987, p.557). In networks of practice, the availability of social cues and feedback is limited. Therefore, in the presence of ambiguous messages, members have few alternatives to reduce uncertainty and have to rely only on written, electronic interactions.

Delayed feedback has an impact as well. Given that the more communication takes place, the higher the decrease in uncertainty will be, feedback and

reciprocation will play an important role in reducing uncertainty. When subjects do not receive any feedback, their level of uncertainty remains at a high level (Berger & Calabrese 1975, p.102). Therefore, we can assume that when delayed feedback occurs, uncertainty is higher. Members are forced to wait a period of time before receiving a response to their postings. This maintains uncertainty on a constant high level.

The knowledge created in a network of practice is open to everyone who possesses access to the appropriate technology (like Internet access). This wide availability allows information produced in these networks to be a public good. As such, it acquires certain characteristics that will play a role in the level of uncertainty experienced by the members. Public goods are nonrival and non-excludable. “Nonrival means that the good is not used up or depleted in its consumption” (Wasko et al. 2009, p.255). The fact that one individual makes use of the knowledge created in the network does not alter the possibility of another member using it as well. “Non-excludable refers to the inability to exclude noncontributors from consumption of the public good” (Wasko et al. 2009, p.255). All individuals in the collective can use this good regardless of their degree of contribution to the creation of that good. In this sense, everyone could make use of the results created by the network of practice without having to contribute with their own knowledge or time for it.

Following this logic, members of the network of practice have no control on the use and response to their contributions. “Knowledge seekers have no control over who responds to their questions or the quality of the responses. Knowledge contributors have no assurances that those they are helping will ever return the favour, and lurkers may draw upon the knowledge of others without contributing anything in return” (Faraj & McLure Wasko 2005, p.37). The phenomenon of free-riding could then appear. Individuals would then prefer to enjoy the benefits of the public good instead of contributing for it. They would make use and get advantage of the knowledge and outputs generated without investing their own effort on them. When all individuals would follow this merely rational individual and opportunistic behaviour, the further creation of knowledge would cease.

BERGER & CALABRESE (1975, p.105) use the concept of information power to refer to a similar problematic. “It seems reasonable to assume that the easiest way in which to reduce mutual uncertainty would be to ask for and give the same kinds of information at the same rate of exchange” (Berger & Calabrese

1975, p.105). This applies mostly in the initial phases of interaction when uncertainty is higher. If all members would contribute in the same amount, no member in the network of practice would then be able to gain information power over the other. However, there is no assurance of reciprocity in these networks. The fact that one member discloses his knowledge and expertise does not assure that he will receive the same amount, value or quality of information back. This asymmetry in information power is a constant source of uncertainty.

Following a network approach, the position within the network is also influenced by the contributions of a member and it influences uncertainty. The giving away of knowledge eventually causes the possessor to lose his or her unique value relative to what others know (Wasko et al. 2009, p.258). Thus, the benefits of contributing are greater for the others than for the contributor himself. Aspects such as status, reputation and social acceptance depend greatly on the perception that members develop from the contributions of the others. The contributor would then endanger his position by giving away his knowledge without the assurance that this effort will be rewarded with a reply. Figure 4.2 gives a graphical overview of the sources of uncertainty in the networks.

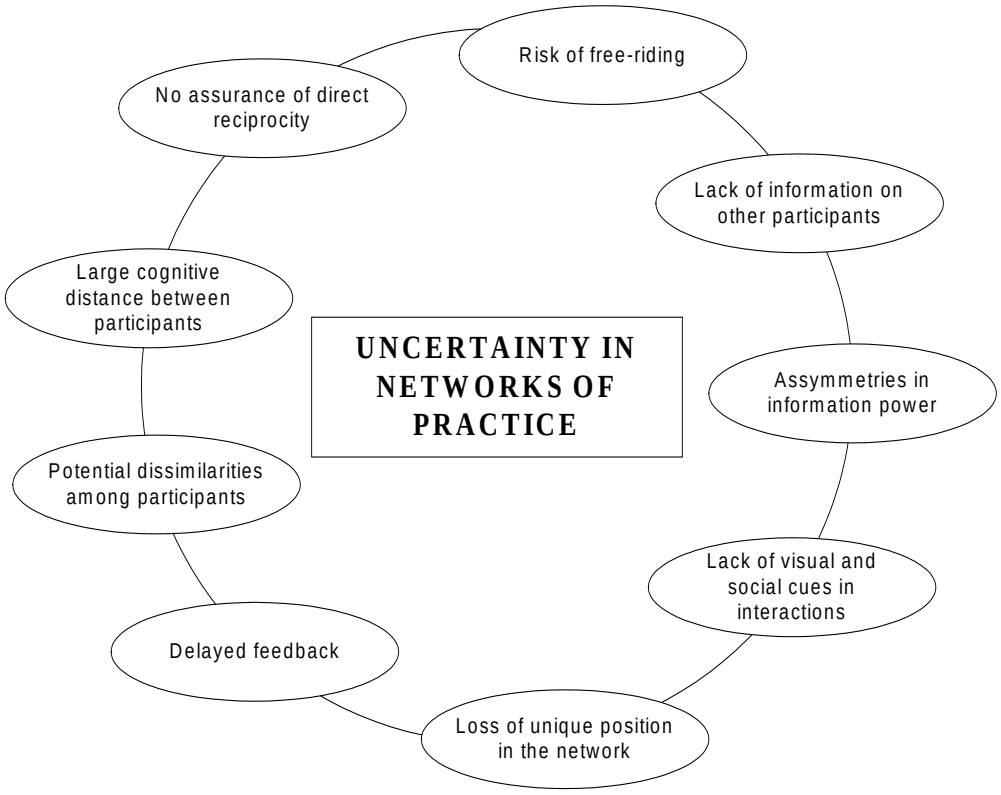


Figure 4.2: Sources of Uncertainty

4.3 Social Capital in a Network of Practice

Networks of practice are activity systems of individuals that self-organize to achieve a goal. This self-organization occurs through social controls that allow the coordination of work. The exchange of ideas in these networks results in the co-production of knowledge as primary output and result. Ties and communication between members are based on this knowledge exchange and reciprocation occurs only on an indirect way (McLure Wasko et al. 2004, p.501).

Trust will become a requirement for collaboration. “Trust is a key enabler in relations between spatially and temporally dispersed people when information asymmetry, uncertainty, and fear of opportunism threaten to inhibit the virtual community” (Fang & Chiu 2010, p.236). The organization, the communication and interaction processes as well as trust will constitute the social capital of a network of practice that will promote collaboration and knowledge sharing. In the following sections, a detailed analysis of these components will describe its importance and dependencies.

4.3.1 Communication and Interaction Processes

Communication in networks of practice takes place through computer-mediated channels. This provides the network with specific characteristics. The knowledge created is stored in repositories which results in an archive of information that can be openly accessed for future reference (McLure Wasko et al. 2004, p.498). In the same way, messages are stored to create a history of the interaction and communication processes. These repositories are available regardless of the participation in the original exchange. The visibility that results from this phenomenon provides network members with complete information about the conduct of other network members, and sharply contrasts with the ephemeral, typically private conversations between a limited number of individuals that occur in face-to-face communication (McLure Wasko et al. 2004, p.498).

The openness and lack of privacy in the communication reduces familiarity and closeness in the interactions. There is no assurance that the postings and effort will be reciprocated by the other participants. WASKO ET AL. (2004, p.501) propose that interaction within networks of practice follows a generalized exchange pattern. “This occurs when one´s giving is not reciprocated by the recipient but by a third party” (McLure Wasko et al. 2004, p.501). This results in an indirect reciprocation with little personal acquaintance.

The interaction in these networks is based on knowledge and information exchanges. The ties that result are then weak in personal and relational content. “Network structures characterized by dense, reciprocal ties are likely to create strong, relational ties between individuals” (McLure Wasko et al. 2004, p.502). In networks of practice, the lack of direct reciprocation leads to weak ties that do not create any personal relation between participants. WASKO ET AL. (2004, p.502) propose that relations among individuals become less relevant and relations between individuals and the network as a whole create a substitution for these relational ties. The identification with the network and the generalized feelings of solidarity substitute the lack of dyadic relations. “The more the structure of ties in the network is characterized by generalized exchange, the greater the likelihood that the relational strength of the ties is determined by the quality of the tie between each individual and the network as a whole” (McLure Wasko et al. 2004, p.502).

4.3.2 Organization

The non-hierarchical nature of these networks creates the need for other kind of controls. WASKO ET AL. (2004, p.503) propose that social controls coordinate the behavior of participants in the network. “Social controls based on value consensus within a network may be more powerful, less apparent, and more difficult to resist than formal controls, constraining behavior even more effectively than formal contracts or hierarchical structures” (McLure Wasko et al. 2004, p.503). Social controls in the shape of social incentives such as reputation and status represent an important asset for enabling coordination and cooperative behavior within the network. To harm a member´s reputation can greatly impact his record in participation and therefore hinder his future collaboration possibilities.

4.3.3 The Role of Trust

Trust is one of the main conditions for cooperation in groups. Taking a sociological perspective, trust must be conceived as a property of collective units, not of isolated individuals (Lewis & Weigert 1985, p.968). In networks of practice, where members come together to achieve a shared goal, trust will play an important role. “Trust can be regarded as the belief in, and willingness to depend on, the other party as the center of knowledge exchange and is important to successful relationships” (Fang & Chiu 2010, p.238). Trust is then a basic component of solidary engagements.

Trust can be seen as a tool for the reduction of complexity in our social lives. Considering that it is not possible to collect the totality of information from our environment in order to rationally predict the behavior of it, trust becomes a functional alternative to rational prediction for the reduction of complexity (Lewis & Weigert 1985, p.969). In this sense, trust represents a solution for handling complexity in our sociological environment and for the reduction of uncertainty.

In networks of practice, individuals are confronted with high levels of uncertainty in their communication and interaction process. The low level of relational ties between them creates a complex environment for the exchange of knowledge. Therefore, the analysis in this paper will concentrate in two different perspectives on trust. On a first step, sources of trust deriving from the relations between the individuals on an interpersonal level will be analyzed. However, these sources of trust are not enough to fully explain its complex nature in these networks. For this reason, other views that derive from environments with higher anonymity and generalized reciprocity will be analyzed. These perspectives that include fairness and justice will serve as complementary and necessary concepts to create a complete picture of the trust processes in networks of practice.

Interpersonal Sources of Trust (Behavioural and Cognitive Trust)

Generally, trust is explained through three main components: benevolence, competence and integrity (Fang & Chiu 2010, p.238). Benevolence refers to the willingness of a party to benefit another. Competence is the belief in the trustee´s ability or skills to fulfill his task as expected. Integrity is the expectation that another will rely on socially accepted principles of behavior (Fang & Chiu 2010, p.238). In networks of practice these three components will be present and are necessary for a smooth collaboration between the members.

As previously mentioned, during initial interactions, individuals will search for information about the other participants. Reputation based on previous projects, history of participation and member profiles will provide some information on the competence and integrity of the members. Some individuals might even have the possibility to collaborate with participants with whom they have collaborated in previous projects. “People prefer to work with those with whom they have worked in the past because of reduced uncertainty stemming from familiarity based on prior collaborative experiences” (Hahn et al. 2008, p.373). An early feeling of confidence on the competences of the others will be created from these initial impressions.

According to LEWIS & WEIGERT (1985, p.969) , trust has three dimensions: cognitive, emotional and behavioral. Cognitive trust relates to a rational choice of the persons and institutions we will trust. We base this choice on “good reasons” that represent for us an evidence of trustworthiness. The idea of cognitive familiarity plays here a role. “Trust involves a degree of cognitive familiarity with the object of trust that is somewhere between total knowledge and total ignorance” (Lewis & Weigert 1985, p.970). Cognitive trust is manifested when individuals don´t need any further rational evidence for their confidence to trust. Therefore, it opens a door that allows a leap towards trusting based on the idea that the others will also trust. “Each trusts in the assumption that others trust” (Lewis & Weigert 1985, p.970).

The emotional aspect of trust relates to its affective component and the emotional bond that emerges between individuals. This is found in deep personal relations such as friendship and it contributes to its cognitive base. Finally, the behavioral dimension refers to the practical significance of trust and it helps to create the cognitive platform of trust. “The behavioral content of trust is the undertaking of a risky course of action on the confident expectation that all persons involved in the action will act competently and dutifully” (Lewis & Weigert 1985, p.971). We constantly assess the behavior of others and define if their actions imply that they trust us. In this case, we reciprocate with trustworthy actions increasing the overall feeling of trust.

The three dimensions of trust interact with each other and they are present in different shares in all social situations. In networks of practice, where individuals come together with the purpose of achieving a goal and where personal ties are constrained by the electronic media channel, the behavioral and cognitive dimensions of trust will play a larger role. Cognitive trust will appear when based on the initial interactions, and on the perception of reputation and status of the members, a participant finds evidence to trust on the competences and integrity of the others. The level of familiarity will be achieved by the common interest and by the commitment in the fulfillment of the shared goal. Participants will then feel confident to collectively trust on the others as well.

Behavioral trust on the other hand appears when participants decide to disclose their expertise and knowledge assuming the inherent risks to it. When members of the network observe others collaborating and sharing knowledge, they will reciprocate by sharing their knowledge as well. Even if there is no warranty to

assure the benevolence, competence and integrity of the members, an individual could take the risk and engage in interaction.

These types of trust provide participants with a degree of confidence to encourage their participation in the network. However, given the high levels of uncertainty faced in networks of practice and the low personal contact among the members, cognitive and behavioral trust in the benevolence, integrity and competences of the other participants might fall short to explain the complete collaboration process. Therefore, different sources for trust and for trusting behaviors such as fairness and justice will be now studied.

Fairness and Justice as Substitutes for Trust

The behavior of individuals within social groups is highly dependent on the level of uncertainty they are faced with. “Uncertainty in organizational and social settings creates a need for trust-based interaction” (Lind & van den Bos 2002, p.182). In networks of practice, where uncertainty is high, the need for trust becomes imperative. However, given this conditions of uncertainty and low relational strength, the traditional sources of interpersonal trust are not enough.

Fair treatment has been associated to positive effects such as commitment, satisfaction and acceptance in social and organizational settings. LIND & VAN DEN BOS (2002, p.184) argue that fairness effects are not constant and that fair treatment has more powerful effects under conditions that create the impression that the situation is uncertain. Therefore, their findings could bring more light into understanding the processes of coping with uncertainty in networks of practice.

The feeling of fairness within networks of practice is associated to how the effort and time that participants invest in collaboration is rewarded. Even under conditions of generalized exchange, participants should sense indirect reciprocation to their contributions. “A member may evaluate the equity of what he/she has received (e.g. the action and speed at which responses and knowledge are received) in relation to that what he/she has contributed in terms of time spent, effort made, and help provided” (Fang & Chiu 2010, p.239). The global impression of fairness assessed by the individuals will be based on the general functioning and organization of the network. “A global impression of fair treatment based on information from procedures, interactions and outcomes is the key to managing uncertainty” (Lind & van den Bos 2002, p.196). In this way,

participants will experience an overall feeling of fairness when they feel supported by the outcomes and the procedures followed in the network.

The sense of fairness will allow members to engage in collaboration and disclosure of information. On the other hand, when the sense of fairness is missing, opportunistic and competitive behavior could take place. “When uncertainty is coupled with clearly unfair treatment, the person will engage in self-protective or even competitive actions in order to relieve the uncertainty by seizing control of his or her own fate and identity” (Lind & van den Bos 2002, p.196). This means that network participants that do not sense global fairness would act in their self-interest and they would not collaborate in the creation of knowledge. They would engage in self-riding behavior enjoying only the personal benefits of the public good.

As uncertainty increases, the importance of fairness increases as well. “Fairness effects are stronger under conditions of greater uncertainty” (Lind & van den Bos 2002, p.195). Therefore, in initial stages in networks of practice, as the collaboration starts, the need for fair treatments becomes imperative. When these early fair experiences are positive, stronger group identification comes to place reinforcing the future sense of global fairness. The initial impression of other participants´ competences and attitudes as well as of the overall functioning of the network will be essential for the sense of confidence that individuals will have on the outcomes of the project. “The perception that the environment (or major entities in the environment) is fair helps individuals to deal with uncertainty” (Lind & van den Bos 2002, p.195).

The transition from fairness to trust is then vital for understanding the dynamics in these networks. We talk then about identity-based trust. “Identity often works by giving people a shared cognitive category that they can use to establish a feeling of trust in those whose otherwise uncertain actions affect them” (Lind & van den Bos 2002, p.201). LIND & VAN DEN BOS (2002, p.201) argue that fairness gives this sense of identity and it can therefore create a sense of trust. Fairness becomes a substitute and enhancement of identity and trust. This means that in situations when trust is not present, fairness can provide the support needed to help people manage with uncertainty. In other words, fair treatment enhances trust especially in the context of external uncertainty (Lind & van den Bos 2002, p.201).

In the context of networks of practice, these findings become important. The high uncertainty experienced and the low relational strength in the ties between

individuals lead us to conclude that trust based on interpersonal relations is not enough. Therefore, fairness acts as a substitute and as a source of trust for participants in these networks. Individuals feel then the necessary trust to collaborate and to disclose knowledge when they perceive a global feeling of fairness in the network. This feeling comes through the proper organization and use of the created knowledge and through the confidence in the quality of the outcomes of the project. Additionally, the treatment they receive from the other members will impact the assessment of fairness as well. People look to the fairness of their treatment for information about whether they are valued members of the social entity (Lind & van den Bos 2002, p.202). Through these judgments, individuals will decide whether they will collaborate or not in the network of practice.

The global impression of fair treatment results from the assessment of the overall organization of the network. The concept of system trust might assist us to further clarify this idea. LEWIS & WEIGERT (1985, p.973) describe system trust as the trust in the functioning of bureaucratic sanctions and safeguards that characterize modern, complex societies. This type of trust appears where widespread anonymity in large systems makes people interact with individuals they hardly know. This trust functions as a warranty to the trustworthiness of individuals and norms. “System trust is activated by the appearance that everything seems in proper order” (Lewis & Weigert 1985, p.974).

In networks of practice, the sense of fairness comes from the assessment of the global organization and structure of the network. A proper functioning of the network, where individuals share their knowledge in a structured and ordered way, generates a feeling of fairness in the system. When participants sense this order and proper organization, they feel comfortable contributing and sharing. The assessment of a positive overall fairness in the network will enhance the trust in its system. We can then find a relation between fairness and system trust to assume that the global impression of overall fairness is positively related to system trust. Electronic platforms, where individuals share expertise and receive at the same time valuable knowledge, offer enough fairness perception that translates into trustworthiness. Then, individuals show willingness to overcome the risks of uncertainty and to engage in shared collaboration. This idea is supported by the analysis of relational ties in networks of practice made by WASKO ET AL (2004, p.502). In their study, WASKO ET AL. (2004, p.502) propose that the relevant ties that provide relational strength in networks of

practice are not the ones between individuals but the ties between each individual and the network as a whole.

System trust implies that individuals perceive fairness in the network as a whole. In this kind of trust, no emotional bond between individuals is needed. “Personal trust and system trust rest on different bases” (Lewis & Weigert 1985, p.974). The trust in the network as a whole proposed by WASKO ET AL. (2004, p.502) is then a type of system trust that provides individuals with an essential identity for communication.

The Relation of Justice and Trust

The concept of justice stays in close relation to fairness. “Justice reflects perceptions of fairness and assessment concerning the appropriateness of performance outcomes or processes” (Fang & Chiu 2010, p.239). Four main types of justices are generally identified: distributive, procedural, interpersonal justice and informational justice. Distributive justice refers to the perceived fairness of the outcomes. Procedural justice relates to fairness in processes that allow the creation of the outcomes. Interpersonal justice describes the degree of politeness, dignity, friendliness and respect that participants receive from others. Finally, informational justice explains the extent to which individuals are provided with information to how decisions are made and how outcomes are distributed (Fang & Chiu 2010, p.239).

In networks of practice, these types of justice are present and they result in the perception of trust. When participants perceive that their effort is proportional to the outcomes, they experience distributive justice (Fang & Chiu 2010, p.239). The time and effort that a member of the network invests in the project are rewarded by the quality of the outcomes. Procedural justice is found when the procedures and policies followed in the network of practice are perceived to be fair. A member who feels that violations to the norms, values or goals to the network are not punished in an appropriate way will not sense procedural justice. Social controls play a role in these procedures.

As mentioned before, networks of practice need to find ways to coordinate and organize the work through non-hierarchical controls. The use of social controls was previously enlightened as an efficient way to coordinate the collaboration. Social controls can be either positive or negative. Among the negative social controls we can find flaming, shunning and expulsion of the network. “Negative social controls are punishments enforced by network members on individuals

who violate network norms, values, or goals" (McLure Wasko et al. 2004, p.503). Their effectiveness will impact the sense on procedural justice.

Interpersonal justice can be also found in networks of practice. Participants of the network will assess the quality of the interpersonal treatment they receive during the collaboration. The politeness, dignity, friendliness and respect with which the other members treat individuals will define the sense of justice. Given the self-organizing and non-hierarchical nature of networks of practice, informational practice will play a slightly smaller role. The decisions taken in the network will follow social controls agreed by all members. Therefore, the information of these decisions will be widely available creating a generalized sense of informational justice for all members.

The justice experienced in the network will result in an enhanced perception of fairness and therefore in a greater sense of trust. Figure 4.3 shows graphically these relations. As distributive, procedural, interpersonal and informational justices increase, the base for cognitive, emotional, behavioral and system trust increases. The cognitive base that allows individuals to discriminate among persons and institutions that are trustworthy will be positively affected when informational and procedural justices are in place. In the presence of distributive justice, the behavioral enactment of trust will become easier to achieve. Interpersonal justice allows for a certain affective component that helps to create a sufficient emotional base to engage in knowledge sharing activities. The sense of fairness in policies and procedures enhances the trust in the system as well.

These relations are neither independent nor unidirectional. Cognitive trust enhances the perception of fairness in outcomes of distributive justice the same way that distributive justice affects behavioral trust. All of these components create an overall feeling of trust that allows individuals to engage into knowledge sharing activities even in conditions of high uncertainty like in networks of practice. Therefore, it is essential that the perception of fairness and that the elements of justice are maintained in the network to reach the necessary trust for collaboration.

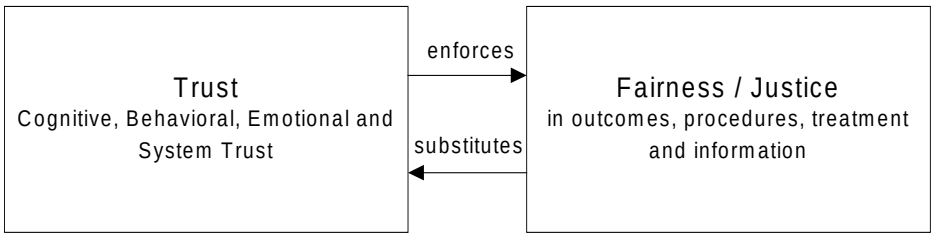


Figure 4.3: Fairness and Justice as Substitutes for Trust

4.3.4 The Creation of Social Capital in the Network of Practice

The processes of communication and interaction, the structure embedded in the network and the trust processes that take place create the social capital of the network of practice. Social capital refers to the resources embedded in a social structure that are accessed and/or mobilized in action (Faraj & McLure Wasko 2005, p.38). It is found in the relationships between individuals and not in the individuals themselves. “Social capital refers to networks, norms, trust, and mutual understanding that bind together the members of human networks and communities, and enable participants to act together more effectively to pursue shared objectives” (Widén-Wulff & Ginman 2004, p.449).

WIDEN-WULFF & GINMAN (2004, p.450) have studied the relation between social capital and knowledge sharing. Generally, social capital is described through three dimensions: structure, content and relational dimensions. The structure dimension is concerned with access to other actors. It involves traditional information science concepts such as availability, reference and time. More specifically, it refers to information behavior in the social network (Widén-Wulff & Ginman 2004, p.450). It includes the structural mechanisms of knowledge sharing. On the other hand, the content dimension refers to the information exchange (the ability to gather, interpret, organize, store and disseminate information) and to problem identification. This means that the network has to be able to exchange information with the objective of identifying problems and finding appropriate solutions. It is concerned with the analysis of the information of the internal environment and its communication processes. Finally, the relational dimension is concerned with expectations and obligations as central features of social capital (Widén-Wulff & Ginman 2004, p.451). Three main aspects come here in play: trust, identification (extent to which actors view themselves as connected to other actors) and social system closure (component that allows the fulfillment of norms).

These three dimensions play an important role in knowledge sharing processes. In networks of practice, the structural dimension represents the organization and structure of the network. The non-hierarchical and open nature, the self-organizing activities and the existence of social controls for the coordination of work represent the structural social capital embedded in the network. The participants will develop the appropriate social incentives and punishments to allow smooth collaboration. This emerging structure represents a source of social capital.

The content dimension is achieved through the communication and interaction processes that allow information exchange. The characteristics of the electronic communication such as the possibility to create a history of message or to construct an archive of knowledge belong to this dimension. Additionally, the generalized exchange and delayed feedback characteristics of information should be also considered. Individuals develop the necessary skills to cope with these circumstances and to develop means to adapt to this type of communication processes. These emerging skills become part of the content dimension of social capital.

The structure of the organization and the interaction processes among members in the group form a network of relations that gain strength as the number of exchanges increase with time. As the exchanges increase, the cognitive distance among members decreases and the ties becomes stronger. The strength of the ties between the members and between each member and the network as a whole result in trust and common identity. This leads to the relational dimension of the social capital in the network. The existence of fairness perceptions and justice of outcomes, procedures and treatment among individuals will substitute and enhance the feelings of trust and identity. Therefore, individuals will create the necessary links to cope with uncertainty and engage in collaboration. These relations are represented in figure 4.4.

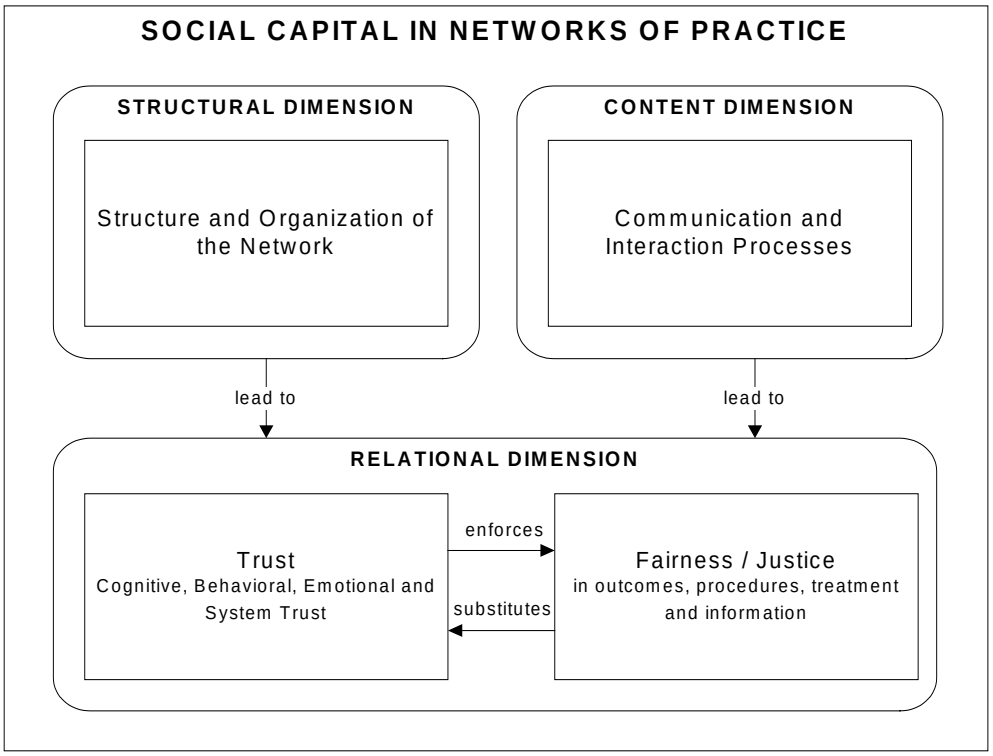


Figure 4.4: Components of the Social Capital in Networks of Practice

The strength of the social capital in the network will allow members to cope with uncertainty. All components of social capital will reduce the perception of uncertainty and will enhance collaboration. The structure of the network and its communication processes will allow coordinated work. Trust and fairness perceptions will reduce negative feelings of uncertainty in the members. In the same way, uncertainty will have an influence on the elements of social capital. Uncertainty will impact the structure and communication processes in the network by creating a need for higher and more effective social controls and information exchange processes. On the other hand, it will increase the perception of fairness and the need for trust. In environments where uncertainty is high, individuals rely more on perceptions of fairness and trust. These relations are explained in figure 4.5.

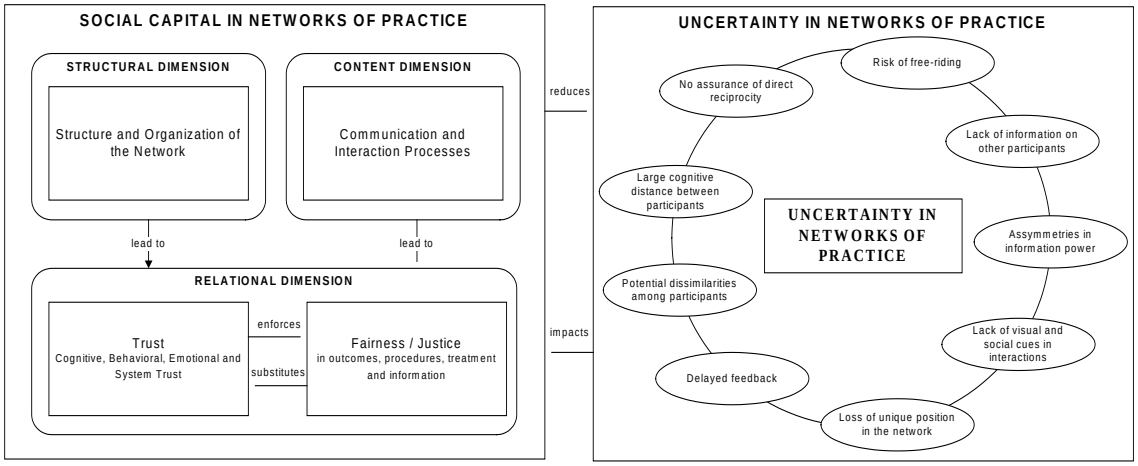


Figure 4.5: Social Capital as a Tool for Overcoming Uncertainty

4.4 Collective Action in Networks of Practice

Up to now the creation of social capital in a network of practice and its value as a tool to cope with uncertainty has been studied. The elements included in this capital will create the necessary commitment and willingness to engage in cooperation for knowledge creation. “Commitment to a collective, such as an electronic network of practice, conveys a sense of responsibility to help others within the collective on the basis of shared membership” (Faraj & McLure Wasko 2005, p.42). Individuals perceive a moral obligation to pay back to the network. This will result in collective action.

Since knowledge represents a public good in networks of practice, collective action for its creation is needed to overcome free-riding and opportunism. “It is widely recognized that collective action and the creation of public goods appears despite rational self-interest and the ability to free-ride” (Wasko et al. 2009, p.256). Therefore, the social capital embedded in the network is the base for this collaboration that translates into commitment and obligation.

The feeling of commitment towards a group is studied in the concept of Organizational Citizenship Behaviors. The voluntary willingness of contributing to the creation of knowledge is an example of such behaviors. “Knowledge-sharing can be conceived as a form of citizenship behavior” (Fang & Chiu 2010, p.237). Aspects such as altruism and conscientiousness have been used to explain why individuals engage in knowledge sharing processes. Organizational Citizenship Behaviors are performed by personal choice and could help explain the voluntary nature of participation in networks of practice.

The existence of effective ways of organization within the network, the availability of communication channels and the skills to use them effectively as well as the trust and fairness conceptions are all sources of motivation for citizenship behaviors that allow collective action . Trust creates a sense of unspecified obligation that may be displayed in citizenship behaviors. “It seems reasonable to suggest that when trust exists between parties, one will be more willing to engage in Organizational Citizenship Behaviors” (Fang & Chiu 2010, p.236).

Both altruism and conscientiousness are related to trust and social capital. Networks with strong social capital possess the necessary motivation to engage in collective action based on Organizational Citizenship Behaviors such as altruism and conscientiousness. Additionally, fairness and justice stay in positive relation to these behaviors as well. “Fairness does not only builds trust between members, but also serves to conquer the dilemma of public good in relation to knowledge sharing” (Fang & Chiu 2010, p.239).

In this way, the social capital in the network will fulfill a dual task. On the one hand, it will provide individuals with a tool for coping uncertainty. On the other hand, it will provide the base for citizenship behaviors that support the collective action for the creation of knowledge as a public good. Therefore, in the presence of social capital in terms of structure, communication and relations, individuals will engage in collaboration for knowledge creation despite of the uncertainty faced in electronic networks of practice. Figure 4.6 shows the integrated model that graphically shows these relations.

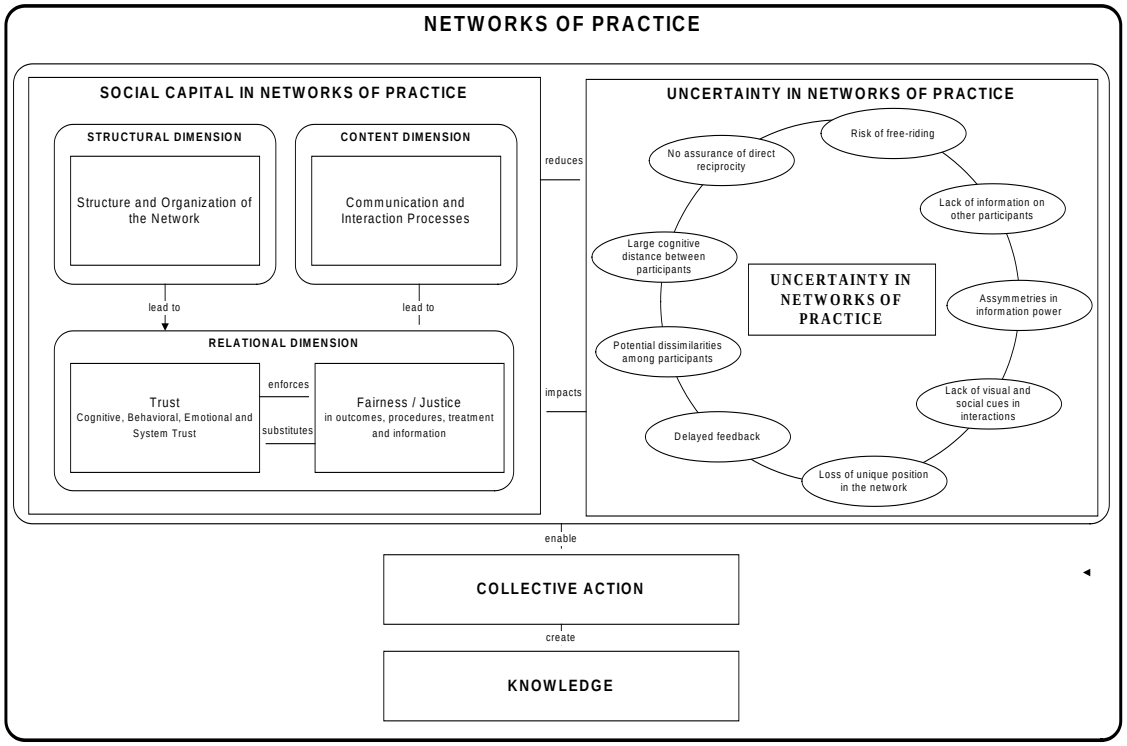


Figure 4.6: Integrated Model of Networks of Practice

4.5 Concluding Remarks

Networks of practice are a valuable source of knowledge and innovation. Understanding the complexity of the social processes that take place within these networks is essential to understand the reasons that drive individuals to collaborate and to create value. Only when these processes are fully understood, the creation and successful deployment of these communities can be encouraged. The current paper has shown an analysis of the structure, the communication processes and the relational aspects in these networks. The role of fairness, justice and trust has been emphasized as essential components of the social capital in the network that serves as a tool to cope with uncertainty and to engage in collective action for the creation of knowledge.

The question of why do individuals in networks of practice engage in collaboration and which role do communication and trust play in the process of overcoming uncertainty has been answered by providing a model that identifies the main social components of these networks that lead to collaboration and value creation. By analyzing in detail the components of the social capital and the sources that create uncertainty among members, it is reasonable to state that thanks to the organization and structure of the group, to the communication and interaction processes as well as to the trust components in the form of

fairness and justice, individuals overcome uncertainty and engage in collective activities to create value. An empirical proof of the model remains open in order to provide confirmation as well as further insights. Therefore, it can be used as a suitable foundation for further analysis.

The scope of this paper was limited to the understanding of the social processes that lead to collaboration in the network. However, there is a large field of opportunity for research in relation to the use and value that can be given to the knowledge created in these networks for organizations and society. A large number of firms encourage the creation of these communities to have access to the insights and innovative ideas that emerge from these undertakings. They bring together companies and customers and provide an opportunity for both parties to extend their knowledge on specific areas. The open nature of these networks, provide also benefits for society. Any person with access to the right technology can take advantage of the value and expertise from others and of the outputs of these projects. Therefore, this paper is also an invitation for further research and analysis on this area that can provide deeper foundations for the successful creation and support to these networks.

5 Cloud Computing – Governing Uncertainty in Distributed Electronic Business Networks

Nils Labusch

5.1 Uncertainty, Governance & the Cloud – Demystifying the Mysteries

Cloud computing is a topic that is, even if dealt with in industry as much as in science (L. Wang et al. 2008, p.825), shrouded in a certain mystery (Rittinghouse & Ransome 2010, p.xxv). The term itself occurred during the last years (L. Wang et al. 2008, p.825) and transfers the trend of an increasing service orientation from other industries and the society into the IT world – especially by no longer providing products (like of-the-shelf-software) but instead the software “as-a-service” (Böhm et al. 2010, p.14).

At almost the same time the topic no longer only permeates information technology related publications but also public media. New sources of uncertainty evolve, e.g. by using the cloud in order to run dictionary attacks against protected wireless networks in very short times by using very few financial resources – $1.68 seems to be enough to decode a wireless network key (heise Security 2011). The topic further gets attention from governmental bodies like the European Network and Information Security Agency (ENISA) that develop guidelines on how to deal with cloud computing and the relevant security issues (Catteddu 2011). However, its flexibility and low prices allow for the development of new business models that deal with uncertainty, businesses had to cope with for decades.

Currently the topic of cloud computing is pervaded with a high variety of buzzwords and abbreviations that are used by different authors in different ways – mostly because cloud computing is just emerging in research and most existing literature focuses on technical aspects derived from grid computing (Böhm et al. 2010, p.20). Since we are interested in the business side, especially the question occurs on what are the differences between cloud computing and outsourcing? This question is even more apparent, when we ask about differences in the governance and the amount of uncertainty that comes along with both concepts. For that reason, our first addressed research question is:

RQ1: What are similarities and differences between outsourcing and cloud computing?

We concentrate the next research question on concrete mechanisms that help to govern different kinds of uncertainty by the concept of cloud computing – we formulate this question as follows:

RQ2: What are mechanisms and aspects to govern uncertainty by cloud computing?

Our third and last research question points to the factors of uncertainty that come along with the concept of cloud computing itself – we formulate the following research question:

RQ3: How to govern cloud computing to handle uncertainty?

We proceed as follows: First, we provide a brief introduction into the theory background of governance and outsourcing. We introduce the cloud as a distributed electronic business network and illustrate the current state of cloud computing. Second, we show the findings of a literature research about linkages between these concepts. This includes governing uncertainty, outsourcing governance and the relation between outsourcing and cloud computing. We discuss and reflect these findings on governing uncertainty related to cloud computing in the discussion paragraph. We conclude with a summary and further research propositions. The structure of the section and the relevant theoretical concepts are illustrated in figure 5.1. Our overall discussion within this section takes place in the context of uncertainty, governance and business networks.

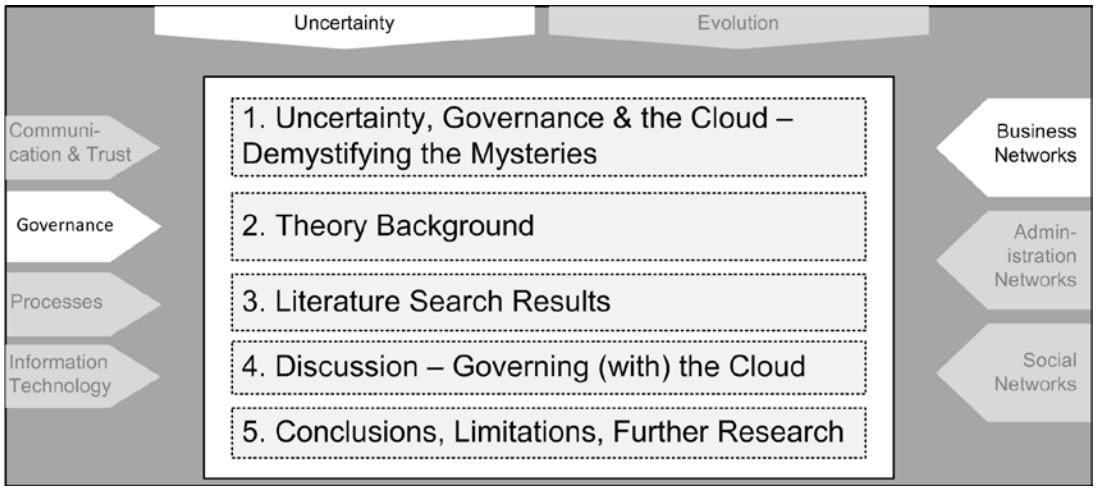


Figure 5.1: Structure of the Section

5.2 Theory Background

5.2.1 Governance

According to HEIDE (1994, p.72), governance is “a multidimensional phenomenon, encompassing the initiation, termination and on-going relationship maintenance between a set of parties”. DAILY ET AL. (2003, p.371) focus on resources when defining governance as “the determination of the broad uses to which organizational resources will be deployed and the resolution of conflicts among the myriad participants in organizations”. These two definitions refer to governance as a much broader concept than control. In here, governance includes elements of establishing and structuring exchange relationships as well as aspects of monitoring and enforcement (Heide 1994, p.72).

However, still other authors stay in the tradition of understanding governance in the way of having different mechanisms to protect shareholders from self-interests of other players (e.g. executives) (Daily et al. 2003, p.371). For example, DIXIT (2009, p.5) defines economic governance as “the structure and functioning of the legal and social institutions that support economic activity and economic transactions by protecting property rights, enforcing contracts, and taking collective action to provide physical and organizational infrastructure”, emphasizing mostly on control structures.

In business networks, governance is no longer limited to single organizations or other entities. This also shifts the focus from bureaucratic structures and formal contracts to informal social systems between organizations in order to coordinate complex products or services in uncertain and competitive environments (Jones et al. 1997, p.911).

5.2.2 Outsourcing

Outsourcing occurs in manifold shapes, like information systems (IS) outsourcing (e.g. Hu et al. 1997; Miranda & Kavan 2005), information technology (IT) outsourcing (e.g. Hancox & Hackney 2000; Loh & Venkatraman 1992) or even outsourcing of whole business processes (e.g. Mani et al. 2010). A special case is offshoring, which describes, “outsourcing performed outside the client organization’s home country” (W. R. King & Torkzadeh 2008, p.207). We are not going to discuss the differences in detail and rather focus on some exemplary definitions of IS- and IT outsourcing.

In a very abstract way we could interpret outsourcing as a make- or buy decision that a company should take (Loh & Venkatraman 1992, p.9). More in detail LOH & VENKATRAMAN (1992, p.9) define IT-outsourcing as the "significant contribution by external vendors in the physical and/or human resources associated with the entire or specific components of the IT infrastructure in the user organization". HU ET AL. (1997, p.288) define IS outsourcing as "an increasingly common business practice in which a company contracts all or part of its information systems operations to one or more outside information service suppliers. This is done to acquire economic, technological, and strategic advantages". Meanwhile these older definitions emphasize on the aspect of contracting some other party in order to gain advantages, e.g. MIRANDA & KAVAN (2005, p.152) also include an aspect of partnership in the definition by stating that "IS outsourcing is a boundary-spanning inter-organizational relationship, in which functions traditionally performed in-house are performed by another organization".

BEHRENS (2007, p.6) extracts out of these and further definitions the following three main determinants of IS outsourcing:

- Involvement of functions like systems operations, application development, application maintenance, network and telecommunications management, help desk, desktop services, end user support, or systems planning.
- Management of these functions by a service provider external to the organization.
- Contract that defines the arrangement and regulates the exchange.

There are several reasons that lead to outsourcing projects in organizations. The most important is saving costs – more than half of the findings investigated by LACITY ET AL. (2009, p.132) report that IT outsourcing is primarily done by firms with poor financial performance. Other reasons are focusing on core capabilities, accessing expertise and skills, increasing flexibility or improving the business process performance (Lacity et al. 2009, p.134). HU ET AL (1997, p.299) further discuss other influences like external media, vendor pressure and internal communication on a personal level among managers to have a significant influence on outsourcing decisions.

However, outsourcing goes along with downsides and risks that might occur. Often mentioned examples are a loss of in-house capability, no overall cost

savings because of biased portrayal by vendors, cultural differences between client and supplier or excessive transaction costs (Lacity et al. 2009, p.136).

5.2.3 Clouds as Distributed Electronic Business Networks

In general, business networks are “cooperative arrangements between independent business organizations that vary from contractual joint ventures to informal exchanges of information” (Lynch et al. 2009, p.164). Additionally in this paper we put special emphasize on the aspect of distribution. Adding this aspect implies that the whole value creation is conducted by bringing together different parts of a supply chain spread around different firms (Iansiti 2004, p.5).

Nowadays, in industries as different as personal computers and personal care products, companies leveraged multiple organizations in distributed supply chains, integrated technological components from a variety of business alliances, collaborated with a number of channel partners to distribute their products, and leveraged complementary services from banks, insurance providers, or retailers. This pushed many industries into a fully networked structure, in that even the simplest product or service is now the result of collaboration among many different organizations (Iansiti 2004, p.5f).

In the remainder of the paper we will mostly concentrate on such networks dealing with electronic business (e-business). We follow the broad definition by AMIT & ZOTT (2001, p.500) who define an e-business firm as “one that derives a significant proportion (at least 10%) of its revenues from transactions conducted over the Internet”. This includes companies who use the internet mostly as a sales channel as much as companies that purely generate their revenues out of the internet (Amit & Zott 2001, p.500f.).

Joining these definitions into a working definition, we consider a distributed electronic business network to be a cooperative arrangement between independent business organizations that in a joint process create and provide an electronic service or product.

This definition fits content-wise most definitions of cloud computing given in literature that we are going to discuss in the following paragraphs.

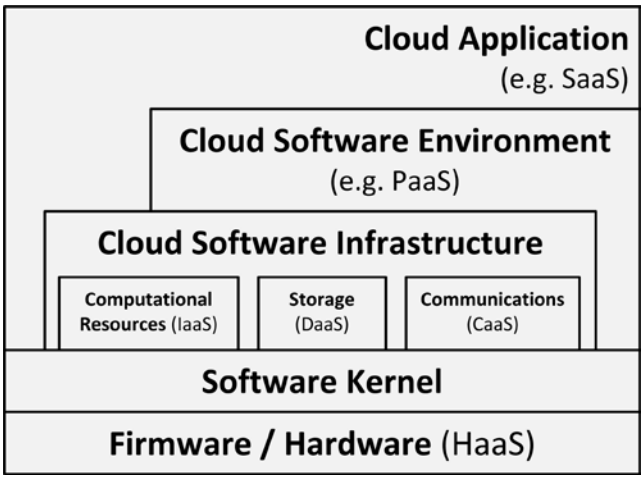
5.2.4 Cloud Computing

So far, there is no commonly agreed on definition on cloud computing (L. Wang et al. 2008, p.825). Reasons are the existence of different views on cloud

computing (e.g. by researchers from grid computing, data storage or software engineering), the continuous emergence of the underlying technologies (e.g. web 2.0 or service oriented architectures) and the still low overall usage of cloud computing services (which would finally justify the concept) (L. Wang et al. 2008, p.825). Thus, also the different terms and abbreviations that come along with cloud computing are not yet sharply defined and used in a common sense (Armbrust et al. 2010, p.50).

ARMBRUST ET AL. (2010, p.51) define the *cloud* as the data center hard- and software. When such a cloud is made available to the public, it can be called a *public cloud*. If it is an internal data center of one organization it is called *private cloud* (Armbrust et al. 2010, p.51). MELL & GRACE (2009, p.2) further mention *community clouds* (in the middle of private and public clouds, e.g. shared by some organizations) and *hybrid clouds* (combinations of the further ones). YOUSEFF ET AL. (2008, p.1) define *cloud computing* as “a new computing paradigm that allows users to temporary utilize computing infrastructure over the network, supplied as a service by the cloud-provider at possibly one or more levels of abstraction”. This is in line with the drafted definition of cloud computing by MELL & GRACE (2009, p.1), given in a National Institute of Standards and Technology (NIST) report, who define cloud computing as “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”.

Different understandings and structures of the manifold concepts that come along with cloud computing exist, especially about how to structure the different concepts appropriately (L. Wang et al. 2008; Youseff et al. 2008). YOUSEFF ET AL. (2008, pp.3-6) differentiate cloud computing into five stacked layers (summarized in figure 5.2).



Source: (Youseff et al. 2008, p.4)

Figure 5.2: Cloud Computing Architecture

- *Cloud Application Layer*: This layer provides the interface to the end-user (e.g. in form of a webpage). Often users pay certain fees in order to get access to such portals (Youseff et al. 2008, p.3).

- *Cloud Software Environment Layer*: The users taken into consideration on this layer are cloud application developers who are provided with interfaces to connect their own applications with the computing power of the cloud (an example would be Google's App Engine that e.g. provides a python runtime environment). Services that are provided on this level are also often referred to as Platform as a Service (PaaS) (Youseff et al. 2008, p.4).

- *Cloud Software Infrastructure Layer*: This layer provides fundamental resources to the other higher-level layers. These resources can be used for the construction of new cloud software environments or new cloud applications. Offered services on this layer are categorized into computational resources, data storage and communications. Computational resources mostly refers to virtual machines (VM's), were users get super-user rights in order to develop and maintain their own applications. These services are also referred to as Infrastructure as a Service (IaaS) (Youseff et al. 2008, p.5). The second kinds of resources are data storage services that allow storing data on a remote disc and accessing them anytime from everywhere. This is also referred to as Data-Storage as a Service (DaaS) (Youseff et al. 2008, p.5). The last considered resources are communications. Cloud systems should provide at least some kind of communication capability that is service oriented, configurable, schedulable,

predictable and reliable. This is also referred to by the term Communication as a Service (CaaS).

- *Software Kernel*: This layer provides the basic software management for the physical servers that compose the cloud. This level covers the relatedness to topics like grid computing – usually such applications were deployed and run on this layer on several interconnected machines. Since there is no hardware abstraction or virtualization on this layer, jobs are closely tied to the actual hardware infrastructure (Youseff et al. 2008, p.6).

- *Hardware and Firmware*: This layer consists of the physical hardware and the firmware that forms the backbone of the cloud. Users are big enterprises who are sub-leasing huge amounts of IT. This is also referred to as Hardware as a Service (HaaS) (Youseff et al. 2008, p.6).

However, this structure is not agreed on in the current discussions in science and practice. For example WANG ET AL. (2008, p.827) consider HaaS, SaaS and DaaS at the same time being constituents of PaaS. Thus the meaning of these terms is different. For this reasons other authors (e.g. Armbrust et al. 2010) decide not to use these terms at all and consider the different layers together. We would further criticize that the presented structure is not as rigorous as shown – the authors themselves state that others can bypass layers in certain situations (Youseff et al. 2008, p.5).

5.3 Literature Search Results

5.3.1 Governing Uncertainty

According to STOKER (1998, p.26), governance “means living with uncertainty and designing our institutions in a way that recognizes both the potential and the limitations of human knowledge and understanding”. We conclude that there have to be more concrete descriptions on how to do this.

FOLTA (1998, p.1010) differentiates between endogenous and exogenous uncertainty. The first one can be decreased by actions of the firm. It may be due to an inability to assess how much time, effort, and materials will be required to complete a project. This kind of uncertainty can only be resolved by learning – undertaking the project in stages so that learning can occur incrementally (Folta 1998, p.1010). The latter one, exogenous uncertainty, “is largely unaffected by firm actions, and is predominantly resolved over time. It is difficult to discern

which capabilities are critical for future success when the technological trajectory is not established, or the commercialization potential in the industry is unknown due to the newness of the industry, a lack of industry infrastructure, or important legislation that is pending. Committing prematurely to a technology or to ownership in a target firm may impose considerable risks because the firm gives up the option of waiting for new information that might affect the desirability or timing of the investment" (Folta 1998, p.1011). The two concepts require different mitigation actions: uncertainty about the value of a project may lead a firm to postpone investing or to speed it up. "If the resolution of uncertainty is independent of what the firm does (exogenous or technological uncertainty) there is an incentive to wait. If the uncertainty can be resolved by investing (endogenous uncertainty), it encourages firms to invest, albeit in a sequential way" (Folta 1998, p.1011).

JONES ET AL. (1997, p.918) consider understanding the sources of uncertainty as important, "since these influence what governance form is used to coordinate and safeguard exchanges". According to them, research on environmental uncertainty and governance form investigated that supply uncertainty; combined with predictable product demand, entice firms to integrate, whereas customer demand uncertainty makes vertical integration for firms risky. Under conditions of demand uncertainty, firms disaggregate into autonomous units, primarily through outsourcing or subcontracting (Jones et al. 1997, p.918).

When uncertainty increases, it is increasingly difficult to distinguish, when parties have met or left unmet their obligations to one another (Jones et al. 1997, p.932). Methods to overcome this are collective sanctions and reputation. The first ones "reduce behavioral uncertainty by increasing the costs of opportunism, decreasing the costs of monitoring to any one party, and providing incentives to sort and monitor compatriots" (Jones et al. 1997, p.932). The latter one "involves an estimation of one's character, skills, reliability, and other attributes important to exchanges and is important under exchange conditions of uncertainty and customization. As environmental uncertainty increases, exchange parties become more concerned with information about their own and others' reputations" (Jones et al. 1997, p.932).

5.3.2 Outsourcing Governance

The same holds true for outsourcing. According to BEHRENS & SCHMITZ (2005, p.30) uncertainty is an environmental factor that surrounds an outsourcing project. It is driven mostly by the content of outsourcing goals. It is for example

hard to evaluate the achievement of outsourcing goals, if they focus on innovation or the access to new technology. Services, which are difficult to specify, are connected to a higher uncertainty (e.g. software development, system integration) or require new non-mature technology. Long runtimes further increase uncertainty since the market development is hard to be foreseen. Taking the discussion of the paragraph before into account, we consider governing outsourcing as a special case of governing uncertainty. According to a literature survey conducted by LACITY ET AL. (2009, p.136), outsourcing governance is next to the outsourcing decision and its support a major driver of outsourcing success.

According to BEULEN ET AL. (2006, p.72) outsourcing service providers and recipients are both responsible to ensure adequate governance, however the recipient retains final responsibility. For these companies, uncertainty and consolidation within the outsourcing industry as much as a dependence on the vendor increase the outsourcing risk (W. R. King & Torkzadeh 2008, p.212). It occurs e.g. because outsourcing relationships are coined by opportunistic behavior, based on the different goals of supplier and recipient (Behrens & Schmitz 2005, p.29). Realizing the mutually set goals of the relationship is complex since there is no common hierarchy (the companies are legally and economically independent from each other) and the respective goals might not be aligned (e.g. cost-saving vs. return-on-investment) (Beulen et al. 2006, p.79).

There are several factors that are relevant for the recipient, the provider and both. Relevant factors for the recipient e.g. are a clear IT strategy (to illustrate the service provider in which direction the client intends to move), embedding IT into the business, having a chief information officer (to develop a suitable strategy) and clear demand management structure on the tactical level (Beulen et al. 2006, pp.118-132). From the recipients point of view MENG ET AL. (2007, p.368) identify two major tasks of outsourcing governance: First, it has to ensure that outsourcing delivers value to the outsourcing organization. This includes the questions if outsourcing is done well and if the organization gets benefits out of the outsourcing initiative. Second, governance should control and minimize the risks that come along with outsourcing. This includes assigning the ownership and accountability for outsourcing decisions in an appropriate way.

There are also some factors that are relevant for outsourcing governance on the vendors' side. Governance factors here are e.g. a clear and consistent market

position (to show potential clients what the provider is able to deliver), a front-office to get in contact, a back-office that ensures the service delivery, and further more a factor is the availability of IT professionals (Beulen et al. 2006, p.149).

Usually two different forms of outsourcing governance are addressed that directly affect the relationship itself (Lacity et al. 2009, p.136; Miranda & Kavan 2005, p.153): First, the contractual governance, including all (formal) contract related practices and decisions. Second, the relational governance, including all practices and decisions concerned with the supplier relationships and thus rather informal mechanisms like trust and psychological contracts.

POWER ET AL. (2004, p.42) state “organizations expend resources on the outsourcing strategy, selecting vendors and negotiating contracts without realizing that this is only the ante to get into the outsourcing game. They need to understand how to manage the ongoing outsourcing relationship”. MIRANDA & KAVAN (2005, pp.152-158) argue that at different points in time of such a relationship different governance mechanisms need to be used. They claim to need a *promissory contract* in the beginning, especially during first negotiations. However, this is not considered to be enough for the overall lifetime of the relationship. Additionally there should be a *psychological contract* later on. Meanwhile the promissory contract is useful to communicate the initial expectations, the psychological contract has to facilitate cooperative work in order to solve problems that occur during the relationship. It consists of social capital and conflict resolution abilities.

Related to these governance constructs different challenges can occur and actions need to be taken. DEMIRKAN ET AL (2010, p.120) emphasize “the increasing complexity of managing the whole infrastructure of disparate information architectures and distributed data and software has made computing more expensive now than ever before to an organization”. BUYYA ET AL. (2008, p.9) identify that “certain quality of service parameters need to be achieved, for example time, cost, reliability, trust/security. These cannot be static but need to be updated continuously in order to follow the changes in business- and operating environments”. Thus, the contracts need to be defined in a way that supports these changes.

There are some frameworks that support IT governance and the outsourcing aspect; examples are “control objectives for information and related technology (COBIT)” or the “capability maturity model for integration (CMMi). These

frameworks provide standard processes and guidelines (Beulen et al. 2006, pp.81-83). BEHRENS (2007, p.27f.) further highlights that outsourcing contracts should be very detailed (and complete) since this increases the success probability of an outsourcing process. POWER ET AL. (2004, p.42) claim that a governance plan is necessary in order to keep the outsourcing relationship aligned. The plan includes descriptions of the outsourcing efforts, identification of key shareholders, schedule of activities, roles and responsibilities, budgets, performance measurements, work products, resources, required skills and know- ledge, change control process, quality assurance, configuration management, communication plan and tools, equipment, facilities and security.

5.3.3 Differences between Outsourcing and Cloud Computing

The relationship between outsourcing and cloud computing is only sparsely researched yet. To our knowledge there is only one paper that explicitly deals with the connection between both, other papers only cover single aspects.

One of the main characteristics of cloud computing is the online-provision aspect – up to recently, outsourcing services were not necessary fulfilled online (Motahari-Nezhad et al. 2009, p.1). However, we can challenge this characteristic when considering private clouds that only belong to one single enterprise (Armbrust et al. 2010, p.51). The aspect of online-provision might be the reason for a fact that BÖHM ET AL. (2010, p.13) identified: Companies who offer the cloud services differ from those who are leading in outsourcing. Especially companies like Google or Amazon stated to market their former by-products (like storage and computing capacity) as new products.

Customers demand more and more flexible efficient IT service delivery from their providers (Böhm et al. 2010, p.12). Usually, setting up an outsourcing project takes time, since e.g. multiple interviews and interactions with customers to ‘discover’ their IT environment and to identify the resources to be managed are necessary (Head et al. 2009, p.175). This is not the case when using cloud services.

MOTAHARI-NEZHAD ET AL. (2009, p.14) consider the opportunity to avoid capital costs and incur predictable expenses that scale up and down with the current needs of the business as very attractive. They further argue that customers with occasional usage see tremendous benefits, as they only pay for resources when they are using them. Customers with stable usage patterns also benefit due to the lower cost of purchasing services than building them in-house. Other

authors also see the high flexibility with respect to costs and demands that cloud computing offers as a huge advantage. The pricing can be much more dependent on actual loads (peak/off-peak) or availability of resources (supply/demand) but still follow rather traditional models (fixed/changing). Accounting and monitoring is necessary in order to set such prices (Buyya et al. 2008, p.8). Further the customer can be delivered with smaller modules that fulfill the specific needs or allow him to try functionalities without large upfront investments (Anding 2010, p.4). This allows accessing new customer groups, since a large and increasing number of services are available that target small businesses and individual consumers (Motahari-Nezhad et al. 2009, p.9).

Furthermore, customers demand more innovation ideas from their providers (Böhm et al. 2010, p.12). Cloud computing supports this by providing services that can be recombined to new services (and thus businesses) (Böhm et al. 2010, p.14). However, since interfaces and access protocols are not completely standardized, this connectability is not a simple task (Youseff et al. 2008, p.1). Mitigation can be provided by web-portals that bundle these to a unified user-interface (Youseff et al. 2008, p.1). It also leads to new challenges for accounting: In traditional outsourcing models the physical resources have been kept either by the customer or the provider. Cloud computing heralds the paradigm of providing technical capabilities and solutions (physical) asset free (Böhm et al. 2010, p.13).

In outsourcing the value chain is more static – divided into infrastructure, applications and business processes – completed by strategy and consulting activities. Different parts of this value chain and its subparts (like plan, build, run) can be outsourced and foster complex relationships with outsourcing vendors (Böhm et al. 2010, p.13). When it comes to cloud computing, this differentiation does not exist in such strict terms any longer.

This has implications for the actors that are active in cloud computing relationships. Meanwhile the borderline between supplier and customer in traditional outsourcing is rather well defined, this changes when it comes to cloud computing. According to BÖHM ET AL. (2010, p.16) the structure changes from a value chain into a value network. This network is comprised of the following participants:

- The *customer* buys a service, directly from a service provider of via a platform provider.

- *Service providers*, also labeled IT vendors, develop and operate services that offer value to the customer and an aggregator respectively. They access hardware and infrastructure of the infrastructure providers.
- *Infrastructure providers* provide the technical backbone. They offer the necessary, scalable hardware for the services upon which the service providers offer their services.
- *Aggregators* combine existing services or service-parts and offer them to customers. Hence, they are both a provider and a customer (depending on the perspective chosen). Rather then on the integration of services, aggregators can also focus on the integration of data. MOTAHARI-NEZHAD ET AL. (2009, p.3) call such companies "virtual businesses" since all or almost all functions are outsourced to online services.
- *Platform providers* act as a kind of catalogue in which different service providers offer services.
- *Consulting firms* for the customers serve as a support for the selection and implementation of relevant services to create value for their business model.

5.4 Discussion – Governing (with) the Cloud

5.4.1 Uncertainty within the Cloud and its Environment

Uncertainty connected to the cloud occurs, because the cloud is handled as an autonomous system which means that its inside components cannot be seen by the users (L. Wang et al. 2008, p.827f.). Uncertainty within the cloud and in its environment might look different or have different implications depending on the perspective chosen, e.g. from the customer's or the provider's point of view (Xinhui Li et al. 2009, p.93). However, we mostly limit our discussion to a customers and thus recipients perspective of cloud computing.

Such a recipient can perceive two different major kinds of uncertainty with cloud computing that we call inner- and outer uncertainty (in order to not confuse with other wording used in uncertainty and governance literature): uncertainty, which is existing in his business environment that might be governed by the cloud (outer-uncertainty) and uncertainty that is induced by the cloud itself and needs to be governed by appropriate mechanisms (inner-uncertainty). Thus, the cloud on the one hand is a tool to govern uncertainty, on the other hand a source of uncertainty by itself. In figure 5.3 we illustrate the difference.

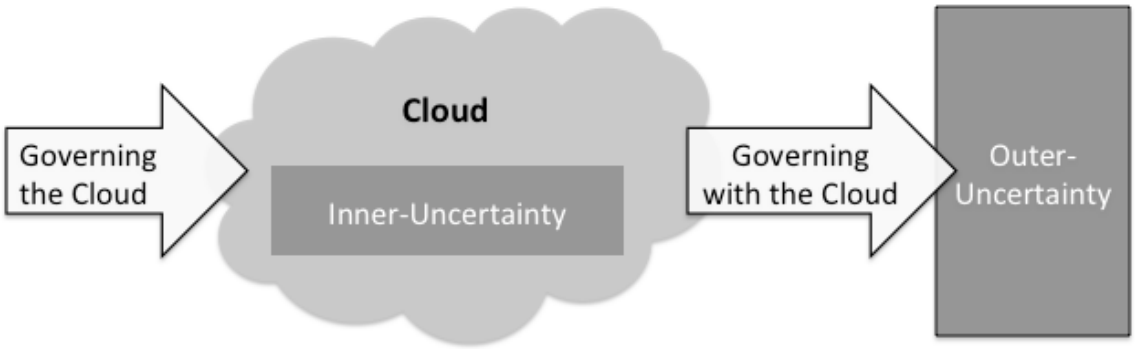


Figure 5.3: Uncertainty and the Cloud

We consider governing cloud computing and governing with cloud computing similar like MENG ET AL. (2007, p.368) do for outsourcing. First, it has to make sure that cloud computing creates value for the organization. Second, it has to identify and minimize the risks that come along with it. Therefore in the remainder of the discussion we differentiate the sources of uncertainty since this is important in order to discuss the pertaining governance mechanisms (Jones et al. 1997, p.918).

5.4.2 Governing Uncertainty with the Cloud

We discussed manifold governance mechanisms before taking into account uncertainty or outsourcing. Cloud computing provides similar or more mechanisms and integrates the already discussed ones. We follow the structure given by PREMKUMAR ET AL. (2005, p.264f) in order to analyze how the character of cloud computing can support governing uncertainty. They differentiate governance with respect to the environment and with respect to the direct partnerships.

Environment: Product & Product Description

Products (and also services) are more and more complex and thus increase uncertainty, especially because of an increasing demand for customization, quantity of components, etc. (Harland et al. 2003, p.51). These aspects foster outsourcing since the single company cannot be excellent in all different parts of the product (Harland et al. 2003, p.51). Further more the description and definition of such products is relevant. A more complex product will lead to more complex information exchange and thus an increased degree of uncertainty (Premkumar et al. 2005, p.265).

Since cloud computing allows for a very modular design of electronic products (Böhm et al. 2010, p.14) and services we consider it as a governance

mechanism for this kind of uncertainty. GARUD & KUMARASWAMY (1995, p.93) state that “technological progress may be achieved by substituting certain components of a technological system while reusing others. The potential for such economies increases if technological systems are modularly upgradable”. The modularization allows the service provider to select a best-of-breed solution. However, problems related to the interfaces that connect the different modules (Youseff et al. 2008, p.1) need to be solved in order to achieve the described advantages.

Environment: Technology

Technology uncertainty refers to the inability to forecast the detailed technical design requirements for a new product. Frequent product- or process innovations create information needs for the partners, which forces firms to interact more recently with their partners in order to reduce this kind of uncertainty (Premkumar et al. 2005, p.265).

Cloud computing is a governance mechanism for this kind of uncertainty. Because of its flexibility users can change very quickly to other technologies or adopt these (Böhm et al. 2010, p.12). Cloud customers can also try new technologies very fast (Anding 2010, p.4). However, finding the needed technology in the cloud market is a problem that occurs here – vendor independent platforms that collect different cloud services and provide an overview for prospective customers can solve this problem (e.g. cloudbook.net 2011).

Environment: Demand

Demand uncertainty refers to the changes in the demand for a product and the inability to precisely predict these. Buyers usually require tight relationships to their suppliers in order to communicate such changes. In order to mitigate this kind of uncertainty, almost real-time processing systems are needed (Premkumar et al. 2005, p.265).

Cloud users only pay for the resources allocated to them. This can benefit cloud users by transferring the risk of economic losses caused by over proportioning (under utilization) and under-provisioning (saturation) to cloud providers (Xinhui Li et al. 2009, p.93). Therefore cloud computing helps to govern this kind of uncertainty in electronic business networks. To the consumer the capabilities

available for provisioning often appear to be infinite and can be purchased in any quantity at any time (Mell & Grance 2009, p.1).

Environment: Supply

Supply uncertainty reflects the unpredictability of the supply market in terms of availability of suppliers and their stability, quality and prices. Such conditions foster procurement risks for the buyer (Premkumar et al. 2005, p.265).

In good markets, supply uncertainty would often lead to integration of companies (Jones et al. 1997, p.918). Such integration is not necessary with cloud computing. However, if cloud computing can support governing supply uncertainty, depends on the kind of service that is requested. If the needed service or electronic product is rather standardized (Youseff et al. 2008, p.8) (e.g. providing a platform to host a virtual operating system), changing to another cloud provider would be possible very fast. If this is not the case and the needed service is rather specific, the kind of uncertainty stays evident.

Environment: Product Criticality

The product criticality determines how much monitoring is necessary in order to forecast outages. If a very critical product is missing, this implies stops in the production etc. (Premkumar et al. 2005, p.265).

The general concept of cloud computing implies a never-ending resource availability on the providers side and a high flexibility for the recipient (Böhm et al. 2010, p.12). That means in an assumed ideal world the problem would not occur any longer. Further switching from one provider to another is rather easy if standard interfaces would be used (Youseff et al. 2008, p.1). However, to mitigate outage risks, multiple vendor strategies should still be considered also in the cloud.

Partnership: Operations

A firm faces operations risk due to the possible underperforming of a partner within his contract (Premkumar et al. 2005, p.265).

Such problem stays evident when using cloud computing and refer to the offered quality of service, e.g. for the appropriate hardware performance (L. Wang et al. 2008, p.827f.). There are mechanisms that allow for detailed monitoring of partners’ performance. Most cloud systems automatically control

and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g. storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service (Mell & Grance 2009, p.1).

However, the uncertainty related to the operations might even increase. Since the cloud services usually are accessed without personal contact with the cloud provider but online (Motahari-Nezhad et al. 2009, p.1), the aspect of the psychological contract (Miranda & Kavan 2005, pp.152-158) with the provider is difficult to govern. Building up trust is purely based on performance, since personal contact is missing. The only solution can be both to accept this new challenge and rate the new won flexibility as more important, or to try to get a relationship with the cloud provider that is more than using the standardized interface (e.g. by meeting with sales people if existent).

Partnership: Opportunism

A firm faces opportunisms risk, if being locked up in a relationship with specific investments that have no value outside that relationship (Premkumar et al. 2005, p.265).

Cloud computing allows to govern this aspect by providing user-centric interfaces that allow accessing the cloud services without forcing a user to change the favorite programming language or installing heavy weighted client software (L. Wang et al. 2008, p.827f.). Therefore firms do not have to invest heavily into the access of the cloud service and hence reduce costs that would create lock-in effects. Further the cloud services can be access in a ubiquitous manner from many heterogeneous platforms (Mell & Grance 2009, p.1), which further reduces lock-in risks.

5.4.3 Governing Cloud Uncertainty

The concept of cloud computing introduces new or already known sources of uncertainty, that come along with the concept itself. All of these come along with uncertainty in the form of risks (Adam 1996, p.215) since usually there is no way to choose another alternative at all or only with certain costs. Within cloud computing we identify the following sources of uncertainty and possible mitigations:

Privacy

A users uncertainty concerning privacy varies strongly with the terms of service and the privacy policies of the cloud provider. Since information in the cloud can be stored in manifold places, they might even have more than one legal location at the same time with different legal consequences. Laws could oblige a cloud provider to search in a users data, e.g. in terms of crime protection (Rittinghouse & Ransome 2010, p.149). Further more, the government might seize a companies data, simply because it is sharing physical resources with another company that conducted a crime (Rittinghouse & Ransome 2010, p.158).

In order to cope with these problems, cloud providers need better practices to secure data, more vigilance by users and changes to law. Further, the industry could develop standards that help to compare different cloud providers, users should pay attention to the consequences of using a cloud provider (Rittinghouse & Ransome 2010, p.151).

These problems are less relevant in traditional outsourcing concepts, since privacy concerns can be governed with strict contracts. A solution might be hybrid cloud models, where both private and public clouds are present. Many enterprises will run mission-critical applications and store business-sensitive data in the private clouds, while outsourcing their supporting services to the public cloud (Motahari-Nezhad et al. 2009, p.15). Further the cloud provider could enable the customer to specify locations at a higher level of abstraction (e.g., country, state, or datacenter) (Mell & Grance 2009, p.1).

Quality of Service

In cloud computing the potential customer usually searches for a cloud service. However, since there is no explicit negotiation of the contract, the customer has to accept the providers general contract in order to use the service. The problem is, that the customer is in a bad position in order rate the quality of the service, if he never used that service before (Jøsang et al. 2007, p.618f.).

Additionally, the cloud platform itself might be faster updated than the software that is implemented based on it. Thus, more updates are needed than usually planned (Rittinghouse & Ransome 2010, p.159). Furthermore, SaaS solutions are mainly built in a way that one size has to fit all customers. Although there are sometimes add-ons to complement the functionality, the customer is limited

to the functionality offered by the SaaS providers and it is difficult to customize solutions based on his needs (Motahari-Nezhad et al. 2009, p.9).

This forces the customer to take a significant risk of bad performance by e.g. paying the service before he can evaluate the quality. The service provider, on the other hand, knows exactly what he gets, as long as he is paid in money. The idea is that even if the consumer cannot try the product or service in advance, he can be confident that it will be what he expects as long as he trusts the seller. A trusted seller therefore has a significant advantage in case the product quality cannot be verified in advance (Jøsang et al. 2007, p.618f.). This refers to the use of reputation as a governance mechanism (Jones et al. 1997, p.932).

In order to investigate if a seller is trustworthy, feedback algorithms are a governance tool to figure this out. The collected feedbacks are stored and aggregated as fundamental evidence to distinguish good web services from bad ones (Sibo Cai et al. 2009, p.190). However, gathering feedback is no simple task. First, inexperienced users in lack of the expertise knowledge about web services may give inaccurate ratings and second, malicious users who want to puff their services may submit fake ratings so as to gain benefits (Sibo Cai et al. 2009, p.190).

Legal Compliance

Also from a legal perspective there are risks that occur because of cloud computing itself. The company for example looses direct control of resources and software, e.g., website infrastructure and operations staff for when they decide to do cloud computing (Motahari-Nezhad et al. 2009, p.9).

This can imply problems when it comes to compliance regulations like the Sarbanes Oxley Act, which are harder to maintain within the cloud (Rittinghouse & Ransome 2010, p.160). Especially, whenever companies will have to prove their compliance with auditors, some rethinking will be necessary since data is not stored statically in one place any longer but fluid between multiple servers (Rittinghouse & Ransome 2010, p.162).

Possible governance mechanisms could be again a combination of public and private clouds that are set up depending on the kind of data and procedures stored and executed (Motahari-Nezhad et al. 2009, p.15). Furthermore a detailed check of contracts and terms of use of the single cloud providers

should allow for a reduction of uncertainty (Lacity et al. 2009, p.136; Miranda & Kavan 2005, p.153).

Security

Cloud computing implies new risks concerning security. Single services might not be compatible with each other, even on purpose (Rittinghouse & Ransome 2010, p.158). This means, that when combining software services in the cloud, developers have to make sure that they do not implement security lacks (Rittinghouse & Ransome 2010, p.159).

If services are encrypted, it is not always clear, who controls the encryption. The customer should make clear that they are the ones who do (Rittinghouse & Ransome 2010, p.158). In general, there is an increased liability risk due to security breaches and data leaks as a result of using shared external resources (Motahari-Nezhad et al. 2009, p.9). Especially also when the service providers may go out of business, causing business continuity and data recovery issues (Motahari-Nezhad et al. 2009, p.9).

5.5 Conclusions, Limitations & Further Research Propositions

Overall we conclude that cloud computing can support mitigating uncertainty that is existent in traditional business relationships. However, the uncertainty it induces by itself should not be forgotten as a side condition.

We started the section by outlining differences between outsourcing and cloud computing and thus answered the first research question (RQ1). Like derived from literature, some differences can be observed that we summarized in table 5.1.

Dimension	Cloud Computing	Outsourcing	Source
Provision Channel	Online	Also on-site, private network	(Motahari-Nezhad et al. 2009, p.1)
Initialization Time	Rather fast	Rather long	(Head et al. 2009, p.175)
Payment Model	Pay-per-use / fixed prices	Usually long term contracts with fixed prices	(Buyya et al. 2008, p.8)
Targeted Customers	Single consumers, small- and midsize companies	Rather midsize and large companies	(Motahari-Nezhad et al. 2009, p.9)
Service Recombination	Possible	Hardly possible	(Böhm et al. 2010, p.12) (Youseff et al. 2008, p.1)
Value Creation	Value Network	Value Chain	(Böhm et al. 2010, p.13)

Table 5.1: Differences between Outsourcing and Cloud Computing

We further conducted literature research on governing uncertainty and outsourcing governance. Taking these findings into account, we answered the second research question (RQ2). We identified specific types of uncertainty from literature and discussed the abilities of cloud computing on how to govern these. We also summarize these findings in table 5.2.

Type of Uncertainty	Source of Uncertainty	Governance Mechanism	Source
Environmental Uncertainty	**Product & Product Description**	Modularity	(Böhm et al. 2010, p.14)
	Technology	Flexibility	(Anding 2010, p.4)
	Demand	Pay-per-use provision	(Xinhui Li et al. 2009, p.93) (Mell & Grance 2009, p.1)
	Supply	Standardization	(Youseff et al. 2008, p.8)
	Product Criticality	Flexibility	(Böhm et al. 2010, p.12)
Partnership Uncertainty	**Operations**	Resource monitoring	(Mell & Grance 2009, p.1)
	Opportunism	User centric interfaces	(L. Wang et al. 2008, p.827f)

Table 5.2: Governing Uncertainty with Cloud Computing

We answered the third research question (RQ3) by investigating sources of uncertainty that are induced by cloud computing itself. We investigated on how to mitigate such sources of uncertainty. This is summarized in table 5.3.

Source of Uncertainty	Possible Governance Mechanisms	Source
Privacy	Standards Hybrid Clouds	(Rittinghouse & Ransome 2010, p.151) (Motahari-Nezhad et al. 2009, p.15)
Quality of Service	Feedback algorithms (reputation)	(Sibo Cai et al. 2009, p.190) (Jones et al. 1997, p.932).
Legal Compliance	Combination of public and private clouds, check of formal contracts	(Motahari-Nezhad et al. 2009, p.15) (Lacity et al. 2009, p.136)
Security	Customer-controlled encryption	(Rittinghouse & Ransome 2010, p.158)

Table 5.3: Governing Cloud Uncertainty

However, there are some limitations concerning the research. First, the used approach is completely literature-based. Since cloud computing is a rather young topic, this research base might not be sufficient in order to investigate the

latest developments and direction of the topic. Second, we focused on a recipients perspective of cloud computing – since cloud computing involves many more parties (like introduced before) that might not be sufficient.

These limitations lead to interesting propositions for further research: First, qualitative research with e.g. cloud experts from practice as much as case studies that focus on the uncertainty aspects could lead to valuable inputs for the topic. Second, other perspectives should be included into the discussion. For example the uncertainty that is governed for a cloud customer fosters higher uncertainty on the providers side – this relationship and the relationship to further cloud related parties could lead to valuable future insights about governance in electronic business networks.

6 The Evolution of Digital Business Processes in e-Government

Sebastian Wiethoff

6.1 Motivation and Objectives

Several challenges like the higher expectations of the public administration customers and the increased complexity of tasks in the public sector lead to a high pressure of reform in the public sector (Becker et al. 2007, p.10f.; Barth 2000, p.51). In this reform managing items of the business sector are adapted to the public sector. This movement is called *New Public Management (NPM)*. The objective of this reform is to increase the service quality and decrease handling time in the public sector (Becker et al. 2007, p.14). Besides the adaptation of managing items of the private sector, the building of networks in the public sector as well as the involvement of citizens and the private sector is a common approach to deal with the challenges of higher service quality (Scholl 2003, p.6; O'Toole 1997, p.45f.).

The technical implementation of these redeveloped services in the public sector is enabled by the use of information technology (IT). The change of public administration on a technical level is called e-Government. The introduction and use of information technology goes along with the change of intraorganizational business processes as well as the integration of government agencies, organizations of the private sector and citizens (interorganizational) (Scholl 2003, p.6).

As the introduction of e-Government is an evolutionary as well as digital/ electronic driven process with different stages over time (Layne & J. Lee 2001; Bèlanger & Hiller 2001; Watson & Mundy 2001), the approach of this section is to investigate the evolution of digital business process in Administration Networks for the interoperability with the private sector. The following research question summarizes the objective of this investigation:

RQ: How do intra- and interorganizational digital business processes evolve through e-Government in Administration Networks for the interoperability with the private sector?

In the second part of this paper, the theoretical foundation for the main part is elaborated. Besides the definition and description of business processes,

business process management and e-Government, the evolution of the public sector up to the need of networks are described. As e-Government is a driver for process change and an enabler for the interaction of organizations the investigation of e-Government evolution is mandatory in the first part of the third subsection. After the elaboration of e-Government evolution the impact on digital business processes is investigated in the next part of the third subsection. Finally, the findings are illustrated on a real life e-Government scenario, which is part of the research project *Information Technology for Adaption and Intelligent Design for e-Government (ITAIDE)*. This research project deals with the domain e-Customs where the interactions between governments as well as governments and business companies are important, in order to improve the effectiveness on the one hand and on the other hand to assure security.

Figure 6.1 describes the classification of this section into the overall research framework and summarizes the topics of this thesis.

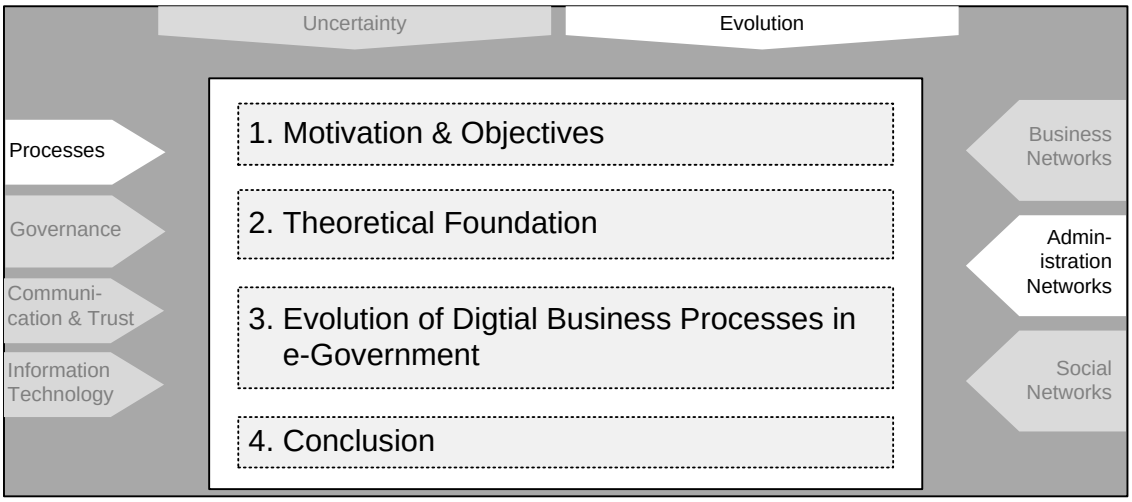


Figure 6.1: Structure of the Section

6.2 Theoretical Foundation

6.2.1 Business Processes and BPM

The process orientation trend on organizations started at the beginning of 1990s with the work of HAMMER & CHAMPY (1993) as well as the investigations of DAVENPORT (1993) and PORTER (1998). BECKER & KAHN (2003, p.6) define process as "[…] a completely closed, timely and logical sequence of activities which are required to work on a process-oriented business object". In

comparison to processes, business processes have interfaces to business partners of the company (e.g. suppliers). For instance, an ordering process at a supplier and a purchasing process can be seen as a business process (Becker & Kahn 2003, p.6). WESKE (2007, p.5) defines the term business process similar and states that one organization enacts a business process, but it may interact with business processes from other organizations. Thus both definitions point out that business processes are not only active within organization, but are capable to interact with other companies, in order to interchange data or trigger processes in partner organizations.

The concepts of modernization in public governments are described with the term New Public Management or e-Government on a technical level and have the objective to reengineer the processes of governments. With respect to a public department a process is the smallest operational unit of a governmental activity with a completely closed and task-oriented working solution (Becker et al. 2007, p.30). The review and evolution of business processes increases with the dynamics of a domain. For instance, the automobile sector has reinvented their processes more often than governmental organizations. The reengineering of processes in the public sector starts with the adoption of e-Government (Becker et al. 2009, p.1).

In order to control this process-oriented arrangement of business, Business Process Management (BPM) is needed. WESKE (2007, p.5) defines this term as follows: “Business process management includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business process”. BECKER ET AL. (2009, p.4) see the term BPM as “[…] the documentation, design and improving of business processes and the IT- support of this business processes” (Becker et al. 2009, p.3). It can be seen that both definitions are taking the evolution of processes into account by pointing out the redesign and improvement of processes over time. The impact of IT leads to intra- as well as interorganizational process redesign. In the first case the business process is changed, in order to take the optimum advantage of the available IT capabilities. In the latter, which can be called business network redesign, the tasks and scope of business networks are defined. This has an effect on the business tasks and consequently processes within and outside the formal boundaries of a focal organization (Venkatraman 1991, p.123f.).

The documentation and representation of this business processes are done by processes models in standardized modeling language like Event Driven Process Chains (EPC) or Business Process Modeling Notation (BPMN) (Becker et al. 2009, p.5). For modeling in the public sector the PICTURE approach of the University of Muenster is useful, as it focuses on the domain specific requirements in the public sector. Such requirements are the complex and comprehensive process environment in the public sector. The PICTURE approach is dealing with these challenges by using different process views and process building blocks, in order to describe business processes in the public sector (Becker et al. 2007, p.85f.).

6.2.2 Evolution of Public Administrations

The public sector has a long history especially in Germany. It undergoes a modernization and reform process since the 1950s. The table below lists the key steps of the reform process.

Phase & Year	Reform & Objectives	Content
Phase 1: 50s	Deregulation	Denazification
Phase 2: 50s to 60s	Reform of territorial allocation	Restructuring of the federal states and local government level
Phase 3: 60s	Reform of functional allocation	Recentralization with concurrent decentralization
Phase 4: 70s and 80s	Establishment of Public responsiveness	Streamlining of administration, Increasing level of transparency, opportunity of participation
Phase 5: 90s	Modernization of the public sector via New Public Management	Public administration is seen as service provider. Citizens and private sector are seen as customers of public goods and services.

Source: (Schiedner 2000, p.11)

Table 6.1: Key steps of the reform process in the public sector in Germany

Different opinions have shown that the public sector in Germany was one of the effectives and reliable ones worldwide (Meyer-Pries 1996, p.130). But in the last decade the governmental departments has fallen under the last ones of the best governmental institutions (Schönreich & Diekmann 1996, p.42). Out of this reason there is a high potential and pressure to reform the public sector in the last years. Some of the following challenges have lead to the need of this reform:

- *Changes in society's value*: The expected value of the customers of the public sector has risen, due to service, handling time and quality. Additionally, the employees in the public sector have changed their functioning, due to autonomous, creative work and team spirit, which are in conflict with the classical bureaucratic structures (Becker et al. 2007, p.10).

- *Technological innovations*: New technological innovations, e.g. the Internet, have changed the social life. These have impact on the relationships between citizens, the private sector and the public sector. Whether people are able to offer products 24 h a day via Internet, they expect the same service from the public sector, e.g. the handing in of proposals independent from the opening hours (Becker et al. 2007, p.10f.).

- *Increasing complexity in public sector:* The tasks of the public sector have increased continuously as well as the interdependences between the different governmental institutions (Barth 2000, p.51).

- *Relationship between public sector and their customers*: The customer focus of the public sector is not sufficient. The main problems are long handling times in approval procedure, long waiting times in administrations and a low level of transparency as well as missing opportunities to do activities online (Becker et al. 2007, p.12f.).

- *Operational- and organizational structure:* The organizational structure does not fit to the process focus in the operational structure. In many administrations the function-oriented organizational structure still is implemented. This function-oriented allocation of tasks as well as rights and duties lead to inefficient business processes (Becker et al. 2007, p.13).

In order to deal with these challenges a reform in the public sector as well as the interaction of administrations by networks is mandatory.

The Growing Importance of Networks in the Public Sector

O'TOOLE (1997) has elaborated in the 90s an enormous need of networks for public administrations. He defines Administration Networks as "[...] structures of interdependence involving multiple organizations or parts thereof, where one unit is not merely the formal subordinate of the others in some larger

hierarchical arrangements" (O'Toole 1997, p.45). Actors of this network are often part of agencies that are additionally connected with other organizations outside the formal authority (Hall & O'Toole 2004, p.187). O'TOOLE (1997) recognized in his investigations the growing importance of networks in the public sector.

In the first part of the twentieth century one bureaucratic organization was sufficient to solve certain tasks and issues, as the goals were clear, the task well defined and the objectives measurable. However, RITTEL & WEBBER (1973) describe an increase of challenging problems, which cannot be handled by dividing them up into simple parts in near isolation from each other, in order to solve this problem within one organization. They call this phenomenon "wicked problem". For wicked problems, agreement is provided by jointly steering of action and delivering policy outputs that are consistent with the multiplicity of societal interests. In order to address this, more nonconventional organization forms, like collaboration, have to be used. The author sees this as one driver for the emergence of networks (O'Toole 1997, p.46).

Although there are restrictions for the reach of direct governmental intervention, this does not dampen but encourage the network approach. On the one hand there is a big demand for service and delivery and on the other hand the involvement of single governmental departments is limited by liberal governmental forces. In order to solve the demand for service and delivery the single departments are loosening the immediate managerial grasp (O'Toole 1997, p.46).

In addition, O'TOOLE (1997, p.47) sees political imperatives and the institutionalization of connections as the third and fourth drivers for the growing importance of networks in the public sector: "Third, political imperatives elicit networking beyond what might be necessitated by policy objectives. Administrators often must balance technical needs for clear and concentrated program authority with political demands for inclusion and broader influence. Fourth, as information has accumulated regarding second-order program effects, efforts have been made to institutionalize the connections."

Fifth, layers of mandates force the need for networked management. For instance, arrangements such as crosscutting regulations and crossover sanctions increase the need for coordination requirements. "For intense policy spheres like economic development or welfare, different programs have different intents, funding sources and priorities, mandated criteria and target

stakeholders. Achieving something meaningful in any one program must mean adapting to several." (O'Toole 1997, p.47).

Out of the perspective of O'TOOLE (1997) it was reasonable to expect an increase in public administration networking. The following studies and investigations on administration networks emphasize this thesis in the next years (Agranoff & M. McGuire 2001; Hall & O'Toole 2004; Provan & Milward 2001; Meier & O'Toole 2003; Wachhaus 2009).

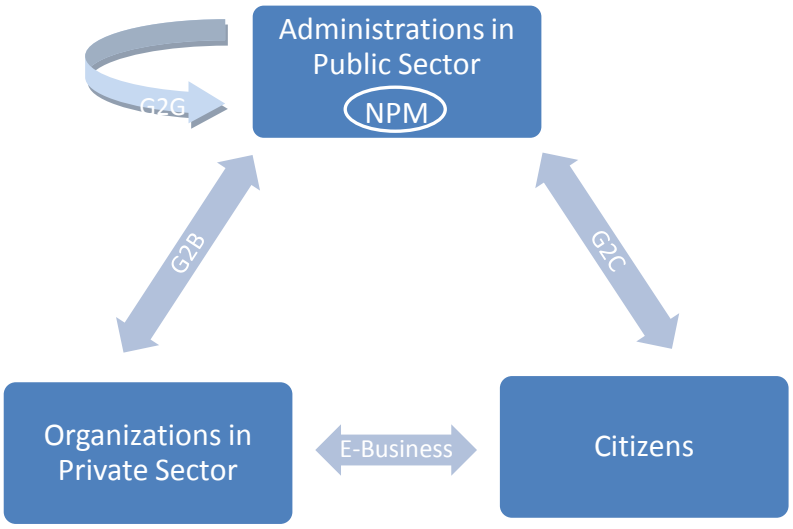
6.2.3 E-Government

On a technical level e-Government is an enabler for New Public Management and the emergence of networks in the public sector. The term e-Government is defined as the execution of commercial processes with support of information technology (IT) via electronic media with respect to the public sector (von Lucke & Reinermann 2000, p.1). These IT solutions ease the processing of information, communication and transaction processes within administration, between administrations as well as between administrations and the private sector respectively citizens (Becker et al. 2007, p.21). In order to strengthen the point of collaboration the United Nations and the Civic Resource Group add, that e-Government improves citizens access to government information and services as well as the relationship between the private sector through enhanced, cost-effective and efficient delivery of services, information and knowledge (United Nations Department of Economic and Social Affairs & Civic Resource Group 2003).

Figure 6.2 illustrates the actors in the environment and gives an overview of the impacts of e-Government on the different relationships. The figure clarifies that e-Government has influences on New Public Management as well as the relations between administrations and organizations of the private sector respectively citizens. Thus e-Government addresses processes within the public sector which are described as government-to-government (G2G), the processes between the public sector and citizens (G2C and C2G), the processes between non-profit and non-governmental organization of the third sector (N2G and G2N) as well as processes between the public sector and business sector (B2G and G2B) (von Lucke & Reinermann 2000, p.3).

As a consequence e-Government establishes the possibility of a new service orientation, participation of citizens, productivity and cost effectiveness in the public sector (von Lucke & Reinermann 2000, p.6). TUNG & RIECK (2005, p.418)

describe the benefits of e-Government similarly as they state that the benefits of e-Government are the increased citizen involvement, greater efficiency, and cost reduction for both the government itself and the adopter of e-Government services.



Source: (Becker et al. 2007, p.22)

Figure 6.2: Actors in Electronic Government

Summing up e-Government eases and encourages the realization of New Public Management and complements NPM through the outward directed perspective (Becker et al. 2007, p.23).

6.3 Evolution of Digital Business Processes in e-Government

In order to show, the impact of e-Government on intra- and interorganizational digital processes in Administration Networks and the influences on the interoperability with the private sector, firstly the evolution of e-Government is investigated. The different stages have various effects on the intra- and interorganizational processes and respectively on the interoperability with the private sector (see subsection 6.3.2 Impact of e-Government Evolution on Digital Business Processes).

6.3.1 Evolution of e-Government

The development of e-Government solutions started at the beginning of the 90s under the pressure of the New Public Management and the growing importance of networks in the public sector. Different authors have examined different stages of e-Government growth.

WATSON & MUNDY (2001) divide the growth of e-Government in three phases: (1) initiation, (2) infusion and (3) customization. In the initiation phase the governments are preparing the introduction of e-Government by developing portals and providing access to information and services via these portals. In the infusion stage nearly all governments have adopted e-Government and the citizens are able to do their financial transaction online. The third phase, customization, enables a one-to-one relationship between citizen and government. In this final phase the citizens have an individual and personal access to the data and can for instance take a look at a detailed breakdown where and how their taxes has been spent. By this final step democracy is enhanced as the citizens can take a look at how effective their governments are performing (Reddick 2004b, p.61; Watson & Mundy 2001). As this approach is taking a political view on the growth of e-Government and relates it to democracy, this model is not useful to describe the business process change.

BÈLANGER & HILLER (2001) developed a five stage model with the following stages: (1) catalogue, (2) two-way communication, (3) service and financial transaction, (4) vertical and horizontal integration and (5) political participation. The first step simply describes, that information of the agencies are available online. In the second stage the citizens are enabled to initiate simple requests and changes via a website. The response of the agency is not directly returned online, but paper-based by mail. However, the third stage describes the fully execution of transactions online. The use of vertical and horizontal integration is part of stage four and addresses the functional and cross-functional integration of services provided by the agencies. An investigation of the evolution of business processes by means of the model of BÉLANGER & HILLER (2001) is not useful since this approach is concentrating on the growth of e-Government in relation to democracy, which can especially be seen at the fifth stage of this model, the political participation of citizens and business companies.

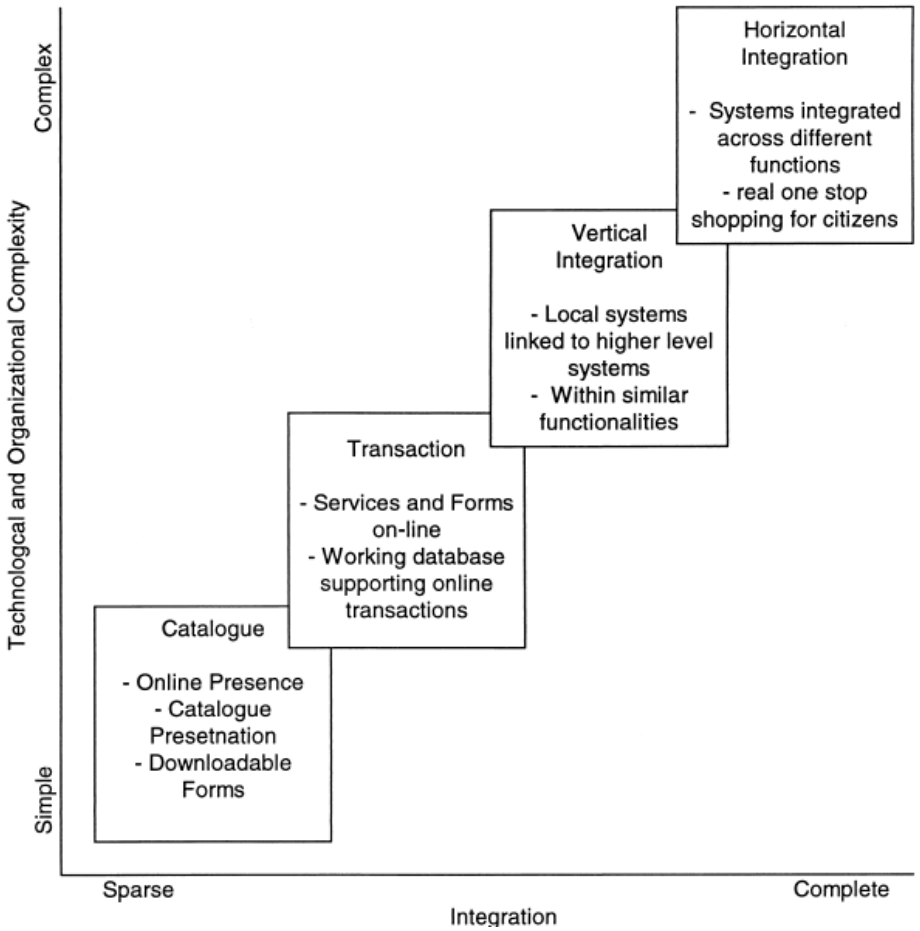
REDDICK (2004b) presents the stages of e-Government growth related to the type of e-Governmental relationship. He only divides the stages: (1) cataloguing and (2) transactions. With stage 1 the author describes as in other models the simple post of information on the web. The second stage combines transactions, vertical and horizontal integration of organizations. The division of the transaction stage and vertical respectively horizontal integration is useful for the investigation of business process change by e-Government. Thus this model is not useful for the analysis of business process change.

LAYNE & LEE (2001) describe e-Government as an evolutionary phenomenon and divide it into four stages: (1) cataloguing, (2) transaction, (3) vertical integration and (4) horizontal integration. As illustrated in Figure 6.3 the stages are divided according to the technological and organizational complexity and the degree of integration. This approach does not take a political view and divides the growth according to the technological and organizational issues, which have an impact on business processes and the interoperability with the private sector for this investigation. In the following the Layne-Lee-model is described in detail.

Catalogue

Stage 1, catalogue, describes the creation of ‘state websites’ of governmental agencies. These programs are often started because of the pressure of citizens and business companies. The citizens and business partners are used to search information that they need on the web as organizations in the private sector are putting information about their company on the web. As a consequence this behavior is expected from the agencies, too. Since the agencies have small Internet know-how in this step, they are only putting non-transactional information on the site, in order to decrease risk and failures in IT projects (Layne & J. Lee 2001, p.126).

Moreover this stage can be divided into two steps. The typical website at this stage offers information for the citizens and private sector, in order to inform the people which agency is responsible for their individual needs. The next step within this first stage is to organize the information on the website via services. According to these services, it is possible to download forms, fill them out and send them to the agency via mail. However, as mentioned above no electronic transaction can be done via the website (Layne & J. Lee 2001, p.126f.).



Source: (Layne & J. Lee 2001, p.124)

Figure 6.3: Dimension and Stages of e-Government Development

Transaction

The second stage "is the beginning of the e-Government as a revolutionary entity changing the way people interact with their government" (Layne & J. Lee 2001, p.128). The difference to the previous stage is the possibility of the customer to interact with governments online at anytime. It is thus not essential, that the people are going to the agency and sitting there face-to-face to the employee of the agency. Instead the citizens get the possibility not only to download a form, but also to fill out and complete the form interactively online (Layne & J. Lee 2001, p.129).

MOON (2002) divides transactions into the categories: external (transactions between governments and the business sector or citizens, as described above) and internal (transactions between governments). These internal transactions enable the government to react faster on citizens' requests. This is enabled through the transfer of data between governmental agencies or providing

information to public employees via the intra- or internet (M. J. Moon 2002, p.425).

Vertical Integration

Vertical Integration describes the interoperability between local, state and federal government for different functions or services of government. In other words, it describes the integration of agencies on different levels. Thus the focus of this stage is not automating and digitalizing existing processes, but basic and permanent changes in the processes of the government (Layne & J. Lee 2001, p.129f.). The driver for this stage is the increased expectations of citizens. Many transaction systems used in stage two are storing the data in local databases. The data is not exchanged with other agencies of different levels. This leads to a data management on different stages. Through this vertical integration the scattered and distributed systems on different levels with different functionalities are integrated (Layne & J. Lee 2001, p.130).

Horizontal Integration

Stage four describes the horizontal integration by connecting systems across different functions. This stage enables, in combination with stage three, real *one–stop shopping* for citizens. In the normal case citizens or business people need more than one service offered by the governmental agencies. These *one-stop shopping* services, also known as *Single-Window Access*, are enabled through communication of databases across different functional areas and sharing of information obtained by one agency (Layne & J. Lee 2001, p.132). The drivers for horizontal integration are the visions of efficiency and effectiveness enabled through the use of information systems. This kind of integration of processes is not only possible in the public sector, but also between governmental agencies and business companies.

6.3.2 Impact of e-Government Evolution on Digital Business Processes

Catalogue

Putting the information online has the effect that citizens or business companies do not search for governmental information in the yellow pages but instead look for information they need from the government online. The citizens learn the specifics of policies and procedures, and find out where to go for governmental service and post-service support. Out of the view of the government this

behavior is beneficial, because the agencies do not have to answer fundamental questions about governmental services and procedures. As a consequence the workload of the frontline employees is reduced. However, citizens and business companies are still using existing service processes like phone calls and in person standing, in order to inform themselves, but with a lesser extent (Layne & J. Lee 2001, p.126). Thus the core processes within the administration and between the government and business resp. citizens are not changed. In addition, the processes of the back-office remain without significant changes (Martin & Montagna 2006, p.6). SCHOLL (2003, p.2) describes it similar: "While the first Layne-and-Lee stage does not yet require any business process change, more fundamental and substantial changes become the norm in subsequent stages."

The governmental agency is only facing some organizational challenges, in order to create and maintain such a website. One organizational issue that arises is the routing of emails. As most websites are offering email addresses for questions from site users, these emails have to be answered, but this addresses a wide range of knowledge which the web master is not able to answer. As a consequence a procedure is required to allocate emails to the right employee who is able to answer this question (Layne & J. Lee 2001, p.127f.).

Summing up, the catalogue stage does not enable networks in the public sector and does not change the core business processes within in the public sector. However, the interoperability between citizens respectively business companies is enhanced by an additional way of communication: Email.

Transaction

This transaction stage transforms the one-way online communication into a real two-way communication between citizens and administrations. The communication between the two actors is changed from '*push e-government*' to '*push/pull e-government*'. In this stage government push information and services online, in order to make them available for citizens resp. business organizations, and data can be pulled from customers online. This means that this stage of the Layne-and-Lee model describes the processing of transaction fully online (Z. Irani et al. 2006, p.6). As mentioned before, citizens are able to download forms from the Internet in the catalogue stage, but have to hand in these forms in a non-electronic format. In this stage the initiation of the business process is done by filling out the formula online. As a consequence the internal

business process has a different trigger. The triggering of this process via the online interface bypasses the front office processes. As a result the web-based representation of the process has to be connected with the back office of the agency respectively with the IT systems of the back office. This of course has an impact on the existing business process, as these processes have to be automated and digitalized (Becker et al. 2007, p.21). In addition, the movement to digitalized business processes eases the information exchange between public administrations (M. J. Moon 2002, p.425) .

This stage can be seen as a starting point for the change of the core business processes to digital business processes within public administrations. The interchange of information between agencies is eased because of digitalization. This stage is the first step in the direction to networks in the public sector, but no real coordinated network building is done because of lack process and data integration. The interoperability between agencies and citizens resp. business organizations is completely changed as transactions can be done online.

Vertical and Horizontal Integration

Vertical and horizontal integration emphasize coordinated network building and the idea of a Single-Window Access, where citizens go online and take care of their governmental business (Ho 2002, p.440). The interaction between administrations and citizens respectively business people change in the way that the customers only have to initiate one process, in order to change things on different levels.

LAYNE & LEE (2001) mention the application for a business license as an example for vertical integration. In the most states in the USA, it is mandatory to have a local and a state business license. With the implementation of stage three the citizen only has to file for a business license at the local transaction server, and this server checks the databases of the state and federal agencies, retrieve corresponding records, propagates changes, and calculates the total license fee (Layne & J. Lee 2001, p.130). In order to achieve vertical integration technical matters and business processes must be taken into account. The task in the vertical integration is to align the processes between the different agencies, as it is mandatory to implement one complete integrated process, in order to have one continuous flow of the process on different levels (Martin & Montagna 2006, p.6).

For the horizontal integration, stage four, the level of process reengineering is getting more difficult as many of the *n* processes of the different *n* authorities are not required anymore. In addition it has to be clarified, which organization and which employees are responsible for the processes because the interaction between agencies force them to define the scope of the task. Normally, the number of processes decreases from the non-integrated to the integrated scenario (Martin & Montagna 2006, p.7).

This integration of processes requires the collaboration of steps and stages of processes across technical and organizational borders. These interdependencies are investigated through the analysis, modeling and design of material as well as information flows. The goal of process integration is to build an inter-organizational flow of processes between the participants. The challenges are:

- the identification and classification of performing entities,
- description and representation of items which are processed and shared,
- indicators for process control (e.g. conditions, events, service levels),
- business process models, workflow models with the reference to informational resources (Klischewski 2004, p.61).

In order to deal with these challenges of process integration, business process management as well as the linkage of functional components is needed. For the technical linkage it is mandatory to build IT infrastructures standardization on the application of Extensible Markup Language (XML), Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL) and Universal Description, Discovery and Integration (UDDI) (Klischewski 2004, p.62).

SCHOLL (2004, p.8) investigated the need for business process management in public administration, especially in the focus of business process change. The author investigated that to a highest degree stakeholder involvement, senior executive commitment, workflow analysis and the readiness assessments of change and culture is mandatory. In addition process and resource inventorying as well as internal competency and learning matters matter to a lower degree.

Summing up, vertical and horizontal integration enables the building of Administration Networks. Networks between authorities on different levels are enabled by the vertical integration. The horizontal integration enables the

networking between cross-functional organizations. The interorganizational business processes have to be aligned between the different partners. In addition, some intraorganizational business processes are no longer used, as through the integration step other authorities are responsible for the business process. The interoperability to the private sector changes; the organization does not have to use several services, but get Single Window Access, in order to get in touch with the public sector.

6.3.3 Case Study: ITAIDE – Paper Living Lab

The process of importing goods into a country shows the exchange between different organizations: importer of goods, shipping country and different governmental agencies. The following case shows that the adoption of e-Government leads to greater efficiency of the administrative processes as well as the interorganizational processes. As a consequence more organizations will adopt e-Government services in order to gain these benefits of efficiency, too (Tung & Rieck 2005, p.425).

The governments of Europe are facing the problems: (1) assuring the security of the international trade and (2) reducing the administrative overhead. It is difficult to deal with these two challenges at the same time as the gathering of data, in order to assure security, is very expensive and time consuming. The "*Information Technology for Administration and Intelligent Design of E-Government*" (ITAIDE) research project, funded by the European Union from 2006 to 2010, investigated these challenges and improves the European interoperability of taxation and customs. The goal of ITAIDE is to develop integrative architectures for e-Customs and taxation involving citizens and businesses by provisioning of online *Single-Window Access Point* services and the enabling of *Authorized Economic Operators* (AEO). The ITAIDE project describes the Single-Window Access as a single access point for businesses, where they can do all their interactions with the public administration offices. Single-Window Access is enabled by the vertical and horizontal integration of public administrations (see subsection 6.3.1 Evolution of e-Government). The Authorized Economic Operators are businesses which are authorized by the governments to operate through the community. These Authorized Economic Operators can use simplified customs procedures, which leads to significant reductions in the administrative workload (Rukanova et al. 2011, p.5f.).

The theoretical outcomes of this research project were tested in real-life e-Government scenarios, so called Living-Labs. These Living-Labs are dealing

with different specific industries intersecting with e-Government and interorganizational integration with challenging network aspects. The real-life testing includes four different Living-Labs, but here only the “Paper Living Lab” is presented, as it shows best the interaction between business companies and government as well as between governments.

In the Paper Living Lab a platform was developed that enables the integration of governmental agencies, small and medium sized enterprises (SMEs) as well as the customers and suppliers of the SMEs. The governmental agencies gain access to supply- chain data, in order to control the custom and taxations (Autere et al. 2011, p.55f.). Before 2009 the custom procedure in Finland was accessible for business companies on two ways: paper-based and XML-based via a website. Since 2009 it is no longer possible to initiate the process via a paper-based form. As a consequence firms that do not have implemented a XML-based solution have to type in their information on a website of the custom and taxation interfaces. However, importers still have to use the paper-based form. It can be seen that the transaction stage of e-Government already has been reached for Finish companies. Russian importers still hand an importer declaration to the Russian governments in a paper-based form with the same information as for the Finnish governments, which is responsible for the export of goods. The reason for this double-initiated process is that there is no integration or communication between the Finnish and Russian authorities. On some days, this leads queues up to 25 miles at the border because of import clearance and border inspections (Autere et al. 2011, p.57).

The lack of integration between authorities in Russia and Finland lead to double invoicing. This double invoicing has become a common practice in Russian trade. The business companies are showing the original invoice to the governmental agencies in Finland and an invoice with a reduced amount to the agencies in Russia. As a consequence the difference between the exported goods in Finland was 60 percent higher than the imported goods in Russia in 2005. In order to solve this problem, Finland, Sweden and Russia agreed on the Green Corridor approach. In this approach it is clarified that the business company sends the data in an electronic format to the Finish respectively Swedish governmental agency for customs before the cargo arrives at the Russian border. After that the Finish agency sends the data to Russian agency for customs. However, this Green Corridor approach has never been successful in use, as Russia demanded these approach at all EU-Russian borders, but the EU was not ready to do this (Autere et al. 2011, p.58).

The approach of this Living Lab is to develop a platform, where all stakeholders (trading partners as well as custom agencies) are integrated. The objective of this platform is to solve the problem of the Green Corridor and at the same time to increase the control at the boarders as well as to decrease the administrative burdens. The platform is called Webmerca and can be seen as a web service from an architectural point of view. In addition, a standardized format for the exchange of information was introduced. In this case the RosettaNet was chosen which is based on XML and defines guidelines, business processes and implementation frameworks between organizations, especially in the supply chain area. This standard is not only used to integrate business companies in this Living Lab, but to enable the interaction with both customs procedures. This means that e-Custom related processes are implemented by the Webmerca platform, too. The information that is needed by the taxation and customs authorities are collected from the documents between the commercial partners of the supply chain. Thus the effort to fill out extra formula for customs is reduced to the minimum (Autere et al. 2011, p.61f.).

In addition, the process for customs and taxation between governments and business changed from a *push* approach to a *pull* approach. Because of the Webmerca platform the business companies are not forced to push their data to the governmental agencies, but the public administrations can retrieve the needed data from the platform (pull). This approach has direct impact on the solution of the Green Corridor problem. A standardized platform exists, which integrates the processes and needed information between the Finnish and the Russian customs agency (Autere et al. 2011, p.66). Thus both governmental agencies have access to the same data and can communicate by the Webmerca platform in a standardized manner.

This case study shows that the vertical and horizontal integration between governments have an impact on intra- and interorganizational processes as well as the interoperability with the private sector. E-Government enables the organizations to interact in a narrower sense. In order to make this integration possible the processes have to be changed from a paper-based approach with an internal focus to a more electronic or digital based approach, in order to enable the communication between other organizations. This interaction has to be done on a standardized information exchange between the different stakeholders. In this Living Lab the communication is done by the standardized XML-based form by the Webmerca platform. The integration of the governments leads to a Single-Window Access for trading companies. In

addition, through the direct access of the government on information on the supply chain data, the effort of the custom procedures is reduced further. Thus this Living Lab addresses one of the key shortcomings of previous attempts on cross boarder communications in customs.

6.4 Conclusion

The investigation in this section has shown that the division of LEE & LAYNE (2001) regarding the evolution of e-Government is useful for the analysis of digital business processes as the focus of this approach is not on political issues, but on the integration of different partners. The research question: *"How do intra- and interorganizational digital business processes evolve through e-Government in Administration Networks for the interoperability with the private sector?"*

can be answered regarding the different steps in the lifecycle of e-Government:

- *Catalogue:* This stage of e-Government has no impact on the core business processes and the evolution of digital business processes in Administration Networks. In this stage the government offers information for citizens and businesses companies. This stage only leads to a reduction of workload at the front office and has no impact on processes at the back office. Some organizational issues regarding the answering of Emails have to be clarified. The interoperability between the agency and other stakeholders is enhanced by the additional way of communication.

- *Transaction:* In the transaction stage the initiation of the processes changes. The citizens and business companies are able to fill out online formulas and start the process online instead of sitting face-to-face to an employee of the agency. This step can be seen as the 'arising' of digital business process in the public sector. The digitalization of processes eases the way of interchanging information flows, which can be described as the first step in the direction of Administration Networks.

- *Vertical and Horizontal Integration:* The objective of these two integration approaches is the enabling of Single Window Access point services. The advantage for the business companies and citizens is the ease of interaction with the public sector. The interfaces for related services are reduced through the integration of vertical and horizontal agencies to a

single interface. In order to offer such kind of services the governmental agencies have to integrate their business processes. This leads to a reduction of internal processes in the public sector, as functions are combined in one services and processed which are doing the same are no longer needed. In addition, these single interfaces are integrated directly with organizations of the private sector as described in the Paper Living Lab. In order to integrate processes of agencies, technologies (e.g. web services) and an increased effort on business processes management are needed.

Although the building of networks in the public sector is beneficial for governmental agencies and for the interoperability with the private sector, many agencies are remaining in the first or second stage of e-Government evolution (Martin & Montagna 2006, p.5; Scholl 2003, p.10). Only some projects in the pilot phase are arising, which are enabling the next stages of e-Government growth (Becker et al. 2007, p.21). Reasons for that, among others, are the lack of high potential IT experts in the public sector (Scholl 2003, p.10) and uncertainty about the real benefits of introducing e-Government as well as the associated building of networks. In addition, the according business process changes with the introduction of e-Government are sometimes difficult because business processes are sanctioned and prescribed by laws, statutes and regulations (Scholl 2003, p.9).

7 Evolution of Communication and Trust in Social Networks

Sebastian Sartor

7.1 Introduction and Objectives

It is estimated that the value of Facebook amounts to 50 billion US dollars (Spiegel-Online 2011). More than 15 million active and unique users in February 2011 only in Germany (facebookmarketing 2011), more than 1 billion pieces of user produced content like photos, links or news updates are shared weekly worldwide (Krasnova et al. 2009, p.40). The numbers produced by the market leader of online social networks are impressive.

The impact of computer mediated communication such as instant messengers, email or social network sites on the management of interpersonal relationships is significant (Dwyer 2007, p.2). The numbers show that social networks embedded in the online environment have experienced a huge increase in popularity in the past few years (Acquisti & Gross 2006, p.36; Dwyer et al. 2007, p.2). AGARWAL ET AL. (2008, p.243) state that especially online social networks become more and more ubiquitous in all facets of individual and social life. In order to abet the success of the network, the network providers assure the usability by making the registration process or the sharing of information easy (Acquisti & Gross 2006, p.37). With this goal in mind, the systems are designed with weak access controls and a low level of security, while the opportunities of gaining and storing data increase and the costs decline (Acquisti & Gross 2006, p.37; Norberg et al. 2007, p.100). Keeping in mind that there are a lot of actors like employers, marketing or even security agencies who could be interested in personal data (Acquisti & Gross 2006, p.37), it is no surprise that the reputation of these sites has been diminished by a number of publications which mostly deal with the data security of SNS (Dwyer et al. 2007, p.3). After the introduction of some applications in Facebook lowering the barrier to publish user actions or data some groups like “Petition: Facebook, stop invading my privacy” or “Facebook Privacy Awareness Syndicate” emerged (Krasnova et al. 2009, p.2).

In consideration of this fact, the success story of social network sites is even more remarkable. It is assumed that in the online context and especially in social network sites there exist new interaction dynamics and mechanisms for communication (M. Ma & Agarwal 2007, p.43), which certainly have an impact on or are even the driver for the compelling success of the social network sites.

This statement indicates that there has been added a new facet to interpersonal communication. Thus, one aim of this section is to identify which aspects were added to communication in the online context after this evolutionary step. In addition we will discuss what role trust plays in the context of social network sites. As not all aspects of trust can be captured, we will focus on the impact of privacy concern and on the disclosure of information and analyse whether there has been a significant change in this relation compared to an offline context.

After the motivation for this topic in this paragraph, the second part will give definitions for the terms “Social Network Sites”, “Trust” and “Communication” with respect to the topic of this section. Then, in the third part of the section, different studies dealing with the interplay of trust and the usage of social network sites identified by a literature review will be presented. Based on these studies we will discuss the results and identify possible explanations for the behaviour of social network site’s users. In figure 7.1 the structure of the section and the theoretical concepts having an impact on this section are summarized.

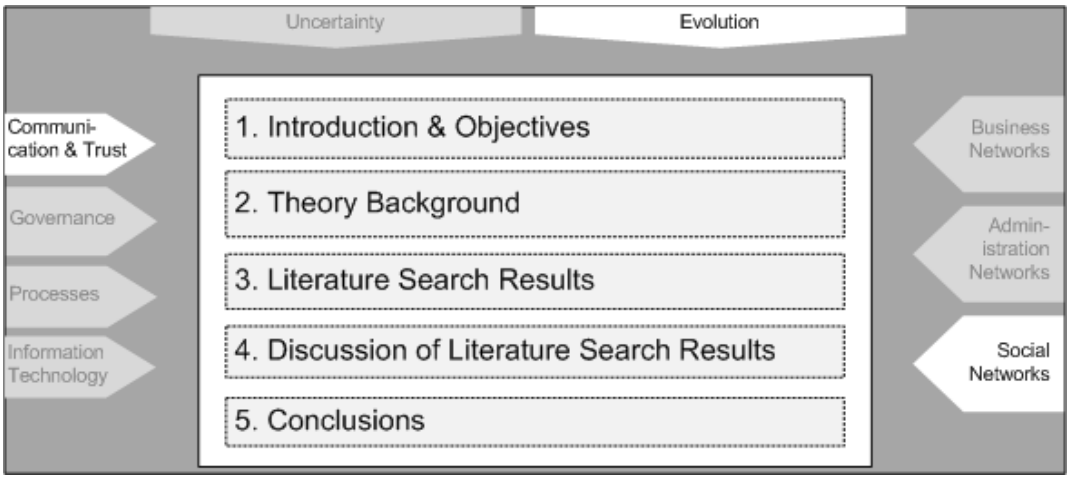


Figure 7.1: Structure of the Section

7.2 Theory Background

7.2.1 Social Network Sites (SNS)

Before being able to describe and define social network sites, one has to know the basics of social networks. In a first step we will define social networks and then give an overview of the common characteristics of social network sites, followed by a definition of this term.

Unsurprisingly, social networks have received intensive research interest by different research disciplines. Beside sociology, psychology, and communication researchers (Agarwal et al. 2008, p.244) also the fields of management and organizational behaviour are existent in the literature concerning the context of social networks (Sykes et al. 2009, p.373). Especially in the second half of the 20th century the research work connected to social networks experienced a significant boost which led to an exponential growth of publications (Borgatti & Foster 2003, p.992).

Keeping in mind the different research streams and the amount of publications there naturally exist different descriptions of the term "social networks". SCOTT (1998, p.109) for example gives the following description:

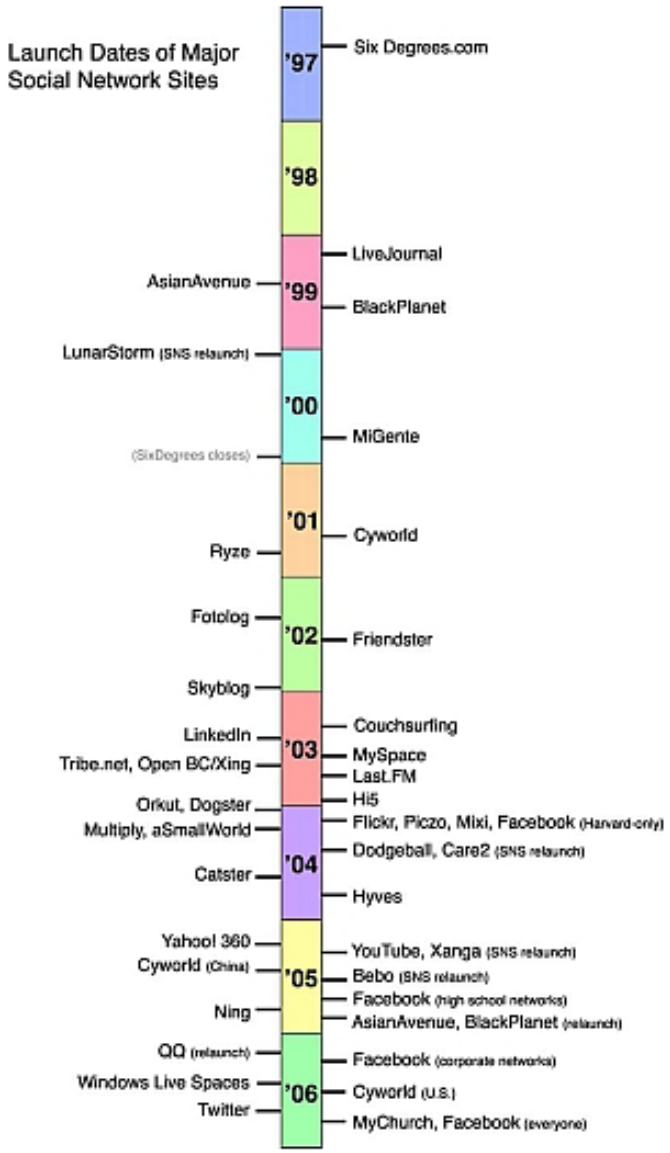
> "The phrase 'social network', with its connotations of textiles, webs, and grids, conjures up a strange but surprisingly powerful image of social reality. Individuals are, as it were, tied to one another by invisible bonds which are knitted together into a criss-cross mesh of connections, much as a fishing net or a length of cloth is made from intertwined fabrics."

One can see the analogies between SCOTT'S explanation and our general definition of networks. Also BORGATTI & FORSTER'S (2003, p.992) description can be compared to it as it refers to social networks as "a set of actors connected by a set of ties" where the actors can be for example persons, teams, or organizations. In addition to SCOTT they distinguish between directed (e. g. giving advice to someone) and undirected (e. g. being close to each other) ties. Furthermore they introduce the term of "ego-network" (Borgatti & Foster 2003, p.992) as a set of nodes and ties when focusing on a single actor. Following these explanations and taking the scope of this section into account, we define social networks as nodes representing individual persons or groups of persons which are connected by directed or undirected ties representing some form of trust or communication between the linked nodes.

While, as already stated, social networks have been mainly in the focus of social science, digital technologies were mainly discussed by computer scientists. Since their emergence, social network sites have attracted scholars from both research streams and the boundaries between these streams got blurry (Agarwal et al. 2008, p.244). This might be one reason for the fact that already the naming is very heterogeneous in the literature. While AGARWAL ET AL. (2008, p.243) talk about "digitally enabled social networks", KRASNOVA ET AL.

(2009, p.39) refer to this term as “online social networks (OSNs)”. Also the namings “social networking services” (Nabeth 2009, p.1), “online communities” (M. Ma & Agarwal 2007, p.42) and “social networking sites” (Dwyer et al. 2007, p.1) are present in the literature. However, we will stick to the term social network sites (SNS) as it is stated by BOYD & ELLISON (2008, p.211) that the term “networking” implicates a focus on the initiation of new relationships. While the initiation of new connections might be one reason for the usage of SNS, for most of them it is not the focus.

From the existing definitions of SNS which can be found in the literature we identified several common elements which were present in some or in all definitions. First of all, most definitions give one or several motivations for the usage of SNS. There is no doubt, that one of the main reasons for the usage of SNS is the maintenance of relationships (Dwyer et al. 2007, p.2; Acquisti & Gross 2006, p.38; Ellison et al. 2007, p.1143; D. Boyd & Ellison 2008, p.211). These relationships can already exist in an offline context, but also the creation of new relationships to foreigners is observable (Dwyer et al. 2007, p.2). Second, there is a general agreement in the literature that one main feature of SNS is the possibility to create and customize profiles (Acquisti & Gross 2006, p.38; Dwyer et al. 2007, p.2; D. Boyd & Ellison 2008, p.211). A profile is in most cases a summary of identifying information which can include the real name or a nickname, birthday, hometown, place of residence, personal interests, religion, ethnicity, or information about the career (Dwyer et al. 2007, p.2). A profile can be public or semi-public (D. Boyd & Ellison 2008, p.211) and has the purpose of making the individual identifiable and searchable for other members of the network. Last but not least, most definitions emphasise the possibility of interacting (Dwyer et al. 2007, p.2; Acquisti & Gross 2006, p.38). The form of interaction can be quite different and can include chats, blogs, comments, messages, sharing photos, or events. Based on these definitions and characteristics, we define social network sites as an online environment where people create public or semi-public profiles, make connections to friends or foreigners, and interact with them. Figure 7.2 shows the timeline of launch dates of major SNS. It also includes dates of re-launches, when major features were added or changed.



Source: (D. Boyd & Ellison 2008, p.212)

Figure 7.2: Timeline of Launch of Major SNS

7.2.2 Trust

The impact of the trust concept has been studied and tested in a variety of situations (Kini & Choobineh 1998, p.3) and was in the focus of many different research directions such as communication science, psychology, sociology, political science or economics (Colquitt et al. 2007, p.909). In this subsection we will first give an overview of different perspectives of trust and give some examples of studies which dealt with outcomes of trust before turning to the more specific field of online trust.

ROTTER (1967, p.651) defines *interpersonal* trust “as an expectancy held by an individual or a group that the word, promise, verbal or written statement of

another individual or group can be relied upon." The survival, the efficiency and the adjustment of social groups are based on the existence of interpersonal trust (Rotter 1967, p.651). Following JOHNSON-GEORGE & SWAP (1982, p.1306) interpersonal trust is especially a basis in situations of cooperation and interdependence where individuals have to decide whether "the risk of becoming vulnerable or dependent is worth the possibility of a shared positive outcome." Furthermore there exists the concept of trust seen from a *personality perspective*. KRAMER (1999, p.575) refers to *dispositional* trust in this context. It was discovered by field experiments and field researches that people differ in their tendency to trust or distrust other people (Gurtman 1992, p.989). It is argued that the actual beliefs about other people and therefore the tendency to trust other people are based on trust-related experiences from the past (Rotter 1971, p.445). Last but not least the *sociological* view, also referred to as the *institutional perspective* of trust, focuses on the social systems in which people are embedded. The trusting person has certain beliefs and expectations about this social system and thus about the person embedded in this social system (Barber 1983, p.164f.). As there exist these different perspectives of trust and there is no standard definition of trust (R. M. Kramer 1999, p.571) we will see trust as interplay of these views.

The impact of trust on different phenomena has been studied in a variety of settings. Leadership, especially concerning direct leaders (e. g. supervisors) is positively influenced by trust and is related to attitudinal, behavioural and performance outcomes (Dirks & Ferrin 2002, p.26). COLQUITT ET AL. (2007, p.918) detected a positive relationship between trust and risk taking, task performance, and citizenship behaviour performance and a negative relationship between trust and counterproductive behaviours. Furthermore, trust can diminish transaction costs (R. M. Kramer 1999, p.582) and thus is an important factor in coordination and cooperation (Limerick et al. 1993). These studies and findings are just an abstract of the research of trust outcomes. For a more detailed overview of this topic we suggest the paper of KRAMER (1999).

Also the effect of trust in the online environment and the challenge to build trust in this context has become a research topic of increasing importance and interest in recent years (Y. D. Wang & Emurian 2005, p.105). Especially in the context of e-commerce online trust has been conceptualized and studied. However, most of the characteristics of online trust identified in those studies can be transferred to other online services such as SNS. KINI & CHOOBINEH (1998, p.2) state that "since the internet is based on open system architecture,

trust is hard to develop and maintain." This is also the fact due to the history of the internet. It was developed as a research environment and was not designed for the purpose of buying and selling. As the numbers of users were small and had usually an academic background, there was no general need for security as the users trusted each other. With the vast increase of users and the change of the user demographics security issues became more and more a topic in the online environment. The appearance of fraud attacks changed the willingness of people to trust the internet as a place for commerce (Kini & Choobineh 1998, p.2). WILSON ET AL. (2006, p.16) stated that the building of trust starts on a lower level in a computer-mediated setting compared to a face-to-face setting. However, the results showed that the trust-level increased and was approximately on the same level over time. According to KINI & CHOOBINEH (1998, p.2), risk is an important component of trust, as risk indicates the possibility of a negative outcome. From this, it follows that users are even more cautious when financial transactions or the providing of personal data are involved. Compared to a scenario where the user only searches for information in the internet without abandoning personal information, the level of trust has to be higher. This is especially relevant for SNS, as the risk of distribution of personal data is very high in this setting. Concluding one can say that trust is a variable which has significant influence on the success or the failure of an online service (McKnight et al. 2003, p.334).

As one can see, there are a lot of different dimensions of trust, which are also especially relevant for the online context. Also in the more specific field of SNS there are a lot of different aspects which are influenced by trust or distrust. However, due to the boundaries of this working report it is not possible to discuss all relevant aspects. Thus we will focus on the impact of privacy concerns on the usage of SNS and on the willingness to share information on SNS. In addition, we will discuss the effect of trust on relationship building in an online environment.

7.2.3 Communication

The term communication has been studied for a long time by many different research specialties and is therefore use with different meanings, which include technical, physiological, informational, and psychological facets (Schulz 2009, p. 171). Therefore there exist many different definitions and research streams in the different specialities (Craig 1999, p.119). We will first discuss broad

definitions and characteristics of communication before then investigating computer-mediated communication as a more specific term.

BERELSON ET AL. (1964, p.527) defines communication as “the transmission of information, ideas, emotion, skills etc. by the use of symbols (...) It is the act or process of transmission that is usually called communication.” Whereas it is generally agreed on the fact that communication is a process, other authors conceptualized the term in a more detailed way. After an analysis of 160 definitions of communication MERTEN (1977) came up with four types of communication:

- Subanimalistic communication
- Animalistic communication
- Human communication
- Mass communication

Human communication is the communication between human beings with the special characteristic of the presence of a linguistic transmission channel. Mass communication is a special form of human communication which requires the usage of technology and is usually directed to the public. PÜRER (2003, p.59) defines communication in the broadest sense as all processes of information transmission and includes technical, biological, psychical, physical and social processors.

In the 1980s the topic of computer-mediated communication (CMC) as a relatively new form of communication got more and more into the focus. Especially the fast improvement of communication and information technologies in the 1990s was accompanied by an increasing interest in computer-mediated communication (Simpson 2002, p.414; Walther 1996, p.3). For example SIMPSON defines computer-mediated communication as an “umbrella term which refers to human communication via computers” (2002, p.414). PÜRER (2003, p.58f.) describes CMC as new communication forms which are available by the merging of telecommunication, computerization and conventional electronic mass media. It is stated that CMC can broadly be divided into synchronous (e. g. chat or audio conferencing) and asynchronous communication (e. g. forums or email) (Simpson 2002, p.414).

There exist many different research streams which try to identify the advantages and disadvantages of CMC (Walther 1996, p.3). KIESLER ET AL.

(1984, p.1125) state that in face to face situations there exist behaviours like head nods, smiles or eye contact which are helpful in the coordination of communication. As this is not or just hardly possible via CMC (at least not with text-based communication), the regulation, modification and control of exchange becomes more difficult as in an offline scenario. Furthermore the absence of status and position cues result in a situation where the hierarchy in social relationships and organizations is not easy to evaluate. These statements lead to the assumption that the reduction of social cues in CMC causes a disadvantage in effectiveness and efficiency compared to face to face communication. On the other hand, BERRY (2006, p.344) states that organizational constraints such as time pressure or geographical conditions such as distributed teams cannot adequately be answered with face to face communication. KAHAI & COOPER (1999, p.166) explain the growing importance of CMC in companies with the growth of globalization, telecommuting and the increasing availability of internet access. DAFT ET AL. (1987, p.363) argue in their article that different communication channels have different levels of media richness. Successful managers should pay attention to the message ambiguity when selecting a communication channel (e. g. use face to face communication in scenarios with high message ambiguity). RICE (1992, p.475) refers to this concept as media richness theory and states that “when (1) information processing capabilities match (2) information processing demands, (3) performance will improve”.

In this section we will concentrate on the disclosure of information in SNS. We mainly talk about messages, status updates, personal information or multimedia data which are available to either a defined number of recipients, to all individuals which have a direct relationship to the sender or to all members of the SNS. Thus we are talking about CMC as a form of human communication or mass communication.

7.3 Existing Studies in Literature

In this subsection we will present different studies which we found in our literature research connected with the topics privacy concerns in SNS and characteristics of communication in SNS before discussing the (partly contradictionary) results of the studies in the next subsection.

ACQUISTI & GROSS (2006, p.36) compared user’s attitude towards privacy which they evaluated in a survey with their actual behaviour which they observed by mining data collected directly from the social network. The study connected

data of 209 respondents from a North American college institution with actual behaviour on the SNS Facebook, which was mainly focusing on college and high-school students in 2006. The actual data from the website were downloaded and archived just before the completion of the survey. The results show that “privacy policy” is a very important topic for the participants of the survey, even more important than the threat of terrorism (questions about the threat of terrorism and other social issues were asked in order not to influence the interviewee). Although the importance of privacy is very high, it does in general not have a significant influence whether an individual joins Facebook or not. In fact, also individuals with the highest level of privacy concern joined the social network. In addition the analysis of the actual behaviour on Facebook shows that there is little or no relation between the reported privacy attitudes and the provision of certain information (e. g. birthday, cell phone number, personal address, sexual orientation) on the website. For example some respondents revealed information about their home address and their schedule of classes even so they articulated the highest concern level for the situation where strangers knew these pieces of information. Comparable results can be found for information about the sexual orientation, partner’s name, and political orientation. The level of quality of provided information is accurate and complete if a certain type of information is provided at all. ACQUISTI & GROSS (2006, p.51) interpret these result as a confirmation of a privacy attitude / behaviour dichotomy which has already been studied by ACQUISTI in an online commerce scenario (2004, p.1).

DWYER ET AL. (2007, p.3) also analyzed in their study in how far internet privacy concern and the willingness to share information and develop new relationships are connected. In addition they investigated how trust in the SNS and in other members of it affects these two way of behaving. In order to be able to evaluate the influence of the site’s culture or technical functionality on the user’s behaviour, the study included two different SNS, Facebook and MySpace. In contrast to ACQUIST & GROSS, the user’s behaviour in this study was reviewed only by a survey which also included questions about perceptions of trust and internet privacy concern. The questions were derived from a qualitative study by DWYER (2007, p.3). The sample contained 117 individuals (69 Facebook members and 48 MySpace members). The results show that there exist some differences between the two SNS. MySpace users are more likely to develop new relationships on the SNS. These new relationships are also extended by using other communication channels such as email, instant messenger or face-to-face meetings. These results are surprising as the level of trust to other

MySpace members is also very low for those individuals who stated that they develop new relationships via MySpace. In contrast to MySpace, the Facebook user's willingness to develop new relationships in an online environment is rather low. They prefer to use the SNS for the maintenance of relationships, which have been initialized offline. The level of trust to other users is higher as well as the willingness to share identifying information such as real name, hometown, or email address, compared to the results of MySpace. The outcomes of a correlation analysis with the dependent variables information sharing and the independent variables, internet privacy concern, trust in the SNS and trust in other members of the SNS are confusing. "The influence of trust in the site is more apparent in the behaviour of Facebook subjects when it comes to development of new relationships, even though there is less trust in MySpace along with more reports of developing new relationships" (Dwyer et al. 2007, p.9). Although there exist significant influences by each independent variable, the results are rather disappointing as the correlation coefficients are quite low.

TUFEKCI (2008, p.23f.) analyzed the relationship between disclosure and privacy concerns and fear of unwanted audiences on MySpace and Facebook. Target group of this study were undergraduate students of a university in the mid-Atlantic region of the US. The researchers gathered 704 usable surveys in the years 2006 and 2007. The results show, that students who had a high level of privacy concern are less likely to start using one of the SNS investigated in this study. When the students joined MySpace they managed their concerns about unwanted audiences by the usage of nicknames. In the case of Facebook users tried to solve this problem by adjusting the visibility of their profiles and made it only visible to their friends. A link between using the real name and adjusting the visibility of the profile was not found. However, adjusting the level of disclosure instead of one of the other solutions was just observable in the case of phone numbers, but not for other pieces of information. Also the probability perceived by the students that government, corporations, future employers, or romantic partners did not influence the setting whether the profile is visible or not. Like in the already discussed studies, also in this study the general privacy concern is not connected to the level of disclosure. However, it was detected that students using Facebook and MySpace managed their profile visibility according to their fear of unwanted audiences.

KRASNOVA ET AL. (2009, p.43) argue that the results from previous studies (also from the studies which were presented in this subsection) are based on

insufficient measures of privacy concern. It is stated that the used measures do not cover all dimensions of user concerns, as the privacy related risks of SNS users are very specific. Therefore a new concept for the measurement of “User Privacy Concerns on OSNs” (Krasnova et al. 2009, p.43) was developed before testing the impact of privacy concerns on self-disclosure. At the end of an exploratory phase with two focus groups and a confirmatory part including a survey, the researchers identified the two dimensions “Concerns about Organizational Threats” and “Concern about Social Threats” (Krasnova et al. 2009, p.51) with all in all eleven items covering the privacy concern concept. The dimension “Concerns about Organizational Threats” includes all aspects about the collection and the usage of information by others. It is stated that users do not differentiate between the SNS itself or third parties. Also there is no distinction by the users between the collection and the actual usage of the information. The “Concerns about Social Threats” dimension includes all risks which arise from the user’s environment like the embarrassment by others, or the lack of control over the actions of other users. In order to analyze the impact of the newly conceptualized concern construct on the amount of information disclosed, the honesty of the disclosed information and conscious control (conscious control means the careful selection of which information are disclosed), an online questionnaire was launched which lead to a sample of 210 Facebook and StudiVZ users. The results show a significant negative influence of the concerns about organizational threats and the amount of disclosed information by the user, which means that users will reduce the amount of information when having the impression that the SNS or other entities tend to collect and use these pieces of information. Despite this relation there was no evidence for a connection between the social threats and amount of information disclosed. For the independent variable “Concerns about Social Threats” there was one significant path leading to the dependent variable “Conscious Control”. The positive path coefficient indicates that users reflect on the selection of information which they reveal when they fear social threats by other users. All other relations between independent and dependent variables are not significant, especially the variable “Honesty” is not significantly influenced by one of the independent variables.

We can see that the results from the different studies are not consistent. Most of the studies in literature indicate that users are highly concerned about their private data. However, the actual behaviour in SNS shows that this fact doesn’t lead to a withdrawal of the information. This is not a new phenomenon. Also in the offline context there has been identified a discrepancy between the personal

information disclosure intention and the actual behaviour which is called “the privacy paradox” (Norberg et al. 2007, p.100). In contrast, the finding by DWYER ET AL. (2007, p.1) that trust is not a precondition for the establishment of new relationships is cannot be observed in an offline scenario. In fact trust is a critical precondition for the creation of new relationships in a face to face situation (Lewis & Weigert 1985, p.968).

7.4 Discussion of previous Study Results

As seen, the results of previous studies are quite vague and often not very significant. However, in most of the studies one can identify a dichotomy between privacy concerns and the actual user behaviour. It indicates that the relationship between trust, privacy and information disclosure is not well enough understood for a modelling of behaviour and activity (Dwyer et al. 2007, p.8). In this subsection we will discuss the results of the studies and give one possible perception of how privacy concerns and communication are connected in SNS.

We begin our analysis with the social exchange theory (Roloff 1981). The social exchange theory states that individuals „seek preferred resources from others” (Roloff 1981, p.25) when it comes to a social exchange, therefore the „guiding force of social exchange is self-interest” (Roloff 1981, p.25). Before beginning a social interaction, individuals execute a cost benefit analysis. They compare what they have to invest in this interaction and what is the outcome. If this comparison seems to be beneficial for the individual, he tends to enter into the interaction. It is assumed, that trust influences the cost benefit analysis on the cost side. When an individual trusts another individual, the perceived risk of a looming interaction is influenced in a positive way. Thus, the higher the trust is, the lower the perceived costs of the social interaction are. On the other side, low trust or distrust leads to a perceived higher risk and therefore to higher costs which makes the interaction, ceteris paribus, less likely. It was shown by studies of interpersonal exchange situations that trust has a positive impact on the willingness of individuals to share information about oneself (Metzger 2004). As we saw in the previous subsection, user’s privacy concerns with regard to the usage of SNS are quite high, reputation of and trust in SNS have been diminished (Dwyer et al. 2007, p.3). Regarding these statements, the increasing user numbers and the amount of information distributed via SNS are even more remarkable. One feasible explanation is that the functionalities and features of SNS influence the benefit side of the cost benefit analysis in a way that social exchanges in this context seem to be beneficial for the user. However, these

functionalities and features must have such an impact so that they are able to outperform the perceived risks on the cost side of the comparison. We argue that this has to be a functionality which cannot be fulfilled by a different tool without an increase of perceived risk.

It is often stated that the maintenance of existing relationships, which are initiated in an offline context, is one of the main advantages of most SNS (Dwyer et al. 2007, p.2; Krasnova et al. 2009, p.40; D. Boyd & Ellison 2008, p.211). As the constraints of physical location and geography are removed in SNS (Agarwal et al. 2008, p.244), the maintenance of these relationships gets easier. In fact, the ability to search for your friends, see all of your existing connections in a list and see existing connections of others are features which unifies SNS. Also the functionalities of chatting, leaving messages on profile sites, private messaging, or sharing events or pictures help to maintain existing relationships. However, in our opinion these functionalities and features can also be covered by other internet based tools, such as emails (including email clients and their functionalities), or instant messengers without disclosing a vast amount of private data. Therefore it is unlikely that this feature is the main reason on the benefit side of the cost benefit analysis which outperforms the distrust and privacy concerns.

As already stated in the introducing sections, profiles are one main component of SNS (Acquisti & Gross 2006, p.38; Dwyer et al. 2007, p.2; D. Boyd & Ellison 2008, p.211). With the information publicized on this page, users can state their home town, contact information, sexual orientation, favourite music genres, films, or books, and other interests. Many SNS also include groups which appear on the profile when the user is member of the group. The topics of the groups are quite divers and range from political groups to fan pages of artists. Most SNS also encourage the user to upload profile pictures so that they can be identified by their friends. Also the upload of other multimedia content as videos or the incorporation of application is made possible by some SNS (D. Boyd & Ellison 2008, p.213). All these possibilities enable the user to create a picture of himself and to present his identity online (D. Boyd & Heer 2006, p.1).

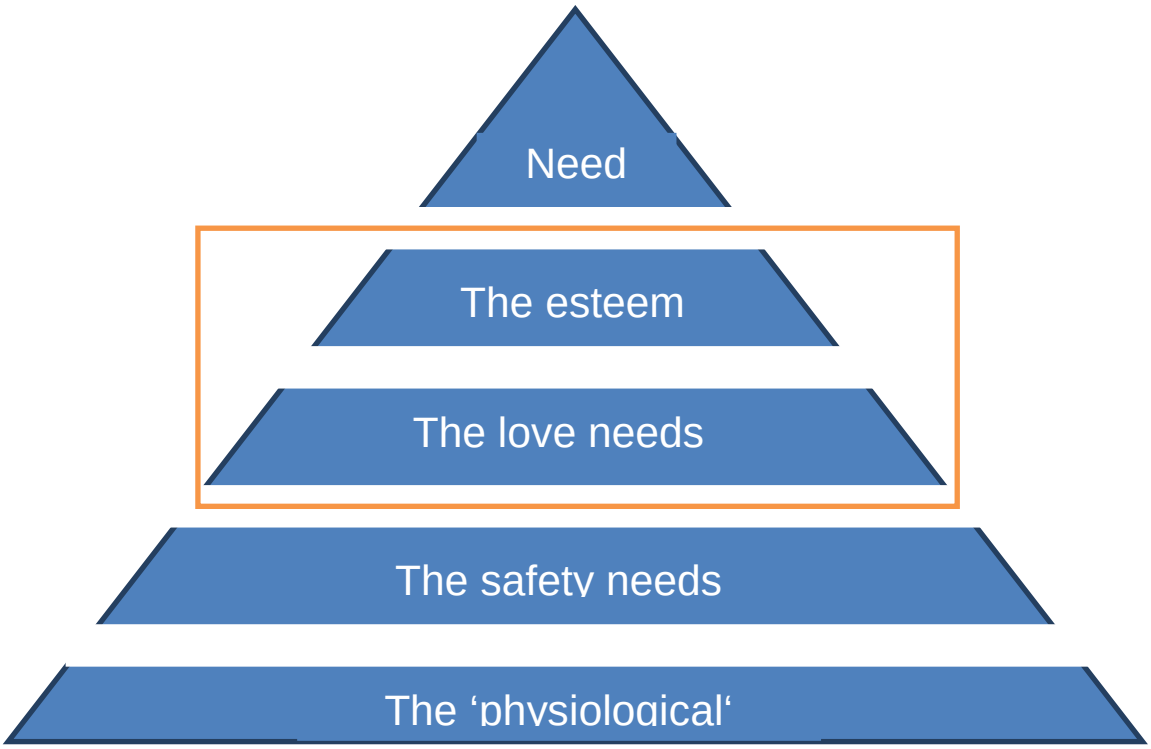
GOFFMAN (1959, p.95) states that when “an individual enters the presence of others, they commonly seek to acquire information about him or to bring into play information about him already possessed”. These pieces of information influence them in their behaviour towards the individual as they can estimate what they can expect from him and what he will expect of the others. From the

individual's point of view it might be important, what the others think of him. He might want the others to hold him in high esteem, or he wants them to think that he holds the others in high esteem. "Regardless of the particular objective which the individual has in mind and of his motive for having this objective, it will be in his interest to control the conduct of the others, especially their responsive treatment of him" (Goffman 1959, p.96). GOFFMAN distinguishes two general kinds of communication. Expressions given are considered as communication in the traditional sense, e. g. the spoken word. Expressions given off are nonverbal communication cues which are presumably unintentional. The control of impressions others form from an individual is called impression management.

Following KRASNOVA ET AL. (2009, p.41) impression management in SNS is related to the asynchronous nature of communication in this environment (Walther 1996, p.4). As nonverbal communication cues step aside in the asynchronous online environment, verbal and linguistic cues are emphasised (Ellison et al. 2007, p.418). Commonly, the nonverbal communication cues are less controllable compared to verbal and linguistic cues what makes online self-presentation more influenceable than face to face self-presentation. Therefore, SNS are a perfect platform for individuals for impression management. In fact, SNS are the first online tools which allow the regular internet user to present himself to a big audience without having particular monetary costs and the skills. Of course already before the emergence of SNS there were opportunities to present himself to a big audience. Impression management can e. g. also be executed by the development of a personal website. However, this requires at least basic skills in the design of websites as well as a webspace, whereas SNS can be used with just a basic knowledge about how to use the internet.

The willingness of people to present themselves can also be traced back to MASLOW'S pyramid of needs. It contains a theory of human motivation and is based on a hierarchical sequence of five needs, namely physiological, safety, love, esteem needs and the need for self-actualization (Maslow 1946, p.1946). According to the theory, the need on the lowest level of the pyramid which is not satisfied has the biggest impact on the motivation of the individual. From our point of view, the love needs and the esteem needs come into consideration when discussing the motivation to use SNS. The love needs become important as soon as the safety needs and the physiological needs are satisfied. They subsume the desire to have friends, a life partner, or children. It is the search for a place in his group which lets the individual feel unsettled. The esteem needs are described as "the desire for reputation or prestige (defining it as respect or

esteem from other people), recognition, attention, importance or appreciation" (Maslow 1946, p.33f.). When individuals are able to satisfy this need they can increase their self-esteem and have the feeling to be needed whereas when not being able to satisfy these needs, feelings of inferiority will arise. We assume that most ordinary users of a SNS have already satisfied the two lowest levels of the pyramid, namely the physiological needs (e. g. hunger, thirst, sexuality) and the safety needs (e. g. a residence, protection against diseases). On the level of love needs, SNS can help to establish new relationships to others and find new friends who are alike. It can give the user the sense of belonging to a group as connections to other people are visualized. On the level of esteem needs, SNS can – as already stated – give a platform for the communication of a self-created image.



Source: (See Maslow 1946)

Figure 7.3: Pyramid of Needs

Confirmation for the hypothesis that people use SNS as a self-presentation medium can be found in literature. KRASNOVA ET AL. (2009, p.2) talk about the "individual's desire to engage in impression management" and their want to "communicate and present themselves to others." One of the main motivations for using SNS is the fact to be seen by other individuals which the user wants to see him in a certain way (Tufekci 2008, p.21). It is stated that users adjust their information disclosure strategies on SNS according to their individual goals

(Gibbs et al. 2006, p.153). LAMPE ET AL. (2007, p.9) claim that someone who is looking for new relationships tends to publish more information about himself. Among other things it is argued that with this strategy the reduction of search costs can be achieved, as the search "for common referents that lead to increased understanding between participants" (Lampe et al. 2007, p.3) is simplified. Also MA & AGARWAL (2007, p.45) indicate that through efficient impression management individuals can find like-minded others with whom they can build relationships. TUFEKCI (2008, p.33) says that individuals in fact do try to manage the border between impression management and privacy. But instead of hiding information and therefore loosing the opportunity to present themselves, they try to manage the audience by restricting the visibility of their profiles. By doing so, users attempt to optimize the balance between their benefit (self-presentation) and costs (risk of gathering and usage of information by others).

7.5 Conclusions

First of all, our aim was to show the impact of privacy concern on the willingness to disclose personal information on SNS. In the third part of the section we presented studies which we identified in our literature research. The results are ambiguous and partly antithetic. However, the general opinion is that there exists a dichotomy between privacy concerns and information disclosure. This behaviour has already been observed in an offline scenario, which shows that this is not a completely new phenomenon. The second aim was to identify new facets of communication which are available through the usage of SNS. In our discussion part we argued, supported by the concept of impression management and the pyramid of needs, that the possibility to present yourself to a big audience is a want of humans. This need can be satisfied easily and in a cost-efficient way with the usage of SNS, contrary to a scenario without such a tool. The management of the boundary between privacy and publicity is supported by the ability to customize the visibility of information. This makes it possible to define your audience.

There are some limitations which have to be announced concerning this section. We have only seen small excerpts of how communication and trust evolve in SNS. The aspects of these concepts seem to be numerous in this environment. An example is the question how trust works concerning the content of information. As we saw, the amount of user created content on SNS is gigantic. The user can easily be overwhelmed by this amount and has to

identify relevant and qualitatively sufficient information. In addition this section is based only on a literature research. Findings are just partly proved by qualitative and quantitative research. Especially in a relative young and very dynamic environment, continuous research is needed. This holds particularly true as new trends, such as the expansion of the SNS to other websites, emerge constantly.

8 An Evolution Perspective on Service Oriented Architectures in Business Networks

Enrique Villalon

8.1 Motivation and Objectives

Public government agencies are increasingly required to deliver more services and with higher quality to citizens and business partners (in the context of the so called Government to Citizen –G2C- and Government to Business –G2B- networks (Reddick 2004a, p.52)). Due to the fact that each individual public agency is as such not providing services by its own (M. Janssen & Kuk 2006, p.1) there exists an interdependence and interoperation among public agencies for the provision of those services (in the context of the so called -G2G- networks) (Reddick 2004a, p.52). This defines the context for the emergence, development and existence of Public Administration Networks (PANs). The services in question can be delivered physically or virtually and can be of informative or transactional nature. However, today's popularized Information and Communication Technologies (ICTs) facilitate and encourage for an increasing service delivery through virtual and electronic channels (Ebrahim & Z. Irani 2005, p.592).

With the rise of the Internet, individual public agencies would start publishing information on static websites as the first type of electronic services they would provide to citizens and business partners (Layne & J. Lee 2001, p.123). However, the tendency towards a higher variety and more complex services has set a requirement upon public agencies to interconnect their systems with other public agencies' systems (G2G) creating a high complexity of the overall interoperability for service delivery, potentially affecting its performance and the adaptability of its development (M. Janssen 2007, p.60). This situation has fostered the evolution of an optimizing enterprise architecture in PANs that is able to cope with the increasing complexity and allows the delivery of better, reliable and effective services. The analysis of this evolutionary process is worth to be considered to understand where today's complexity in PAN architectures is coming from and foresee some key opportunities and scenarios for the future.

There have been many attempts in the literature to explain the changes of Information Systems in the form of stages of growth where each stage implies an optimized and better adaptation to the environment compared to the

previous stage ((M. Janssen & Van Veenstra 2005, p.194). Most studies, however, have focused on the description of each stage rather than on the mechanisms that drive each stage to the next one (J. L. King & Kraemer 1984, p.473). Additionally, researches on Information Systems' evolution have a greater focus on intra-organizational contexts i.e. they consider the organizations individually, but much less on inter-organizational contexts i.e. consider the networks of them. Finally, recent developments in the Information Systems research area and its increasing complexity have given birth to the development of Enterprise Architecture studies as a more holistic and integral view to understand and address the development and maintenance of Information Systems (M. Janssen & Van Veenstra 2005, p.194).

As part of the evolution process of E-government, Enterprise Architectures enable the cooperation of services among public agencies and the delivery of electronic services to citizens and to business partners. Therefore PANs are opting more and more for an architecture approach that focuses on the services themselves, a requirement that suits very well to the concept of Service Oriented Architectures (SOA). According to (Leganza et al. 2006, p.5f.) this tendency is even stronger than in the business networks due to the natural fit between SOA and the context of service delivery requirements in PANs.

Thus, there is a need of an analysis to understand better from an evolutionary perspective the interoperability architectures in PANs for the service delivery and therefore an analysis under the light of the evolution of their design towards well implemented Service Oriented Architectures. Such an analysis of the stages identified by other researches and the evolutionary mechanisms and processes that trigger the upgrade from one stage to the next one is the main objective of this paper. Together with the evolutionary stages a framework to simplify the architectural analysis of service interoperability among public agencies will be presented under the scope of the evolution process.

It is important to highlight the fact that this paper does not aim at providing a prescriptive approach to achieve an optimal interoperability architecture for PANs, neither it is to propose a maturity model for SOA implementation in E-government. It rather suggests a descriptive overview as to how to analyze and understand the stages and the mechanisms that enable their evolution. Eventually, some future scenarios can be identified based on this model.

In the subsequent section an overview of basic definitions in this context will be presented, i.e. the evolutionary approach as an adaptation of Darwin's

evolutionary theory for organizations applying the four fundamental evolutionary processes (variation, selection, retention and struggle), Public Administration Networks and a brief overview on Service oriented Architectures. In section 3 the framework for analysis of interoperability architectures in PANs is introduced and in section 4 the stages of evolution as well as the drivers that trigger their evolutionary path are presented. Finally, a case study about the evolution of an interoperability framework in the European Union is analyzed under the lenses of the evolutionary approach. The paper ends with some conclusions and an outlook into future research and scenarios.

Figure 8.1

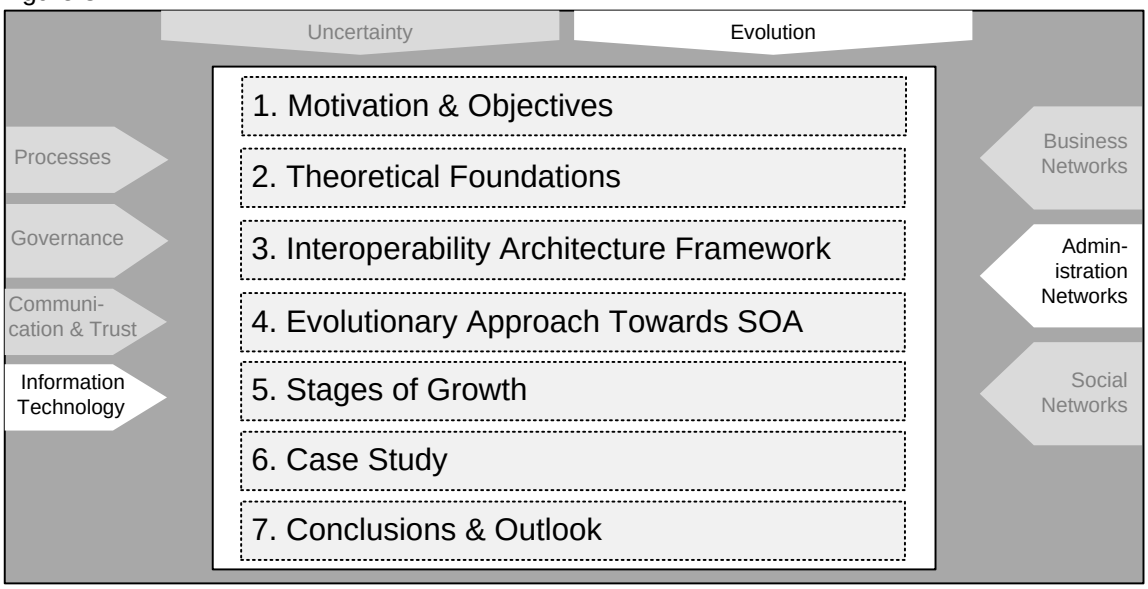


Figure 8.1: Structure of the Section

describes the classification of this section into the overall research framework and summarizes the topics of this thesis.

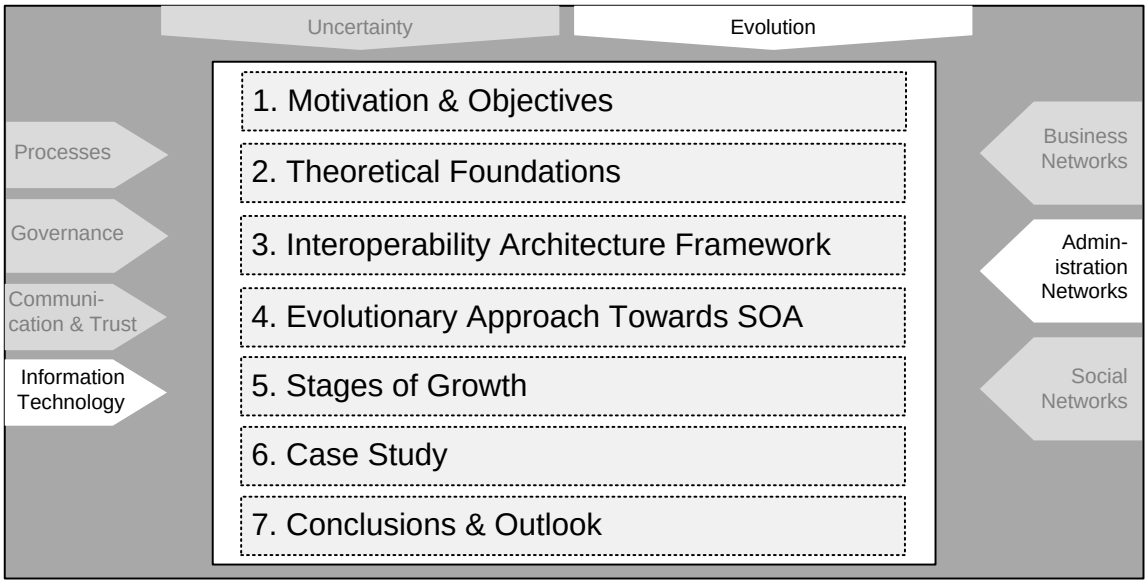


Figure 8.1: Structure of the Section

8.2 Theoretical Foundations

8.2.1 Evolution Theory in Organizations and Enterprise Architectures

Charles Darwin explained the evolution of the species introducing a set of evolutionary processes and laws that rule the mutation and survival of species. ALDRICH & RUEF (2006, pp.16-27) adapt Darwin's evolution concept of species into how organizations evolve in an environment of scarce resources. The authors describe four main evolutionary processes that determine the evolution of organizations: Variation, Selection, Retention and Struggle. On the following, these processes are briefly explained (Aldrich & Ruef 2006, p.16):

- **Variation:** The process of change from current routines and competencies that generates change in the organizational form. It can be an intentional variation i.e. active or deliberate attempt by people to create alternatives and find solutions, or it can be a blind variation where it happens without any intentional or conscious planning.

- **Selection:** The process of positive selection or negative elimination of some variations. Selection can come from forces external to the organization (external selection) affecting its form or be generated internally in the organization (internal selection)

- **Retention:** The process of preserving, duplicating or otherwise reproducing certain variations of organizational forms that have been selected. (e.g.
- **Struggle:** The process of competition to obtain resources from the environment that are scarce and limited.

The evolution theory in organizations explains how organizational forms are created, evolve and survive in time within an environment where resources are scarce. In reality, the four processes occur simultaneously rather than in sequence where they are linked in continuous feedback loops and cycles (Aldrich & Ruef 2006, p.26), as shown in Figure 8.2

Variation generates the "initial" range of forms that the external or internal selection processes eliminate or choose, of which some, in turn, are preserved by the retention process. However, retention also influences variation as it ultimately narrows down the range of forms that "suffer" variation later on again and the processes struggle for scarce resources, including the formation of cooperative alliances, would affect the criteria of selection processes (Aldrich & Ruef 2006, p.26).

Figure 8.2: Evolution Process Overview

Several authors have proposed in the literature an approach based on evolution stages in which Information Systems progress within organizations as a result of influences from the organizational environment (J. L. King & Kraemer 1984, p.473) (Nolan 1973, pp.399-405). Furthermore, several maturity models have been proposed to describe the maturity in the implementations that Information Systems go though in organizations e.g. CMMI, COBIT. Historically these studies have focused more on business organizations and solely on Information Systems but recently some studies have been realized in regards to the evolution Information Systems (and even Enterprise Architecture) in Public agencies like LAYNE & LEE (2001), REDDICK (2004a), MOON, however, have

remarked the differences between the evolutionist and evolutionary approach. Most of the found approaches (including the maturity models) are rather evolutionist i.e. the focus of analysis is the aim at a final state of equilibrium and fitness with the environment realities. On the other hand, an evolutionary approach focuses on the drivers and present mechanisms that enable the evolution progress from stage to stage. In this way, an evolutionary approach for Service Oriented Architectures in the interoperability of PANs can be considered and it bases on existing evolutionist models but that also takes a look at those evolutionary processes that influence the evolution itself.

8.2.2 Enterprise Architectures and Service Oriented Architectures

The above explained overview of evolution of Enterprise Architectures in PANs towards a well implemented service orientation brings us to the need of defining the second fundamental concept: Service Oriented Architectures. The concept of Enterprise Architecture does not have a universally agreed definition (Rohloff 2005, pp.1-2) but can be understood as a kind of a master plan that describes the enterprise holistically by unifying the business goals, strategies, governance and structures with its infrastructure, including IT capabilities like databases and applications, thus providing policies and standards for its design (M. Janssen & Kuk 2006, p.2) (Hailstone & Eager 2009, p.174). In essence, an architecture aims at creating some kind of structure in a chaotic environment using systematic approaches (M. Janssen & Kuk 2006, p.2). When referring to an Enterprise Architecture, its scope is specified by the consideration of the organization as a whole or multiple organizations as a whole (i.e. a network of public agencies, in the present case), rather than a fraction or a project/program of it. In this way, the models of an Enterprise Architecture provide ways to deal with the complexity including work (who, where), function (how), information (what) and infrastructure (how to) (M. Janssen & Kuk 2006, p.2) by describing relationships among technical, organizational and institutional components of the enterprise.

When it comes to designing an Enterprise Architecture a set of design principles are followed, which together form an architecture design paradigm (Erl 2007, p.35). A Service Oriented Architecture (SOA) is a design paradigm according to which application functionality is not provided by large monolithic information systems but by means of web services (Linthicum 2004, pp.16-19). These services and their assembly (i.e. applications) deliver functions of value to the organization (i.e. PAN in our case) enabling dynamic business processes.

Several design principles of SOAs have been introduced in literature, being one the most acknowledged ones the Service Design Principles proposed by ERL (2007): Standardized Service Contract, Service Lose Coupling, Service Abstraction, Service Reusability, Service Autonomy, Service Statelessness, Service Discoverability, Service Composability (for a brief description of these principles see Appendix A). The evolution of interoperability architectures in PANs is therefore the evolution of these design principles that ultimately lead to the modularization, accessibility, well description of business logic though interoperable services independently of their physical implementation, thus, the implementation of a Service Oriented Architecture across public agencies to deliver high quality services to citizens, business partners and among themselves. JANSSEN (2006, p.2) summarizes this by stating that principles restrict architectures and set the direction of the future.

8.2.3 Public Administration Networks

After introducing fundamental concepts of the evolutionary theory and their potential applicability to the development of Enterprise Architectures, we land to the specific case of the Public Administration Networks (PANs). In the most abstract level, a network is a set nodes interrelated by edges. In the present study, we are particularly interested in governmental public agencies as nodes (under any scope i.e. local, regional, national and international governments) and the connections among them for the provision and interconnection of services. In the context of the electronic government, the provision of electronic information and transaction services is becoming a strategic move for them as it is increasing the efficiency of public transactions, implementation of government policies and running government process, information and resources (Ebrahim & Z. Irani 2005, p.590) (Marijn Janssen & Joha 2006, p.102). Additionally, the provision of services is increasingly organized around networks of agencies that have a variety of heterogeneous Information Systems (M. Janssen & Kuk 2006, p.1). SOA and the electronic integration of organizations come naturally together (Hailstone & Eager 2009, pp.17-18) and the following sections will describe a framework to understand the evolution of it under the light of PANs.

8.3 An Interoperability Architecture Framework for Service Delivery in Public Administration Networks

The adoption of E-government is not straight forward (Ebrahim & Z. Irani 2005, p.590) due to its increasing challenges in regards to adaptation to new

environmental requirements (M. Janssen & Kuk 2006, p.1) mainly because of the complexity of its heterogonous legacy systems (Leganza et al. 2006, p.5f.). This is especially more the case when it comes to integrating networks of government agencies that are naturally heterogeneous in inter-regional and international environments. As mentioned previously, an Enterprise Architecture aims at dealing with this complexity and therefore an architecture framework becomes instrumental to structure the main aspects of the technical and business interoperability of PANs. The most common way to depict architecture viewpoints is through interconnected layers providing several levels of abstraction that facilitate the separation of concerns of the complexity and thus the analysis of smaller problems without losing the big picture. EBRAHIM & IRANI (2005, pp.591-601), for example, proposes an architecture framework for E-government depicting five layers that go from the lowest layer (infrastructure) towards the highest layer (access) shows an integral view of the business and technical interoperability of public entities and business partners for the provision of services to the final user (the citizen at the access layer) (see Appendix B for an overview of the framework).

The interoperability architecture framework for PANs bases on the framework proposed by EBRAHIM AND IRANI (2005, pp.591-601) but in order to abstract further from its inherent inter-organizational complexity and facilitate a more focused analysis in light of its evolution and drivers, a more simplified framework will be used. The interoperability architecture framework describes the “what” of the evolution process.

Figure 8.3 presents the architecture interoperability framework. It is based on layers and depicts the technical interoperability (left) and business interoperability (right) separated but connected within each layer.

On the right side the Business Architecture aspects of the PAN are depicted which are reflected and connected to the left IT Architecture side of the framework. The model shows how from the lowest layer (infrastructure) the business and IT architecture artifacts of the network are put together and relate with each other in order to provide and share (at the top level) the services to the outside.

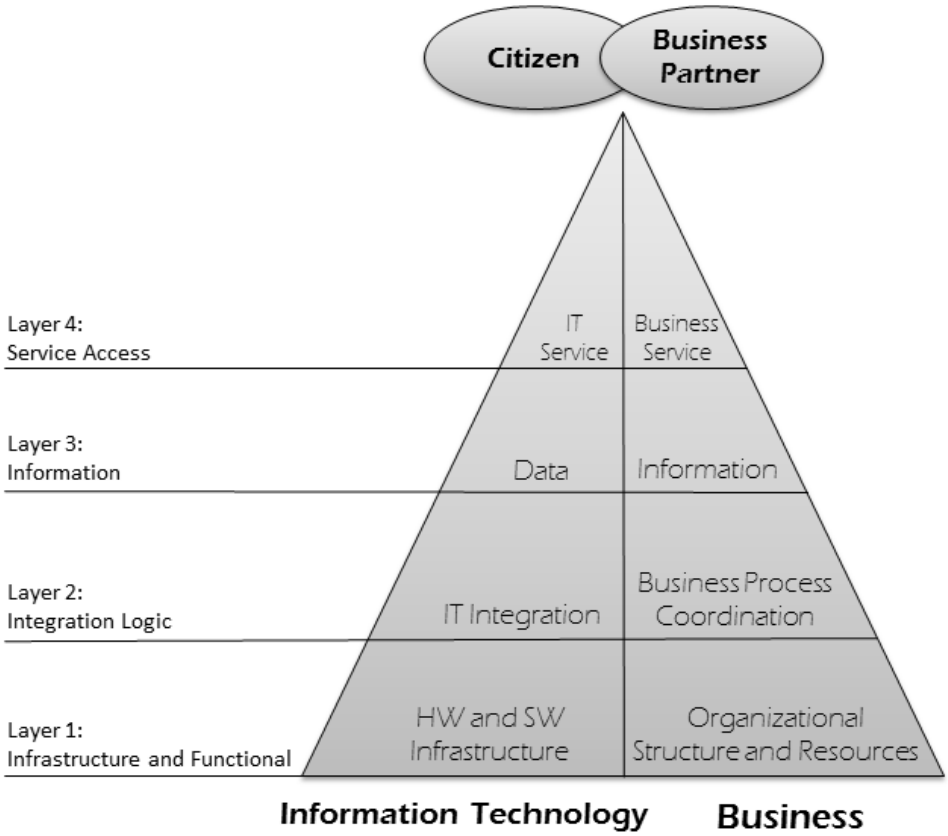


Figure 8.3: Interoperability Architecture Framework for Public Administration Networks

Layer 1 – Infrastructure and Functional Layer: It describes the IT hardware (HW) and software (SW) infrastructure and functionalities that the public agencies have in place to support the business processes and their integration. It is very common to find here stand-alone legacy applications due to which the majority of maintenance and development costs for e-government initiatives leak to this layer (Leganza et al. 2006, p.5). On the business counterpart, the organizational structure (functions) and its (financial and human) resources define and determine the scope and shape in which the IT is laid out and developed.

Layer 2 – Integration Logic Layer: At the integration layer, the design of the interoperability layout among public agencies is addressed. The business side aims at the required interoperability when Business Processes (BPs) from different agencies of the PAN need to be integrated and coordinated among them. On the IT side, the layer deals with the design of the interoperability across the agencies of the PAN of their various IT functionalities and components in Layer 1. In this layer, it becomes clear that every integration attempt of two or more agencies creates the need of the integration between their data and information, thus the set up for the next layer.

Layer 3 – Information Layer: The Information Layer describes how the organizational information is created, stored and shared among the functional and structural components established in Layer 1 and through the integration logic established in Layer 2. The business side focuses on the organizational information objects whereas the IT counterpart concentrates to their implementation in terms of data objects.

Layer 4 – Service Access Layer: The composition and interrelation of the lower layers facilitate the structure, functionalities, information and their interoperability among the PAN agencies allowing them to provide electronic services in the form of information retrieval and transactions to the outside, thus fulfilling ultimate objective of any e-government initiative (Leganza et al. 2006, p.5f.).

The analysis of the interoperability architecture and its evolution towards a SOA could be done focusing in any of the layers separately or in all the layers at once. For example, at the information layer, different types of integration can be analysed (Guijarro 2007, p.94), for example: semantic, syntactic and even linguistic. In the same way an integration approach can be seen from the point of view of the physical infrastructure elements that need to interconnected or perhaps merged at Layer 1. The analysis of the present study will consider all layers but have a greater concetration on SOA design principles manifested in the integration layer (Layer 2).

8.4 An Evolutionary Approach for the Interoperability Architecture Framework towards a well implemented Service Orientation

The analysis of the evolution of SOAs in PANs is concerned with the question of how the evolution of the interoperability architecture framework evolves from its beginnings towards a design that enables the sharing and provision of services that follow the SOA principles presented in section 2. The first step in the analysis is to determine the main drivers of evolution, which describe the mechanisms that enable the interoperability architecture to advance from one evolution stage to the next one. The drivers foster a deliberate or blind realization of the evolutionary processes (variation, selection, retention and struggle) and therefore determine its course.

Keeping an alignment with the IT and Business sides of the interoperability architecture framework described in the previous section, the drivers are differentiated into Business and IT drivers. Business drivers influence the

evolution affairs of the network interoperability (structure, information, Business Process coordination) that are formed for the provision of public services to citizens and business partners. On the other hand, the IT drivers influence the evolution affairs of the technical interoperability of the infrastructure, its integration design, and its data in order to enable the provision of electronic services (e.g. web services). At each side, three types of drivers have to be distinguished according to their nature and scope: Contextual, Requirements and Constraints. Figure 8.4 depicts how the drivers influence the overall architecture interoperability model.

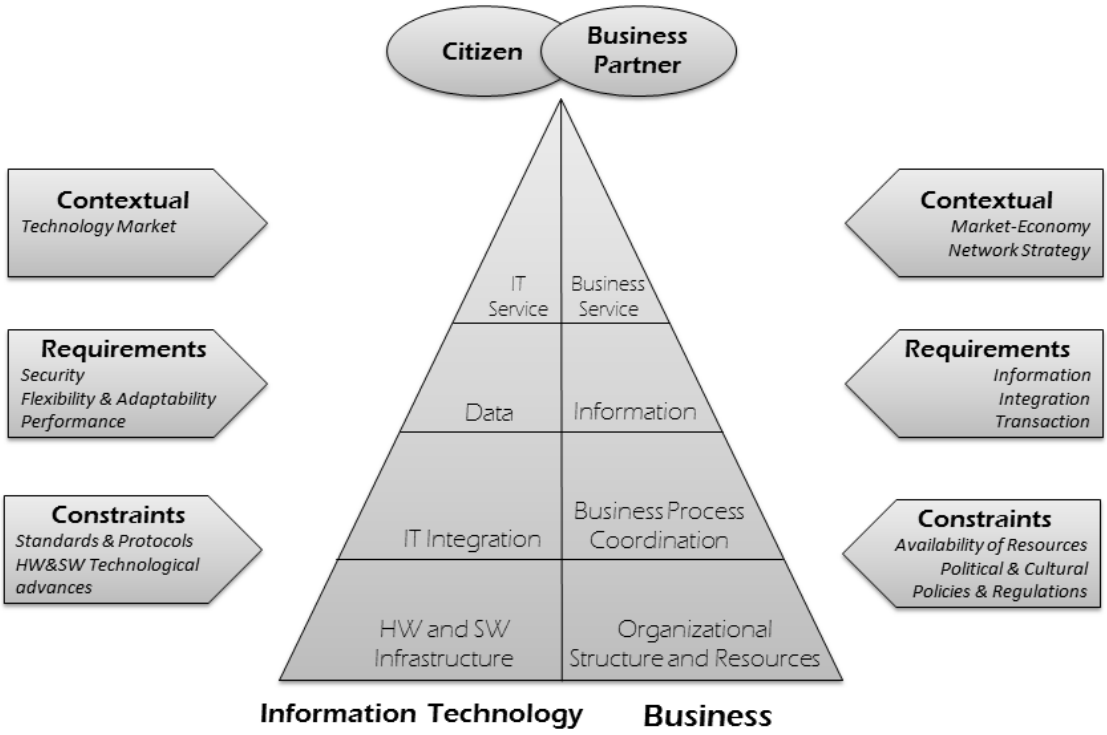


Figure 8.4: Evolution Drivers that Influence the Interoperability Architecture Framework

8.4.1 Business Drivers

Contextual

These drivers are concerned with the environmental elements of the network that influence the evolution of the interoperability architecture. The elements that compose these drivers are present inherently in the context of any PAN and may (or may not) influence the deliberate or blind application of evolution processes on any given period of time. Two main areas in the contextual drivers can be distinguished:

- **Market-Economy:** The market and economy context in which the scope of the specific PAN operates determines the extent to which the available resources are scarce as well as the opportunities and threats that can potentially have a direct influence on its interoperability architecture. HAILSTONE & EAGER (2009, pp.26-29) for example, describes how in times of economic crisis survival opportunities are generated for organizations and networks that have advanced in the implementation of SOAs by allowing a better adaptability of their processes and allowing thus a dynamic business partnering and efficient outsourcing.

- **Network strategy:** This area comprises the objective itself around which the network is formed. Many studies have analysed the reasons why organizations form networks to deal better with environmental conditions (Aldrich & Ruef 2006, p.240). In the present case of study this aspect is concerned with the strategy determined by the governmental bodies that foster the creation of networks of governments to deliver better services. EBRAHIM & IRANI (2005, p.590) mentions strategic connections among public agencies that seek for new ways of dealing with businesses and partners while fulfilling the increasing expectations from the citizens. (Hailstone & Eager 2009, p.90) highlights the importance of the economies of scale that can be achieved by several organizations sharing common services in a networked environment. JANSSEN & VAN VEENSTRA (2005, p.193) also define the need for inter-organizational coordination in E-government initiatives.

Requirements

An architecture implementation for the delivery of services by PANs faces by its very nature the requirements at business level that need to be met and which influence the quality and layout of its design, thus, its evolution. Three main complementary types of requirements can be distinguished:

- **Information:** The simplest service that can be provided to the final user (citizen, business partner) is the response to an action in which it requests a specific set of information. The availability of information ranges from simple websites to complex catalogues of publicly available data. As it will be explained in the next section, in the first stages of a SOA evolution informational services are the most common ones and with which PANs start any interoperability implementation process (M. Janssen & Van Veenstra 2005, p.195). One of the most important

requirements for information provision is the transparency of it (M. Janssen 2007, p.59). Especially in the case of governments delivering public services, transparency has to be ensured, thus, increasing the trust of citizens and business partners in using them from the specific government entity that provides them. Availability, transparency, quality and ownership/accountability of the information in a PAN are a straight forward requirement that influences the design and evolution of its interoperability architecture.

- **Integration:** Business integration is a natural requirement in any network arrangement. (Hailstone & Eager 2009, pp.17-18) assesses the importance of integration requirements as orchestration and coordination business capabilities that determine a SOA design. JANSSEN & VAN VEESTRA (2005, p.198) see in integration the key requirement that enables the creation of new government services by composing existing ones from different agencies. The need and scope of putting together various business elements (i.e. the business side in the interoperability architecture framework) among various agencies determines in a greater extent the design of the interoperability architecture itself and the form of the services provided to the final users.

- **Transaction:** A transaction requirement fosters capabilities across the network architecture that enable services the end user requires to formalize an agreement, movement of resources or communication with a particular network agency effectively. EBRAHIM & IRANI (2005, pp.594-595) emphasizes on the delivery of more efficient transactions in order to increase the overall network agility and the benefit of reducing the amount of them within a PAN through a well-integrated service architecture. WILLIAMSON (1993) in his widely known Transaction Cost Theory manifests the influence that the cost of a transaction can have in inter-organizational arrangements. The design of the architecture to support the interoperability among public agencies is thus highly influenced by the reduction of transaction costs among them and for the citizens and business partners. A SOA approach, in particular, has a greater impact in the reduction of transaction costs due to the reusability of services and the composability of them underpinning network processes, optimizing their efficiency and costs.

Constraints

There are some business aspects that are fixed and set within the scope where a specific network exists which in any case determine the limitations and frame of the implementation of any network architecture arrangement. The constraints can be the availability of resources, political and cultural and policies and regulations.

- **Availability of resources:** Human and financial resources available in the environmental context of a PAN are and will be scarce. The extent to which a network and its composing organizations can have access to those resources will determine the scope in which an interoperability architecture can be properly implemented i.e. the required and available resources for the appropriate implementation of an architecture. In fact, public agencies and networks constantly compete with business organizations for (limited) skilled human resources and the leadership required to build architectures (Cellary & Strykowski 2009, p.6). Financial resources are seen differently compared to business networks as the source of the resources is different (government budgets coming from the citizen taxes in the case of PANs versus revenue in the case of business networks). However, the resources allocated for PANs and the contribution from the each agencies' budget is a crucial constraint and determinant on any architecture implementation project and thus in its evolution.

- **Political and Cultural:** Political and cultural issues present in PANs define a crucial driver for the evolution of interoperability architectures as these are the human behaviour aspects which are to some extent unpredictable but in any case limiting the decisions and implementation of any Enterprise Architecture initiative in PANs. This is accentuated in the case of cross regional and international networks where these differences are more remarkable. EBRAHIM & IRANI (2005, pp.603-604) mentions the importance of trust among agencies in the development of e-government architectures as well as the role that the organizational culture plays in it. JANSSEN & KUK (2006, p.9) discuss the political impediments present in a public enterprise architecture implementation initiative and the influence they have in the evolution timeline due to complex agreement processes and decisions upon the required investments which can take time.

- **Policies and regulations:** Within the context of influence of a specific PAN, a fixed set of internal and external policies and regulations restrict the reach of the design of the interoperability architecture and thus its evolution. HAILSTONE & EAGER (2009, p.25) remark the limitations that the regulations concerning the ownership of information can pose over the design of interoperability architecture as well as the auditing capabilities that architectures must contain to comply with the law. The Policies and regulations aspects increase tremendously the complexity of architecture when networks reach international boundaries and may affect the overall evolution timeline (delay).

8.4.2 IT Drivers

Contextual

In a broad sense the influence of the IT market dynamics represents a major driver in the evolution of interoperability architectures PANs. The competition of vendors selling HW and SW architecture appliances has widened the portfolio of alternatives of architecture implementation and made possible the commoditization of technologies (i.e. more accessible to smaller networks with fewer resources). Nowadays, even open source SOA appliances are available from new and traditional big vendors (Hailstone & Eager 2009, pp.82-86). The evolution of the technology market has enabled the creation of a breed of technologies that support different architecture approaches which lately have been moving more and more towards SOA, especially the appliances that construct Enterprise Service Buses and other orchestration designs (Hailstone & Eager 2009, p.10). The technology market dynamics have recently enabled the diffusion of Cloud Computing which widens up tremendously the future possibilities of SOA implementation (Hailstone & Eager 2009, pp.91-94) because of the connectivity and compatibility between cloud services and PAN services in its interoperability architecture (Cellary & Strykowski 2009, p.1).

Requirements

Due to the different realities that the PAN nodes have in terms of the technologies deployed in their own infrastructures, the alignment of technical requirements for the interoperability architecture affairs is challenging (M. Janssen & Kuk 2006, p.1) and the best option to deal with this is to find a minimum set of requirements that could satisfy the overall expectation toward the network architecture (M. Janssen & Kuk 2006, p.4) and that also could be

met by each and every agency of network. In this sense, three types of requirements can be identified:

- **Security:** One of the most important requirements for any Information System today is the assurance of security, privacy and confidentiality in its operative environment. The requirement is especially outstanding in the case of public agencies' Information Systems that store and process sensitive information and what this means when it comes to sharing and delivering some services within a PAN and to the outside (Hailstone & Eager 2009, p.62). In that sense, the risk of misuse of externally provided services is also very high. JANSSEN (2007, p.58) debates the impact that lose coupling (one of the design principles of SOAs) can actually have on the accountability when more services form compositions of services and it becomes complex to hold the composition accountable to security, confidentiality and privacy (because of the difficulty of tracking any weakness in an individual service). Therefore, and perhaps opposite to SOA design principles, a tight coupling of services could offer a better possibility to deal with complex security affairs. Thus a balance between lose and tight coupling needs to be considered in this regard. In any case, this driver is a major influence in the evolution of interoperability architectures for PANs.

- **Flexibility and Adaptability:** Whereas SOA implementation across disparate network nodes represents a major challenge for security concerns and the accountability of individual services, its design principle of lose coupling fosters a high adaptability and flexibility (M. Janssen 2007, p.58). In addition, modularization of flexible and adaptable components is a natural tendency of the design of architectures and becomes an inherent principle when it aims at a well implemented SOA. The influence of this driver in general supports the reduction of redundancy and the replacement of obsolete and legacy systems and thus the development of a well implemented SOA (Hailstone & Eager 2009, pp.18-19). Issues like monolithic and legacy inflexible systems increase the complexity enormously in PANs and can affect the proper delivery of services. Therefore, this aspect must be considered for a proper architecture design as the more the network grows the more impact of its inherent complexity can have over the architectures and its services.

- **Performance:** When it comes to designing an interoperability architecture for PANs one of the major concerns is the performance of the systems present already in each agency and which are required to interact with the rest of systems across the network to ensure the delivery of high quality services to citizens and business partners. JANSSEN (2007, p.58) again raises the attention on the paradoxical approaches of the design approaches of tight coupling which ensures a better accountability on security and performance versus lose coupling in which security and performance based on the composition of various services is quite complex to asses and trace and where the overall performance is determined by the weakest node. Service level agreements (SLAs) are to be put in place to ensure the overall accountability on performance and security of individual services but on the other hand a too strict SLA could hinder a fast adaptation in the evolution timeline of the architecture in question.

Constraints

Similarly to the business drivers, there are some constraints and determinants in the IT context that frame the limitations of the course of evolution of a SOA. Two main aspects can be identified:

- **Standards and Protocols:** Since the beginnings of computing, IT Standards and Protocols have evolved and diffused and they continue in doing so until today. Many standards and protocols have been adopted by the industry so far e.g. TCP/IP and HTTP as the main protocols upon which modern Internet works and furthermore they have been also adopted by architectural design standards for SOA. Nowadays, services in a SOA interoperate over the HTTP protocol in the forms of web services using the SOAP messaging protocol. However, use of web services with REST standards is gaining popularity (Hailstone & Eager 2009, pp.74-75). Currently a wide variety of web service standards over SOAP are available (known as WS* standards) and address a wide range of features. HAILSTONE AND EAGER (2009, pp.18-25) discusses the impact that the available standards for Business Process Execution like BPEL, BPMN, BPRMS are having in the current implementations of SOAs at enterprise and network levels.

- **Technological advances in HW and SW:** The ongoing advance of Information and Communication Technologies creates new opportunities

in the evolution of interoperability architectures but also constraints its limits. It sets a requirement of ongoing upgrade to keep up with it. A well implemented SOA, being an advanced evolutionary stage of these architectures, benefits from the advances in HW and SW artifacts. HAILSTON & EAGER (2009, pp.78-79) discuss the generation of new "SOA in a Box" HW appliances, brand new SOA XML firewalls to increase efficiency and new Java 2 EE features to implement the business logic of web services more efficiently.

8.5 Stages of Evolution

After introducing the interoperability architecture framework and the drivers that influence its course of evolution towards a well implemented SOA in the context of PANs with the objective of sharing and delivering high quality services, their main evolution stages along with a brief analysis of the influence of the drivers is presented next.

The evolution drivers do not act individually or in sequence but rather complementary, sometimes contradictory (as seen above in the case of accountability versus adaptability) and in constant feedback loops that trigger the evolutionary processes introduced in section 2. They ultimately drive the interoperability architecture from its beginnings to a well implemented SOA.

As stated in the objective of this paper, the focus will be the assessment of the mechanisms (i.e the drivers) that trigger the evolution rather than the description of the stages of evolution themselves. Therefore most of the researches that have proposed a stage models can be suitable for this analysis. Several studies are more specifically concerned with a stage model for E-government networks but for the objectives of this study, however, the stages of growth in E-government model of JANSSEN & VAN VEENSTRA (2005) is the most suitable as it focuses on the progress of Enterprise Architectures in its evolution following the "the need for more horizontally integrated architectures addressing the communication between systems within and between departments and organizations" "by analysing how the dependencies interdependencies between Information Systems in front and back offices are managed and thus finding the evolution in five stages of the architecture necessary for services delivery to citizens and business". Thus, in the following, we will take a slightly adapted version of this growth model and analyse on the light of the evolutionary theory and interoperability architecture model and the evolution drivers described in previous sections.

8.5.1 Stage 1: No Integration

Before the diffusion of the Internet, government agencies were hardly interconnected. The majority of the services were provided manually or through scarce direct electronic channels. The advent of Internet generated a wide range of possibilities and technologies through which businesses and citizens could start interacting directly with their government public agencies and who would start using and choosing the electronic services against the physical ("old-fashioned") ones as they fit better their needs and more efficiently. Those practices of providing electronic services to citizens and businesses will be copied and retained by more government organizations. There is still no integration yet at this stage, however the most standardized way to interact with citizens is through the provision of informational services over the internet using the websites which are being updated with manual mechanisms. LAYNE & LEE (2001, pp.126-128) describe these as cataloguing services where the website comprises an overview of useful services. The web applications and data are stand-alone applications and there is no need for exchange of data. An exemplary overview of the evolution processes and drivers, as well as the affected layers of the architecture framework is shown in table 8.1.

Evolution Drivers	Evolution processes	Affected Layers
IT Constraints: The advent of the Internet as a new information channel and platform.	Variation: Creates a wide range of new possibilities and opportunities to deliver information services	Infrastructure and Functional
Business Requirements: Need to deliver information more efficiently to citizens and business partners to meet their rising expectations.	Selection/Retention: New information channels would be preferred by users. More agencies would copy and implement this approach.	Information, Service Access
Business Constraints: End users using old-fashioned information channels.	Struggle: Old-fashioned channels compete against new channels for resources and investments.	Service Access, Infrastructure and Functional

Table 8.1: Evolution Drivers and Processes of Stage 1 (Excerpt of the Most Relevant)

8.5.2 Stage 2: One to One Integration

In stage 1, the only way in which two systems (i.e. from two different nodes of the PAN) can interact is though manual (human) copy of data between each other. When the architecture starts growing i.e. more services need to be added and interconnectivity is needed among agencies to enable them it starts becoming unmanageable and a one to one integration approach starts being implemented. Some automatic mechanisms for updating the content are

already in place (web forms) as well as some direct communication with citizens and partners through E-mails. Therefore a higher responsibility in terms of the ownership, security, privacy and transparency of the information exchanged becomes an important requirement as well as the administration of organizational resources for the maintenance and operation of this approach need to be considered. This leads to the necessity to already start implementing some policies and standards for the delivery of electronic services.

Message adapters and middleware start appearing in this stage to facilitate the interoperability between applications while making it possible to cope with the complexity of their interfaces, encapsulating the implementation details and make them “talk to each other”. In order to achieve this, middleware based on a common language, communication protocols (e.g. HTTP, TCP/IP) and means of delivery of the messages between services (a channel like the Internet or an intranet) appears. In addition, the role of middleware in this stage can be widened with additional services like naming and directory and even transaction capabilities. An exemplary overview of the evolution processes and drivers, as well as the affected layers of the architecture framework is shown in table 8.2.

Evolution Drivers	**Evolution processes**	**Affected Layers**
IT Requirements: Better performance for and more flexibility in the information publishing process.	Selection: Agencies would select ways to provide services in a more efficient way.	Service Access, Integration Logic
Business Requirements: need to have transaction and integration capabilities in the services.	Selection: New possible service capabilities are selected.	Infrastructure and Functional, Integration Logic, Service Access.
Business Contextual: New network strategies arise among public agencies to leverage on its benefits.	Variation: Many new networking opportunities and benefits arise. Retention: Best practices of inter-organizational networks are kept	Service Access, Integration Logic.
IT Constraints: New standards and protocols allow new ways to interconnect PANs’ systems.	Variation/Retention: Many new standards arise with the advent of the Internet and only the best ones are preserved and selected by PANs.	Integration Logic, Infrastructure and Functional.

Table 8.2: Evolution Drivers and Processes of Stage 2 (Excerpt of the Most Relevant)

8.5.3 Stage 3: Centralized Integration

With the further growth of the PAN and an ongoing increase in the interconnection of its nodes’ Information Systems, the emergence of a robust interoperability architecture for a more reliable delivery of services is imminent.

However, the one to one integration approach starts becoming obsolete as its inherent complexity is becoming unmanageable due to the amount of one-to-one connections among the systems which results in the so called “spaghetti” of interfaces. Problems like low transparency and accountability in the services offered and the problematic update one system’s node without affecting all the nodes connected to it create the need for a different approach that can decrease in a structured way the number of links.

In a centralized integration architecture the concepts of a shared data warehouse and an Enterprise Service Bus (ESB) appear. The idea behind this design is that there is a central appliance that either stores shared data (fed from all systems of the network nodes) and a service offered by a PAN accesses and/or there is central messaging entity (broker middleware - ESB) that underpins the communication among the various systems. The broker has message translation and routing capabilities allowing the real time exchange of information between systems and a one stop shop connection among all systems. An exemplary overview of the evolution processes and drivers, as well as the affected layers of the architecture framework is shown in table 8.3.

Evolution Drivers	**Evolution processes**	**Affected Layers**
Business Contextual: Growth of the PAN in its connected nodes and systems and services.	Variation: Increase in network nodes, systems and needed interconnections.	Infrastructure and functional, Integration Logic
IT Requirements: Better performance required while increasing the adaptability of interconnected services.	Selection: New approaches that allow more flexibility and adaptability are selected.	Integration Logic, Service Access
Business Requirements: More efficient integration and better quality in the information.	Selection and Struggle: Better integrated services and with more information quality will win the struggle and be selected by their utilizations by end users.	Integration Logic, Infrastructure and Functional
Business Constraints: Resources available to build the architecture need to be optimized (cost efficiency).	Struggle: PANs and agencies struggle for government financial resources.	Infrastructure and Functional.

Table 8.3: Evolution Drivers and Processes of Stage 2 (Excerpt of the Most Relevant)

8.5.4 Stage 4: Orchestrated Integration (SOA)

The centralized integration approach has a lot of benefits already as the most efficient way to interconnect different systems is through a central point (a shared database or a broker). Thus, any system of the PAN needs only one

connection to plug in the whole architecture. The flexibility, performance and scalability as well as maintenance costs and the economies of scale are the main advantages of this design. Besides, adapters for the shared database and broker allow different heterogeneous technological environments to communicate seamlessly.

This approach, however, implies sometimes the risk of having a single point of failure of the overall network architecture and even if there is a high flexibility for interoperability purposes, when it comes to efficiently implement new processes and services dynamically across the network nodes, its design is not enough to do that without huge costs and hassle. Therefore the extension of this centralized architecture towards a full application of the SOA is the idea behind this orchestrated integration stage.

The migration of the functional logic from the monolithic applications towards web services which follow the SOA design principles makes the interoperability architecture highly adaptable and allows to create new workflows and rules (e.g. in combination with specialized standards like BPEL and BPRMS). This allows for not only the dynamic information exchange between systems but also for the dynamic invocation of functionalities and management of the sequence those invocations. Thus, the merge of the application integration requirements with Workflow Management requirements is fostered. The service composition principle and capability of SOA facilitates the dynamism of workflow creation of new business processes required to provide new services to the outside. Advance Enterprise Service Bus technologies with an appropriate Master Data Management capability enable a the centralized architecture to become a modern orchestrated architecture (Hailstone & Eager 2009, pp.97-98) with a backbone as a repository of reusable services that interoperate across all the network agencies and that can fulfil the major requirements that PAN expects from its supporting architecture. An exemplary overview of the evolution processes and drivers, as well as the affected layers of the architecture framework is shown in 8.4.

Evolution Drivers	Evolution processes	Affected Layers
Business Requirements/IT Contextual: More flexibility and possibilities of integrating and creating new Business Processes	Variation/Struggle: Many new possibilities of integration are available and offered from a struggled technology market.	Integration Logic, Infrastructure and Functional
Business Contextual: PANs need more dynamic processes and services to fulfill citizens' and business partners' expectations.	Selection: Better approaches for more dynamism on network processes are adopted.	Integration Logic, Infrastructure and Functional
IT Constraints: New standards available that join Business Process and SOA initiatives.	Selection/Retention: Adopted standards that seem to work in the industry are being retained for further implementation in PANs.	Integration Logic, Infrastructure and Functional

Table 8.4**:** Evolution Drivers and Processes of Stage 4 (Excerpt of the Most Relevant)

8.5.5 Potential Future Scenarios

The last stage of evolution of the interoperability architecture presents a highly advanced evolution status where it has passed from just interconnecting and coordinating information systems across network nodes towards focusing on the dynamic implementation of Business Processes through workflows. Innovation potentials and a wide range of new possibilities are opened up in this latest stage. New trends like the Cloud Computing capabilities and Web 2.0 features can further extend the capabilities of this modern interoperability architecture. On one hand, the diffusion of Cloud Computing offers modularized cloud services which can easily be connected to the PAN interoperability architecture to extend and create new and more robust services. Cloud Computing, also due to its inherent flexibility can also avoid vendor lock in, thus, easing the new implementations in PANs. Advanced capabilities of Web 2.0, on the other hand may allow the end users of the PAN services build their own composite applications themselves through mashups based on the services readily available. In this sense future scenarios/stages in the evolution will enable PANs to concentrate more on the organizational and socio-political issues for service provision (M. Janssen & Van Veenstra 2005, p.198) rather than investing lots of resources and being hindered by the complexity of their heterogeneous systems. An exemplary overview of the evolution processes and drivers, as well as the affected layers of the architecture framework is shown in table 8.5.

Evolution Drivers	Evolution processes	Affected Layers
IT Contextual: New vendors offering Cloud Computing services and web 2.0 trends in users.	Selection/Struggle: New market trends and vendors struggle for a share, while PANs will see and adopt new technology opportunities for them.	Service Access. Information, Integration Logic
Business Constraints: Cultural differences and political interests foster innovation from the end user.	Selection/Variation: New adopted technologies will create many new user-driven applications increasing the variation tremendously.	Service Access. Information, Integration Logic

Table 8.5: Evolution Drivers and Processes in potential future scenarios (Excerpt of the Most Relevant)

8.6 Case Study: European Interoperability Framework (EIF)

The European Interoperability Framework (EIF) is a set of recommendations and guidelines to promote integration across EU countries. It specifies how administrations, businesses and citizens interoperate and communicate with each other within the EU and across member states borders. Its objectives are (ISA 2010, p.1):

- “To promote and support the delivery of European public services by fostering cross-border and cross-sectorial interoperability”.
- “To guide public administrations in their work to provide European public services to businesses and citizens”.
- “To complement and tie together the various National Interoperability Frameworks (NIFs) at European level”.

First of all, the framework specifies a set of five interoperability levels: Political, Legal, Organisational, Semantical and Technical (see Appendix C). Here we can see a relationship with the interoperability architecture framework proposed in this paper:

- Infrastructure and Functional Layer: Political, Legal, Organizational
- Integration Logic Layer: Semantical, Technical
- Information Layer: Semantical

By taking a look at the needs and benefits specified in its documentation, one can find a direct relationship with most of the evolution drivers' areas presented in this paper:

EIF Need/Benefit	Evolution Driver Area
Cooperation	Network Strategy
Exchanging Information	Information, Integration, Transaction
Sharing and Reusing Information	Information, Flexibility & Adaptability
Improved Public Service Delivery	Performance, Integration
Lower Costs	Availability of Resources

Table 8.6: Evolution Drivers and Processes in potential future scenarios (Excerpt of the Most Relevant)

Similarly, the recommended interoperability design principles (see Appendix D) of EIF follow another set of evolution drivers proposed in this study:

EIF Design Principles	Evolution Driver Area
Nr. 4: Security and privacy	Security
Nr. 7: Administrative Simplification	Network Strategy, Political & Cultural, Transaction
Nr. 7:Transparency	Information, Transaction
Nr. 10: Reusability	Flexibility and Adaptability
Nr. 11: Technological Neutrality and Adaptability	Standards & Protocols, Flexibility and Adaptability
Nr 12: Effectiveness and efficiency	Performance

Table 8.7: EIF Design principles in relation to Evolution Driver Area

Thus we can see that the main motives and principles of fostering an official interoperability framework among the EU member for service delivery states is very aligned with the drivers that foster the evolution of interoperability architectures towards a SOA approach. Furthermore we can infer from the EIF conceptual model (see Appendix E) that the recommended interoperability architecture that should be followed is very similar to the fifth stage of the stage model presented in this paper, where an orchestration integration approach is suggested for EU member state to plug in their services. No Cloud Computing or Web 2.0 features are yet proposed in the EIF but once the ideal conceptual model implementation has reached a critical mass of countries and services connected to it, it may be an alternative for the future evolution worth to look at.

Finally, we can see that the conceptual model in principle is a space where all four evolution processes play an ongoing role. The variation caused by the heterogeneous EU countries' systems is centralized and standardized (selection and retention of standards like web services, recommended by EIF)

through an orchestration capability which will opens up country services to the European level so some services will be more used/preferred than others (struggle) by citizens and business partners. Thus some services will further evolve (mutate, merge with others, be reused) and some will not.

8.7 Conclusions and Outlook

In this paper we have reviewed the fundamental concepts of evolution theory for organizations applied to the evolution of enterprise architectures in Public Administration Networks towards an approach that conceives Service Orientation as an advanced stage which can be reached to deliver high quality services to citizens and business partners. A simplified interoperability architecture framework has been proposed to clarify the “what” of the evolution process in this context. Furthermore, a thorough analysis of the drivers that trigger the evolution processes of the interoperability architecture framework has been done. The influence that the evolution drivers plays upon the interoperability architecture framework trigger the variation, selection, retention and struggle processes taking it through five stages of evolution which have been described highlighting the most important evolutionary events in each stage. The last stage is meant to be a full implementation of SOA design principles.

The evolution stage model is a descriptive approach that helps understanding the courses of evolution that interoperability architectures in PANs can go through in their aim of searching a seamless and efficient provision of quality services to citizens and business partners. It helps to foresee (i.e. predict) future potential scenarios of opportunities and threats for the interoperability architecture. Cloud computing and Web 2.0 benefits have been identified in this brief review but surely more scenarios (opportunities, threats) can be derived from this basis.

A real case analysis of an international (European) PAN has proven the applicability of this evolution perspective. However, in the future, the robustness of this approach should be further tested and definitely further complemented. Finally, since the service orientation is a promising approach that organizations of any type are and will be pursuing, the validity of this approach in other types of networks besides PANs should be researched and further extended to a more generic framework for the evolution of interoperability architectures.

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Appendix

Data Base

Leistungsphase der HOAI	Bereich	Aktivität
I. Grundlagen-ermittlung	Grundlagen-ermittlung	Aufgabenstellung klären
		Raum- und Funktionsprogramm erstellen
		Leistungsbedarf ermitteln
		Ergebnisse zusammenfassen
II. Vorplanung (Projekt- und Planungsvorber ei-tung)	Vorplanung	Grundlagen Architektur und Fachplanung analysieren
		Vorplanungskonzept Architektur und Fachplanung erstellen
		Wesentliche Zusammenhänge klären und erläutern
		Gutachten Sonderfachleute einholen
		Vorverhandlungen zur Genehmigungsfähigkeit durchführen
		Rahmenterminplan festlegen
III. Entwurfsplanun g (System- und Integrationsplan ung)	Entwurfsplanung	Entwurfsplanung Architektur und Fachplanung erstellen
		Zeichnerischen Entwurf erstellen
		Verhandlungen über Genehmigungsfähigkeit durchführen
		Entwurfsunterlagen zusammenfassen
IV. Genehmigungs-planung	Genehmigungs-planung	Vorlagen für erforderliche Genehmigungen erarbeiten
		Unterlagen einreichen
		Planungsunterlagen gemäß Vorgaben anpassen
V. Ausführungs-planung	Ausführungs-planung	Ausführungskonzeption erarbeiten
		Detaillierte zeichnerische Darstellung erstellen
		Ergebnisse zusammenstellen
VI. Vorbereitung der Vergabe	Vergabe-management	Quantitäten ermitteln und zusammenstellen
		Leistungsbeschreibungen aufstellen
		Vergabeunterlagen zusammenstellen
VII. Mitwirkung bei der Vergabe		Angebote einholen
		Angebote prüfen und werten
		Mit Bietern verhandeln
		Bei Auftragserteilung mitwirken
VIII. Objektüberwach ung (Bauüberwachun g)	Objektüber-wachung	Ausführung überwachen
		Fertigteil-Erstellung überwachen
		Zeitplan aufstellen und überwachen
		Bautagebuch führen
		Aufmaß durchführen
		Abnahme durchführen
		Mängelbeseitigung überwachen
		Objekt einschließlich Unterlagen übergeben

IX. Objektbetreuung und Dokumentation	Objektbetreuung	Zeichnerische Darstellungen und rechnerische Ergebnisse zusammenstellen
		Objektbegehung durchführen
		Mängel beseitigen und Mängelbeseitigung überwachen

(Querschnitts-aktivität über alle Phasen hinweg: Kostenrechnung)	Kostenrechnung	Kostenschätzung durchführen
		Kostenberechnung durchführen
		Kostenkontrolle durchführen
		Kostenanschlag durchführen
		Rechnungsprüfung durchführen
		Kostenfeststellung durchführen

(Kirchner 2009, p.29f.)

App. A.1 Akteur Generalplaner: Bereiche und Aktivitäten

Bereich	Aktivität
Akquisition	Aktive Akquisition durchführen
	Passive Akquisition durchführen
	Vorprüfung der Ausschreibung durchführen
Angebots-bearbeitung	Angebotsstrategie und -projektorganisation festlegen
	Budgetplanung durchführen
	Aufgaben- und Terminplanung durchführen
	Vertragliche Aspekte analysieren (juristische, kaufmännische, technische Aspekte)
	Risikoanalyse und Kalkulation vorbereiten
	Projektrisikoanalyse durchführen
	Kalkulation durchführen
	Angebotsprüfung und Preisgestaltung durchführen
	Entscheidung über Abgabe des Angebots fällen
	Leistungsverzeichnisse ausfüllen und erforderliche Unterlagen zusammenstellen
	Angebot abgeben
Auftrags-verhandlungen	Vertrag mit Auftraggeber ausarbeiten
	Systematische Auswertung der Vergabeergebnisse durchführen
	Vertrag abschließen
AVOR/Produkt-ionsplanung	Auftragsdatenblatt anlagen
	Projektcontroller bestimmen
	Erste Baustellenbegehung durchführen
	Arbeitskalkulation erstellen und Controlling vorbereiten
	Prozess- und Bauverfahrensplanung durchführen
	Termin- und Ressourcenplanung durchführen
	Baustellenorganisation festlegen
	Qualitäts- und Arbeitssicherheitsplanung durchführen
Bauausführung	Baustelle einrichten
	Administration planen und festlegen
	Logistikplanung durchführen
	Bauablaufsorganisation durchführen
	Baumethodenorganisation durchführen
	Logistikdisposition ausführen
	Bauproduktion ausführen
Übergabe	Baustelle räumen
	An Abnahme teilnehmen
	Mängelbeseitigung durchführen
	Abnahmeprotokoll anfertigen
	Baustellenschlussgespräch durchführen
	Aufmaß erstellen
	Revisionsunterlagen erstellen

Gewährleistung	Mängelanzeigen prüfen
	Mängel bearbeiten

(Kirchner 2009, p.32f.)

App. A.2 Akteur Bauunternehmen: Bereiche und Aktivitäten

Akteur	Bereich	Aktivität
Bauunternehmen	Projektcontrolling	Subunternehmerbeauftragung
		Rechnungsprüfung
		Kostenkontrolle
		Koordination
		Kostenanschläge erstellen
		Aufmaß erstellen

(Kirchner 2009, p.34)

App. A.3 Bauunternehmen: Bereich Projektcontrolling

Bereich	Aktivität
Projektleitung	Entscheidungen herbeiführen und treffen
	Erforderliche Maßnahmen und Vollzug des Vertrages durchsetzen
	Erforderlichkeiten bezüglich Genehmigungsreife herbeiführen
	Konfliktmanagement ausführen
	Projektbesprechungen leiten
	Projektbezogene oder vertragsrechtliche Verhandlungen führen
	Abarbeitung des Entscheidungs-/Maßnahmenkatalogs durchsetzen
	Repräsentationspflichten wahrnehmen
Projektsteuerung	Organisation, Information, Koordination und Dokumentation steuern
	Qualitäten und Quantitäten steuern
	Kosten und Finanzierung steuern
	Termine, Kapazitäten und Logistik steuern
Nutzermanagement	Nutzermanagement ausführen
Geschäftsführung	Bauherrenseitige Entscheidungen treffen
Einkauf	Leistungen beschaffen
Finanzen	Finanzierung gewährleisten
Recht	Rechtliche Absicherung gewährleisten

(Kirchner 2009, p.35)

App. A.4 Akteur Bauherr/Steuerung: Bereiche und Aktivitäten

Bereich	Aktivität
Facility Managment-Objektplanung	Dokumentationsrichtlinie einführen und durchsetzen
	Programmoptimierung durchführen
	Flächenwirtschaftlichkeit optimieren
	Energetische Konzepte erstellen
	Planung hinsichtlich Betriebsoptimierung beurteilen
	Bestands- und Revisionsunterlagen formal prüfen und aufbereiten

Nutzungskostenmanagement	Zielgrößen definieren
	NK-Prognose durchführen
	NK-Schätzung durchführen
	NK-Berechnung durchführen
	NK-Anschlag durchführen
	Ausschreibungsergebnisse für FM-Leistungen mit einbeziehen
	Soll-/Ist-Vergleiche durchführen
	Ergebnisse in die Planung rückkoppeln
	NK-Feststellung durchführen
	NK-Optimierung durchführen
Betreiberkonzept	Objektspezifische FM-Leistungen definieren
	Betriebsprozesse abbilden
	Beschaffungsstrategie erstellen
	Eigen- und Fremdleistungen definieren
	Fremdleistungen ausschreiben
	Stellenbeschreibungen für Eigenleistung erstellen
	Inbetriebnahme begleiten
	CAFM-System implementieren

(Kirchner 2009, p.37)

App. A.5 Akteur FM Consulter: Bereiche und Aktivitäten

Baustein	Kooperations aktivität	Informationso bjekt	Quelle	Ziel	Art
Projekt-organisation	Planer beauftragen	Planungs-auftrag	BS - Projektleitung	G - Akquisition	
	Organisations handbuch versenden	Organisations-handbuch	BS - Projektleitung	FMC – FM-Objektplanung	
		Organisations-handbuch		G - Grundlagener mittlung	
Projektstart	Pflichtenheft versenden	Pflichtenheft	BS - Projektleitung	G - Grundlagener mittlung	
		Pflichtenheft		FMC – FM-Objektplanung	
	Kostenrahmen festlegen	Kostenrahmen	BS - Projektsteueru ng	G - Grundlagener mittlung	
		Kostenrahmen		FMC - Nutzungskoste nmanagement	
	Rahmentermin plan versenden	Rahmentermin plan	BS - Projektsteueru ng	G - Grundlagener mittlung	

Kooperative Planung des Nutzer-bedarfs	Nutzerbedarfs pro-gramm weiterleiten	Nutzerbedarfs-programm	BS – Projektsteuerung	FMC – FM-Objektplanung	I
	Optimiertes Nutzerbedarfs programm versenden	optimiertes NB-Programm	FMC – FM-Objektplanung	G - Grundlagenermittlung	I
		optimiertes NB-Programm		BS - Projektsteuerung	I
	Detailliertes Nutzerbedarfs programm versenden	detailliertes Nutzerbedarfs programm	G - Grundlagenermittlung	BS - Projektsteuerung	I
		detailliertes Nutzerbedarfs programm		FMC – FM-Objektplanung	I
Dokumenta-tion	Standardrichtlinie versenden	Standardrichtlinie	BS – Projektsteuerung	FMC – FM-Objektplanung	
	Optimierte Richtlinie versenden	Optimierte Richtlinie	FMC – FM-Objektplanung	BS – Projektsteuerung	
		Optimierte Richtlinie		G - Grundlagenermittlung	

(Kirchner 2009, p.38f.)

App. A.6 Modul Projektvorbereitung: Kooperationsaktivitäten und Informationsflüsse

Baustein	Kooperationsaktivität	Informationsobjekt	Quelle	Ziel	Art
Kooperative Analyse der Nutzer-anforderungen	Raum- und Funk-tionsprogramm versenden	Raum- und Funktionsprogramm	BS – Projekt-steuerung	FMC – FM-Objektplanung	I
	Optimiertes Raum- und Funktionsprogramm versenden	betriebsoptimiertes Programm		BS – Projektsteuerung	I
		betriebsoptimiertes Programm	FMC – FM-Objektplanung	G – Grundlagenermittlung	I
	Planerinput Raum- und Funktionspro-gramm geben	planungsoptimiertes Programm	G - Grundlagenermittlung	FMC – FM-Objektplanung	I
		planungsoptimiertes Programm		BS - Projektsteuerung	I
	Definition der objektspezifischen FM-Leistungen versenden	Definition FM-Leistungen	FMC - Betreiberkonzept	BS - Nutzermanagement	
Nutzungs-kosten-Prognose	Flächendaten und Baubeschreibung versenden	Flächendaten	G - Grundlagenermittlung	FMC – Nutzungs-kostenmanagement	
		Baubeschreibung	G - Grundlagener	FMC – Nutzungs-	

			mittlung	kostenmanagement	
	Nutzungskosten-prognose versenden	Nutzungskos-tenprognose	FMC - Nutzungskostenmanagement	BS - Projektsteuerung	
Dokumenta-tion	Dokumentation Grundlagen-ermittlung	Dokumenta-tion	G - Grundlagenermittlung	BS - Projektsteuerung	
	Überprüfung der Dokumentation hinsichtlich der Richtlinie	Prüfung auf Richtlinie	FMC – FM-Objektplanung		P

(Kirchner 2009, p.40)

App. A.7 Grundlagenermittlung: Kooperationsaktivitäten und Informationsflüsse

Baustein	Kooperationsaktivität	Informationsobjekt	Quelle	Ziel	Art
FM-Leistungen	Abgebildete Betriebsprozesse versenden	Betriebsprozesse	FMC - Betreiberkonzept	BS - Nutzermanagement	
	Planungsanforderungen versenden	Planungsanforderungen	FMC - Betreiberkonzept	G – Vorplanung	
Kooperatives Gestalten der Vorplanung	Vorplanung versenden	Grundlagen Architektur/Fachpla-nung	G - Vorplanung	FMC – FM-Objektplanung	I
	Optimierte Vorplanung versenden	Optimierte Vorplanungsunterlagen	FMC – FM-Objektplanung	G – Vorplanung	I
		Optimierte Vorplanungsunterlagen		BS - Projektleitung	I
Kosten-schätzung	Investitionskostenschätzung versenden	Investitionskostenschätzung	G - Kostenrechnung	FMC - Nutzungskostenmanagement	
	Flächendaten und Baubeschreibung Vorplanung versenden	Flächendaten Vorplanung	G - Vorplanung	FMC - Nutzungskostenmanagement	
		Baubeschreibung Vorplanung	G - Vorplanung	FMC - Nutzungskostenmanagement	
	Nutzungskostenschätzung-Ergebnisse versenden	Investitionskostenschätzung	FMC – Nutz-ungskostenmanagement	BS - Projektsteuerung	
		Nutzungskostenschätzung	FMC – Nutz-ungskostenmanagement	BS - Projektsteuerung	
	Kostenoptimierung versenden	Kostenoptimierung	FMC – Nutz-ungskostenmanagement	G - Vorplanung	

Dokumenta-tion	Dokumentation Vorplanung	Dokumentation	G – Vorplanung	BS - Projektsteuerung	
	Überprüfung der Dokumentation hinsichtlich der Richtlinie	Prüfung auf Richtlinie	FMC – FM-Objektplanung		P

(Kirchner 2009, p.41f.)

App. A.8 Vorplanung: Kooperationsaktivitäten und Informationsflüsse

Baustein	Kooperationsaktivität	Informationsobjekt	Quelle	Ziel	Art
FM-Leistungen	In- und Outsourcingkonzept versenden	In- und Outsourcingkonzept	FMC - Betreiberkonzept	BS – Nutzermanagement	
	Planungsanforderungen versenden	Planungsanforderungen	FMC - Betreiberkonzept	G – Entwurfsplanung	
Kooperatives Erarbeiten eines Entwurfs	Planungskonzeption versenden	Planungskonzept	G - Entwurfsplanung	FMC – FM-Objektplanung	I
		Zeichnerischer Entwurf	G - Entwurfsplanung	BS – Projektleitung	I
	Optimierten Entwurf versenden	Optimierte Entwurfsunterlagen	FMC – FM-Objektplanung	G – Entwurfsplanung	I
		Optimierte Entwurfsunterlagen		BS – Projektleitung	I
Kosten-berechnung	Investitionskostenberechnung versenden	Investitionskost-enberechnung	G - Kostenrechnung	FMC – Nutzungs-kostenmanagement	
	Flächendaten und Baubeschreibung Entwurf versenden	Flächendaten Entwurf	G - Entwurfsplanung	FMC – Nutzungs-kostenmanagement	
		Baubeschreibung Entwurf	G - Entwurfsplanung	FMC – Nutzungs-kostenmanagement	
	Nutzungskostenberechnungs-Ergebnisse versenden	Investitionskost-enberechnung	FMC - Nutzungskostenmanagement	BS - Projektsteuerung	
		Nutzungskost-enberechnung	FMC - Nutzungskostenmanagement	BS - Projektsteuerung	
	Kostenoptimierung versenden	Kostenoptimierung	FMC - Nutzungskostenmanagement	G - Entwurfsplanung	
Dokumenta-tion	Dokumentation Entwurfsplanung	Dokumentation	G - Entwurfsplanung	BS - Projektsteuerung	
	Überprüfung der Dokumentation	Prüfung auf Richtlinie	FMC – FM-Objektplanung		P

	hinsichtlich Richtlinie				
	Implementierung eines CAFM-Systems	Einführung CAFM-System	FMC - Betreiberkonzept	BS - Nutzermanagement	

(Kirchner 2009, p.43)

App. A.9 Entwurfsplanung: Kooperationsaktivitäten und Informationsflüsse

Baustein	Kooperations-aktivität	Informations-objekt	Quelle	Ziel	Art
Genehmi-gungs-planung	Genehmigungsunterlagen versenden	Genehmigungsunterlagen	G - Genehmigungsplanung	BS – Projektleitung	
	Unterschriebene Genehmigungsunterlagen versenden	unterschriebene Genehmigungsunterlagen	BS - Projektleitung	G – Genehmigungsplanung	
FM-Leistungen	Stellenbeschreibung versenden	Stellenbeschreibungen	FMC - Betreiberkonzept	BS – Nutzerman-agement	
	Planungsanforderungen versenden	Planungsanforderungen	FMC - Betreiberkonzept	G – Ausführungsplanung	
Koopera-tives Konzept-ionieren einer Lösung	Ausführungskonzeption versenden	Lösungskonzeption	G - Ausführungsplanung	FMC – FM-Objektplanung	I
		Zeichnerische Lösungen	G - Ausführungsplanung	BS – Projektleitung	I
	Optimierte Lösungskonzeption versenden	Optimierte Lösungskonzeption	FMC – FM-Objektplanung	G – Ausführungsplanung	I
		Optimierte Lösungskonzeption		BS – Projektleitung	I
Vergabe	Ausschreibung	Funktional-/Leistungsausschreibung	G – Vergabeman-agement	B – Akquisition	
	Angebot versenden	Angebot	B - Angebotsbearbeitung	G - Vergabemanagement	
	Vergabeergebnis versenden	Vergabeergebnis	G – Vergabeman-agement	BS - Projektleitung	
	Auftragserteilung	Auftrag	BS - Projektleitung	B - Auftragsverhandlungen	
Kosten-anschlag	Investitionskostenanschlag versenden	Investitionskostenanschlag	G - Kostenrechnung	FMC - Nutzungskostenmanagement	
	Leistungsbeschreibungen/-Verzeichnisse versenden	Leistungsbeschreibungen	G - Ausführungsplanung	FMC - Nutzungskostenmanagement	

	Nutzungskosten anschlags-Ergebnisse versenden	Nutzungskostenanschlag	FMC - Nutzungskostenmanagement	BS – Projekt-steuerung	
		Investitionskostenanschlag	FMC - Nutzungskostenmanagement	BS – Projekt-steuerung	
	Kostenoptimierung versenden	Kostenoptimierung	FMC - Nutzungskostenmanagement	G - Ausführungsplanung	
Dokumen-tation	Dokumentation Ausführungsplanung	Dokumentation	G - Ausführungsplanung	BS – Projekt-steuerung	
	Überprüfung der Dokumentation hinsichtlich Richtlinie	Prüfung auf Richtlinie	FMC – FM-Objektplanung		P
	Implementierung eines CAFM-Systems	Etablierung CAFM-System	FMC - Betreiberkonzept	BS – Nutzerman-agement	

(Kirchner 2009, p.45f.)

App. A.10 Ausführungsplanung: Kooperationsaktivitäten und Informationsflüsse

Baustein	Kooperations-aktivität	Informations-objekt	Quelle	Ziel	Art
Koordinie-rung der Bau-aktivitäten	Bau überwachen	Bauüberwachung	BS – Projekt-steuerung	B – Bauausführung	P
	Ausführungskoordination	Ausführungskoordination	G - Objektüberwachung	B – Bauausführung	P
	Kostenermittlung	Kostenabschläge	B - Projektcontrolling	G – Objektüberwachung	P
		Kosteninformation	G - Objektüberwachung	BS – Projektsteuerung	P
Abnahme	Objektbegehung	Abnahmen	BS - Projektleitung		
		Abnahmen	G - Objektüberwachung	B – Übergabe	
	Protokollierung	Übergabeprotokolle	G - Objektüberwachung	BS – Projektleitung	
		Übergabeprotokolle	B - Übergabe		
Dokumen-tation	Baudokumentation versenden	Baudokumentation	G - Objektbetreuung	FMC – FM-Objektplanung	
	Revisionspläne versenden	Revisionspläne	B - Übergabe	FMC – FM-Objektplanung	
	Betreiberhandbuch versenden	Betreiberhandbuch	FMC – FM-Objektplanung	BS – Nutzerman-agement	

	CAFM-System übergeben	CAFM-System	FMC - Betreiberkonzept	BS – Nutzerman-agement	
Kosten-feststellung	Leistungsabrechnung versenden	Leistungsabrechnung	B - Übergabe	G - Kostenrechnung	
	Kostenfeststellung versenden	Kostenfeststellung	G - Kostenrechnung	BS - Projektsteuerung	
Implemen-tierung Betrieb	Einweisungen vornehmen	Einweisungen	B - Übergabe	BS – Nutzerman-agement	
	Inbetriebnahme begleiten	Begleitung Inbetriebnahme	FMC - Betreiberkonzept	BS – Nutzerman-agement	
Mängelbe-arbeitung	Mängelanzeigen versenden	Mängelanzeigen	BS - Nutzermanagement	G - Objektbetreuung	P
	Mängelanzeigen Bau versenden	Mängelanzeigen Bau	G - Objektbetreuung	B - Gewährleistung	P

(Kirchner 2009, p.47f.)

App. A.11 Ausführung: Kooperationsaktivitäten und Informationsflüsse

SOA

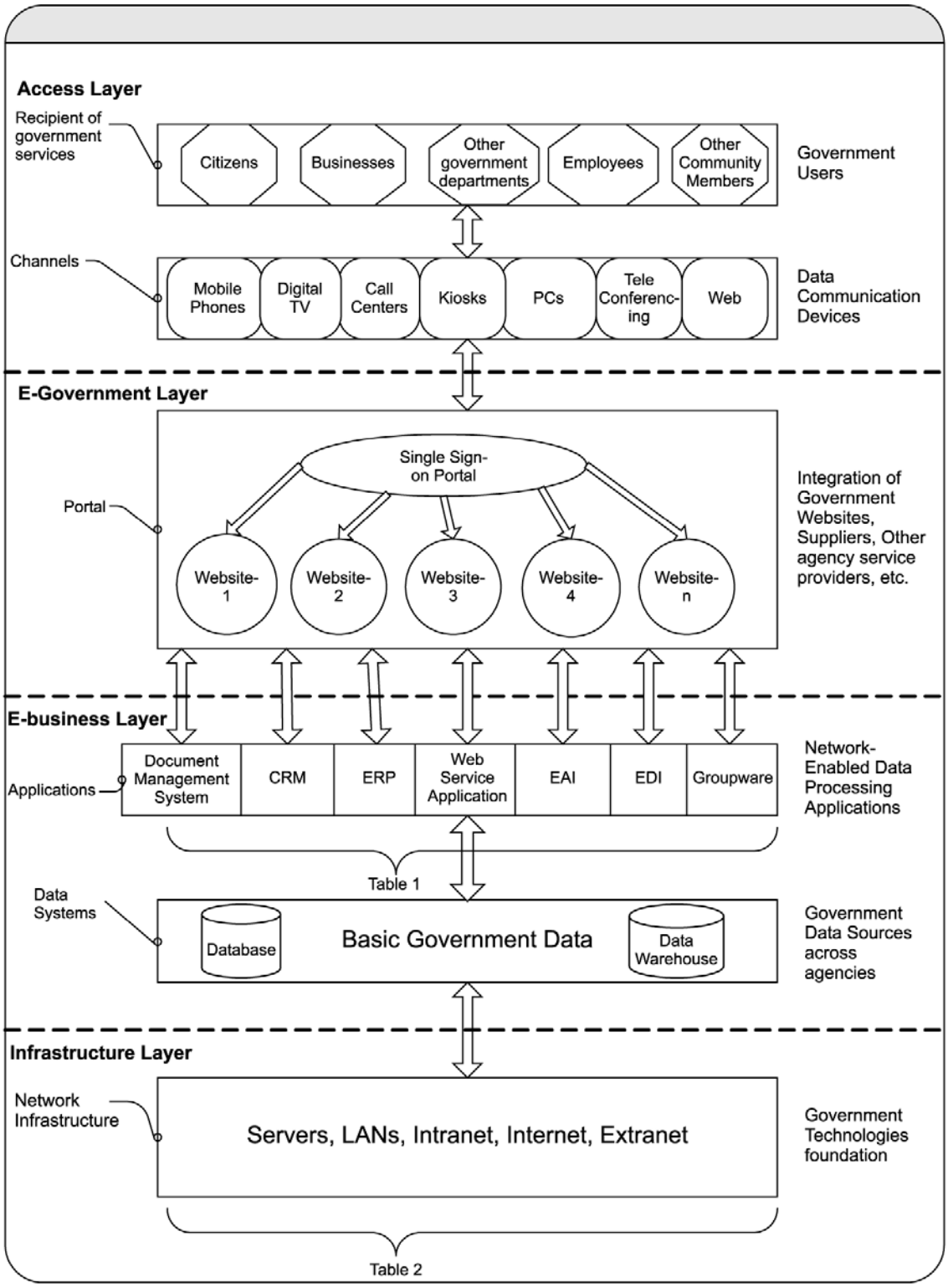
SOA Design Principles

Like stated in (Erl 2007):

- **Standardized Service Contract:** Services within the same service inventory are in compliance with the same contract design standards.
- **Service Loose Coupling:** Service contracts impose low consumer coupling requirements and are themselves decoupled from their surrounding environment.
- **Service Abstraction:** Service contracts only contain essential information and information about services is limited to what is published in service contracts.
- **Service Reusability:** Services contain and express agnostic logic and can be positioned as reusable enterprise resources.
- **Service Autonomy:** Services exercise a high level of control over their underlying runtime execution environment.

- **Service Statelessness:** Services minimize resource consumption by deferring the management of state information when necessary.
- **Service Discoverability:** Services are supplemented with communicative meta data by which they can be effectively discovered and interpreted.
- **Service Composability:** Services are effective composition participants, regardless of the size and complexity of the composition.

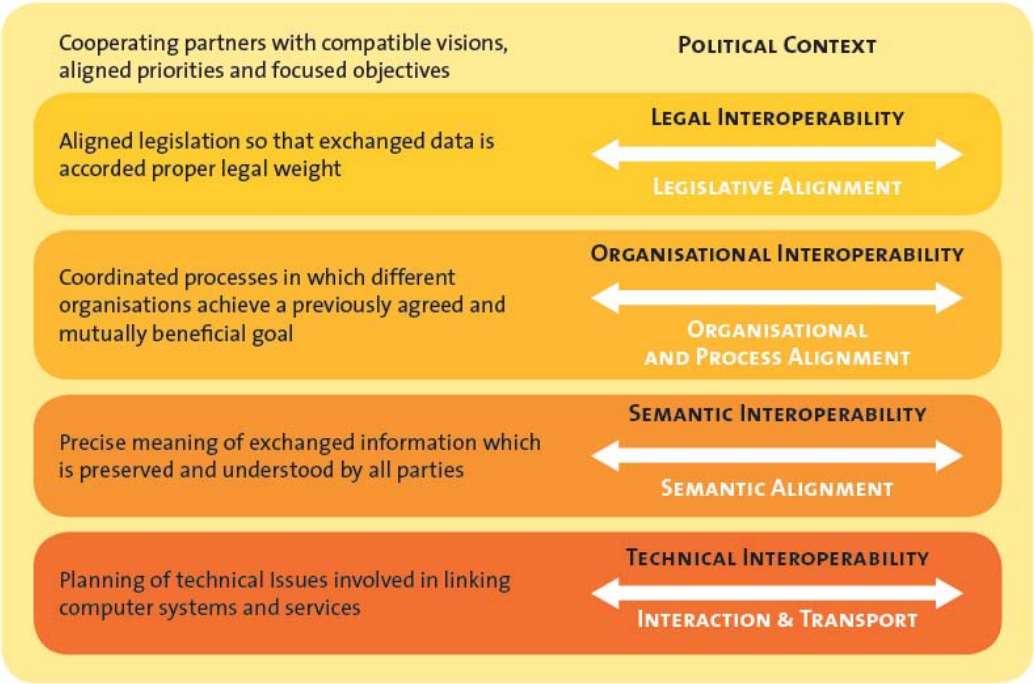
Framework of e-Government Architecture



(Ebrahim & Z. Irani 2005, p.593)

App. A.11 Framework of e-Government Architecture

European Interoperability Framework: Interoperability Levels



(ISA 2010, p.28)

App. A.11 European Interoperability Framework: Interoperability Levels

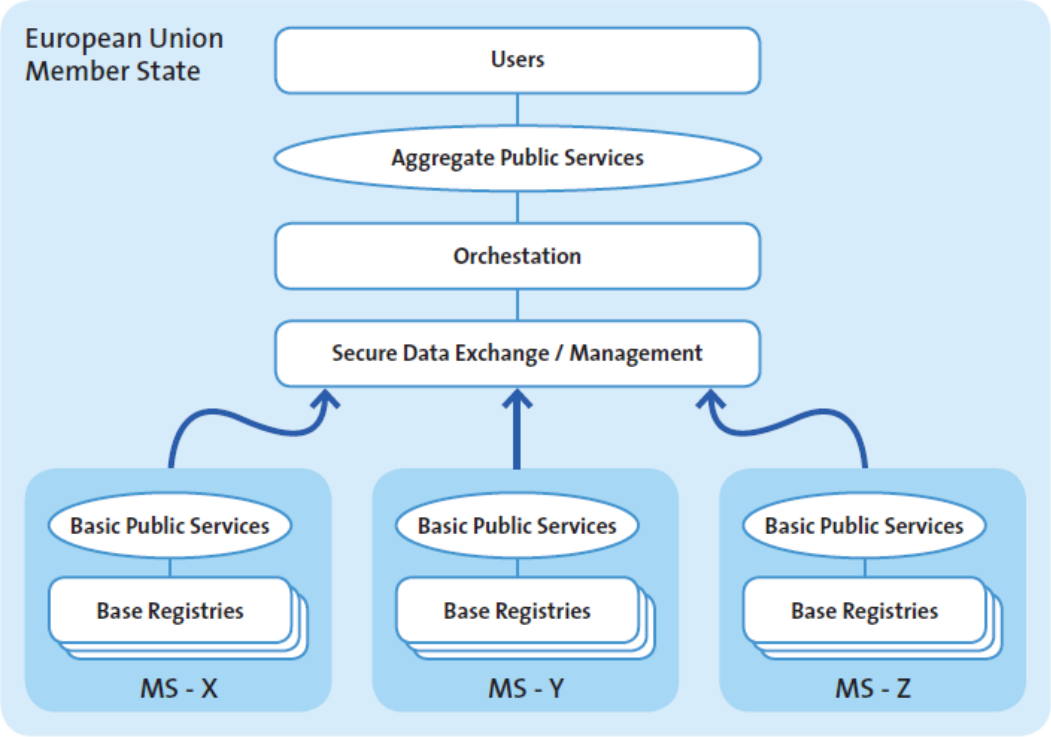
European Interoperability Framework: Underlying Principles

Introduced in (ISA 2010, pp.14-18):

- Underlying principle 1: Subsidiarity and proportionality
- Underlying principle 2: User-centricity
- Underlying principle 3: Inclusion and accessibility
- Underlying principle 4: Security and privacy
- Underlying principle 5: Multilingualism
- Underlying principle 6: Administrative simplification
- Underlying principle 7: Transparency
- Underlying principle 8: Preservation of information
- Underlying principle 9: Openness
- Underlying principle 10: Reusability

- Underlying principle 11: Technological neutrality and adaptability
- Underlying principle 12: Effectiveness and efficiency

European Interoperability Framework: Conceptual Model



(ISA 2010, p.25)(ISA 2010, p.28)

App. A.11 European Interoperability Framework: Conceptual Model

Working Papers, ERCIS

Nr. 1 Becker, J.; Backhaus, K.; Grob, H. L.; Hoeren, T.; Klein, S.; Kuchen, H.; Müller-
Funk, U.; Thonemann, U. W.; Vossen, G.; European Research Center for Information Systems (ERCIS). Gründungsveranstaltung Münster, 12. Oktober 2004. October 2004.

Nr. 2 Teubner, R. A.: The IT21 Checkup for IT Fitness: Experiences and Empirical Evidence from 4 Years of Evaluation Practice. March 2005.

Nr. 3 Teubner, R. A.; Mocker, M.: Strategic Information Planning – Insights from an Action Research Project in the Financial Services Industry. June 2005.

Nr. 4 Vossen, G.; Hagemann, S.: From Version 1.0 to Version 2.0: A Brief History Of the Web. January 2007.

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Nr. 7 Ciechanowicz, P.; Poldner, M.; Kuchen, H.: The Münster Skeleton Library Muesli – A Comprehensive Overview. 2009.

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Nr. 9 Majchrzak, T. A.; Jakubiec, A.; Lablans, M.; Ückert, F.: Evaluating Mobile Ambient Assisted Living Devices and Web 2.0 Technology for a Better Social Integration

Nr. 10 Majchrzak, T. A.; Kuchen, H.: Muggl: The Muenster Generator of Glass-box Test Cases. 2011.