INNOVATION-DRIVEN ENTERPRISE ARCHITECTURE

-- MASTER THESIS --

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Innovation-driven Enterprise Architecture

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ABSTRACT

It has been argued that many organizations do not use EA to leverage innovation as much as they should (Rohloff (2011), Buckl, Ernst et al. (2009)). And this while the ability of organizations to innovate is acknowledged as an essential capability to compete in a competitive market (Deloitte (2014), Dewangan and Godse (2014)). The intent of an EA is to determine how an organization can most effectively achieve its current and future objectives. It can be assumed that EA stands for the development and implementation of strategy. Considering that every strategy will have to support the organization's continued existence, it is imperative to embrace innovation. Therefore it is of most importance to bridge the knowledge gap on how EA can be used to enhance an organization‘s ability in business innovation.

EA has its roots in Information Technology (IT) (Zachman (1987)), and IT can enable business innovation (Anaya, Dulaimi et al. (2015), Cui, Ye et al. (2015)). In the context of this research, IT is the common denominator between EA and business innovation. The objective is to provide new insight into the relation between EA and IT-enabled business innovation. The research is focused on determining EA resources, in terms of capabilities and assets, underlying this kind of innovation. By studying the confluence of perspectives on business innovation, IT and EA, theories about the three concepts have been linked. Linking these theories reveals new insight into the usage of EA in order to drive innovation. Based on the insight, a conceptual model has been developed to describe and visualize the findings of this research into one overview.

This exploratory research has been conducted according to the Design Science Research Methodology. During the different phases of this methodology, I have carried out a literature research and an empirical research. The Rapid Structured Literature Review has been used to review the literature at the nexus of EA and IT-enabled business innovation. 50 Articles out of 139 were selected, studied and summarized. Based on the findings, four broad capability domains are determined. I then propose a first draft of a conceptual model linking the capability domains to assets of an organization’s social -and technical architecture. The model explicates the role of these architectures in IT-enabled business innovation. The empirical research was carried out through an embedded case study and an expert review. Within these methods, qualitative data is collected through five interviews. The expert review was focused on validation and improvement of the conceptual model. In general, results from the empirical research were consistent with the results from the literature research.

This research reveals that organizational learning is critical to the innovative capabilities of an organization. Based on this statement, I have synthesized the most important capabilities into four domains:

- Knowledge;
- Collaboration & communication;
- Information processing & coordination;
- Ideation.

The importance of organizational learning has also been recognized in the field of EA (Lapalme (2012)). He argues that an EA should be fostering this aspect by designing the various facets of the enterprise, including the relationship to its environment. To address the facets and facilitate the capabilities which drive IT-enabled business innovation, several technological and organizational assets are identified per capability domain.

I suggest that the following organizational assets within a social architecture need to play their part in IT-enabled business innovation:

- Key stakeholders;
- Collaborative organizational culture.

The technical assets are essential within a technical architecture for providing the infrastructure to support the organizational assets and the capabilities which contribute to business innovation:

- Web technologies;
- Knowledge management systems;
- Data Analytics.

My conclusion is that the field of EA is a viable approach to systematically address and facilitate IT-enabled business innovation. Such an approach is to be found in the conceptual model provided by this research. Organizations can use this model to focus on important capabilities that drive innovation. Facilitating these capabilities through the organizational –and technical assets will enhance an organization‘s ability in IT-enabled business innovation.

Although this research has been carefully conducted, there are several limitations. It concerns a graduation project for a Master study, carried out by a single researcher, among a limited number of respondents within one organization. The results and the conceptual model provide an answer to the research questions. However, it cannot be assumed that these insights are complete, or contain the desired level of detail. The research offers a model and foundation for future studies to explore the role of EA in IT-enabled business innovation. Therefore, further research into this area is a necessity.

"According to Darwin's Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself."

(Megginson (1963))

1. INTRODUCTION

The ability of organizations to innovate is acknowledged as an essential capability to compete in a competitive market (Deloitte (2014), Dewangan and Godse (2014)). Changes in social structures and operating environments, technology disruptions, and competitiveness arising from globalization are forcing organizations to increasingly look towards innovation. Therefore, I consider innovation as the process of change that creates and grows wealth. The changes are due primarily to the digital revolution of technological influences. Examples are big data and analytics, cloud computing, socialization of business through mobile devices, and the Internet of Things (e.g. Anaya, Dulaimi et al. (2015), Ismail (2014)). They argue that organizations that can manage change effectively are generally more successful than those that cannot.

In the current economic climate, a new or creative idea is not necessarily new for long. Since products and services are 'easy to copy', the capability for continuous innovation is crucial to the survival or growth of organizations. Information Technology (IT) has been acknowledged as a facilitator for innovation and development. Both researchers and practitioners have realized the importance of IT in effective innovation activities and in facilitating organizational learning and innovation (Huang (2014)).

Many researchers and practitioners also feel that Enterprise Architecture (EA) can play a key role in helping to design the organizations of the future in order to develop new core capabilities to survive or to grow (Lapalme, Gerber et al. (2015)). But how to use EA as a viable approach to systematically address and facilitate IT-enabled business innovation?

1.1 Problem Description

Change affects many elements of an organization's value chain, like products and services, corporate capabilities and assets, partners, suppliers, and customers. Organizations can respond to the ever-changing environment by redesigning their organizational structures and processes, and by leveraging information systems –and technology for digitizing their business (Ahlemann, Stettiner et al. (2012)). They thereby continuously change the fundamental structure of the organization, which can be considered as the EA.

The importance of EA to business innovation has been emphasized in literature (Lapalme, Gerber et al. (2015), Missah (2015)). However, many organizations only partially use EA to leverage innovation (Rohloff (2011), Buckl, Ernst et al. (2009)). This is partly due to the fact that the relation between EA and business innovation is not articulated and remains mostly implicit (Prahalad and Krishnan (2008)). It has also been emphasized that IT can have a positive effect on business innovation. This too is relatively understudied in literature (Anaya, Dulaimi et al. (2015)).

My research attempts to bridge the knowledge gap on how EA can enhance an organization's ability in IT-enabled business innovation. The scope relates to the confluence of perspectives on business innovation, EA and IT (Figure 1).

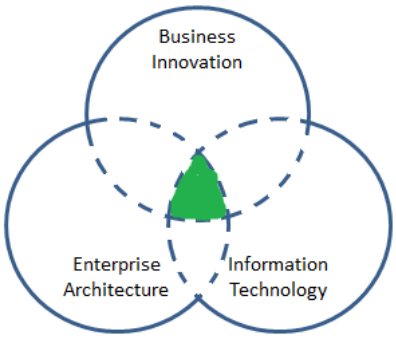

Figure 1: High level research scope

By studying theories about these perspectives, new insight can be obtained about the usage of EA towards (IT-enabled) business innovation. I consider EA as the independent construct and (IT-enabled) business innovation is the dependent construct. To operationalize the construct of EA, I use a configuration of EA in terms of capabilities and assets. This approach is derived from the resource-based theory (Wernerfelt (1984)). The resource-based view argues that organizations possess resources. A subset of which enables them to achieve competitive advantage, and a further subset which leads to superior long-term performance (Wade et al. (2004), Wernerfelt (1984)). Wade et al. (2004) define resources as assets and capabilities that are available and useful in detecting and responding to market opportunities or threats. The proposition that EA capabilities and assets found in literature can enhance the organization's ability to innovate is also empirically validated during this study.

1.2 Research Objective

The objective of this research is to provide new insight into the usage of EA in order to enhance an organization's ability in IT-enabled business innovation. It is focused on identifying the primary capability domains that drive such innovation and their possible correlations with related assets. The rationale behind this concept is that these capabilities can be facilitated by assets.

A conceptual model is developed in order to describe and visualize the research findings in one overview. This model positions the capability domains and key assets that significantly influence IT-enabled business innovation. I consider this model as a prototype to be used for further research.

1.2.1 Relevance

This research is focused on theories regarding EA and IT-enabled business innovation. Literature shows relationships between:

1. Business innovation - EA (e.g. Missah (2015), (Højsgaard (2011));
2. Business innovation - IT (e.g. Anaya, Dulaimi et al. (2015), Cui, Ye et al. (2015));
3. EA - IT (e.g. Lapalme, Gerber et al. (2015), Zachman (1987)).

However, limited research has been published regarding the confluence of all three concepts (Figure 2). Where do these concepts meet each other? Or how can these concepts complement each other?

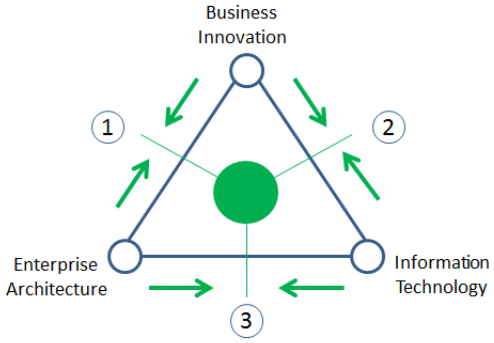

Figure 2: Confluence of business innovation, EA and IT

Regarding the three relationships in Figure 2, I consider that business innovation is about learning, while the focus of EA is changing from blueprinting to a holistic approach with a more external focus (1). Business innovation is also about adding value and IT can provide instruments in terms of tooling, technology (2). IT requires a kind of model to reduce complexity, and EA can provide a structure (3).

By linking theories about these three concepts, it can be studied how to facilitate business innovation with IT and EA. New insights gained from this research can be added to existing knowledge, which will ensure anchoring in the field of EA.

1.3 Research Questions

The high-level research question of this paper is:

How can EA be used in order to enhance an organization's ability in IT-enabled business innovation?

In order to provide a scientifically grounded answer to this question, the following main questions are formulated:

1. What capabilities domains and assets can be determined for usage within EA to drive IT-enabled business innovation?

2. What conceptual model can be developed based on these capability domains and assets to drive IT-enabled business innovation?

The first main question contains a number of concepts for which literature research is required. The following sub questions are formulated to provide a more precise answer:

1.1 What capability domains influence IT-enabled business innovation?
- 1.1.1 What is (IT-enabled) business innovation?
- 1.1.2 What capabilities influence IT-enabled business innovation?

1.2 What could Enterprise Architecture mean for IT-enabled business innovation?
- 1.2.1 What is EA in general?
- 1.2.2 What assets can facilitate the capability domains?

The research questions below are derived from main question 2, and need to be answered during an empirical research. Questions 2.1, 2.2 and 2.3 will be answered through the single case study. Question 2.4 will be answered through an expert review.

2.1 To what extent do the capability domains enable the organization's ability to innovate?

2.2 To what extent does the application of IT support the capabilities domains?

2.3 To what extent do the assets enable the organization's ability to innovate?

2.4 How can the results from the literature and the empirical research be integrated in a conceptual model?

1.4 Research Method

The Design Science Research Methodology (DSRM) (Peffers, Tuunanen et al. (2007)) is used to conduct the research. This methodology is consistent with the lack of literature on the research topic. It provides a layout and structure to deliver an artifact, which is in this case a conceptual model. The chronological order of research steps is schematically displayed in Figure 3.

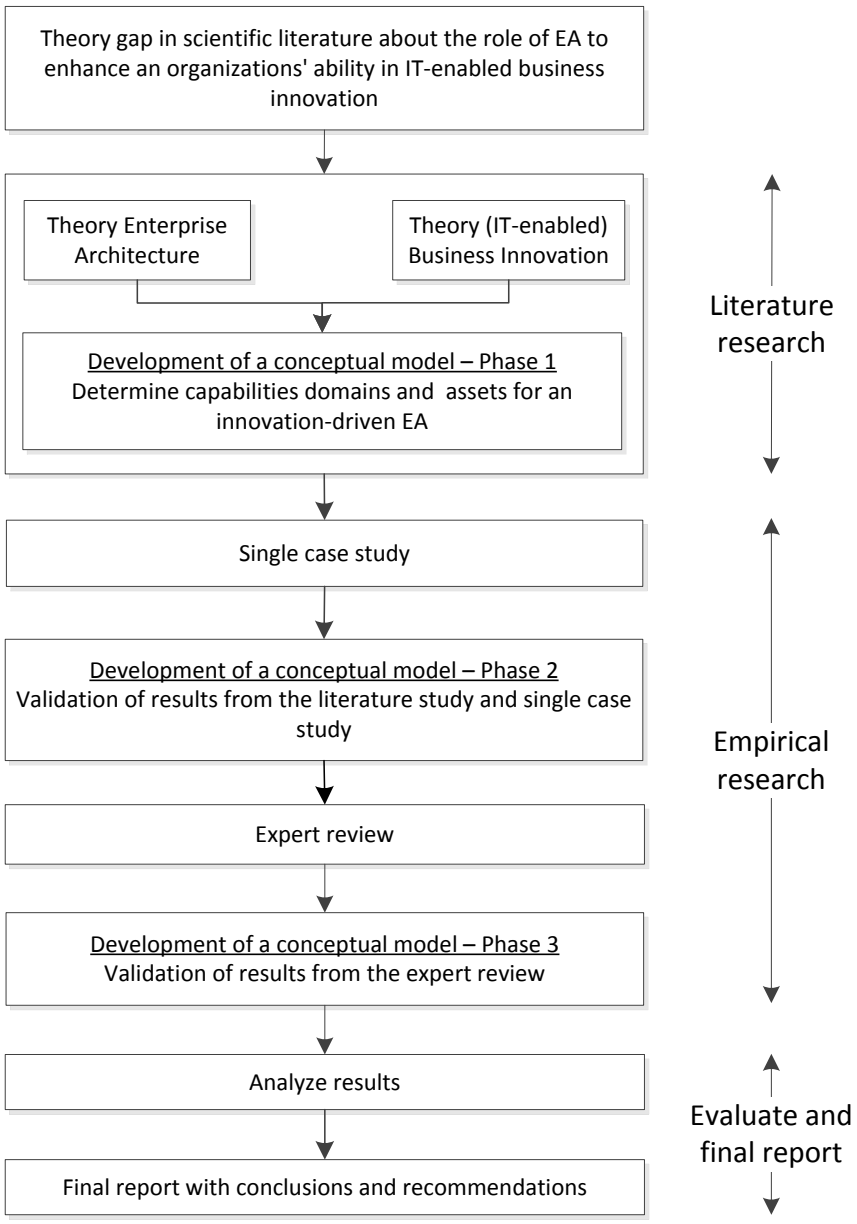

Figure 3: Research method

The literature research regarding theories about EA and IT-enabled business innovation provide insight in primary capability domains and key assets which influence innovation. This insight is used to answer the sub research questions 1.1 and 1.2, and subsequently answer main research question 1. In addition, the findings are also used to develop a first draft of a conceptual model. During the empirical research, the results are validated for accuracy and importance through a single case study. Based on these results, sub research questions 2.1, 2.2 and 2.3 are answered. The findings are also used to develop a second draft of a conceptual model which is reviewed with an expert. This in order to answer sub research question 2.4, and to increase the quality of the model. Answers to sub questions 2.1 – 2.4 are used to analyze the results from the empirical research during the evaluation phase. The findings provide an answer to main research question 2. The answers to both main research questions provide the input to address the high-level research question.

The empirical research has been conducted at a global manufacturing company in the automotive industry. The company is a global technology leader in the design, manufacture and customer support of high-quality light-, medium- and heavy-duty trucks. Their products are sold and serviced by a network of over one thousand independent dealer locations throughout Europe, the Middle East, Africa, South America, Australia, New Zealand and Asia.

1.5 Thesis Outline

This thesis is structured in seven main chapters:

- Chapter 1 contains the introduction, research objective, research questions and the overall research method.
- Chapter 2 concerns the literature review. Section 2.1 shows how the literature search is conducted. Sections 2.2 and further focus on answering research question 1. This chapter ends with result and conclusion of the literature review.
- Chapter 3 focuses on describing the research approach of the empirical research. It contains the research strategy, methods for data collection, data sources, validity, reliability and research ethics.
- Chapter 4 contains the results of the empirical research and answers research question 2.
- Chapter 5 describes the overall conclusion of the research and answers the high level research question. It also contains recommendations for follow-up research.
- Chapter 6 is a discussion and reflects on the conclusion.
- Chapter 7 contains a reflection on the research process and includes some improvements with regard to this process.
- Detailed information on research results can be found in the appendices.

2. FINDING THE JOINT CONSTRUCT

To create a theoretical framework about EA driving IT-enabled business innovation, a literature review has been conducted. This chapter describes how this research is carried out. It also contains the results and provides an answer to the first main research question: "*What capability domains and assets can be determined for usage within EA to drive IT-enabled business innovation?*".

2.1 Literature Research

First, I identified relevant context about the role of EA in relation to IT-enabled business innovation through a semi-structured literature review. An attempt is made to gain results from both academic and 'grey literature'. Although grey literature is not always peer-reviewed, I believe that by including both, the gap that often exists between research and practice can be overcome. This is also in line with the DSRM applied as described in section 1.4 Research Method. Next, I adopted a more structured approach by using the Rapid Structured Literature Review (RSLR) (Armitage and Keeble-Ramsay (2009)). RSLR is a downsized version derived from the Structured Literature Review (Tranfield, Denyer et al. (2003)), which is more appropriate for this graduation project. A limitation of RSLR is a reduced number of phases compared to SLR. However, it outweighs the benefit of structured literature research.

2.1.1 Search Strategy

Digital libraries and search engines used to find academic literature are:

1. EBSCO Host (http://search.ebscohost.com/)
2. Elsevier ScienceDirect (http://www.sciencedirect.com)
3. Emerald Insight (www.emeraldinsight.com)
4. Google Scholar (http://scholar.google.com)
3. SpringerLink (http://www.springerlink.com/home/main.mpx)

Parameters defined for the literature research (Saunders, Lewis et al. (2011)) are displayed in Table 1.

Table 1: Parameters literature research

Parameter	Criteria
Language	English
Field of research	Enterprise Architecture, (IT-enabled) business innovation
Publication period	2010 - present
Type of literature	Descending in value: scientific and peer-reviewed articles, books, conference proceedings, and PHD/Master theses

Since the scope of the research fields are broad and an abundance of literature on these topics can be found, I selected the publication period from 2010 to present in order to reduce the number of results. The assumption for this criterion is that pioneering literature, which is also relevant for this research, can be found by applying the citation index and snowball method. Scientific -and peer-reviewed articles, PHD/Master theses and books are reviewed during the literature research.

To assess the relevance of the literature found, I used the checklist shown in Appendix A: Checklist relevance assessment of literature (Saunders, Lewis et al. (2011)).

Search items (Saunders, Lewis et al. (2011)) are used for searching literature. In addition to this systematic search, the citation index and snowball method are applied in order to get a complete overview of the literature. Other literature is found by applying these methods, such as articles published in a different publication period and/or articles derived from peer-reviewed literature. A disadvantage is that these methods can be time-consuming. The search items used in this literature research are listed in Table 2.

Table 2: Search queries

innovation OR “business innovation” OR “IT-enabled innovation” OR “IT-enabled business innovation”
innovation AND (“organizational learning” OR collaboration OR knowledge OR ideation OR “information processing”
innovation AND (“enterprise architecture” OR architecture)
innovation AND (“information technology” OR it)
“enterprise architecture” AND “organizational learning”

Relevance and quality of the literature has been assessed by three steps:

1. Judge the relevance of literature from the search results on title and abstract;
2. Judge the relevance of remaining literature on their introduction, conclusion, and a quick scan;
3. Read remaining literature in more detail and judge their content on relevance and quality.

These steps resulted in respectively 137, 75 and 50 documents. The full list is shown in Appendix B: Overview literature assessment (Table 5). I used EndNote X7 (Reuters (2015)) to collect and manage the literature.

2.2 Capability Domains that influence IT-enabled Business Innovation

This section provides an answer on research sub question 1.1: "*What Capability Domains influence IT-enabled Business Innovation?*".

2.2.1 IT-enabled Business Innovation

Business Innovation

Business innovation has been widely recognized as a mechanism for organizations to gain profitability, competitive advantage, growth, and market share (e.g. Ismail (2014), Joshi, Chi et al. (2010)). It has also been regarded as critical for the survival of organizations (Dewangan and Godse (2014)). The term 'innovation', deriving from the Latin term *Innovare*, means to renew or to change. A definition for business innovation relevant in the context of this research is:

"*The creation of substantial new value for customers and the organization by changing one or more dimensions of the business system*" (Sawhney, Wolcott et al. (2006)).

Examples are the introduction of new products or services, technological change in the production of products already in use, the exploration of new markets or of new sources of supply, improved handling of material, the startup of new business organizations. Important is that business innovation should enable the achievement of goals across the entire organization, with sights set on accomplishing core business aims and initiatives.

Business innovation is not only creating ideas but also the ability to implement new ideas rapidly, and the ability to succeed in the market (products, services) or within the organization (services or processes) (Rohloff (2011)). It does not depend on a single genius inventing things, but should be a process of creation that involves the entire organization. For innovation to be sustainable and have an impact on results, it must be structured and measured (Davila, Epstein et al. (2012), Prahalad and Krishnan (2008)). Therefore, it is vital that business innovation forms part of an organization's day to day operations.

The process by which organizations innovate has changed during the past decades. Innovation has shifted from the traditional vertical integration model[1] to a model where organizations innovate jointly in collaboration with other organizations and entities (Cui, Ye et al. (2015), Chesbrough (2006)). In this approach, I emphasize with literature on the importance of organizational learning.

[1] Vertical integration refers to the model where internal Research & Development activities lead to internally developed products or services that are then distributed by its organization.

Organizational learning is critical to the innovative capabilities of an organization (Cohen and Levinthal (1990)). It is seen as the driving force behind change, flexibility, and innovation (Jiménez-Jiménez and Sanz-Valle (2011), Prieto and Revilla (2006)). Although other factors are also suggested by these authors, I limit the scope for practical reasons to organizational learning. Therefore the basic assumption is that organizational learning plays a key role to enhance an organization's ability to innovate.

Organizational learning can be defined as an effort to develop methods for the generation and practical management of organizational knowledge in order to respond to changes in the internal and external environment (Calantone, Garcia et al. (2003)). For organizational learning to take place, there must be proper mechanisms implemented. For example, to transfer the acquired knowledge from the external environment to the team/individual employee.

Fostering business innovation is not only providing a creative environment. It is also providing the ground for implementation of business innovation and success in the market or the organization. The importance of social aspects regarding business innovation is argued extensively and has to be paid high attention (Chatterjee, Moody et al. (2015), Davila, Epstein et al. (2012)). An example of a social aspect is the innovative culture of the organization, both inside (leaders and employees) as well as outside the organization (customers and users). However, addressing social aspects is only one important side of it which should be supplemented by a systematic approach in order to enhance an organization's ability to innovate. The other side is considered as the technical aspects, and this is where IT comes into place.

IT-enabled Business Innovation

IT is seen as an enabler of business innovation in addition to its contribution to cost savings and increased efficiency (Ashurst, Freer et al. (2012)). Elaborating on the definition for business innovation, IT-enabled business innovation is considered as business innovation through the application of IT. For example, the adoption of social media is creating opportunities for new forms of collaboration, as individuals devote time and expertise to tackling a wide variety of issues in ways that are made possible by IT.

(IT-enabled) Business innovation can be measured in terms of patenting activity of new products, services, or processes. It is important to note that this perspective on measuring innovation has not gone unchallenged (Ahuja, Lampert et al. (2008)). Some argue that patenting may be indicative of an organization's corporate strategy or may be used by organizations to prevent litigation. Despite such arguments, patenting activity is considered to be a useful measure of innovation and is widely used in the literature (Joshi, Chi et al. (2010), Ahuja, Lampert et al. (2008)). In employing this definition, it is helpful to illustrate the distinction between IT-enabled business innovation and innovation that is not IT-enabled. An example of a non IT-enabled business innovation is the "rusk with notch" (Dutch patent 1012379) that was created without the aid of IT.

2.2.2 Capabilities that influence IT-enabled Business Innovation

The effect of IT on business innovation has been captured in several studies. Although several researchers claim a relationship between IT and business innovation (e.g. Missah (2015), Rohloff (2011)), empirical evidence is limited (Joshi, Chi et al. (2010)). In order to determine the influence of IT, I have searched the literature for capabilities that relate to organizational learning and significantly contribute to the ability to innovate. In this context, many definitions can be found in literature for capability. For example "an organizational capability that makes effective organizational learning possible by managing the process of organizational learning" (Jiménez-Jiménez and Sanz-Valle (2011)). For practical reasons, I define capabilities as characteristics of the organization that makes effective organizational learning possible. They are repeatable patterns of actions in the use of assets to create, produce, and/or offer products to a market (Wade et al. (2004)). The scope is limited to literature which relate to a similar definition of organizational learning and IT-enabled business innovation as discussed previously.

An overview of the results is shown in Appendix C: Business innovation capabilities (Table 6). I synthesized the capabilities found in the literature into the following domains:

- Collaboration & communication;
- Knowledge;
- Information processing & coordination;
- Ideation;
- Processes;
- Absorptive capacity;
- Projects.

Selection criteria

In order to focus on domains which are considered as most significant to contribute to business innovation, I have used a criteria to select them. For practical reasons, I selected the domains which are referred to in more than 30% in the reviewed literature (Appendix C: Business innovation capabilities, Table 7).

Based on the criteria, the following capability domains are selected:

- Collaboration & Communication

  Collaboration, including cross-functional integration and teamwork, enabled by IT can drive innovation. Collaborative IT affordance in the context of this research refers to how IT allows individuals and (cross-functional) teams to work together and share, hand over, and integrate each other's knowledge. This can lead to improved product quality and reduced product cycle time and development cost (Banker, Bardhan et al. (2006)). Collaboration can take the form of virtual teams, online electronic networks of practice, or other new patterns of collaboration. It can also be embodied as many-to-many collaboration (e.g. via the Internet) or one-to-many collaboration (e.g. through list servers) (Chatterjee, Moody et al. (2015)).

  So collaborative affordance can promote dialogue in virtual and distributed settings in which members have not met in person. Such organizational dialogue enabled by IT serves to socialize individuals to a set of values and norms or create collegial and collaborative relationships (Zammuto, Griffith et al. (2007)). These dialogues are important in developing collective thinking and knowledge. Organizational knowledge is developed through collective and interactive processes, and evolves through a dialogical process among organizational members that integrates multiple perspectives (Zaidman and Goldstein-Gidoni (2011)).

- Knowledge

  Knowledge related capabilities driven by IT are an important enabler of innovation. IT can help organizations to capture, store, retrieve, and distribute knowledge. Knowledge capabilities can facilitate organizational learning by helping companies to leverage their resources for innovation (Huang (2014), Cohen and Levinthal (1990)). It can also enhance an organizations' absorptive capacity which results in improved innovation capabilities (Joshi, Chi et al. (2010)).

  The knowledge perspective also argues that organizations can draw on external sources of knowledge for innovation. IT can play a significant role in facilitating this phenomenon (Anaya, Dulaimi et al. (2015), Lindič, Baloh et al. (2011)). Dong (2010) argues that new knowledge created through IT-based information exchange with suppliers can be an important mechanism leading to IT-enabled innovation in supply chains.

- Information processing & Coordination

  IT can improve information processing and coordination capabilities to drive innovation. Research in this area supports the view that IT can help in the organization of tasks and in the processing of data to support decision making (Cui, Ye et al. (2015), Chatterjee, Moody et al. (2015)). This is managed by providing information about the organization and its competitive environment.

  IT can also enhance coordination efficiency and communication by facilitating organizational routines in the innovation process (Han and Ravichandran (2006)). They argue that information processing and information integration enabled by IT help innovation by enhancing the creative and coordinated behaviors both inside and between organizations. This view of IT promoting information processing and coordination across organizations is also supported by Yang, Wang et al. (2009). Their research reveals that the quality of information from information systems can help companies in coordinating with their upstream and downstream partners, and in leveraging their capabilities in the innovation process.

- Ideation

  IT can act as a stimulus for enhancing individual-level mechanisms - such as creativity, analyzing and solving complex problems - that can influence innovation. Literature related to this area claim that specific computer programs can improve the creativity of individuals (Gordon and Tarafdar (2007), Chatterjee, Moody et al. (2015)). Another aspect identified by Füller, Mühlbacher et al. (2010) is the empowerment of consumers through IT. The authors found that the Internet triggers consumer empowerment which stimulates their participation in innovation co-creation activities of organizations.

2.3 Contribution of EA to IT-Enabled Business Innovation

This section provides an answer on research sub question 1.2: "*What can EA mean for IT-Enabled Business Innovation?*".

2.3.1 Enterprise Architecture

For centuries, architecture has been used in the design and construction of buildings. Architects use standard symbols that can be recognized and understood by all members of their industry to carry out the construction work. In the building industry, the architecture represents a blueprint for a building.

Architecture at the level of an entire organization is commonly referred to as Enterprise Architecture. In comparison with the building industry, EA is better understood as city planning versus planning the architecture of only a single building. However, it is challenging to answer what EA exactly is. This is partly due to the abundance of terminology and lack of shared meaning in this domain. In order to stay neutral and to facilitate the understanding of this research, I have adopted the following definition build upon the ISO/IEC/IEEE42010 (2011) standard:

"EA should be understood as being constituted of the essential elements of a socio-technical organization, their relationships to each other and to their changing environment as well as the principles of the organization's design and evolution."

Despite the different views and definitions, literature emphasizes the fact that EA should enable business innovation strategy (Lapalme, Gerber et al. (2015), De Vries and Van Rensburg (2012), Ross, Weill et al. (2006)). As IT-enabled business innovation involves a wide spectrum of concepts, managing these enterprise-scale changes and their complexity requires a structured approach. EA is considered as such an approach, because it can holistically cover the impacted business areas and plan for major changes in business capabilities to achieve strategically relevant outcomes. The objective is to allow an organization to most effectively achieve its current and future objectives. Therefore, EA has to facilitate the development and implementation of strategy. This can be achieved by translating the strategy into an effective, organization-wide change. For example, by creating, communicating, and improving the key requirements, principles, and models that describe the organization's future state and enable its evolution. Considering that every strategy will have to support the organization's continued existence, it is of most importance for an EA to support and provide ample room for innovation.

EA serves also as the blueprint for the organization. An EA framework can describe the underlying infrastructure and thus provide the groundwork for the organization, processes, human resources, information / data and IT systems to work together. There are a number of architectures and architectural frameworks in use today. Though they may overlap or address similar views, frameworks also have been designed to address specific needs or concerns. Although the structuring differs per framework, several frameworks like the Zachman Framework, DoDAF, TEAF and TOGAF distinguish between the social and technical aspects of an organization (Lapalme (2012), Winter and Fischer (2006)).

2.3.2 Assets that drive IT-enabled Business Innovation

As mentioned previously, organizational learning is an important factor in business innovation. This has also been recognized in the field of EA (Lapalme (2012), Gharajedaghi (2011)). Lapalme (2012) introduces organizational learning with the concept of "Enterprise Ecological Adaptation" where EA is the means for organizational innovation and sustainability.

The rationale behind this concept is about fostering organizational learning by designing the various facets of the enterprise, including the relationship to its environment. This in order to enable innovation and system-in-environment adaptation. System-in-environment is derived from the open systems theory (Emery (2000)). In the context of this research, the purpose of an open system is to promote and create change towards a world where an organization (system) and its environment are living harmoniously together[2]. The open system (Figure 4) expresses the interaction between system and environment. The environment acts upon the system and is known through the function of learning. The system acts upon the environment and can be considered as the planning function.

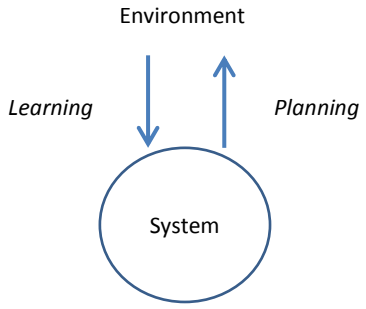

Figure 4: The model of open system (Emery (2000))

The guiding principle is that a systemic approach alone is not sufficient to enterprise design. It is necessary to achieve environment and enterprise coevolution by purposefully changing the environment, systematically designing the enterprise as well as its relationship to its environment. This principle has been also emphasized in literature on other fields of expertise. For example, within the field of market-orientation it has broadly been captured as "outside-in thinking" (Day and Moorman (2010)). The (re)designing of an enterprise should therefore not deliver an EA for the organization and their information systems only. It should deliver an EA for the external environment, the organization and their information systems.

[2] This includes the concept of open, jointly optimized, organizational systems, optimizing human purposefulness and creativity, and the best options afforded by changing technologies.

The review of literature also reveals that IT-enabled business innovation can be fostered by organizational -and technical assets. Assets are defined as anything tangible or intangible the organization can use in its processes for creating, producing, and/or offering its products (goods or services) to a market (Wade et al. (2004)). The assets link the social and technical aspects of an organization's architecture to IT-enabled business innovation. They can be broadly characterized as the social architecture and technical architecture of the organization (Prahalad and Krishnan (2008)). Prahalad and Krishnan (2008) have focused on how IT and access to a global network of resources present a new competitive environment for organizations, creating new opportunities and prerequisites for successfully achieving and sustaining continuous change and innovation. In line with enterprise-in-environment learning, they too embrace the thought to enable and demand changes in organizations by focusing on innovation from both inside as well as outside the organization.

Social Architecture

According to Prahalad and Krishnan (2008), the social architecture is important because IT must be supported by the social structure of an organization. They define social architecture to include the organizational structure, performance measurement, training and skills, and reward systems. The importance of a social architecture is also referred to in other literature. For example, Bogenrieder (2002) argues that a social architecture is a prerequisite for organizational learning. However, she also concludes that the specific design for such an architecture depends on the characteristics of the problem situation, which can be characterized along the dimension of goal uncertainty and technical uncertainty. While there are probably multiple assets of the social architecture that can potentially be important for IT-enabled business innovation, I have focused on assets which are referred to in literature used to determine the capability domains (Appendix C: Business innovation capabilities, Table 6). Based on this literature, I have identified the following assets:

- Key stakeholders;
- Collaborative organizational culture;
- Organizational structure;
- Performance measurement;
- Processes;
- Reward systems;
- Training and skills.

A complete overview of the results is shown in Appendix D (Table 8).

I have used the same selection criteria as described in section 2.2.2. As a result, the following assets for social architecture are selected:

- Key Stakeholders
  An asset of the social architecture comprises the key stakeholders of an organization. Prahalad and Krishnan (2008) refer implicitly to leaders, customers, and employees as the stakeholders.

  Leadership is of importance to innovation because leaders can establish the conditions needed for innovation and can garner support for innovation teams. Results from several studies reveal the importance of leadership to encourage innovation. For example, leaders can promote innovation by supporting a sense of team/group identity and commitment. They can encourage team members to cooperate through the expression of ideas and participation in decisions (Paulsen, Callan et al. (2013)). Jung, Chow et al. (2003) argue that transformational leadership can influence innovation through employees' perception of empowerment and support. They also argue that leaders can be the embodiment of change and innovation in the organization. Strong leadership can overcome barriers by helping to gather information and communicate effectively with various stakeholders to guide innovation. Sustainable innovation requires strategic guidance from top executives of the organization. In the context of IT-enabled business innovation, business leaders and IT leaders can both play a part. While IT leaders can provide guidance in how to apply IT to business innovation, business leaders' understanding of IT can help them support IT initiatives in line with the business needs. The characteristics of leaders (such as demographics, leadership styles) can promote the generation of ideas by encouraging creativity and innovation through the provision of resources.

  Organizations can drive innovation by involving customers, partners, vendors, users, and even fans in the innovation process. Management and marketing literatures recognize the potential role of customers in innovation (e.g. Day and Moorman (2010), Chesbrough (2006)). The increasingly digitally enabled nature of innovation (Ismail (2014), Prahalad and Krishnan (2008)) magnifies the potential role of customers. IT plays a major role in enabling capabilities of customer-orientation and collaborative development of products and services. For example, LEGO and BMW use IT-based platforms to absorb customer insights into product development (Bughin, Chui et al. (2008)). IT can also promote customer involvement in design, ideation, and innovation processes (Nambisan (2003)). The employees of the organization play a crucial role in order to drive innovation. How employees interact socially through the exchange of ideas and sharing of knowledge is important. The social ties and connections among employees facilitate the generation and implementation of innovative ideas (Ismail (2014)). The use of IT can facilitate this socialization process by promoting the sharing of knowledge and exchange of ideas by employees online.

- Collaborative Organizational Culture

  A collaborative organizational culture can also enhance innovation. Incentives to employees to pursue innovation-oriented initiatives are more likely to result in innovation compared to a culture where employees are restrained from pursuing such goals. Adobe Systems is a fitting example of such a social architecture. They launched the "Kick Start Innovation Workshop". Participating employees receive a red box containing a step-by-step guide and a prepaid credit card with $1000 in seed money, and are given forty-five days to experiment with and validate innovative ideas. Although they have access to coaching from some of the company's top innovators, the rest is up to them (Ismail (2014)).

  A culture of collaboration can create an environment where new ideas can be fostered and allowed to take shape (Lee (2012)). Such a culture can play a role in innovation by promoting knowledge sharing. A culture of knowledge sharing helps transcend silos among employees in different units/teams of the organization. Interaction with customers helps break down communication barriers with customers and helps understand their needs and incorporate them into innovation. Leaders of the organization can establish the conditions needed for increased collaboration across organizational silos. When employees access broader sources of knowledge across silos, it allows them to widen their perspective, fostering greater innovation (Gordon and Tarafdar (2007)).

- Organizational Structure

  Management literature argues that large organizations often use what is called a matrix structure, and these organizations find it extremely difficult to deal with rapid or disruptive change (Chatterjee, Moody et al. (2015), Ismail (2014)). A matrix structure can make traditional organizations highly efficient at expansion and growth by incremental change as long as market conditions remain unchanged. However, it also reduces the ability to adapt to a changing environment which makes them extremely vulnerable to disruption (Ismail (2014)). In order to increase the ability to innovate, several organizations have implemented autonomous structures (Ismail (2014), Lin (2011)). They describe autonomy as self-organizing, multi-disciplinary teams operating with decentralized authority. According to Ismail (2014) and Lin (2011), this organizational structure also creates a sociable, open and trusting culture featuring highly satisfied staff. In the context of IT-enabled business innovation, such characteristics can play a part by promoting improved and less bureaucratic IT-business linkages and faster decision-making. For example, lower formalization can enable IT and business employees to more freely share knowledge on ideas to drive innovation.

Technical Architecture

Prahalad and Krishnan (2008) define the technical architecture as the "Information Technology backbone", comprising applications that enable business processes in the organization. Technologies such as knowledge management systems and business intelligence systems can provide the infrastructure for innovation. For example, by facilitating the creation of new products, services, or processes, or by facilitating the process of knowledge generation and knowledge access. Collaborative technologies can enhance the ability to synthesize knowledge and generate new knowledge required for innovation.

While there are probably multiple assets of the technical architecture that can potentially be important for IT-enabled business innovation, I have focused on the same literature as used to determine the assets for the social architecture. The following assets are identified:

- Web technologies;
- Knowledge management systems;
- Data Analytics;
- Flexible IT infrastructure;
- System integration;
- IT-enabled design;
- Decision support systems.

A complete overview of the results is shown in Appendix D (Table 9). I have used the same selection criteria as described in section 2.2.2. As a result, the following assets for technical architecture are selected:

- Web Technologies

  Collaborative technologies can enhance the ability to synthesize knowledge and generate new knowledge required for innovation. IT can help with these so called Web technologies, which can facilitate the streamlining and consolidation of information and knowledge sharing. The ability to find and integrate information using information technologies can enhance innovation.

  Another example of Web technology is collective intelligence and can be important aids as well (Anaya, Dulaimi et al. (2015)). Not just in propagating ideas, but also in generating them. They are certainly no replacement for brilliant insights from a line manager or a eureka moment during a meeting, but they can complement and speed the search for business process innovations. Web technologies such as wikis, blogs, and multimedia online toolkits greatly empower individual customers and end-users of products and services to engage in organization' innovation process to help better identify and commercialize good ideas and inventions for greater financial returns (Joshi, Chi et al. (2010)).

- Knowledge Management Systems

  Organizations increasingly depend on their knowledge capabilities to continuously innovate. Knowledge management systems can provide the infrastructure for innovation by facilitating the process of knowledge generation, knowledge access. and knowledge management. IT enables the creation, dissemination, and use of knowledge, thus greatly augmenting and enabling organizations' knowledge capabilities (Joshi, Chi et al. (2010)). For organizations intending to draw knowledge from a diverse range of external sources, knowledge management systems used in open innovation activities should be designed to ensure they can be easily adapted to work with new collaborative partners and easily extended to accommodate new functions (Cui, Ye et al. (2015)).

- Data Analytics

  IT-enabled analytics capabilities, such as business intelligence systems, can streamline decision-making and provide organizations with insight in the innovation process (Prahalad and Krishnan (2008)). Anaya, Dulaimi et al. (2015) argue that applying data analytics tools into data accumulated from information systems, to extract new insight, lead to innovative practices. These authors also argue that data analytics tools can benefit organizations in many areas. For example, the data generated from a Customer Relationship Management system can be analyzed using data mining tools. The information obtained from this analysis can enable organizations to increase their sales and to offer new and better products and services. By applying different statistical methods on the prepared data set and using data analysis tools, an organization can classify the customers into different segments and groups based on their historical transactions and demographics. This can allow the organization to forecast customers' behaviors whenever an organization proposes certain innovative products, services or marketing initiatives (Ismail (2014), Lin (2011)).

2.4 Conclusion

This section provides conclusions of the literature research by answering the first main research question "*What capability domains and assets can be determined for usage within EA in order to drive IT-enabled business innovation?*".

The role of EA in IT-enabled business innovation is important, yet relatively understudied in literature. The literature research reveals several insights contributing to the understanding of how IT can facilitate business innovation capabilities. The following capability domains are derived from the literature:

- Knowledge;
- Collaboration & communication;
- Information processing & coordination;
- Ideation.

In order to facilitate the capabilities for these domains, several assets have been determined. These assets are categorized into social –and technical related assets. Based on the results of the literature research, I suggest that the following assets of the social architecture need to play their part in IT-enabled business innovation:

- Key stakeholders;
- Collaborative organizational culture;
- Organizational structure.

The following technical assets are essential for providing the infrastructure to support the social assets and the capabilities which contribute to business innovation:

- Web technologies;
- Knowledge management systems;
- Data analytics.

Figure 5 displays the assets in relation with the capability domains, and the percentage of references per relation found in literature. In this graph, 10 bars are above the limit of 30%. It means that 10 relations between a capability domain and an asset are more than 30% referred to in the reviewed literature.

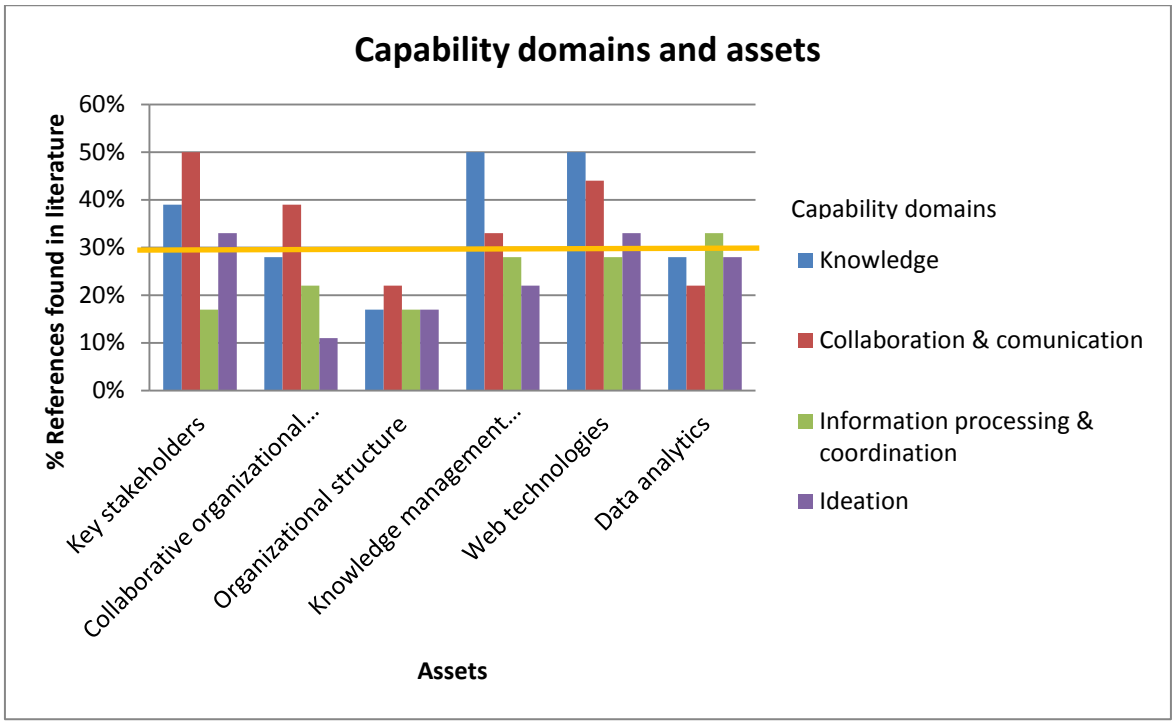

Figure 5: Capability domains and assets

A complete overview of all identified relations is shown in Appendix E (Table 10). The percentage of references for all relations found in literature is shown in Appendix E (Table 11). The 10 relations which I consider as input for a conceptual model and therefore need to be validated during the empirical review are displayed in Table 3. This table represents an initial draft of the conceptual model.

Table 3: Relations between capability domains and assets

Relation	Capability domain	Asset	% Refs
1	Knowledge	Knowledge management systems (technical)	50%
2	Knowledge	Web technologies (technical)	50%
3	Knowledge	Key stakeholders (social)	39%
4	Information processing & coordination	Data analytics (technical)	33%
5	Collaboration & communication	Knowledge management systems (technical)	33%
6	Collaboration & communication	Web technologies (technical)	44%
7	Collaboration & communication	Collaborative organizational culture (social)	39%
8	Collaboration & communication	Key stakeholders (social)	50%
9	Ideation	Web technologies (technical)	33%
10	Ideation	Key stakeholders (social)	33%

3. EMPIRICAL RESEARCH

The chapter describes how the empirical research is conducted. It contains the research strategy, methods and techniques for data collection and analysis, data sources, validity – reliability – ethics of research.

3.1 Research Strategy

Limited information has been published about the applicability of EA to enhance an organization's ability to IT-enabled business innovation. The main objective of my research is to better understand this problem and provide new insights which can be used for further research. Therefore, I have chosen to conduct an exploratory research (Saunders, Lewis et al. (2011)). This type of research is used for a problem that has not been clearly defined. As in my research, it often occurs before enough knowledge is available to make conceptual distinctions or posit an explanatory relationship. The three most important aspects of exploratory research are (Saunders, Lewis et al. (2011)):

1. Literature research;
2. Gather information from experts in the relevant field;
3. Conduct a focus interview.

My research is focused on the confluence of three perspectives: EA, business innovation and IT. The lack of literature suggests that the number of experts is limited. Therefore, I have chosen to conduct a number of focus interviews (3). An expert in the field of EA will be consulted to validate the results (2). Two disadvantages of focus interviews are time allocation and the risk that no relevant information can be obtained from these interviews.

The focus interviews are conducted during an embedded case study. A case study becomes an embedded case study when, within a single case, attention is paid to more than one subunit (Yin (2013)). It is a suitable method for exploratory research in which the researcher is focused on a specific and detailed situation or environment with limited possibilities for structuring upfront (Saunders, Lewis et al. (2011), Verschuren and Doorewaard (2007)). In addition, using a case study is also in line with DSRM. Appendix F (Table 12) shows an overview of the research methods and whether they can be applied within my research. The disadvantage of case studies is the limited external validity as described in section 3.4.2 (Verschuren and Doorewaard (2007)).

For answering the main research question, it is important to get insight in the situation at different types of business units within the entire organization. Seen from a more general data collection effort, this is a useful complement to enhance the depth of understanding of key aspects. A downside of the approach is the time effort and obtain access to multiple departments. The application of triangulation is limited, because I have used one respondent per business unit. However, for practical reasons and given the effort of finding respondents, the benefits of the approach seem to outweigh the disadvantages.

Based on results of the case study and literature review, I have further developed the conceptual model. A validation of the model can increase its quality, which can be achieved through the use of expert reviews, Delphi sessions or resubmit the model to respondents. For the same practical reasons as mentioned above, I have chosen for one review with an expert in the field of EA. An alternative, such as submitting to the same respondents, has the disadvantage that their views on the model does not significantly change (see also section 3.4).

3.2 Data Collection and Analysis

I have conducted the embedded case study with semi-structured interviews. Semi-structured interviews can be applied in exploratory research to gain new insight (Saunders, Lewis et al. (2011)). Such type of interview is useful to get certain answers clarified, since the respondents will have the opportunity for further explanation of their answer. It is also a suitable method to provide or receive additional information and explanations. This is important, because the context of my research contains a number of complex aspects.

It is likely that the respondents have limited experience with the context of my research. To mitigate this risk, I have provided general information and key aspects regarding the research prior to the interviews (Appendix G). The information will be limited to prevent the view of the respondent to be affected too much and serves mainly to clarify the research topic. Providing information also contributes to clarifying the purpose of the study in order to gain access to the respondent (Saunders, Lewis et al. (2011)).

Myers and Newman (2007) have provided guidelines for semi-structured interviews. Preparation of the interviews has a relationship with the quality of data obtained from these interviews. Therefore, I have created an agenda for the interviews (Appendix H), and an agenda for the expert review (Appendix I). These agendas contain the aspects for both sessions, and provide guidance during the sessions.

Analysis on data obtained from all interviews have taken place on the basis of notes and sound recordings. I have created a detailed transcript of each interview and shared this with the associated respondent in order to validate the answers. Next, I have summarized the answers from each transcript in order to reduce the data (Saunders, Lewis et al. (2011)). These summaries are displayed per respondent for each question to make analysis easier (Appendix J and Appendix K).

3.3 Data Sources

I have used data obtained from primary sources. Using data from secondary sources, like document analysis, offers the ability to validate comments from the interviews. However, organizations see their business innovation as confidential. This raises the risk of limited documents available, both in numbers as well as the added value. Therefore, I have chosen to focus on primary sources only.

To ensure the value of results, I have used the following criteria to select respondents for the case study:

1. Respondent has an active role within the domain of IT-enabled business innovation[3];
2. Respondent has a minimum of 3 years of experience within the domain of business innovation;
3. Respondent has a bachelor degree (or higher) and has a function on this level;
4. Business unit of respondent is part of the organization selected for this research.

Since it concerns an exploratory, qualitative research with case studies in a large population, stochastic sampling is not feasible. Therefore, I have used a non-stochastic sampling or self-selective sampling (Saunders, Lewis et al. (2011)). I have asked respondents in my network to voluntarily participate in the interview. To gain access to these potential respondents is more effective, because of my relationship with them (Saunders, Lewis et al. (2011)). The sources are not focused on a specific environment, which ensures the homogeneity of the audience is not affected. Disadvantages of self-selective sampling are limited control over the characteristics of the respondents, and the participation of respondents with a positive attitude towards the subject only. However, such attitude allows for a greater opportunity to obtain relevant information from the interviews (Saunders, Lewis et al. (2011)). The use of an expert review helps to mitigate the bias of a positive attitude towards the subject.

To my knowledge, there are no clear guidelines available for the number of qualitative interviews within a research. Baker and Sinkula (2002) argue that it depends on the situation, level and the purpose of the research. According to Swanborn (1996), determining the number of interviews is based on an assessment of costs and benefits within the resources available. For the same practical reasons as mentioned in section 3.1, I have selected a total of 5 interviews and 1 expert review.

The expert review was focused on the theoretical and practical relevance. To ensure the expert is able to link the theory to practice in order to assess the usability of the conceptual model, I have determined the following selection criteria:

1. Master degree;
2. Active within the scientific domain of EA;
3. Engaged in business with a minimum of 5 years of experience at strategic level;
4. Within the organization seen as an EA expert.

[3] For example, proven experience (resume) in innovative project with application of IT. A project is considered to be innovative, in case new technology has been implemented or the project has resulted in patents

3.4 Validity, Reliability and Ethics of Research

Validity, reliability and ethics of research are important aspects in designing and conducting case study evaluations (Saunders, Lewis et al. (2011), Yin (2013)). Especially when the number of cases being studied is highly limited (even limited to a single case) (Yin (2013)). These topics address the quality of my research.

3.4.1 Internal Validity

Internal validity is the approximate truth about inferences regarding cause-effect or causal relationships (Saunders, Lewis et al. (2011)). It is focused on the results and the validity of the measuring instrument.

The internal validity of this research has been secured as much as possible by making a questionnaire prior to the interviews in order to provide the same structure in every interview. During the interviews, the questions could be clarified and answers from respondents could be further explained. The respondents also had the opportunity to ask additional questions. Providing information upfront the interviews about EA and IT-enabled business innovation has contributed to a common understanding about the research topic among all respondents. By using a logic model (Yin (2013)), the collected data is analyzed by comparing the empirical findings with the initially stipulated theoretical relationships. The match between the empirical and the theoretical adds to the support for explaining how an intervention produced its outcomes (Yin (2013)). Triangulation is applied by using the results from other cases (Yin (2013), Myers and Newman (2007)).

3.4.2 External Validity

The external validity, or generalizability, is about the extent to which the results can be projected to the entire population (Swanborn (1996)).

The generalizability has been secured as much as possible by providing insight into the organization and characteristics of the respondents. By the extraction of a more abstract level of ideas from other case study findings, analytic generalization has been applied (Yin (2013)). The results of the empirical research are linked to the literature in order to increase the generalizability (Saunders, Lewis et al. (2011)).

However, generalizability of the research results is limited by the type of examination, the chosen methodologies, the number of respondents and the criteria of the population from which the respondents were selected. In addition, the generalizability of the research results is reduced since a solution is specific and limited to the scope of the research.

3.4.3 Reliability

Reliability is about the stability of the measurement results over time, and whether these are independent to the researcher(s) and to the contextual properties (Swanborn (1996)).

Reliability of the measurement results is increased by preserving the rules and guidelines for conducting structured interviews (Saunders, Lewis et al. (2011), (Myers and Newman (2007)).

3.4.4 Ethics of Research

The ethics of research is focused on the way you handle the respondents, and the information they provide. I have used the following measures to ensure an ethically proper research is conducted. The measures are adopted from Saunders, Lewis et al. (2011).

Respondents:

- are not required to answer;
- are anonymous in my research;
- may at any time stop participation;
- get a copy of the interview and have the ability to comment and submit changes to take effect.

In addition, the following measures are used to ensure anonymity:

- No references to names of respondents in the analysis;
- Audio recordings and notes are only accessible to the researcher;
- Respondents have signed for participation;
- The interviewer has signed to ensuring the anonymity;
- Several technical measures have been taken to secure the dates of the interviews.

4 EMPIRICAL RESEARCH RESULTS

This chapter contains the results from both the case study as well as the expert review.

4.1 Results Case Study

Characteristics per case study

Five respondents from one global manufacturing company are interviewed during the empirical research. The characteristics of each respondent and their department are displayed anonymously in the table below (Table 4).

Table 4: Characteristics of respondents and their department

	Case study 1	Case study 2	Case study 3	Case study 4	Case study 5
Respondent	R1	R2	R3	R4	R5
- Years of service	22 years	20 years	30 years	23 years	15 years
- Years of experience with business innovation	8 years	9 years	15 years	5 years	11 years
- Function	Manager	Manager	Manager	Manager	Supervisor
- Education	University	Technical University	University	Bachelor	MBA
Department					
- Business unit	After Sales	Logistics	ITD	Production Engineering	Product Development
- Department size	60 FTE	12 FTE	15 FTE	53 FTE	10 FTE

As displayed in Table 4, the respondents meet the selection criteria for the case studies as determined in section 3.3. In addition to these characteristics, all respondents explained their involvement in at least 2 IT-enabled business innovation projects in the past 3 years. This in order to demonstrate their active role within the domain of business innovation. Some examples are a global platform for collaboration, an online service tool, a web based transport management solution, electronic work instructions at production lines, connected vehicles.

All respondents are working for the same company, but each within a different business unit. They all have a similar function and at least 15 years of professional experience.

Contribution of Capability Domains to IT-enabled Business Innovation

Results of the case study research regarding the research sub questions 2.1 "*To what extent do the capability domains enable the organization's ability to innovate?*" and 2.2 "*To what extent does the application of IT support the capability domains in order to enable the organization's ability to innovate?*" are summarized below. For more details and answers of the respondents, I refer to Appendix J (Tables 13 – 16).

All respondents answered the following questions for each capability domain, as determined in section 2.4 Conclusion:

- "What is the contribution of the capability domain in relation to business innovation?"
- "What is de contribution of IT in relation to this capability domain?"

- Capability domain "Knowledge"

  Contribution of capability domain in relation to business innovation

  Each respondent stressed the importance of the knowledge domain in order to enable the organization's ability to innovate. They recognized knowledge as a requirement and an enabler for innovation. Respondents 2, 4 and 5 mentioned that knowledge is mostly embedded in the minds of employees. They all started to apply a cross-functional way of working in order to ensure knowledge is shared within their departments and to be less dependent of a single employee. Respondents 1 and 2 argued that experience is a critical aspect to have/gain new knowledge.

  Contribution of IT in relation to capability domain

  Respondents 1, 2, 3 and 5 argued the importance of IT to store and share knowledge. Respondents 3 and 5 indicated that new knowledge is created within their departments through IT-based information exchange with suppliers. Respondents 4 and 5 mentioned that they use external sources of knowledge which are accessible through the application of IT (e.g. research publications, professional literature). Respondents 2, 4 and 5 have also indicated that they find it difficult on how IT can best be deployed. For example, this because of a lack of knowledge about available IT solutions and best practices.

- Capability domain "Information processing & coordination"

  Contribution of capability domain in relation to business innovation

  Although each respondent mentioned this domain as indispensable in the innovation process, various opinions and explanations were given regarding its contribution. According to respondent 1, information becomes more important during the innovation process. Respondents 2, 3 and 4 considered information as a starting point for innovation. All respondents have indicated that visualization of information is the most important aspect in this domain.

Contribution of IT in relation to capability domain

All respondents argued the importance of IT to improve information processing and coordination capabilities. Respondents 2, 3 and 5 mentioned to have a lot of data available within their department. However, they explained it is often historical data instead of real-time data. In addition, the current IT systems and processes are too immature to provide the information to drive innovation.

- Capability domain "Collaboration & communication"

Contribution of capability domain in relation to business innovation
All respondents argued this domain as critical in the process of innovation. However, according to them collaboration and communication is not self-evident and should be facilitated. It requires a team of people with different knowledge and experiences. Respondents 1 and 2 mentioned that the composition of the team should be changed during the process.

Contribution of IT in relation to capability domain
Respondents 1, 2, 3 and 4 indicated that the most important aspect in this domain is human interaction (face-to-face). Respondents 1 and 5 are using IT to allow individuals and teams to work together and share, hand over, and integrate each other's knowledge. Respondents 2 and 3 mentioned to have little need regarding IT support to improve collaboration & communication. Respondent 4 argued the importance of automated workflows to improve collaboration and communication. All respondents stressed the importance of IT to improve communication.

- Capability domain "Ideation"

Contribution of capability domain in relation to business innovation
According to each respondent, ideation is also critical in order to enable the organization's ability to innovate. Respondents 1, 2, 3 and 4 mentioned the importance of giving a certain freedom to people to generate ideas, where people can think in terms of opportunities instead of constraints.

Contribution of IT in relation to capability domain
2 out of 5 respondents argued a significant contribution of IT in this domain. Respondent 2 and 5 mentioned the opportunities of the Internet triggers consumer empowerment which stimulates their participation in innovation co-creation activities (e.g. feedback).

Contribution of Assets per Capability Domain

Results of the empirical research regarding the research sub question 2.3 "*To what extent do the assets enable the organization's ability to innovate?*" are summarized below. For more details and answers of the respondents, I refer to Appendix K (Tables 17 – 26). All respondents answered the question below for each relation between a capability domain and an asset, as determined in section 2.4. I consider this as a validation of the conceptual model.

- "What is the contribution of the asset in relation to the capability domain according to your experience?"

- Relation 1: Knowledge - Knowledge management systems
  All respondents argued that knowledge management systems make it easier to capture, store, retrieve, and disseminate knowledge. Respondents 1, 3, 4 and 5 indicated that access to knowledge refers to the greater availability of more sources of knowledge to employees. If they have more access to knowledge and information, their potential to generate new knowledge for innovation is likely to improve. According to these respondents, organizations can enhance their ability to innovate through improved access to knowledge. Respondents 4 and 5 also mentioned that a lot of knowledge is isolated within employee or sub-unit boundaries. This can hinder the capacity to recombine various sources of knowledge during the innovation process.

- Relation 2: Knowledge - Web technologies
  Although these technologies are not yet widely used in their departments, respondents 1, 2, 4 and 5 argued the importance of Web technologies for creating, streamlining and consolidation of information and knowledge sharing. They claim that Web technologies, such as social networks, can help facilitate access to knowledge and expertise which might have been otherwise difficult to achieve. Respondent 1 and 5 also mentioned the use of these technologies to empower customers and end-users of products and services to engage in the innovation process to help better identify trends.

- Relation 3: Knowledge - Key stakeholders
  The importance of key stakeholder involvement within the knowledge capability domain is stressed by each respondent. Respondents 1, 3 and 5 specifically mentioned to identify these stakeholders in order to clarify their roles and responsibilities during the different stages of the innovation process. Respondents 1, 2 and 3 argued that employees play a crucial role in order to drive business innovation. They indicated that the use of IT can facilitate the interaction between employees, suppliers and – to a lesser extent – customers by promoting the sharing of knowledge online.

Relation 4: Information processing & coordination - Data analytics

According to all respondents, data analytics is critical in order to enhance the organization's ability to innovate. They argued that applying data analytics tools can provide new insights, which can lead to innovative practices, and streamline decision-making. For example, respondent 4 uses data analytics to improve the production processes in the factories. Respondent 5 uses data analytics based on historical data in order to improve the product. All respondents mentioned business intelligence systems as prime examples of such technological capabilities which can promote organizational learning. Respondent 1 argued the possibility to forecast a products' behavior whenever an organization proposes a certain innovative product.

- Relation 5: Collaboration & communication - Knowledge management systems
  Respondents 1, 2, and 3 indicated that knowledge management systems have the capacity to reduce or break down organizational silos of knowledge. This by making it easier to capture, store, retrieve, and disseminate knowledge. All respondents argued that these systems can provide the ability to transcend invisible barriers within an organization and provide greater access to knowledge sources. Access to greater number of knowledge sources improves risk analysis (respondent 3), and the likelihood of obtaining knowledge that leads to valuable innovations (respondents 1 and 2).

- Relation 6: Collaboration & communication - Web technologies
  Respondents 1, 3 and 4 indicated that Web technologies can facilitate access to distant stakeholders through information exchange, enhancing the abilities of employees to leverage on the expertise of these stakeholders. For example, respondents 1 and 4 referred to online social networks which facilitate access to co-employees who might not have otherwise connected with each other. Respondent 5 mentioned that blogs promote the ability for employees to get feedback on ideas from socially distant or geographically distant acquaintances.

- Relation 7: Collaboration & communication - Collaborative organizational culture
  All respondents indicated that a collaborative organizational culture is a critical aspect in order to enhance the organization's ability to innovate. Respondent 1 and 2 mentioned that IT can facilitate the sharing of values and norms between employees in different subunits of the organization. According to respondents 1, 4 and 5, this social asset can also help to reduce silos in the organization. For example, a culture of knowledge sharing helps transcend silos among employees in different business units.

- Relation 8: Collaboration & communication - Key stakeholders
  According to each respondent, the key stakeholders of an organization play a crucial role in order to drive business innovation. They all claimed that the social interaction between employees through the exchange of ideas and sharing of knowledge is important. Respondent 1 uses IT to facilitate this kind of socialization by supporting collaboration processes online. Respondent 3 indicated that interaction with customers helps to break down communication barriers with them, helps to understand their needs and incorporate them into business innovation. Respondents 2 and 4 argued that leaders can establish the conditions needed for increased collaboration across organizational silos. When employees access broader sources of knowledge across silos, it allows them to widen their perspective which can foster greater innovation.

- Relation 9: Ideation - Web technologies
  Respondents 2, 3 and 5 argued that Web technologies can help generating and propagating ideas. According to them, it is relatively easy to reach large groups of people by using these kind of technologies. All respondents indicated that these technologies only can complement and speedup the search for business innovations, but it is not a replacement for the face-to-face aspect.

- Relation 10: Ideation - Key stakeholders
  All respondents stressed the importance of key stakeholder involvement in the Ideation domain. Respondents 2 and 4 referred to strategic guidance from top management of the organization as a requirement for sustainable innovation. This guidance also applied to the application of IT. They also mentioned that leaders can promote the generation of business innovation ideas by encouraging creativity through the provision of resources. Respondents 1 and 5 argued the involvement of customers in ideation, in which IT can also facilitate.

4.2 Results Expert Review

The expert argued the change in the view and purpose of EA these days. EA was often used as only a static blueprint with reference architecture focused on the internal organization. It is now increasingly seen as a holistic approach to cover impacted areas of an organization with a more external focus. EA should be used to plan for major changes in business capabilities to achieve strategically relevant outcomes. This is much in line with the concept of this study. Therefore, the expert recognized the relevance and contribution of this research to science.

4.2.1 Validity

The expert indicated a high level of abstraction in this study by researching the confluence of the concepts of business innovation, EA and IT. Consequently, the analysis based on a literature review and interviews is justified. In addition, the overall research method is recognized as sufficiently robust. Although the limited number of interviews, the expert recognized and acknowledged sufficient effort is made for scientific research. Suitable candidates within the case study organization, who can be used as counter parts, are difficult to find. Few people have relevant knowledge and experience with the research topic. To cope with this limitation, the case study could be extended to other organizations. The generalizability of the research is increased since the results of the empirical research are linked to the literature research results.

4.2.2 Applicability

According to the expert, recognition of the theoretical framework is high. The sources that have been used sketch no other truth regarding the expert's knowledge. The results from the literature review and the case study contain no surprises or conspicuousness. They provide realistic insight into the drivers of IT-enabled business innovation and a possible usage of EA.

The practical applicability is lower. This is due to the lack of a scan/measuring instrument which can be used to audit an organization. Such an instrument, for example a maturity model, can help to apply the theory into practice. The development of a conceptual model in order to describe and visualize the important aspects and their correlations is acknowledged as well. Although the limitation of the applicability of the model, it can serve as a prototype for further research.

4.2.1 Conceptual model

The conceptual model of an EA driven by IT-enabled business innovation is displayed in figure 6.

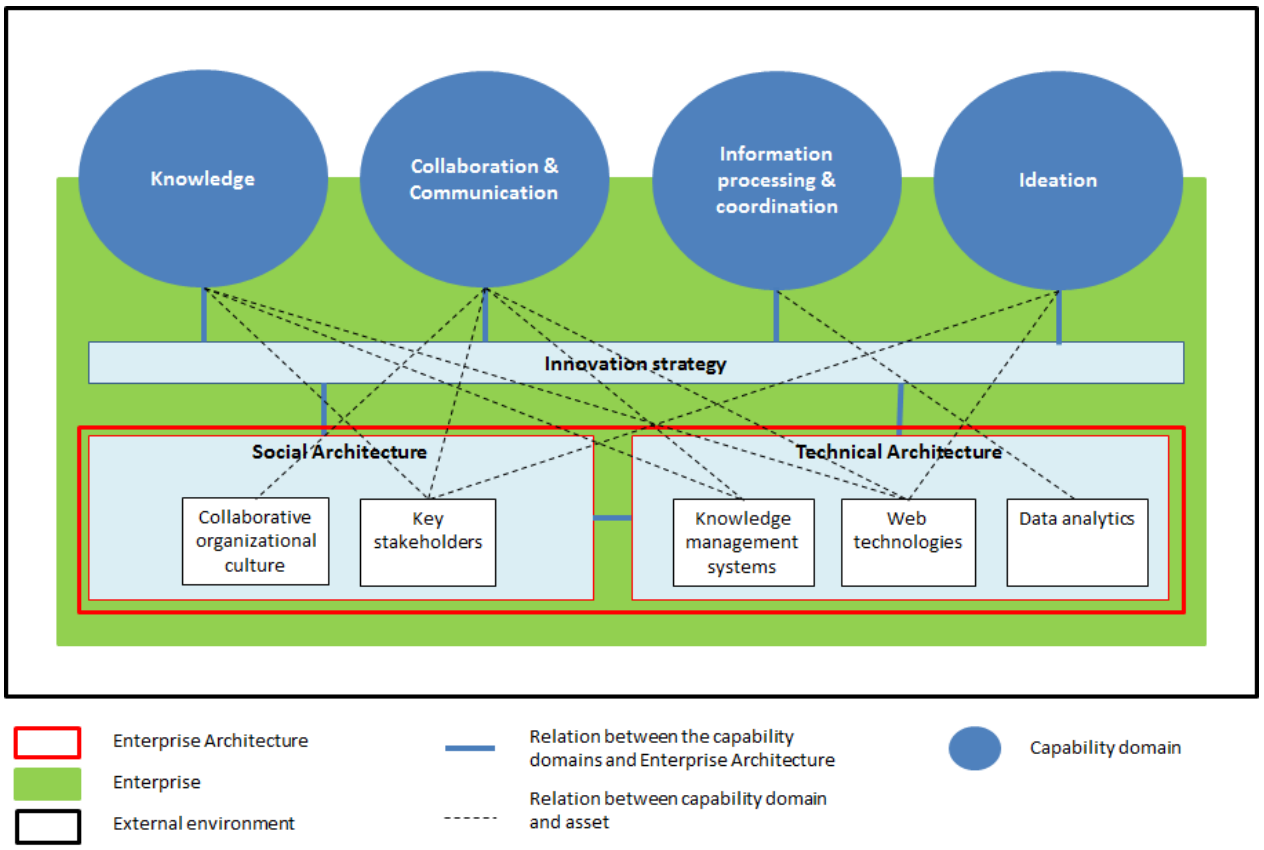

Figure 6: Conceptual model for an Enterprise Architecture driven by IT-enabled business innovation

The four capability domains - Knowledge, Collaboration & Communication, Information processing & coordination and Ideation - are considered as the drivers for IT-enabled business innovation. They should be focused on both the external environment, as well as the internal organization. Through an organization's strategy on innovation, the capabilities within these domains should be facilitated by one or more assets. These assets are considered to be important aspects within an EA driven by IT-enabled business innovation.

5. CONCLUSIONS AND RECOMMENDATIONS

This research has yielded several contributions to the field of EA. The objective was to gain new insight regarding the usage of EA in order to enhance an organization's ability in IT-enabled business innovation.

5.1 Conclusions

In answering the first main research question, I reviewed the literature at the confluence of business innovation, EA and IT. This revealed limited research attention to the role of EA in IT-enabled business innovation. However, the review also revealed that organizational learning is critical to the innovative capabilities of an organization. Based on this, four primary capability domains are identified as being crucial in order to drive IT-enabled business innovation. By facilitating the capabilities in these domains, IT can have a positive effect on business innovation. The review also revealed that the importance of organizational learning has been recognized in the field of EA as well. An EA should be fostering organizational learning by designing the various facets of the enterprise, including the relationship to its environment. To address the facets and support the capabilities which drive IT-enabled business innovation, several technological and organizational assets are identified per capability domain. By doing so, the social and technical aspects of an organization's architecture are linked to IT-enabled business innovation.

In answering the second main research question, I have validated the results from my literature review with people who have to deal with IT-enabled business innovation in a professional capacity. These evaluations proved to be positive on many accounts regarding the conclusions from the literature review. The results show that all four capability domains identified during the literature review are recognized in practice as enablers for the organization's ability to innovate. The results also show that a significant contribution of IT by facilitating these domains is recognized as well. In addition, the suggested relations between each capability domain and one or more architectural assets are confirmed as well. Remarkable is the unsolicited response from the majority of participants in my research regarding the importance of a strategy focusing on IT-enabled business innovation. Such a strategy can promote alignment among diverse groups within an organization, clarify objectives and priorities, and help focus efforts around them.

I have proposed a conceptual model which contain important aspects in order to drive IT-enabled business innovation. A first draft of the model (Table 3) was developed based on literature results only. It included the capability domains and assets, and provided an indication of possible relations between them. This model has been validated during the empirical research. The results are used to develop the final model (Figure 6). Compared to this final version, the aspect of an innovation strategy was not included in the draft model. The necessity of this was repeatedly referred to by all respondents. Comparing the relations in the two models reveal a few notable differences as well. The percentages of references in both literature and empiricism are used to serve as a benchmark. Figure 7 displays an overview of each relation, including the percentages of references from reviewed literature and validation during empirical research. Relation 4 (Information processing & coordination - Data analytics) and relation 10 (Ideation - Key stakeholders) show the most significant deviation. It is remarkable that these relations are recognized and acknowledged by all respondents from the case study, but to a lesser extent referenced in literature.

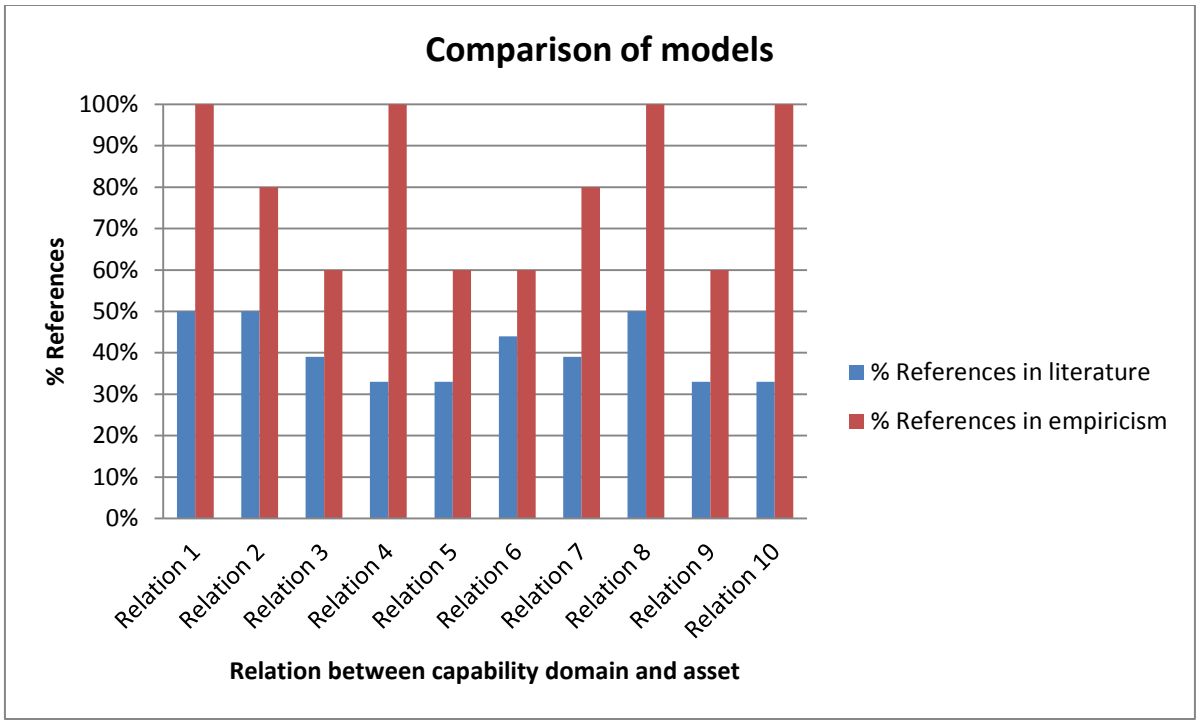

Figure 7: Comparison of models

Finally, my overall conclusion is that the field of EA is a viable approach to systematically address and facilitate IT-enabled business innovation. However, it is not being said that organizations need an EA in order to enhance their ability to innovate. In case an organization is using EA and innovation is part of its strategy, then the insight provided by this research can contribute to increase the ability to innovate. Above all, this research offers a conceptual model and foundation for future studies to explore the role of EA in IT-enabled business innovation.

5.2 Recommendations

Derived from the empirical research, the following recommendations for further research are identified.

First, while this research is about innovation in a general sense, it has led to discussions with the participants regarding the different types of innovation driven by IT. Therefore, it is possible to extend the research by examining these types. Innovation covers the continuum from incremental or sustainable innovation (remodeling functionality) to radical or disruptive innovation (breakthrough, paradigm shift) (Assink (2006)). EA is often applied and find its resonance within large organizations. Typical large organizations are mostly developing incremental innovations. Disruptive innovations are particularly developed by new organizations like Tesla, Google, Uber and Airbnb. Is it likely to assume that these companies had no or different EA applied during their startup? Is there a relation between EA and the ability to support either incremental or disruptive innovation?

The second recommendation pertains to one aspect of the social architecture of an organization. All participants stressed the importance of key stakeholders, and in particular leadership. Top management support is crucial for sustained innovation capabilities of an organization because it helps to create a culture and "mindset for innovation", and makes innovation "meaningful for the entire firm" and "part of the strategic conversation" (Ahuja, Lampert et al. (2008)). The role of leadership in organizational innovation has received attention in the management literature (Jung, Chow et al. (2003)). From an EA perspective, EA leadership (e.g. Enterprise Architect) can play an important role in the extent to which EA can drive business innovation. For example, the Enterprise Architect can serve as a channel between EA and the business to garner resources and support needed for innovation.

Third, the results do suggest certain correlations between the capability domains, and between a capability domain and one or more assets. Further research can be focused to identify any possible causal correlations, or theorize potential complementarities between the social -and technical assets. Further research can also be focused on extending the case study to one or more organizations.

A fourth recommendation is the development of a measuring instrument to improve the practical applicability of the conceptual model. This will help to apply the theory behind the model into practice.

Finally, the extent of influence of each capability domain towards innovation in relation to another domain could be taken into account. It is likely to assume that the impact of one domain is more significant than the impact of the other. As in my previous recommendation, even potential complementarities between the domains can be theorized. This insight can help setting the priorities when focusing on the organizations capabilities to enhance its ability in IT-enabled business innovation.

6. DISCUSSION

My research is exploratory in nature, in an area where limited research is carried out. There are no unambiguous definitions for EA and IT-enabled business innovation. A common ontology in these fields is missing, and I had to establish several definitions for my research.

The literature review resulted in a large amount of articles. This has made it possible to find multiple references in different articles about the same key assumptions used in this research, which enhances the reliability of the results. However, the criteria used for searching the literature limit the search results meaning that potentially relevant articles were not found.

The empirical research is conducted among a limited number of respondents within one company in a specific industry. This sample decreases the generalizability. However, the answers of the respondents match with each other which increases the value of the final result. Results from the empirical research also strengthen the validity of the literature review results.

I have restricted the conceptual model to capabilities and architectural assets that I believe to be among the more important ones for IT-enabled business innovation. It certainly does not represent the entire spectrum of social and technical architecture of an organization. Nor does it represent the entire spectrum of IT resources that could potentially influence IT-enabled business innovation. Also, the model does not theorize potential complementarities between the social -and technical assets.

The conceptual model can be used by organizations as a guidance when focusing on innovation. It identifies the capability domains which drive specific aspects of innovation, including their relation to one or more assets. These assets should be considered as facilitators for the capabilities. The model also represents the importance of an innovation strategy as a glue between the capability domains and assets. However, the lack of a measuring instrument is a limitation regarding the applicability of the conceptual model.

7. REFLECTION

This chapter contains a reflection on the process which I followed in order to complete my research.

Having a family life and a full-time job is wonderful, but time is scarce. During the week, I could only spent max. two hours per day on my research project. For me, this was often too little time to finalize the very thing I was working on at that moment. In addition, when I continued a next day it took me at least 30 minutes to pick up that thing I was working on previously. In the weekends, I could spent 4 – 8 hours a day. It was during these time blocks where I made the most progress with my research.

It has taken a lot of time and effort for me to come up with an appropriate research topic. In my opinion, this is mainly due to the lack of experience I have in academic research, and the fact that EA is a relatively new concept for me. Since EA is such a broad and emerging concept, plenty of interesting literature can be found about different subjects within the field of EA. I have read at least 200 articles about all kinds of subjects within the field of EA, just to formulate that one research topic. Although I experienced these difficulties with focusing on a topic, I certainly learned how to search and process the literature. As the research progressed, my focus on the research topic increased…. and it is still increasing while I write this.

In general, I guess the lack of experience within a field of interest can positively influence the objectivity. However, as I learned more and more about my topic, I had some difficulties in keeping an objective attitude. Especially during the interviews, it required a lot of attention to myself not to ask suggestive or guiding questions.

I tend to be an optimist by nature in getting things done. As a result, I sometimes take quick steps without keeping a self-critical attitude to what I read. For example, in the beginning I wanted to be successful with the first few articles found in a first attempt to search for relevant literature. Of course, this is not how it works in science. On the other hand, I also want to be as completely as possible. Therefore, I found it difficult to make decisions on which literature to refer to, or which citations to include in the report. My father always said: “In der Beschränkung zeigt sich erst der Meister”. He was right, but to me it is easier said than done.

With each new step in the research process, a new challenge arose. I experienced these challenges as small new studies in itself. I never realized there was such a systematic approach behind a scientific research. It took a while before I understood this and sincerely accepted it, but now I can see the need for it and know to appreciate it. In addition, this approach helps me in my daily work to structure complex problems or questions.

Finally, I learned a lot during this graduation project. Both regarding my research topic, as well as regarding the process of doing scientific research.

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APPENDICES

Appendix A: Checklist relevance assessment of literature

Relevance:

- How recent is the article?
- Any chance the article is obsolete?
- Are the research questions –or targets close enough to yours to be relevant for your own research?
- Is the context of that difference in order to be the article little relevant to your research questions – and objectives?
- Did you found references to this article (or to the author) in other usable articles?
- Does the article support your arguments, or is it in contradiction?

Value:

- Does the article seems biased?
- What are the methodological gaps in the work?
- Is it accurate enough?
- Does the article provides help for future research?

(Source: Saunders, Lewis et al. (2011))

Appendix B: Overview literature assessment

Table 5: Overview literature assessment

Nr.	Type	Author(s)	Year	Title	Step 2 – relevance	Step 3 – quality and relevance
1	Journal Article	Abrantes, R., & Figueiredo, J.	2013	Preparing Project based Organizations for Change	No	-
2	Journal Article	Agievich, V., & Skripkin, K.	2014	Enterprise Architecture Migration Planning Using the Matrix of Change	No	-
3	Book	Ahlemann, F., Stettiner, E., Messerschmidt, M., & Legner, C.	2012	Strategic enterprise architecture management: challenges, best practices, and future developments	Yes	Yes
4	Journal Article	Ahuja, G., Lampert, C. M., & Tandon, V.	2008	1 moving beyond Schumpeter: management research on the determinants of technological innovation	Yes	Yes
5	Journal Article	Albani, A., & Dietz, J. L.	2011	Enterprise ontology based development of information systems	No	-
6	Journal Article	Alwadain, A., Fielt, E., Korthaus, A., & Rosemann, M.	2015	Empirical insights into the development of a service-oriented enterprise architecture	Yes	No
7	Journal Article	Anaby-Tavor, A., Amid, D., Fisher, A., Bercovici, A., Ossher, H., Callery, M., . . . Simmonds, I.	2010	Insights into enterprise conceptual modeling	No	-
8	Journal Article	Anastasios, P., Iacob, M.-E., Daneva, M., & Quartel, D.	2014	Capability-based planning with TOGAF® and ArchiMate®	Yes	No
9	Journal Article	Anaya, L., Dulaimi, M., & Abdallah, S.	2015	An investigation into the role of enterprise information systems in enabling business innovation	Yes	Yes
10	Journal Article	Ashurst, C., A. Freer, J. Ekdahl and C. Gibbons	2012	Exploring IT-enabled innovation: A new paradigm?	Yes	Yes
11	Journal Article	Austrian, E., Berry, K., & Sawyer, M.	2015	A Cross-cutting Human Factors Impact Assessment of Planned NextGen Changes	Yes	No
12	Journal Article	Azevedo, C. L. B., Iacob, M.-E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G.	2015	Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate	Yes	No
13	Journal Article	Baker, W. E., & Sinkula, J. M.	2002	Market Orientation, Learning Orientation and Product Innovation: Delving into the Organization's Black Box	Yes	No
14	Journal Article	Banker, R. D., Bardhan, I., & Asdemir, O.	2006	Understanding the Impact of Collaboration Software on Product Design and Development	Yes	Yes
15	Journal Article	Bauer, W., Hämmerle, M., Schlund, S., & Vocke, C.	2015	Transforming to a Hyper-connected Society and Economy – Towards an "Industry 4.0"	No	-
16	Journal Article	Béjar, R., Latre, M. Á., Nogueras-Iso, J., Muro-Medrano, P. R., & Zarazaga-Soria, F. J.	2012	An RM-ODP enterprise view for spatial data infrastructures	No	-
17	Journal Article	Belaud, J.-P., Negny, S., Dupros, F., Michéa, D., & Vautrin, B.	2014	Collaborative simulation and scientific big data analysis: Illustration for sustainability in natural hazards management and chemical process engineering	No	-
18	Journal Article	Bernus, P., Goranson, T., Gøtze, J., Jensen-Waud, A., Kandjani, H., Molina, A., . . . Turner, P.	2015	Enterprise engineering and management at the crossroads	Yes	No
19	Book	Bernus, P., Nemes, L., & Schmidt, G. J.	2012	Handbook on enterprise architecture	Yes	No
20	Journal Article	Bernus, P., Noran, O., & Molina, A.	2015	Twenty years of the GERAM framework	No	-

21	Journal Article	Bogenrieder, I.	2002	Social Architecture as a Prerequisite for Organizational Learning	Yes	Yes
22	Journal Article	Boucharas, V., van Steenbergen, M., Jansen, S., & Brinkkemper, S.	2010	The contribution of enterprise architecture to the achievement of organizational goals: Establishing the enterprise architecture benefits framework	Yes	No
23	Journal Article	Bradley, R. V., Pratt, R. M., Byrd, T. A., Outlay, C. N., & Wynn Jr, D. E.	2012	Enterprise architecture, IT effectiveness and the mediating role of IT alignment in US hospitals	Yes	No
24	Journal Article	Brandis, K., Dzombeta, S., & Haufe, K.	2014	Towards a framework for governance architecture management in cloud environments: A semantic perspective	Yes	No
25	Journal Article	Buckl, S., Ernst, E. M., Lankes, J., Matthes, F., & Schweda, C. M.	2009	State of the art in enterprise architecture management 2009	Yes	Yes
26	Journal Article	Bughin, J., Chui, M., & Johnson, B.	2008	The next step in open innovation	Yes	Yes
27	Journal Article	Cabiddu, F., Lui, T. W., & Piccoli, G.	2013	MANAGING VALUE CO-CREATION IN THE TOURISM INDUSTRY	No	-
28	Journal Article	Calantone, R., Garcia, R., & Dröge, C.	2003	The Effects of Environmental Turbulence on New Product Development Strategy Planning	Yes	Yes
29	Journal Article	Chaharsooghi, K., & Ahmadi Achachlouei, M.	2011	Developing life-cycle phases for the DoDAF using ISO15704 Annex A (GERAM)	No	-
30	Journal Article	Chatterjee, S., Moody, G., Lowry, P. B., Chakraborty, S., & Hardin, A.	2015	Strategic Relevance of Organizational Virtues Enabled by Information Technology in Organizational Innovation	Yes	Yes
31	Journal Article	Chesbrough, H.	2006	Open innovation: a new paradigm for understanding industrial innovation	Yes	Yes
32	Book	Christensen, C.	2013	The innovator's dilemma: when new technologies cause great firms to fail	Yes	No
33	Journal Article	Cohen, W. M., & Levinthal, D. A.	1990	Absorptive capacity: A new perspective on learning and innovation	Yes	Yes
34	Journal Article	Corsi, S., & Di Minin, A.	2014	Disruptive Innovation … in Reverse: Adding a Geographical Dimension to Disruptive Innovation Theory	Yes	No
35	Journal Article	Cui, T. R., Ye, H., Teo, H. H., & Li, J. Z.	2015	Information technology and open innovation: A strategic alignment perspective	Yes	Yes
36	Journal Article	Dastranj Mamaghani, N., Mousavi Madani, F., & Sharifi, A.	2012	Customer oriented enterprise IT architecture framework	Yes	No
37	Book	Davila, T., M. Epstein and R. Shelton	2012	Making innovation work: How to manage it, measure it, and profit from it	Yes	Yes
38	Book	Day, G., & Moorman, C.	2010	Strategy from the outside in: Profiting from customer value	Yes	Yes
39	Journal Article	De Vries, M., & Van Rensburg, A. C. J.	2012	EVALUATING AND REFINING THE 'ENTERPRISE ARCHITECTURE AS STRATEGY' APPROACH AND ARTEFACTS	Yes	Yes
40	Journal Article	Dewangan, V., & Godse, M.	2014	Towards a holistic enterprise innovation performance measurement system	No	-
41	Thesis	Dijkman, M.	2014	De aansluiting van enterprise-architectuur op productinnovatie binnen organisaties	Yes	No
42	Journal Article	Dong, J. Q.	2010	How does information technology enable innovation in supply chains?	Yes	Yes
43	Book	Doucet, G., Saha, S. P., Bernard, B. S., & Bernard, S.	2009	Coherency management: Architecting the enterprise for alignment, agility and assurance	No	-

44	Journal Article	Emery, M.	2000	The current version of Emery's open systems theory	Yes	Yes
45	Journal Article	Enos, J. R.	2014	Modifying the X-Matrix to Capture the Joint Capability Architecture	No	-
46	Journal Article	Fasanghari, M., Amalnick, M. S., Taghipour Anvari, R., & Razmi, J.	2015	A novel credibility-based group decision making method for Enterprise Architecture scenario analysis using Data Envelopment Analysis	No	-
47	Journal Article	Foorthuis, R., van Steenbergen, M., Brinkkemper, S., & Bruls, W. A. G.	2015	A theory building study of enterprise architecture practices and benefits	No	-
48	Conference proceeding	Foorthuis, R., van Steenbergen, M., Mushkudiani, N., Bruls, W., Brinkkemper, S., & Bos, R.	2010	On Course, but not There Yet: Enterprise Architecture Conformance and Benefits in Systems Development	No	-
49	Journal Article	Froehlich, J., Findlater, L., & Landay, J.	2010	The design of eco-feedback technology	Yes	Yes
50	Journal Article	Füller, J., Mühlbacher, H., Matzler, K., & Jawecki, G.	2010	Consumer Empowerment Through Internet-Based Co-creation	Yes	Yes
51	Journal Article	Garriga, H., von Krogh, G., & Spaeth, S.	2013	How constraints and knowledge impact open innovation	Yes	No
52	Journal Article	Gassmann, O., Enkel, E., & Chesbrough, H.	2010	The future of open innovation	Yes	No
53	Journal Article	Gharajedaghi, J.	2011	Systems thinking: Managing chaos and complexity: A platform for designing business architecture	Yes	Yes
54	Journal Article	Giachetti, R. E.	2012	A Flexible Approach to Realize an Enterprise Architecture	Yes	No
55	Journal Article	Gill, A. Q.	2015	Agile enterprise architecture modelling: Evaluating the applicability and integration of six modelling standards	Yes	No
56	Journal Article	Gordon, S. R., & Tarafdar, M.	2007	How do a company's information technology competences influence its ability to innovate?	Yes	Yes
57	Book	Greve, H. R.	2003	Organizational learning from performance feedback: A behavioral perspective on innovation and change	Yes	Yes
58	Journal Article	Hall, B. H., Lotti, F., & Mairesse, J.	2012	Evidence on the Impact of R&D and ICT Investment on Innovation and Productivity in Italian Firms	Yes	Yes
59	Journal Article	Han, S., & Ravichandran, T.	2006	Does IT impact firm innovativeness: An empirical examination of complementary and direct effects	Yes	Yes
60	Journal Article	Hinkelmann, K., Gerber, A., Karagiannis, D., Thoenssen, B., van der Merwe, A., & Woitsch, R.	2015	A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modelling and enterprise ontology	No	-
61	Journal Article	Højsgaard, H.	2011	Market-driven enterprise architecture	Yes	No
62	Book	Hoogervorst, J. A.	2009	Enterprise governance and enterprise engineering	Yes	Yes
63	Journal Article	Hoyland, C. A.	2012	RQ-Tech, A Strategic-Level Approach for Conceptualizing Enterprise Architectures	No	-
64	Journal Article	Huang, H.-L.	2014	Performance effects of aligning service innovation and the strategic use of information technology	Yes	Yes

65	Journal Article	Huizingh, E. K. R. E.	2011	Open innovation: State of the art and future perspectives	No	-
66	Book	Ismail, S.	2014	Exponential Organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)	Yes	Yes
67	Journal Article	James, T. L., Cook, D. F., Conlon, S., Keeling, K. B., Collignon, S., & White, T.	2015	A framework to explore innovation at SAP through bibliometric analysis of patent applications	No	-
68	Journal Article	Javed, A., Azam, F., & Umar, A.	2015	Model Driven Upstream and Downstream Artifacts	No	-
69	Journal Article	Jiménez-Jiménez, D., & Sanz-Valle, R.	2011	Innovation, organizational learning, and performance	Yes	Yes
70	Journal Article	Joshi, K. D., Chi, L., Datta, A., & Han, S.	2010	Changing the Competitive Landscape: Continuous Innovation Through IT-Enabled Knowledge Capabilities	Yes	Yes
71	Journal Article	Jung, D. I., Chow, C., & Wu, A.	2003	The role of transformational leadership in enhancing organizational innovation: Hypotheses and some preliminary findings	Yes	Yes
72	Journal Article	Kandjani, H., Tavana, M., Bernus, P., Wen, L., & Mohtarami, A.	2015	Using extended Axiomatic Design theory to reduce complexities in Global Software Development projects	No	-
73	Journal Article	Kang, D., Lee, J., Choi, S., & Kim, K.	2010	Alignment of Business Enterprise Architectures using fact-based ontologies	No	-
74	Journal Article	Kaushik, A., & Raman, A.	2015	The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector	No	-
75	Journal Article	Khayami, R.	2011	Qualitative characteristics of enterprise architecture	Yes	No
76	Journal Article	Kruize, J. W., Robbemond, R. M., Scholten, H., Wolfert, J., & Beulens, A. J. M.	2013	Improving arable farm enterprise integration – Review of existing technologies and practices from a farmer's perspective	No	-
77	Conference proceeding	Labusch, N., Aier, S., Rothenberger, M., & Winter, R.	2014	Architectural support of enterprise transformations: insights from corporate practice	No	-
78	Journal Article	Lagerström, R., Johnson, P., & Höök, D.	2010	Architecture analysis of enterprise systems modifiability – Models, analysis, and validation	No	-
79	Journal Article	Lange, M., & Mendling, J.	2011	An experts' perspective on enterprise architecture goals, framework adoption and benefit assessment	Yes	No
80	Journal Article	Lapalme, J.	2012	Three schools of thought on enterprise architecture	Yes	Yes
81	Journal Article	Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K.	2015	Exploring the future of enterprise architecture: A Zachman perspective	Yes	Yes
82	Journal Article	Lê, L.-S., & Wegmann, A.	2013	Hierarchy-oriented modeling of enterprise architecture using reference-model of open distributed processing	No	-
83	Journal Article	Lee, O.-K. D.	2012	IT-enabled organizational transformations to achieve business agility	Yes	Yes
84	Journal Article	Liao, Y., Lezoche, M., Panetto, H., Boudjlida, N., & Loures, E. R.	2015	Semantic annotation for knowledge explicitation in a product lifecycle management context: A survey	No	-
85	Journal Article	Lichtenthaler, U.	2011	Open Innovation: Past Research, Current Debates, and Future Directions	No	-

86	Journal Article	Lin, L.-H.	2011	Electronic human resource management and organizational innovation: the roles of information technology and virtual organizational structure	Yes	Yes
87	Journal Article	Lin, L.-M., & Hsia, T.-L.	2011	Core capabilities for practitioners in achieving e-business innovation	Yes	Yes
88	Journal Article	Lindič, J., Baloh, P., Ribière, V. M., & Desouza, K. C.	2011	Deploying information technologies for organizational innovation: Lessons from case studies	Yes	Yes
89	Journal Article	Liu, Y., Liang, X., Xu, L., Staples, M., & Zhu, L.	2011	Composing enterprise mashup components and services using architecture integration patterns	No	-
90	Journal Article	Lopes, A. J., Lezama, R., & Pineda, R.	2011	Model Based Systems Engineering for Smart Grids as Systems of Systems	No	-
91	Book	Luisi, J. V.	2014	Part I – Introduction Pragmatic Enterprise Architecture	No	-
92	Book	Luisi, J. V.	2014	Part VII – Cross-Discipline Capabilities Pragmatic Enterprise Architecture	No	-
93	Journal Article	Martinez, M. G.	2014	Co-creation of Value by Open Innovation: Unlocking New Sources of Competitive Advantage	No	-
94	Journal Article	Mezgár, I., & Rauschecker, U.	2014	The challenge of networked enterprises for cloud computing interoperability	No	-
95	Journal Article	Missah, Y. M.	2015	Business Innovation with Enterprise Architecture	Yes	Yes
96	Journal Article	Molnár, B., & Benczúr, A.	2013	Issues of Modeling Web Information Systems Proposal for a Document-centric Approach	No	-
97	Journal Article	Molnár, B., & Benczúr, A.	2015	Document Centric Modeling of Information Systems	No	-
98	Journal Article	Nagorny, K., Colombo, A. W., & Schmidtmann, U.	2012	A service- and multi-agent-oriented manufacturing automation architecture	Yes	No
99	Journal Article	Nambisan, S.	2003	Information Systems as a Reference Discipline for New Product Development	Yes	Yes
100	Journal Article	Närman, P., Holm, H., Ekstedt, M., & Honeth, N.	2013	Using enterprise architecture analysis and interview data to estimate service response time	No	-
101	Journal Article	Närman, P., Holm, H., Höök, D., Honeth, N., & Johnson, P.	2012	Using enterprise architecture and technology adoption models to predict application usage	No	-
102	Journal Article	Nesvetailova, A., & Palan, R.	2013	Sabotage in the financial system: Lessons from Veblen	No	-
103	Journal Article	Noran, O.	2013	Building a support framework for enterprise integration	No	-
104	Journal Article	Noran, O.	2014	Collaborative disaster management: An interdisciplinary approach	No	-
105	Journal Article	Noruzy, A., Dalfard, V. M., Azhdari, B., Nazari-Shirkouhi, S., & Rezazadeh, A.	2013	Relations between transformational leadership, organizational learning, knowledge management, organizational innovation, and organizational performance: an empirical investigation of manufacturing firms	Yes	Yes
106	Journal Article	Panetto, H., Jardim-Goncalves, R., & Molina, A.	2012	Enterprise Integration and Networking: Theory and practice. Annual Reviews in Control	No	-

107	Journal Article	Paulsen, N., Callan, V. J., Ayoko, O., & Saunders, D.	2013	Transformational leadership and innovation in an R&D organization experiencing major change	Yes	Yes
108	Journal Article	Plessius, H., Steenbergen, M. v.	2014	PERCEIVED BENEFITS FROM ENTERPRISE ARCHITECTURE	No	-
109	Book	Prahalad, C. K., & Krishnan, M. S.	2008	The new age of innovation: Driving cocreated value through global networks	Yes	Yes
110	Journal Article	Prieto, I. M., & Revilla, E.	2006	Assessing the Impact of Learning Capability on Business Performance: Empirical Evidence from Spain	Yes	Yes
111	Journal Article	Rampersad, G., Plewa, C., & Troshani, I.	2012	Investigating the use of information technology in managing innovation: A case study from a university technology transfer office	Yes	Yes
112	Journal Article	Rijo, R., Martinho, R., & Ermida, D.	2015	Developing an Enterprise Architecture Proof of Concept in a Portuguese Hospital	Yes	No
113	Journal Article	Rogers, D.	2015	Orthus v2 Authentication Protocol Enhancement, and Supporting Enterprise Architecture	No	-
114	Journal Article	Rohloff, M.	2011	Integrating Innovation into Enterprise Architecture Management	Yes	Yes
115	Book	Ross, J. W., Weill, P., & Robertson, D.	2006	Enterprise architecture as strategy: Creating a foundation for business execution	Yes	Yes
116	Journal Article	Rouhani, B. D., Mahrin, M. N. r., Nikpay, F., Ahmad, R. B., & Nikfard, P.	2015	A systematic literature review on Enterprise Architecture Implementation Methodologies	No	-
117	Journal Article	Sari, A. C., Rahayu, A., & Budiharto, W.	2015	Developing Information System of Attendance and Facebook Status for Binus University's Lecturer Using Raspberry Pi Architecture	No	-
118	Journal Article	Šaša, A., & Krisper, M.	2011	Enterprise architecture patterns for business process support analysis	No	-
119	Journal Article	Savel, T., Hall, K., Lee, B., McMullin, V., Miles, M., Stinn, J., . . . Lenert, L.	2010	A Public Health Grid (PHGrid): Architecture and value proposition for 21st century public health	No	-
120	Journal Article	Sawhney, Wolcott et al. (2006)	2006	The 12 different ways for companies to innovate	Yes	Yes
121	Journal Article	Schmidt, S.	2015	Balancing the spatial 59localization 'Tilt': Knowledge spillovers in processes of knowledge-intensive services	No	-
122	Journal Article	Sembiring, J., & Siregar, M. I. H.	2013	A Decision Model for IT Risk Management on Disaster Recovery Center in an Enterprise Architecture Model	No	-
123	Journal Article	Sembiring, J., Triono, R. N. E., & Chair, M. S.	2013	Designing IT Personnel Hard Competencies Model in the Enterprise Architecture Case Study: Forestry Research and Development Agency of Indonesia	No	-
124	Journal Article	Storbacka, K. E., Payne, A., & Frow, P.	2008	Managing the co-creation of value	No	-
125	Journal Article	T. Hazen, B., Kung, L., G. Cegielski, C., & Allison Jones-Farmer, L.	2014	Performance expectancy and use of enterprise architecture: training as an intervention	Yes	No
126	Journal Article	Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P.	2011	How does enterprise architecture add value to organizations	Yes	No
127	Journal Article	Trad, A.	2015	A Transformation Framework Proposal for Managers in Business Innovation and Business Transformation Projects-intelligent Atomic Building Block Architecture	No	-
128	Journal Article	Trad, A., & Kalpić, D.	2014	The Selection and Training Framework (STF) for Managers in Business Innovation Transformation Projects – Business Enterprise Architecture Integration	No	-

129	Journal Article	Vargas, A., Cuenca, L., Boza, A., Sacala, I., & Moisescu, M.	2016	Towards the development of the framework for inter sensing enterprise architecture	No	-
130	Conference proceeding	Winter, R. and R. Fischer	2006	Essential layers, artifacts, and dependencies of enterprise architecture	Yes	Yes
131	Journal Article	Wolfert, J., Verdouw, C. N., Verloop, C. M., & Beulens, A. J. M.	2010	Organizing information integration in agri-food—A method based on a service-oriented architecture and living lab approach	No	-
132	Journal Article	Yang, M.-L., Wang, A. M.-L., & Cheng, K.-C.	2009	The impact of quality of IS information and budget slack on innovation performance	Yes	Yes
133	Journal Article	Yoo, Y., Boland Jr, R. J., Lyytinen, K., & Majchrzak, A.	2012	Organizing for innovation in the digitized world	No	-
134	Journal Article	Zaidman, N., & Goldstein-Gidoni, O.	2011	Spirituality as a Discarded Form of Organizational Wisdom: Field-Based Analysis	No	-
135	Journal Article	Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S.	2007	Information Technology and the Changing Fabric of Organization	Yes	Yes
136	Journal Article	Zandi, F., & Tavana, M.	2012	A fuzzy group multi-criteria enterprise architecture framework selection model	No	-
137	Journal Article	Zheng, T., & Zheng, L.	2013	Examining e-government enterprise architecture research in China: A systematic approach and research agenda	No	-

Appendix C: Business innovation capabilities

Table 6: Business innovation capabilities

Nr.	Research	Research question / focus	Research finding	Research type	Capability domain	Social and/ or Technical
1	Anaya, Dulaimi et al. (2015)	Understanding about the role of enterprise information systems (EIS) in developing innovative business practices.	1) Integrating EIS with other system(s) or with digital devices can provide new practices that could not be easily available without these technologies 2) Applying data analytics tools into data accumulated from EIS to extract new insights, lead to innovative practices.	Case study	Knowledge, Information processing and coordination	Technical, Social
2	Chatterjee, Moody et al. (2015)	1. How does IT influence organizational virtues? 2. What is the relevance of organizational virtues to organizational capabilities and innovation?	Organization's improvisational capabilities to innovate are strongly influenced by the ethical nature of the organization, which in turn is engendered by the affordances provided by IT.	Empirical	Collaboration, Creativity (part of Ideation), Knowledge, Information processing	Technical, Social
3	Cohen and Levinthal (1990)	The ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities.	Absorptive capacity to improve innovation.	Empirical	Knowledge, Information processing, Collaboration and communication	Social
4	Cui, Ye et al. (2015)	How IT impacts organizational open innovation performance.	Alignment between IT flexibility and breadth enhances innovation radicalness and innovation volume.	Empirical	Knowledge, Collaboration and communication	Technical, Social
5	Dong (2010)	How do IT resources for SCM enable product and process innovations in conjunction with supply chain partners?	IT enables product and process innovations through e-business capability in the supply chain.	Empirical	Knowledge, Collaboration, Information processing & coordination	Technical
6	Füller, Mühlbacher et al. (2010)	How are consumers empowered through Internet-based co-creation activities?	Experienced IT tool support impacts intention of future participation via perceived consumer empowerment.	Empirical	Knowledge, Information processing, Ideation, Collaboration and communication	Technical
7	Gordon and Tarafdar (2007)	How do an organization's IT competences affect its innovation processes?	IT competences in KM, collaboration and communication, and business involvement positively affect an organization's ability to innovate.	Case study	Knowledge, Communication, Information coordination	Technical, Social

8	Huang (2014)	Contribute to literature and practices concerning the strategic alignment of service innovation and IT by pursuing several specific objectives.	Service innovation alignment model within which service innovation and strategic use of IT coexist in evaluating performance.	Empirical	Knowledge, Collaboration	Technical, Social
9	Ismail (2014)	Why new organizations (ExO) are ten times better, faster, and cheaper than yours (and what to do about it).	An ExO can eliminate the incremental, linear way traditional companies get bigger, leveraging assets like community, big data, and new technology into achieving performance.	Empirical	Knowledge, Collaboration and communication, Information processing & coordination, Ideation	Technical, Social
10	Joshi, Chi et al. (2010)	Does IT-enabled absorptive capacity influence innovation?	Knowledge capabilities that are enhanced through the use of IT contribute to firm innovation.	Empirical	Knowledge, Absorptive capacity, Collaboration and communication, Ideation	Technical
11	Lin (2011)	Identify adoptions of IT and virtual organizations (VO) are expected to influence organizational innovation.	IT and VO adoptions positively affect organizational innovation. Furthermore, IT and VO adoptions also positively moderate the relationship between employees' creativity and organizational innovation.	Empirical	Ideation, Information processing and coordination, Collaboration	Technical, Social
12	Lin and Hsia (2011)	Identify the core capabilities that are necessary for achieving e-business innovation.	Thirteen essential capabilities were considered as the keys to e-business innovation.	Empirical	Collaboration, Absorptive capacity	Technical, Social
13	Lindič, Baloh et al. (2011)	How leading organizations are using emerging technologies to enable new forms of ideation that can radically increase the volume of ideas they explore.	Technologies can play in various aspects of the innovation process.	Case study	Knowledge, Ideation, Information processing	Technical
14	Nambisan (2003)	What is the potential for IS to contribute to New Product Development (NPD) research?	Process management, project management, information and KM, and collaboration and communication are important in NPD research.	Descriptive	Knowledge, Processes, Project management, Information processing, Collaboration and communication	Technical, Social
15	Paulsen, Callan et al. (2013)	To add to the understanding of how transformational leaders influence R&D team outcomes around being more innovative.	Results revealed that group identification and perceived support for creativity exerted equal independent effects in fully mediating the relationship between transformational leadership and team innovation.	Empirical	Collaboration and communication, Ideation	Social

16	Prahalad and Krishnan (2008)	Focused on strategy formulation for an organization at the critical operational link in the evolving approach to innovation and value creation.	Building organizational capabilities that allow an organization to create the capacity for continuous innovation.	Empirical	Collaboration and communication, Processes	Technical, Social
17	Rampersad, Plewa et al. (2012)	Investigate the use of IT to manage innovation.	Integrating technology acceptance constructs to innovation process performance and marketing literature, as well as by investigating technology acceptance in an innovation context.	Case study	Collaboration and communication, Processes	Technical, Social
18	Sawhney, Wolcott et al. (2006)	Development of an innovation framework which identifies ways for companies to innovate.	12 Dimensions for companies to moderate the effects of business innovation are determined.	Empirical	Collaboration and communication, Processes	Social

Table 7: References of business innovation capability domains

Capability domain	# Refs	Literature
Collaboration and communication	16 (89%)	Chatterjee, Moody et al. (2015), Cui, Ye et al. (2015), Huang (2014), Ismail (2014), Paulsen, Callan et al. (2013), Rampersad, Plewa et al. (2012), Lin (2011), Lin and Hsia (2011), Dong (2010), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Bughin, Chui et al. (2008), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007) Nambisan (2003), Cohen and Levinthal (1990)
Knowledge	13 (72%)	Anaya, Dulaimi et al. (2015), Chatterjee, Moody et al. (2015), Cui, Ye et al. (2015), Huang (2014), Ismail (2014), Lindič, Baloh et al. (2011), Dong (2010), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Bughin, Chui et al. (2008), Gordon and Tarafdar (2007), Nambisan (2003), Cohen and Levinthal (1990)
Information processing & coordination	10 (56%)	Anaya, Dulaimi et al. (2015), Chatterjee, Moody et al. (2015), Ismail (2014), Lin (2011), Lindič, Baloh et al. (2011), Dong (2010), Füller, Mühlbacher et al. (2010), Gordon and Tarafdar (2007), Nambisan (2003), Cohen and Levinthal (1990)
Ideation	8 (44%)	Chatterjee, Moody et al. (2015), Ismail (2014), Paulsen, Callan et al. (2013), Lin (2011), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010)
Processes	4 (22%)	Rampersad, Plewa et al. (2012), Prahalad and Krishnan (2008), Sawhney, Wolcott et al. (2006), Nambisan (2003)
Absorptive capacity	2 (11%)	Lin and Hsia (2011), Joshi, Chi et al. (2010)
Projects	1 (6%)	Nambisan (2003)

Appendix D: References of assets

Table 8: References of social assets

Asset	Examples	# Refs	Literature
Key stakeholders	Leaders, customers, employees, partners, vendors, users, fans	10 (56%)	Chatterjee, Moody et al. (2015), Ismail (2014), Paulsen, Callan et al. (2013), Rampersad, Plewa et al. (2012), Dong (2010), Füller, Mühlbacher et al. (2010), Bughin, Chui et al. (2008), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007), Sawhney, Wolcott et al. (2006)
Collaborative organizational culture	Virtuous communities, developing partnerships, improving co-production and co-creating value	9 (50%)	Chatterjee, Moody et al. (2015), Huang (2014), Ismail (2014), Rampersad, Plewa et al. (2012), Lin and Hsia (2011), Bughin, Chui et al. (2008), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007), Nambisan (2003)
Organizational structure	Autonomous structures, holacracy, organizational structures to support cultivating virtues	6 (33%)	Anaya, Dulaimi et al. (2015), Chatterjee, Moody et al. (2015), Ismail (2014), Lin (2011), Prahalad and Krishnan (2008), Sawhney, Wolcott et al. (2006)
Performance measurement	Real value metrics including repeat usage, retention percentage	3 (17%)	Ismail (2014), Prahalad and Krishnan (2008), Cohen and Levinthal (1990)
Processes	New Product development	2 (11%)	Sawhney, Wolcott et al. (2006), Nambisan (2003)
Reward systems	Appraising and rewarding systems should emphasize risk taking and profits through innovation	2 (11%)	Lin (2011), Prahalad and Krishnan (2008)
Training and skills	HR planning systems, career management systems	2 (11%)	Lin (2011), Prahalad and Krishnan (2008)

Table 9: References of technical assets

Asset	Examples	# Refs	Literature
Web technologies	Wikis, blogs, social networks and other virtual communities	10 (56%)	Anaya, Dulaimi et al. (2015), Huang (2014), Ismail (2014), Lin (2011), Lin and Hsia (2011), Lindič, Baloh et al. (2011), Joshi, Chi et al. (2010), Füller, Mühlbacher et al. (2010), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007)
Knowledge management systems	Document management systems, Sophisticated search and retrieval technologies	9 (50%)	Anaya, Dulaimi et al. (2015), Cui, Ye et al. (2015), Huang (2014), Ismail (2014), Lindič, Baloh et al. (2011), Joshi, Chi et al. (2010), Füller, Mühlbacher et al. (2010), Gordon and Tarafdar (2007), Nambisan (2003)
Data Analytics	Business Intelligence systems	7 (39%)	Anaya, Dulaimi et al. (2015), Ismail (2014), Lindič, Baloh et al. (2011), Lin (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Prahalad and Krishnan (2008)
Flexible IT infrastructure	Cloud computing infrastructure, Service-oriented architecture (SOA)	5 (28%)	Cui, Ye et al. (2015), Ismail (2014), Lin (2011), Lin and Hsia (2011), Prahalad and Krishnan (2008)
System integration	ERP, CRM, SCM, eHRM, eBusiness	5 (28%)	Anaya, Dulaimi et al. (2015), Chatterjee, Moody et al. (2015), Rampersad, Plewa et al. (2012), Lin (2011), Dong (2010)
IT-enabled design	Computer-aided design systems, 3-D visualization tools	4 (22%)	Chatterjee, Moody et al. (2015), Dong (2010), Joshi, Chi et al. (2010), Gordon and Tarafdar (2007)
Decision support systems	---	1 (6%)	Cui, Ye et al. (2015)

Appendix E: Relations between capability domains and assets

Table 10: Relations between capability domains and assets

Relation		Referred to in literature by	# Refs
Knowledge	Key stakeholders	Chatterjee, Moody et al. (2015), Ismail (2014), Dong (2010), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007)	7
Knowledge	Collaborative organizational culture	Chatterjee, Moody et al. (2015), Huang (2014), Ismail (2014), Gordon and Tarafdar (2007), Nambisan (2003)	5
Knowledge	Organizational structure	Anaya, Dulaimi et al. (2015), Chatterjee, Moody et al. (2015), Ismail (2014)	3
Knowledge	Knowledge management systems	Anaya, Dulaimi et al. (2015), Cui, Ye et al. (2015), Huang (2014), Ismail (2014), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Gordon and Tarafdar (2007), Nambisan (2003)	9
Knowledge	Web technologies	Anaya, Dulaimi et al. (2015), Huang (2014), Ismail (2014), Lindič, Baloh et al. (2011), Dong (2010), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Sawhney, Wolcott et al. (2006), Füller, Mühlbacher et al. (2010)	9
Knowledge	Data Analytics	Anaya, Dulaimi et al. (2015), Ismail (2014), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010)	5
Collaboration & communication	Key stakeholders	Chatterjee, Moody et al. (2015), Ismail (2014), Paulsen, Callan et al. (2013), Rampersad, Plewa et al. (2012), Dong (2010), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007)	9
Collaboration & communication	Collaborative organizational culture	Chatterjee, Moody et al. (2015), Huang (2014), Ismail (2014), Rampersad, Plewa et al. (2012), Lin and Hsia (2011), Gordon and Tarafdar (2007), Nambisan (2003)	7
Collaboration & communication	Organizational structure	Chatterjee, Moody et al. (2015), Ismail (2014), Lin (2011), Prahalad and Krishnan (2008)	4
Collaboration & communication	Knowledge management systems	Cui, Ye et al. (2015), Huang (2014), Ismail (2014), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Gordon and Tarafdar (2007)	6
Collaboration & communication	Web technologies	Huang (2014), Ismail (2014), Lin (2011), Lin and Hsia (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Prahalad and Krishnan (2008), Gordon and Tarafdar (2007)	8
Collaboration & communication	Data Analytics	Ismail (2014), Lin (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Prahalad and Krishnan (2008)	4
Information processing & coordination	Key stakeholders	Ismail (2014), Dong (2010), Gordon and Tarafdar (2007)	3
Information processing & coordination	Collaborative organizational culture	Chatterjee, Moody et al. (2015), Ismail (2014), Gordon and Tarafdar (2007), Nambisan (2003)	4
Information processing & coordination	Organizational structure	Chatterjee, Moody et al. (2015), Ismail (2014), Lin (2011)	3

Information processing & coordination	Knowledge management systems	Anaya, Dulaimi et al. (2015), Ismail (2014), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Gordon and Tarafdar (2007)	5
Information processing & coordination	Web technologies	Anaya, Dulaimi et al. (2015), Ismail (2014), Lin (2011), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010)	5
Information processing & coordination	Data Analytics	Anaya, Dulaimi et al. (2015), Ismail (2014), Lin (2011), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Cohen and Levinthal (1990)	6
Ideation	Key stakeholders	Chatterjee, Moody et al. (2015), Ismail (2014), Paulsen, Callan et al. (2013), Lin (2011), Füller, Mühlbacher et al. (2010), Prahalad and Krishnan (2008)	6
Ideation	Collaborative organizational culture	Chatterjee, Moody et al. (2015), Ismail (2014)	2
Ideation	Organizational structure	Chatterjee, Moody et al. (2015), Ismail (2014), Lin (2011)	3
Ideation	Knowledge management systems	Ismail (2014), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010)	4
Ideation	Web technologies	Ismail (2014), Lin (2011), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010), Gordon and Tarafdar (2007)	6
Ideation	Data Analytics	Ismail (2014), Lin (2011), Lindič, Baloh et al. (2011), Füller, Mühlbacher et al. (2010), Joshi, Chi et al. (2010)	5

Table 11: Summary score relations

Asset \ Capability domain		Knowledge	Collaboration & communication	Information processing & coordination	Ideation
Social Architecture	Key stakeholders	7 (39%)	9 (50%)	3 (17%)	6 (33%)
	Collaborative organizational culture	5 (28%)	7 (39%)	4 (22%)	2 (11%)
	Organizational structure	3 (17%)	4 (22%)	3 (17%)	3 (17%)
Technical Architecture	Knowledge management systems	9 (50%)	6 (33%)	5 (28%)	4 (22%)
	Web technologies	9 (50%)	8 (44%)	5 (28%)	6 (33%)
	Data analytics	5 (28%)	4 (22%)	6 (33%)	5 (28%)

Appendix F: Overview research methods

The following table (Table 12) shows the research methods from Saunders, Lewis et al. (2011) and explains whether the method is suitable for my research.

Table 12: Determination research method

Method	Reasoning	Suitable for answering the research question?	Suitable within my research?
Experiment	Is applicable to research on causal relationships. This does not apply in my research. There is also no suitable environment available for an experiment.	No	No
Survey	Is often used with the deductive method and is focused on quantitative research. The limited research delivers a small basis for a substantiated quantitative research. Stochastic sampling does not seem attainable.	No	No
Case study	Can be used when a particular context or phenomenon should be examined. Is often applied in the inductive method in an exploratory or explanatory research. Disadvantages of this method are the low validity and reliability, and the high cost for obtaining information.	Yes	Yes
"Action-research"	A method which actively investigates a situation while being influenced by means of diagnosis, planning and actions to influence the context in which the research is carried out. This method requires a context in which the researcher can participate. This is not available within my research.	Yes	No
Grounded theory	Is applicable in case a model or theory is being developed. It builds models or theories on the basis of observations in a specific context. These models or theories are then reviewed by performing observations. Compared with Action research, committing an intervention in the context is missing. This method can be applicable within my context. However, this requires a foundation of a company that uses EA to enhance their ability to innovate. This is not available for me at this time.	Yes	Yes
Ethnography	A method which is embedded in the inductive method. In this method, the researcher actively participates in the context and analyzes what happens. The duration of the ethnographic method is too long and does not fit within the time available for this graduation research.	Yes	No
Archive research	Focused on documented events in the past in order to draw conclusions. The exploratory nature of my research excludes this method. My expectation is no representative archive material is available.	Yes	No

Appendix G: Information prior to interviews

Subject:
Research to improve the applicability of EA in order to enhance an organization's ability to IT-enabled business innovation.

Introduction:
Thank you for participating in my research. As a manager of a team, father and student I know that time is scarce and I really appreciate your willingness to help me in my final stages of my study.

My name is Joris Stouthandel. I live in Grave (Netherlands) with my girlfriend and our two children. In my function as Operational IT Manager, I am responsible for IT systems -and processes supporting the production plants and logistics within my company. In order to ensure the availability and continuous improvement of the systems, I manage a team of Technical Application Managers. n addition to my work, I study Business Process Management & IT at the Open University. It is a master study for which I will graduate by completion of this research. The study focuses on the interface between business and IT, emerged from a collaboration between computer science and management science.

I provide you this information to be able to spend our time as effectively as possible during the interview. It will be an semi-structured interview. This means I have some open questions to be answered, but there is room for elaboration on certain aspects when needed.

Definitions:

- IT-enabled business innovation:
  Business innovation is the creation of substantial new value for customers and the organization by changing one or more dimensions of the business system. Examples are the introduction of new products or services, technological change in the production of products already in use, the opening up of new markets or of new sources of supply, improved handling of material, the setting up of new business organizations such as department stores. IT-enabled business innovation is considered as business innovation through the application of IT. For example, the adoption of social media is creating opportunities for new forms of collaboration, as individuals devote time and expertise to tackling a wide variety of issues in ways that are made possible by IT.

- Enterprise Architecture (EA):
  EA is being constituted of the essential elements of a socio-technical organization, their relationships to each other and to their changing environment as well as the principles of the organization's design and evolution. It can be considered as a blueprint of an organization.
  The objective of an EA is to allow an organization to most effectively achieve its current and future objectives.

Research:

Business innovation has been widely recognized as a mechanism for organizations to gain profitability, competitive advantage, growth, and market share. It has also been regarded as critical for the survival of organizations. Information Technology (IT) can have a positive effect on business innovation. In order to innovate, organizations need to respond to the ever-changing environment. For example by leveraging information systems –and technology for digitizing their business. They thereby continuously change their fundamental structure, which can be considered as the Enterprise Architecture (EA).

My literature review reveals that limited research have been published about the relation between EA and business innovation. This research attempts to bridge the theory gap on how EA can enhance an organization‘s ability to innovate, through the application of IT. Therefore the objective of this research is to improve the applicability of EA in order to enhance an organization’s ability to innovate through the application of IT, by development of a conceptual model.

In order to achieve the research objective, I have focused on identifying the capabilities behind IT-enabled business innovation and its relation to assets within EA. Several insights contributing to the understanding of how IT can facilitate business innovation capabilities are identified in literature. The following capability domains are determined, since they are most referred to:

- Knowledge;
- Collaboration and communication;
- Information processing and coordination;
- Ideation.

In order to support the capabilities for these domains with an EA, a number of assets have been determined. These assets are categorized into social –and technical related assets. Based on the results of this literature research, I suggest that the following assets of the social architecture need to play their part in IT-enabled business innovation:

- Key stakeholders;
- Collaborative organizational culture.

The technical assets are essential for providing the infrastructure to support the social assets, and the capabilities which contribute to business innovation:

- Web technologies;
- Knowledge management systems;
- Data analytics.

The combination of each capability domain with an asset has been analyzed in order to determine a possible relation between them. Ten of these combinations are more than 30% referred to in reviewed literature. I consider these combinations as input for the conceptual model and therefore need to be validated during the empirical review. These relations are shown in the table below:

Nr.	Capability domain	Asset
1	Knowledge	Knowledge management systems
2	Knowledge	Web technologies
3	Knowledge	Key stakeholders
4	Information processing & coordination	Data analytics
5	Collaboration & communication	Knowledge management systems
6	Collaboration & communication	Web technologies
7	Collaboration & communication	Collaborative organizational culture
8	Collaboration & communication	Key stakeholders
9	Ideation	Web technologies
10	Ideation	Key stakeholders

In my research, I am interested in your vision, experience and opinion whether these capability domains and assets contribute to enhance an organization's ability to innovate. My goal for the interview is to answer the following questions:

- To what extent do the capability domains enable the organization's ability to innovate?
- To what extent does the application of IT support the capability domains in order to enable the organization's ability to innovate?
- To what extent do the assets enable the organization's ability to innovate?

Appendix H: Interview agenda embedded case study

Entry (10 minutes)

I will introduce myself, after which I will explain the objective of this research and the role of this interview within my research. Next step will be to sign off the consent form. I will continue with providing an indication of the duration of the interview, and ask if there is a possibility to extent this time. Then I will ask if we can be disturbed during the interview, and mention that a I prefer not to be disturbed. I will emphasize that the results will be processed anonymously. I will describe the results from my literature study.

Script (45 minutes)

- Characteristics of business unit / department and interviewee (5 minutes)

	Characteristic	**Response template**
Business unit / department	Business unit / department size	Number of FTE
	Business domain	Marketing / Product Development / Sales / Production / After Sales
	Innovation examples from past 5 years	Subject / description
	Involvement IT in above mentioned innovations	Name / description IT system and/or technology
Interviewee	Number of years of service for the company	Number of years
	Highest level of education	Bachelor / Bachelor + / Master / PhD
	Current function or job position	Job title and description
	Number of years of experience within the field of business innovation	Number of years

- Aspects (40 minutes)

  Conducting an in-depth interview includes to continue to ask questions until the precise reason why someone has experienced a certain aspect becomes more evident. The questions mentioned below are intended as guidance during the interview, not as a template for the questions. Creating space for the respondent to share his/her vision, experiences opinion comes first.

1	**Insight into IT-enabled business innovation**	**Research questions 2.1 and 2.2**
	To what extent does KNOWLEDGE enable the organization's ability to innovate?	2.1
	To what extent does the application of IT support this capability domains?	2.2
	To what extent does COLLABORATION & COMMUNICATION enable the organization's ability to innovate?	2.1
	To what extent does the application of IT support this capability domains?	2.2
	To what extent does INFORMATION PROCESSING & COORDINATION enable the organization's ability to innovate?	2.1
	To what extent does the application of IT support this capability domains?	2.2
	To what extent does IDEATION enable the organization's ability to innovate?	2.1
	To what extent does the application of IT support this capability domains?	2.2

2	**Insight into contribution of assets**	**Research question 2.3**
	Social related assets	
	To what extent do KEY STAKEHOLDERS support the capability domain KNOWLEDGE?	
	How would you describe the involvement of KEY STAKEHOLDERS for this purpose?	
	To what extent does a COLLABORATIVE ORGANIZATIONAL CULTURE support the capability domain COLLABORATION & COMMUNICATION?	
	How would you describe important aspects of COLLABORATIVE ORGANIZATIONAL CULTURE for this purpose?	
	To what extent do KEY STAKEHOLDERS support the capability domain COLLABORATION & COMMUNICATION?	
	How would you describe the involvement of KEY STAKEHOLDERS for this purpose?	
	To what extent do KEY STAKEHOLDERS support the capability domain IDEATION?	
	How would you describe the involvement of KEY STAKEHOLDERS for this purpose?	
	Technical related assets	
	To what extent does KNOWLEDGE MANAGEMENT SYSTEMS support the capability domain KNOWLEDGE?	
	What is you experience with the use of such system for this purpose?	
	To what extent does WEB TECHNOLOGIES support the capability domain KNOWLEDGE?	
	What is you experience with the use of such technology for this purpose?	
	To what extent do DATA ANALYTICS support the capability domain INFORMATION PROCESSING & COORDINATION?	
	What is you experience with the use of such tools for this purpose?	
	To what extent does a KNOWLEDGE MANAGEMENT SYSTEMS support the capability domain COLLABORATION & COMMUNICATION?	
	What is you experience with the use of such system for this purpose?	
	To what extent does WEB TECHNOLOGIES support the capability domain COLLABORATION & COMMUNICATION?	
	What is you experience with the use of such technology for this purpose?	
	To what extent does WEB TECHNOLOGIES support the capability domain IDEATION?	
	What is you experience with the use of such technology for this purpose?	

Exit (5 minutes)

I will explain that I make a detailed report of the interview, which I will be sent to the interviewee.
He/she can comment on this. Next, I will ask if any documents related to business innovation and the subjects discussed during this interview are available for my research. Finally, I will ask if I can contact the interviewee to validate certain aspects from this interview in case necessary. I will close the interview by thanking the interviewee for his/her participation.

Appendix I: Interview agenda expert review

Entry (10 minutes)

I will introduce myself, after which I will explain the objective of this research and the role of this interview within my research. Next step will be to sign off the consent form. I will continue with providing an indication of the duration of the interview, and ask if there is a possibility to extent this time. Then I will ask if we can be disturbed during the session, and mention that a I prefer not to be disturbed. I will emphasize that the results will be processed anonymously. I will describe the results from my literature study.

- Characteristics of expert (using public sources only).

Script (45 minutes)

- Aspects
  The questions mentioned below are intended as guidance during the interview, not as a template for the questions. Creating space for the respondent to share his/her vision, experiences opinion comes first.

1	**Research methods and techniques** What is your opinion about the research process which leads to the results? What are the possible areas for improvement? How would you indicate the validity and reliability of the research? What do you think of the results? To what extent do you recognize / are you surprised by the results?	**General**
2	**Conceptual model** What do you think of the structure of the model? What do you think of the shape / design of the model What do you think of the usefulness and necessity of the model within the context of EA and business innovation?	**Research question 2.4**

Exit (5 minutes)

I will explain that I make a detailed report of the interview, which I will be sent to the expert.
He/she can comment on this. I will close the review by thanking the expert for his/her participation.

Appendix J: Detailed answers case study (1)

Table 13: Capability domain Knowledge

R	Contribution to business innovation?	Contribution of IT in capability domain?	Application	Applicable for IT-enabled business innovation according empiricism	Conclusion
1	Knowledge is very important. You need a certain level of knowledge to know what you are doing in the context of an innovation. For example, knowledge is required to assess the feasibility of an innovation. Experience is a critical aspect to increase knowledge. By realizing innovative ideas, you gain more experience which increases the level of knowledge	The importance of support by the application of IT will increase during the innovation process. The use of IT is a mean for achieving this.	Yes, IT is used to store and share knowledge	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	- According to all respondents, this capability domain enables the organization's ability to innovate; - 4 out of 5 respondents argue a significant contribution of IT in relation to this domain.
2	Knowledge is very important. For example, knowledge is critical to solve complex problems. Applying existing knowledge is much easier than to gain new knowledge. This makes it difficult to initiate disruptive innovations. To ensure our knowledge is shared and maintained, we work as much as possible in pairs (e.g. 2 project leaders that work cross functional).	Although knowledge is for most part embedded in the minds of people, the use of IT can significantly contribute.	Yes, IT is used to store and share knowledge However, it can and should be used more intensively. One important reason why this is not the case, is a lack of knowledge to the capabilities and possibilities of available IT solutions	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	

3	Substantive knowledge on a subject and knowledge about processes is crucial for business innovation.	The use of IT to capture, store and share knowledge is important. However, it requires a lot of effort to maintain this.	IT is used to store knowledge related to strategy and trends from research publications. Knowledge from employees is not stored. A lot of (new) knowledge is accessible through IT systems from suppliers.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	
4	Very important. Knowledge can be expressed in expert knowledge of experts and knowledge of people that may think different (people who have a different background for example). Combining these different forms of knowledge creates a concept of new ideas.	Knowledge should be very accessible and easy to read. So a critical aspect is unlocking of the information. Although IT can be helpful, it can be questioned whether IT is required to secure knowledge. For example, think about training or results of projects. The people should have the knowledge of this.	Crucial and specific knowledge is shared and embedded in the minds of individuals. External IT systems (e.g. research publications, professional literature) are used to retrieve new knowledge about general concepts. Knowledge about process management and machines documentation is stored in online collaboration platform.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	
5	Knowledge is an enabler and requirement for business innovation. Without knowledge, you do not know what to innovate and which direction to go to. This is knowledge about new technologies and market developments.	The use of IT to capture, store and share knowledge is important. Using IT for this can also facilitate a uniform way of working with suppliers	Yes, IT is used to store and share knowledge from employees and suppliers. It is a challenge to keep it all transparent (e.g. to search and find documents).	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	

Table 14: Capability domain Information processing & coordination

R	Contribution to business innovation?	Contribution of IT in capability domain?	Application	Applicable for IT-enabled business innovation according empiricism	Conclusion
1	Gather information is crucial. There will always be gaps in the information. However, incomplete or unreliable information should not be a problem. During the process of innovation, more information should be gathered. It is important to have sufficient information to make choices.	Use of IT for information processing is critical. It offers the possibility to reveal 'hidden' information, which otherwise would take too much effort when doing this manual.	Data mining is applied, but it is an immature process.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	- According to all respondents, this capability domain enables the organization's ability to innovate; - 4 out of 5 respondents argue a significant contribution of IT in relation to this domain.
2	This is the first step in the process of innovation. It is very important to have access to information. If there is no visualized data, I cannot decide which direction to take.	Use of IT is very important. There is a lot of data available, but without the use of IT this cannot be processed efficiently. Without efficient processing of data it is also difficult to obtain a different cross-section / view of the information.	Data downloads from several sources are being imported into database. A data warehouse is being developed, but it is a relatively unknown concept and there is a lack of experience with this. For example, how to guarantee that all the necessary data is processed and published (e.g. every morning an automatically generated report).	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	
3	Combining facts by processing information is what I consider as an incremental method of innovation. It can certainly lead to new insights, but it will not lead to revolutionary jumps (disruptive innovations). For an existing situation within a given framework you can find an optimum. So you will be able to improve a process, but the process itself will not change. When used to make predictions, it can lead to shortened	If you have predictive analysis -instead of employees who are looking for trends themselves – and standard reports, than the contribution of IT will be significantly. This requires good analytical tools that can process the information into links / trends within a number of conditions.	Not applied within own department, but it is applied within departments for internal customers (e.g. Business Intelligence, Big Data).	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	

	processing times and better results.				
4	This is important in order to monitor processes and to take preventive actions. However, it is still required to bring everything back to basics. This leads to a certain low level accessibility and transparency. This can be achieved by writing such things on a whiteboard or yellow memo stickers.	Yes, IT should be of added value. However, we have experimented with IT systems which should be able to do this. It turns out that these systems are too difficult to use. Many of them visualize the information too little, while this is one of the most important aspects. How to visualize is less important, as long as it happened quickly and easily accessible.	Yes, but currently only to process data in the back end. For front end interpretation and presentation, pen and paper works best for us.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	
5	Data analytics is a very important aspect.	The use of IT can provide insight into the information. We do this much too little, so I still cannot properly understand its importance.	We use databases with historical data, but this is not real-time information. In addition, there is also no structural way of processing this data into information.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	

Table 15: Capability domain Collaboration & communication

R	Contribution to business innovation?	Contribution of IT in capability domain?	Application	Applicable for IT-enabled business innovation according empiricism	Conclusion
1	This is essential, but is not obvious. There are dependencies for smooth collaboration and communication. For example, the selection of a right group of people.	The use of IT can help to retrieve, store and share knowledge.	Yes, an online collaboration platform and standard communication tools.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	- According to all respondents, this capability domain enables the organization's ability to innovate; - 3 out of 5 respondents argue a significant contribution of IT in relation to this domain.
2	Perhaps the most important aspect to be able to innovate. Finding a technical solution is often easier than smooth collaboration and communication. Even if you have the best solution for a problem but this insufficient communicated, it does not work. A much less good solution which is communicated properly works on the other hand. Smooth collaboration and communications is a condition to be able to innovate. Being able to communicate at different levels within the organization is of great importance to get support from all the different people involved. Also to get a joint decision to an idea (that might be less good than another idea) which is supported by the whole team is many times more important than to achieve a ' perfect ' idea.	The use of IT for communication is necessary. However, I have a little need for IT support regarding collaboration purposes.	An online collaboration platform, but it is used to a lesser extent. In addition, standard communication tools are used.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - Respondent is not convinced of a significant contribution of IT.	

3	This is very important, especially in a free format. Team building, openness, criticism, confidence and enthusiasm are important aspects. It may be necessary to have a coordinator. Someone who prevails in order to ensure that the entire group is heard and facilitates in dialogues. This is critical.	It is important to document certain things. However, it is key to see each other face to face and accomplish something together during one or more sessions. I do not know to what extent an IT system to support this. I see little role for IT in here. It is important that if you work together, the results are documented and shared.	An online collaboration platform, but it is used to a lesser extent. In addition, standard communication tools are used.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - Respondent is not convinced of a significant contribution of IT.	
4	This is critical in all areas within the entire organization. In case collaboration / communication is not working, you need to talk to people face to face. The challenges and problems we have are mostly focused on communications than on technique. Particularly between departments, and to a lesser extent within the department.	For example, the use of automated workflows is a significant contribution of IT.	Yes, an online collaboration platform with workflow functionality and standard communication tools.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	
5	It is important that the right people get the right information. And therefore it is essential that you collaborate and communicate with each other. Collaboration and communication also ensures that the reason(s) for certain choices made in the past are not forgotten and that everybody is working towards the same goals. In general, collaboration and communication is essential to innovate.	The role of IT in this domain contributes to improve collaboration and communication.	Yes, an online collaboration platform and standard communication tools.	- Respondent is convinced this domain is necessary to enable the organization's ability to innovate. - IT can provide a significant contribution.	

Table 16: Capability domain Ideation

R	Contribution to business innovation?	Contribution of IT in capability domain?	Application	Applicable for IT-enabled business innovation according empiricism	Conclusion
1	Innovation arises from an idea that ultimately add value in the form of a product or service. It is the first and crucial step in the innovation process.	At this stage of the innovation process, the use of IT is not so important. It starts with a whiteboard, yellow memo stickers and possibly a spreadsheet or mind map. However, as the process progresses IT will get an ever more dominant role. For example, designs net to be worked out in Enterprise Architect as a starting point software development. Later, also test tools etc. will be needed.	Not in use		- According to all respondents, this capability domain enables the organization's ability to innovate; - 1 out of 5 respondents argue a significant contribution of IT in relation to this domain.
2	This is necessary to be able to innovate. There are different forms of idea generation; structured (brainstorm sessions) and unstructured (individual). Within the organization, little is done to structured idea generation. Mostly occurs at the individual level when a problem situation leads to an idea.	Yes, for example simulate certain processes to get new insights which can lead to ideas. IT can also be used to gather knowledge from the external environment to generate ideas.	Use of MS Excel-like tools. Far too little, IT tools are used to simulate certain processes. In addition, Minitab used as a supporting tool for Six Sigma projects to support certain hypotheses to be evaluated or ideation.		
3	This domain is crucial. It is all about thinking in the possibilities, and not to the constraints. It is a difference of bypassing risk behavior and 'keep the lights on' versus innovation and to want something different. It is critical that people challenge each other within the organization.	I do not see a role for IT in this domain. For example, using a mind map is all baloney. It is mainly about the generation of an idea, individually or collectively (human aspect). Openness, motivation and character of people is important.	No		

4	This is always important. It is a challenge to generate and to deal with ideas during brainstorm sessions. People should have the chance to prepare and need to be brought together. These days, the 'Ei van Columbus' will not be invented by an individual. It is also a matter of performance of the entire team, not just on an individual level. People should have as much freedom as possible. So you have to have some form of autonomy. In addition, successes should also be celebrated.		No. For example, looking at brainstorming sessions only whiteboard and markers are used. The only IT resources used are the standard MS Office products.		
5	Very important, because this is the starting point for innovations. Knowledge is the input for this.	For example, more feedback on a particular subject can help generate ideas. IT can enable this by the use of Internet.	In my group, IT is used to a lesser extent. At most, in the form of brainstorming/mind map tools.		

Appendix K: Detailed answers case study (2)

Table 17: Knowledge - Knowledge management systems

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Wiki pages work very well, as long as they are accessible. For example, knowledge databases are also used to secure knowledge of employees who leave the company. It is often too expensive to hire someone as an successor. Data management systems can be used to store all documentation. Within software development this is very important in order to manage complexity. In addition, it is also important for reuse. For example, in case a new project is started, it is possible to search for best practices.	Wiki pages and an online collaboration platform is used to store developed software and documentation.		- All respondents argued the importance of the relation between Knowledge management systems (asset) and Knowledge (capability domain).
2	Very important.	An online collaboration platform is used to store knowledge.		
3	This is important for capturing the current situation, ensuring conclusions are saved and preventing errors from the past.	An online collaboration platform is used to document Reference Architecture and knowledge of vendors.		
4	Important. Knowledge should be very accessible and easy to read. So a critical aspect is unlocking of the information. This is a challenge in the factory. For example, the use of iPad's would be a solution with added value. However, it remains a discipline to read the available documentation. People often apply a trial-and-error approach, without reading the documentation.	Knowledge about process management and machines documentation is stored in online collaboration platform.		
5	A knowledge management system is an important starting point, but you still have to organize the people and processes. However, I would almost say that if you have your people and processes in place, you no longer need such system. If you know who you need to have certain knowledge, then this is just as good as having a database where this info is stored. The disadvantage and risk is that the knowledge only resides in the minds of people (explicit knowledge vs. implicit knowledge). This may adversely affect the survival of the company.	Wiki pages and an online collaboration platform is used to store knowledge.		

Table 18: Knowledge - Web technologies

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Web technologies can significantly contribute to support this domain. For example, an internal "you tube" channel for sharing movies of projects. There were no user manuals, but instruction movies about how a product to use. Another form is a variety of apps that can be searched for specific applications. What you use at home to this technology, you also actually at work.	Within the organization I see the use of such technology to a lesser extent. This technology is often used for promotional material. An example is an instructional film for installing a certificate for customers. This is a typical example of an application in order to train the customer (original need) that suits the way of working these days. Society has changed, books are no longer read and almost everyone wants to have on demand information in visual format. The original need of humans remains, however, the available resources associated with behavior change over time.		- 4 out of 5 respondents argued the importance of the relation between Web technologies (asset) and Knowledge (capability domain).
2	This technology significantly contributes to create, share and store new knowledge.	Not in use. There is a lack of knowledge within the organization to see the possibilities of this. We should use this much more.		
3	Knowledge is an interaction between people and I do not see how such technologies can contribute to this domain. It is more applicable for maintaining contacts and to start relationships. It can be used to easily access information, but I do not see this as knowledge management. However, this technology does contribute to connect with larger groups of people who can provide input.	Hardly used, because there is no company strategy on how to use this technology. Banks use it more, because they can see if there are certain outages are, or what the view of the public is about a particular product. We are more in a supply market. Our products are sold before you know it.		
4	Such technologies might work. However, this is often related to communication. The separation between business and private is less clear. For example, it makes it possible.at night to easily and quickly communicate something for your work.	A good example is in the paint shop of our factory. There is a fanatic team responsible for maintenance, and they perform very well. Within their team, they share their knowledge intensively via WhatsApp. Because they work in shifts, they do not always have the possibility to meet with each other. In addition, this required a change of culture.		
5	Such systems make knowledge easier to access and you can identify new trends much faster. In addition, they are a means to share knowledge.	Not in use.		

Table 19: Knowledge - Key stakeholders

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Customers involved in the innovation process is of great importance. For example, they can be questioned during the innovation process about usage or their opinion on certain ideas / solutions. Often this customer gets more involved, which in turn can lead to extra enthusiasm, insights and even new ideas. This is a form of open innovation. In addition, this can also be a good way to get funding from the customer (if applicable). Leadership throughout the innovation process is indispensable. They can be considered as facilitators and should provide guidance in how to apply IT to business innovation. It is a key to success in combination with the right employees at the right moment. It is also very important to identify the stakeholders and to determine the roles and responsibilities during the different stages of the innovation process.	In many situations, the stakeholders are not aligned on an organizational level. They are just focused on department or individual level. This can be a killer for innovation. IT tools are used by employees to interact with suppliers and internal customers. It helps to share knowledge between them.		- 3 out of 5 respondents argued the importance of the relation between Key stakeholders (asset) and Knowledge (capability domain).
2	Customers are less important in this domain, employees and leaders are indispensable. Employees must significantly contribute to create and maintain knowledge. Leaders need to enable this and must understand it is a requirement for innovation. It is important to invest in more knowledge than is strictly necessary, because it is unknown what knowledge is needed in advance.	Senior employees (in terms of age) are less inclined to new create knowledge and use IT in contrast to the young people. Leaders are aware of the fact that this is important. However. they not always take the lead in helping to support IT initiatives. The latter is also highly dependent on the characteristics of the leader.		
3	A domain architect should be well aware of sources such as suppliers. It is also important that these individuals share knowledge with fellow counter parts in other countries. Sponsors and champions of suppliers must also support this domain. They should be able to express their vision. In addition, it is very important that employees support this domain. However, I also see a vendor as a key stakeholder. Anyone who can provide source information should be considered as a key stakeholder.	The use of IT facilitates the interaction between employees and suppliers in sharing of knowledge online.		
4	The vision and the way an organization works, should be carried out by Management. In return, this should be adopted by the employees. This can be achieved by approaching people properly (e.g. respectful). This includes a more bottom-up approach instead of a top-down approach (the inverse pyramid).	Not a significant relation in IT-enabled business innovation.		

5	All 3 stakeholders are essential. Customers to identify market developments. Employees to generate ideas. Leaders for facilitating innovation. The aspect of IT in this is less relevant	People are often implementing innovations as they are told to by their supervisor. For example, there is no such culture where the possibilities of IT are promoted.		

Table 20: Information processing & coordination - Data analytics

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	This is crucial. Data mining offers the possibility to reveal 'hidden' information. For example, when simulating a completely modelled product, it becomes possible to put it virtually into action and collect the data from its behavior. This form of data mining functioned as a kind of 'eye opener' and can lead to innovations.	Data analytics is used, but it is only just starting to develop. Within Product Development an IT system is used to simulate reality. This enable testing of the performance of both functionalities as well as non-functionalities in advance.		- All respondents argued the importance of the relation between Data analytics (asset) and Information processing & coordination (capability domain).
2	This is crucial.	A few IT systems are used, but it is an immature process. We are not sure how to handle this. It is not the challenge to get the correlations from big data (analysis), but more the on demand and visualization of the information.		
3	In the traditional sense it is very important. It is an enabler to identify relations and dependencies in order to make conclusions and decisions more easily. In addition, it can help in creating better forecasts and planning.	Business Intelligence and Big Data-like IT solutions are developed for internal customers. However, there are different views on the design of such systems. For now it is not an issue, because in the end it is survival of the fittest. But there should be some sort of cohesion to these different designs, otherwise it would be a waste of effort. The business demand for these systems is increasing, so we must act quickly. For example, the application of workflows to automate processes and collect data.		
4	It is very important. Data analysis is an enabler in order to act preventively. This requires a fast processing of information, which can be a challenge.	Manufacturing Execution System (MES), system used for hottest of products.		
5	This is a very important aspect.	Field data regarding errors is gathered and stored in databases. After analysis, the information from these sources is used in new product development / product improvements.		

Table 21: Collaboration & communication - Knowledge management systems

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Knowledge must be applied. Sharing knowledge is also a form of application. However, this does not mean that a knowledge management system improve collaboration and communication. In particular, collaboration is more of a 'human' matter. On the other hand, such a system helps with the communication, and communication also influence collaboration between people. It is only one ingredient for a smooth collaboration, but a very important one.	An online collaboration platform.		- 3 out of 5 respondents argued the importance of the relation between Knowledge management systems (asset) and Collaboration & communication (capability domain).
2	A knowledge management system contributes significantly to this domain. It is an enabler to create knowledge within the team which is needed for a smooth collaboration. These systems also make it possible to reuse existing knowledge in other departments or business units. It is important to manage all knowledge and such a system can help with that.	An online collaboration platform.		
3	Knowledge management can lead to some discussion and ideas, so it can lead to a conversation which is positive. It can confirm a vision. For example, an external sourcing of product information from Gartner on the plus – and downsides of a product, or the requirements. Support of such a system can therefore be stimulating and can work in the affirmative work.	IT systems used to create knowledge to identify certain risks, missed opportunities.		
4	I am not convinced whether instructions should be in a specific knowledge management system. It is an ongoing process to try and find out a proper solution for managing knowledge.	An online collaboration platform is used. There have been other initiatives, but these are not used anymore. Often, there is an owner who has built such a system. When this person leaves the team, there is no one who takes ownership over this system.		
5	It can be a helpful tool, but I have never seen this work. That is why I am not convinced that such a system significantly contributes to improve collaboration & communication. My approach is still to get people to talk to each other.	An online collaboration platform and Wiki pages. Important is the responsibility of employees themselves to maintain their knowledge. However, their attention on this often last for only a few weeks.		

Table 22: Collaboration & communication - Web technologies

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	If communication is successful, collaboration is also better. Culture of collaboration (such as f2f) is by far the most important aspect. Tooling can be helpful for ongoing communication. F2F communication is required to create a solid basis for a relationship. For example, it makes no sense to use WhatsApp with a stranger.	Several technologies are used for collaboration and communication between employees from different locations.		- 3 out of 5 respondents argued the importance of the relation between Web technologies (asset) and Collaboration & communication (capability domain).
2	This is less relevant for collaboration and communication on innovations. However, IT support for automated workflows can significantly contribute, but this is not considered to be a Web technology.	It is little used, because there is a lack of knowledge and experience regarding the possibilities of such technologies.		
3	There they are precisely intended to support this domain.	Hardly used. There is much unknown regarding the use and intention from a corporate level of the company. Currently, the traditional technologies are used most.		
4	These technologies as used at home, can also contribute in business. However, this requires a vision, standards and support from the company. At this moment, I do not see a significant contribution of these technologies to improve collaboration and communication.	Used within one team.		
5	Less applicable, the face to face aspect remains essential.	Office communication tool		

Table 23: Collaboration & communication - Collaborative organizational culture

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	This is one of the most essential aspects of innovation. Guidelines can contribute to promoting and improving the culture. Just bringing the right people together to innovate is not enough. It should be clear how people should behave in relation to each other (e.g. respectful, not thinking in obstacles, if email doesn't work then call – then travel etc.). Aspect of the culture should be agreed by all members in order to create a team culture and support.	IT can facilitate the sharing of values and norms between employees in different subunits of the organization. IT can even help to reduce silos in the organization.		- 4 out of 5 respondents argued the importance of the relation between a Collaborative organizational culture (asset) and Collaboration & communication (capability domain).
2	It is much harder to create and maintain a proper culture over e.g. different business units as it is within a team within one department. Even within one department there is not always the same logic and objective. In addition, there can also be a clear difference in culture between geographically dispersed departments. Support from line management is of great importance. Innovation is about thinking across borders which requires a proper culture.	The sharing of decisions or statements from Management among employees in different subunits of the organization can be facilitated by IT.		
3	Very important. Each stakeholder should have a certain level of positivity without any kind of negativity. It is however, that bureaucracy (e.g. process for quality standards such as SOX) can negatively affected the pragmatism. It can be difficult for people to understand the reason why to follow these processes. If the formalities and handling procedures are too complex and/or take too much time, it can have a negative impact on the innovation process.	No significant contribution of IT here, it is more a human related aspect.		
4	Very important. For example, to reach a next maturity level in the process of innovation often requires a change of culture. Breaking down barriers between stakeholders is important and need to be facilitated. People who help the teams to make progress. This requires involvement of multiple, different people.	IT can help in breaking down barriers between stakeholders.		
5	A certain culture is required for smooth collaboration. If everyone just wait for a clear mandate without alignment with others, this will not lead to innovations. Nowadays everything is so specialized, that you need people with different disciplines. A certain collaborative organizational culture is a prerequisite for people to work together.	People should be focused and working on common goals, and not operate on their own. IT can even help to reduce silos in the organization to facilitate in collaboration and communication solutions.		

Table 24: Collaboration & communication - Key stakeholders

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Stakeholders must be part of collaboration and communication. For example, this prevents escalations from management and/or customers. In case these stakeholders are involved, they stay better informed and aware of the status.	IT is supporting the process of software development online between department and suppliers.		- All respondents argued the importance of the relation between Key stakeholders (asset) and Collaboration & communication (capability domain).
2	Everyone expect a smooth collaboration. However, in reality this is very difficult. For example, it happens when certain things are explained several times, but at that time there is no/insufficient attention to it. So people are not aligned and unaware of certain situations, which can lead to escalations in the future. Therefore, Management should be considered as a key stakeholder too.	Management and leaders can establish the conditions needed to improve collaboration across organizational silos. When employees access broader sources of knowledge across silos, it allows them to widen their perspective which can foster greater innovation.		
3	Preferred suppliers must support this, especially in the start-up phase of an innovation. They also should test complex cases. The customer should be involved with the implementation. After delivery of an project or solution, it is important to provide after care (e.g. measuring the customer satisfaction).	IT can facilitate in interaction with customers, which helps to break down communication barriers with them. It also helps to understand their needs and incorporate them into innovation.		
4	This is crucial. Imagine an executive who does not support this. Such a leader is needed to convince and align all participants, even celebrates the successes with the team. If this is lacking, then all the initiatives within the organization will disappear over time. The same is also true for employees. If there are people who are not cooperative, it can be disastrous for the rest of the organization.	Leaders can support the conditions needed to improve collaboration across organizational silos.		
5	Customers are less important, at least in my area. Leaders and employees are essential. Employees must ultimately work together. There must be a leader who facilitates, otherwise the people are tend to work for themselves.	So leaders facilitate the conditions required to improve collaboration.		

Table 25: Ideation - Web technologies

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	These technologies are less important in this domain. Ideas are generated by the right people. For the design of a Linux system, it may be a different situation. However, if the innovation should be profitable (in terms of money), it is a different story.	Not in use.		- 3 out of 5 respondents argued the importance of the relation between Web technologies (asset) and Ideation (capability domain).
2	It can be important. For example to gather knowledge from the external environment (question and answer in community groups).	Little in use, at most on an individual basis.		
3	This could be helpful. For example, to address an idea or question to a large group of people	Not in use.		
4	These technologies do not significantly contribute to this domain. Maybe it helps to improve accessibility.	Not in use.		
5	More feedback on a particular subject can help to speed up the search for innovations. But how to deal with data security? It is not acceptable when an internal company discussions is available in public.	Use of WhatsApp, but this is more related to social things.		

Table 26: Ideation - Key stakeholders

R	Contribution to support capability domain?	Application?	Relevance	Conclusion
1	Involvement of customers and management, presence of leadership (facilitators) and enthusiastic employees is crucial. IT-based platforms to absorb customer insights into product development can significantly contribute to Ideation. For the various phases in the innovation process, different types of people are needed.	Involvement of customers is promoted and support from IT is increasing.		All respondents argued the importance of the relation between Key stakeholders (asset) and Ideation (capability domain).
2	Key stakeholders are important in this domain. Customers to express their needs. Leaders must be involved, because of a more overall understanding and strategic (IT) guidance.	Much focused internally on daily operational issues, and to a lesser extent in relation to IT.		
3	They are crucial. One delivers the business case that describes the objective.. Another shows his/her experience in the market and the product capabilities. Innovation is often a combination of things. For example, a combination of proven technologies can lead to something new.	Suppliers are often asked to come up with a roadmap. We have many sessions with them to think about solutions. Back in the days, these were always face to face sessions where you have to pay sign up. These has been changed by e.g. online webinars which is a positive development. Sharing of ideas with other customer organizations happens still too little. IT can also be helpful here.		
4	This is crucial. Ideation can be triggered by employees (bottom up), or from Management (top down).	A point of attention is the lack of clarity about the organization's strategy. It is not always clear which way to go, including the use of IT. For example, I do not know what is going to happen the next 5 years which might have an impact on my department.		
5	Customers should provide input. It is helpful to involve them in the process (define what they want, watch what they do with the product, how do customer's business processes work). Leaders to facilitate and employees to carry out the work. In this triangle, all key stakeholders are required.	Customers are not yet well involved. However, it is currently not a priority from leaders to change the way of working by the use of IT systems. Employees are also not yet well involved. Involvement in and access to IT systems used by teams for ideation processes would be a first step. However, this is currently not promoted by leadership.		