Business process reengineering (BPR) for enterprise resource planning (ERP) implementation in the construction sector

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Project title:

Business process reengineering (BPR) for enterprise resource planning (ERP) implementation in the construction sector

Project type & weighting:

Master thesis – 30 ECTS-point

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Project period:

1st February 2019 – 7th June 2019

65 Project pages

28 Appendix pages

Citation style:

Harvard Anglia

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Abstract

A sheer amount of literature has been written about enterprise resource planning (ERP), making it one of the most researched topics in information systems literature. However, ERP related research is most prevalent in business and information systems journals, enjoying a lesser coverage in construction management journals. Despite that, it continues to be a relevant topic, being linked with various technological breakthroughs such as IoT, big data, cloud computing and building information modeling (BIM), reason why this study chooses to reiterate the importance of ERP in construction companies and investigate how implementation failure rates can be reduced. Theory regarding four primary ERP areas is reviewed and one area is selected to be further investigated. This area encompasses the processual and strategic aspects of ERP, where the relationship between business process reengineering (BPR) and ERP is analyzed and discussed.

This study examines the importance of process formalization and use of BPR concepts such as AS-IS and TO-BE process mapping in relation to achieving ERP implementation readiness. Moreover, the contribution of BPR to achieving ERP implementation readiness is also investigated by looking into the different ERP implementation approaches, which involve use of BPR. The theoretical perspectives presented in the literature review are verified using qualitative primary data which is collected using semi-structured interviews, performed with four case companies and one client consulting company. The implications of the findings are then presented through a discussion.

Keywords: Enterprise resource planning, ERP, Business process reengineering, BPR, Construction sector

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Preface

This Master's thesis report was carried out in the period 1st of February – 7th of June 2019 as part of the 4th and last semester in the master's program Management in the Building Industry at Aalborg University. This project was written under the supervision of Associate Professor Lene Faber Ussing and PhD fellow Ekaterina Aleksandrova Petrova. Moreover, I would like to thank my family for their moral support throughout the study years and during thesis writing. Furthermore, thanks to my close friend Mantas, who a MSc. himself, found the time and energy to relentlessly motivate me through his typical sarcastic style, which can create a sense of urgency in solving even the most trivial matters. Lastly, special thanks to all the companies that were willing to be participate in the study's data collection, which ultimately helped me achieve the study's goals.

My interest in process management, and generally in business administration, arose as a gradual interest for analytics, optimization and standardization, which reached its highest during the academic internship I was enrolled in the 3rd semester of this education. There I have been involved in achieving system integration between client IT systems and own developed systems. However, the path to selecting this topic has not been quite as straightforward as the reader would expect, with numerous ideas within the field of technology and business running both through my head, as well as landing on my supervisors' e-mail inboxes. Despite all this, it seems now quite natural that I have chosen to work with the ERP topic. Even though I had almost no prior knowledge of the topic, I am quite pleased with this little research's outcomes and the knowledge which I have acquired while working with the topic. I wish the reader a pleasant reading.

Raul Strugar
Aarhus, June 2019

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List of abbreviations

Abbreviation	Meaning
A	Attitude toward behavior
API	Application programming interface
BI	Behavioral intention
BIM	Building information modeling
BPCL	Bharat Petroleum Corporation Limited
BPMN	Business process model and notation
BPI	Business process improvement
BPR	Business process reengineering
CMMI	Capability maturity model integration
CRM	Customer relationship management
CSF	Critical success factor
EL	Electricity (contracting field)
ERP	Enterprise resource planning
HR	Human resources
HRM	Human resources management
HVAC	Heating, ventilation, air conditioning (contracting field)
IaaS	Infrastructure as a Service
IoT	Internet of Things
IT	Information technology
IS	Information System
MRP	Material requirements planning
MRP II	Manufacturing requirements planning
PaaS	Platform as a Service
PEOU	Perceived ease-of-use
PU	Perceived usefulness
RFI	Request for interest
RFP	Request for proposal
RQ	Research question
SaaS	Software as a Service
SCM	Supply chain management
SME	Small-medium enterprise
SN	Subjective norm
RE	Requirements engineering
ROI	Return on investment
TRA	Theory of reasoned action
TAM, TAM2	Technology acceptance model, first and second versions of the model
WQ	Working question

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1   Introduction

Introduction of new technologies and information systems (IS) are often occurrences in organizations. They create change movements inside the organizations on different plans and different organizational levels. Even though the motivations for such implementations are diverse, they must always be derived from a strategic intent guiding the enterprise, where the need for adequate strategic planning is essential throughout all life cycle phases of the new IS, in order to ensure its success. Large enterprises have technological needs which are proportional to their size and which need to be satisfied for the enterprise to reach its maximum capacity and not experience production or even administrative bottlenecks. As businesses grows larger, organizations have increasing needs for optimization, standardization and better integration of their departments and business units. This is achieved through the processes which links them.

The advent of enterprise resource planning (ERP) software in the manufacturing sector in the 1990s, followed by its successful and wide adoption in this sector, has popularized this enterprise system to other markets as well, triggering implementation attempts by many companies fascinated by its capabilities. However, the ERP implementations are filled with pitfalls, and many such attempts have led to total failures, with the low successful implementation rate continuing up to date. The construction sector has been lagging other sectors in many regards, including technology. This creates the opportunity to investigate the ERP topic in the construction sector. This study chooses to focus on large[1] construction contractor companies in Denmark, with which the student has experience with on both theoretical and practical level.

Elements such as organizational structure, communication, top management support and commitment, user behavior, system selection criteria, process mapping and business process reengineering, just to name a few, each contribute to some degree to the successful implementation of ERP systems. These elements are investigated in chapter 2, which consists of a broader literature review. The literature review is opened by introductory chapter about ERP – a brief ERP history, ERP critical success factors (CSF) and ERP life cycle phases introduction. The remaining part of literature study is divided into sections based the ERP life cycle dimensions as follows: Change management, People, Process and Product. Each of these sections discusses ERP from a different point of view, covering the topic from all perspectives. Chapter 3 consists of the study's problem identification and statement. This chapter refines the broader literature review by identifying a topic relevant to both the student and from a research point of view. It establishes the fact that the process dimension is a major topic in ERP research and that business process reengineering (BPR) will be investigated closer in the study. This leads to the definition of a research question (RQ) and three working questions (WQ), which support this research question. The research question to be is answered is:

RQ1. *What is the link between business process formalization and ERP implementation readiness?*

The three research questions that will help answering the main research question are:

WQ1. *Are companies required to undertake AS-IS and TO-BE process mapping in order to achieve ERP implementation readiness?*

WQ2. *How does the process maturity level corelate with the companies' ERP implementation readiness?*

WQ3. *Can ERP implementation readiness be achieved through varying degrees of BPR?*

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[1] Based on European Comission SME classification https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

Lack of process formalization results in unpredictable and unstandardized processes, which are not supported by a clear strategy, making companies embark on an unsure journey through their business life. Operating in such way also makes ERP implementation readiness uncertain. These are the topics which are investigated in this study. The practical process of moving from research topic identification to problem statement is described in Figure 1. Chapter 4 covers the study's research methodology, where the research process is explained through the research framework and the reasoning for the different research decisions is motivated for.

Chapter 5 reports and analyzes the study's primary data results – the interviews which were performed with the four case companies and the third-party consulting company, all in Denmark. Individual narrative of each case company is performed, supplied with cross case comparisons of similarities and dissimilarities. Chapter 6, the discussion chapter, reflects on the previous chapter and compares the qualitative data with the literature review, aiming to answer the problem statement. Lastly, chapter 7 sums up the study, while chapter 8 presents further study topics and areas.
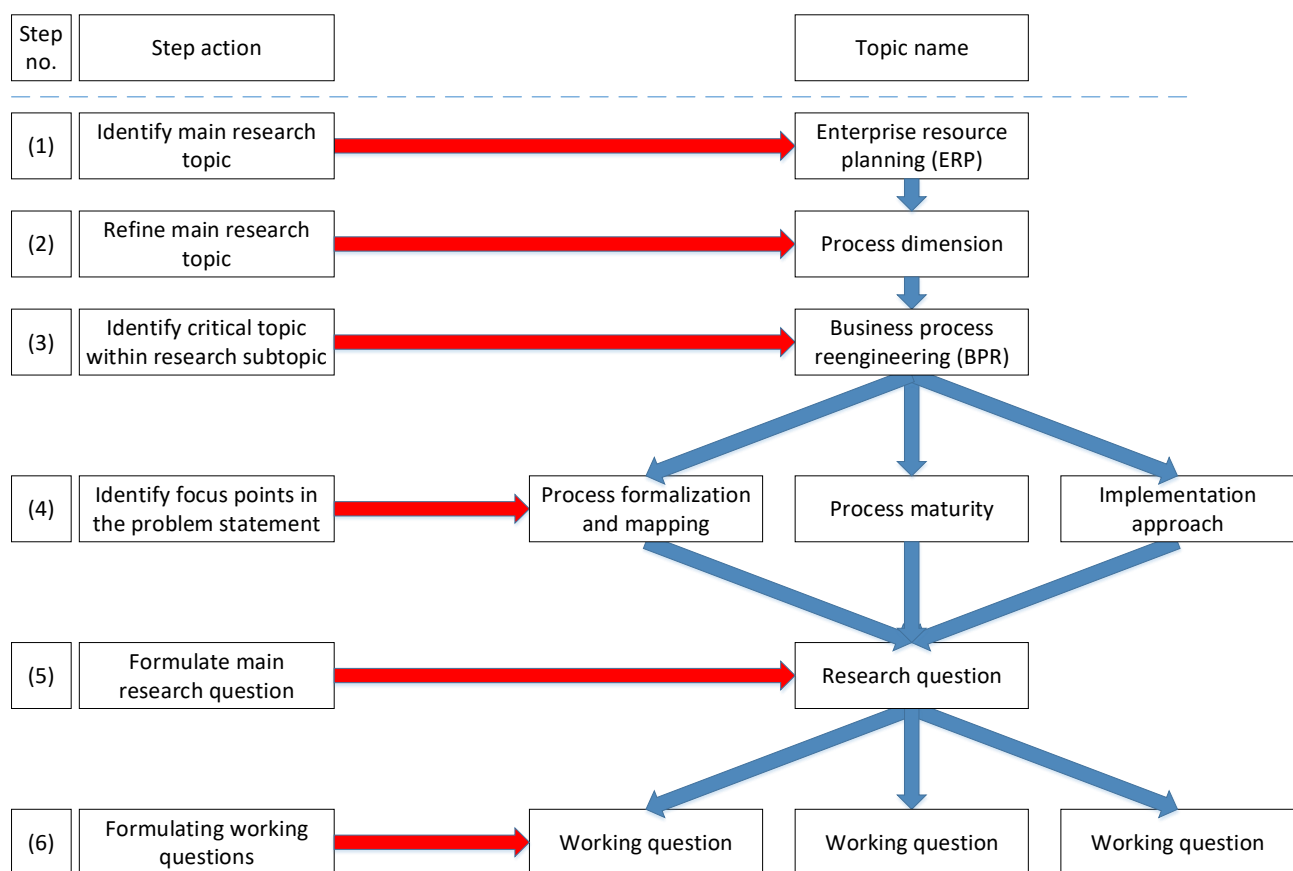
Figure 1 – Research problem identification procedure

2 Literature review

2.1 Introduction to enterprise resource planning

2.1.1 Enterprise resource planning history and development

The development of enterprise resource planning (ERP) started in the 1960s, initially as inventory control packages, a tool used to aid the increasing automation in the manufacturing industry and followed by the subsequent development of material requirements planning (MRP) and manufacturing requirements planning (MRP II) in 1970s and 1980s respectively, which represent the real technological foundations for current ERP software (Rashid, et al., 2002). In 1990, ERP was introduced, being much broader and extensive in scope than MRP and MRP II, which only focused on production related processes, whereas ERP focuses on an organization's core business processes, connecting and integrating the processes across the departments, while sharing a common set of data (Elragal & Haddar, 2012).

ERP systems are business applications, desktop- or web-based, which support the informational needs of an organization and deliver benefits linked to: reduction in cycle time, faster information transactions, improve financial management and interdepartmental collaboration, e-commerce enhancement, making process knowledge explicit (Davenport, 2000). ERP systems deliver a wide variety of integrated business applications addressed to, virtually, all business functions in an organization and promising to integrate these business functions (Al-Nafjan & Al-Mudimigh, 2011). These business functions are traditionally are not linked to each other and the free flow of information is possible between each function only with the aid of middle managers (Davenport, 2000).

2.1.2 ERP challenges

Most literature focuses on the implementation phase, while a lesser amount of studies investigates the other life cycle phases. There are good reasons for the literature to focus on the implementation phase – around 90% of ERP implementations deviate from time and cost targets, while 70% of the ERP implementations fall behind the expected benefits (Lee & Kim, 2016). However, this is not to say that ERP issues are solely implementation phase related. Many critical decisions are taken prior to actual implementation, in the adoption decision phase and acquisition phase. It is also on these phases this study focuses on. The ERP phases are discussed in section 2.1.3 – ERP life cycle phases.

Computer Economics (2019) performed an analysis in 2019, where 249 IT organizations were interviewed, and where it was found for the second year in a row that ERP ranks last in terms of both return on investment (ROI) and total cost of ownership, as well as customer satisfaction, ERP being the only technology classified as High Risk/Low Reward (Figure 2). However, ERP represents a vital tool for doing business for most companies and can be regarded as such as a necessary evil – an indispensable technology for managing the business. In spite of these setbacks, companies have still continued to massively invest in ERP, with only IT security technology, business and data analytics and Software as a Service (SaaS) ranking higher in terms of rates of investment (Computer Economics, 2019). However, ERP software, just like building information modelling (BIM) are large complex sociotechnical ISs that consist of both technical and social parts (Mondrup, et al., 2012), and where the social part is just as important as the technical part in ensuring ERP success. Social part includes elements such as processes, organizational structure, change management etc.
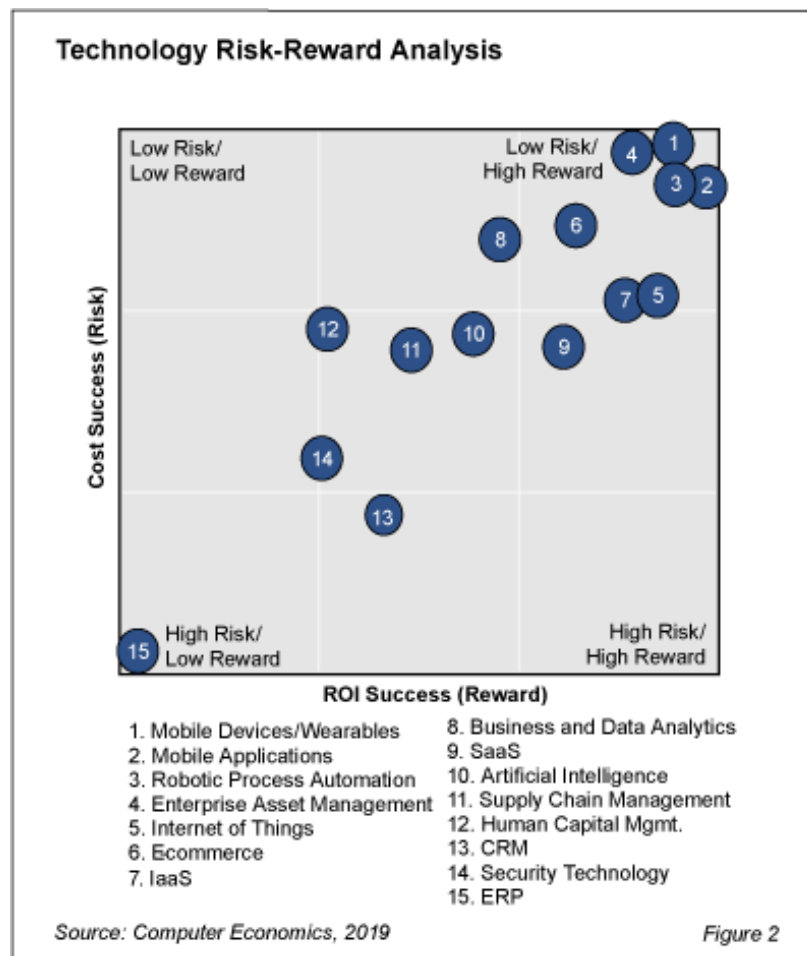
Figure 2 – Technology Risk-Reward Analysis (Computer Economics, 2019)

2.1.3 ERP life cycle phases

The typical life cycle of an ERP system consists of six phases, starting with (1) adoption decision and followed by (2) acquisition, (3) implementation, (4) use & maintenance, (5) evolution and ending with (6) retirement (see Figure 3). In the adoption decision phase, top management decides to investigate the need of adopting an ERP system which can enhance the company's business and organizational performance. System requirements, goals and benefits are also included. The acquisition phase consists of selecting the ERP system that fits best to the needs of the organization, selection of a consulting team which will assist the company in the implementation phase, as well as the other phases. The implementation phase involves customization of the ERP to meet the needs of the organization, as well as actual ERP roll-out. The use & maintenance phase involve maintenance of the ERP system, as well as optimization and improvement work. The evolution phase consists of enhancement of the ERP system's capabilities, addition of new modules (like customer relationship management or project management), as well as integration with other unlinked systems. The retirement phase involves the stage when the current ERP system becomes obsolete and requires replacement with a new IS (ERP or non-ERP) that better fits the business and organizational requirements of the organization (Esteves & Pastor, 1999).

Esteves & Pastor's (1999) define four ERP dimensions which can be researched – Change management, People, Process and Product (Figure 4). This study describes each of these dimensions but chooses to merge together the Change management and People dimension, due to their interrelatedness, as well as adding the Strategy with the Process dimension, due to their interrelatedness.
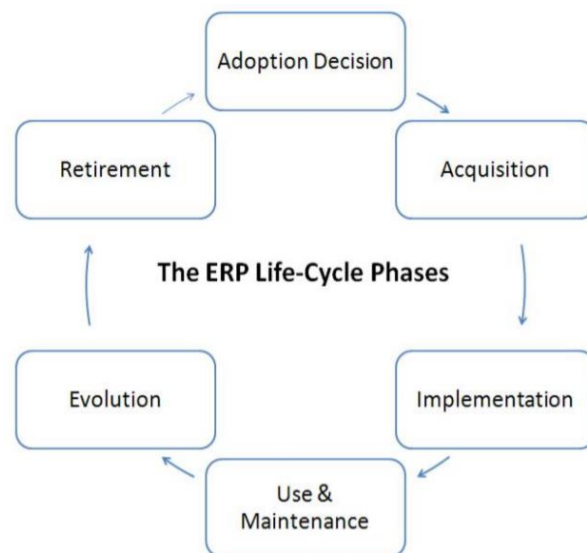
Figure 3 – ERP life cycle phases, based on (Esteves & Pastor, 1999)
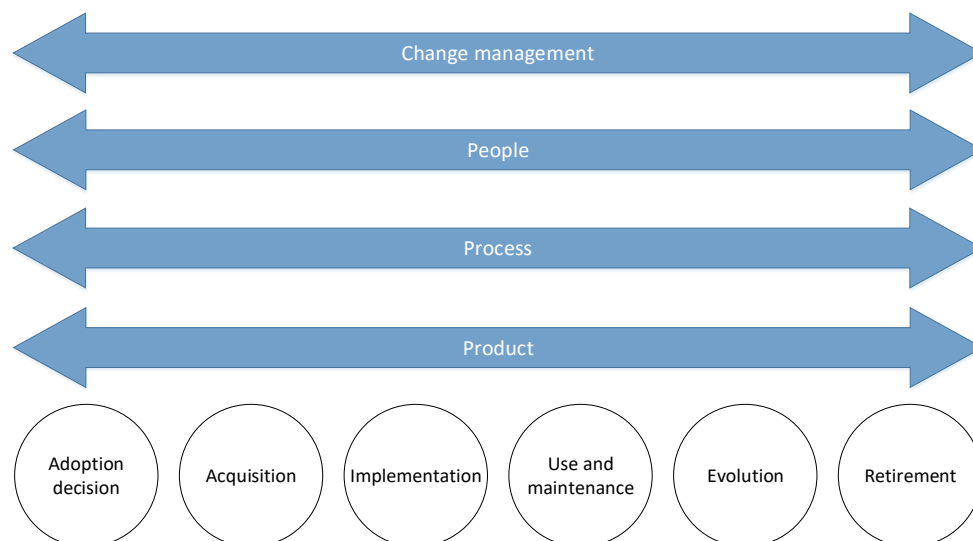
Figure 4 – ERP life cycle phases and dimensions (Esteves & Pastor, 1999)

2.1.4   ERP Critical success factors

Numerous papers have set out to identify the critical success factors (CSF) linked to ERP implementation, each using different CSF importance rankings. However, Elgaral & Haddar (2012) notes that "usually the rankings differ according to the cases studied, context, culture and many other variables". Elgaral & Haddar (2012) have identified a number of CSFs based on a literature study based on how many times the different factors were identified as leading CSFs (Figure 5). Although business process reengineering (BPR) is not listed directly among these CSFs, Elgaral & Haddar (2012) indicate that BPR, software customization and configuration are regarded as CSFs, meaning these are grouped together under an umbrella term, implementation strategy. Žabjek et al. (2009) mentions that change management is the only factor that is often cited as most important, but in their study, change management together with top management commitment and support are regarded as the top CSFs leading to successful ERP implementation. This correlates with Elgaral & Haddar (2012), where change management and top management commitment and support are equally ranked as most important. While Esteves & Pastor (1999) defines four ERP dimensions (change management, people, process and product), many CSF classifications use a broader range of factors, which can either fit into one or several such dimensions, depending on how the individual CSF research decides to break down and categorize the factors.
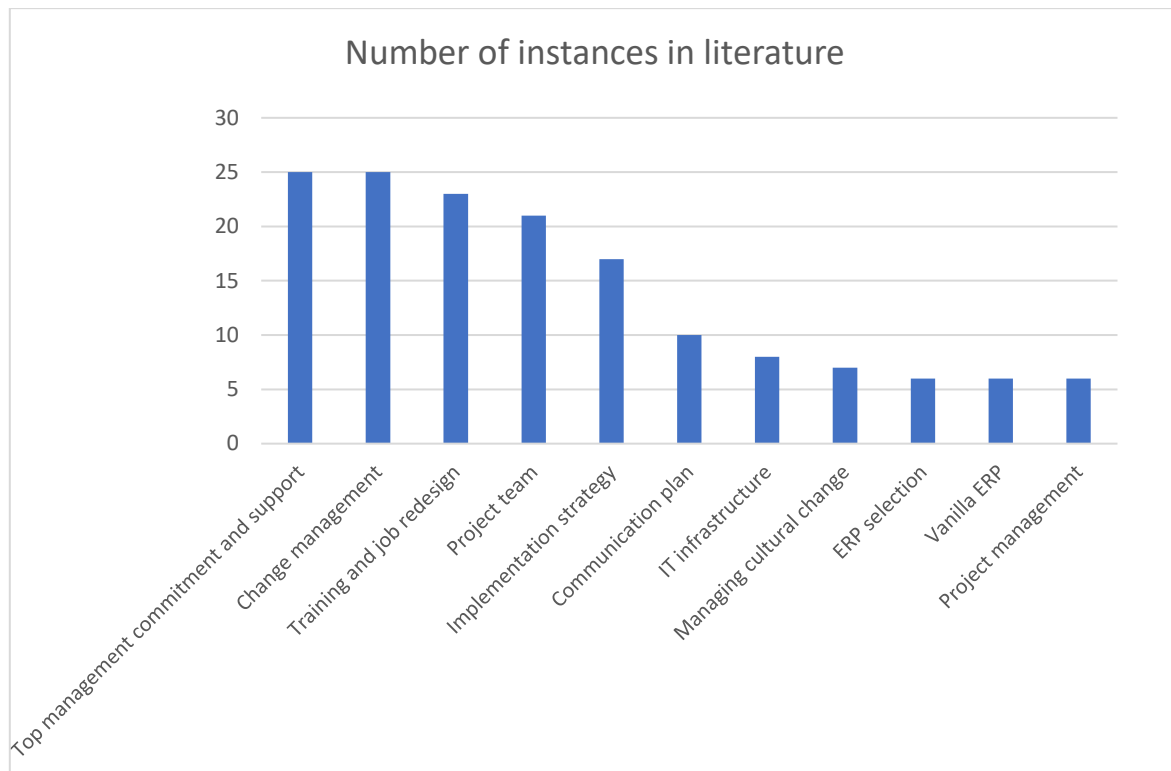
Figure 5 – Critical success factors (CSF) in ERP implementation based on (Elragal & Haddar, 2012)

2.2 Product dimension

2.2.1 ERP structure

Siriginidi (2000) has developed a general model of ERP, which describes its structure, cross-functionality and contribution to strategic, business and operational planning and execution (Figure 6). Description of this model will be made by referencing to Figure 6. The center of the figure (circle) illustrates the core of ERP, which consists of several entities called modules (such as cost accounting, fixed assets, logistics etc. – the exact module nomenclature varies across literature/ERP vendors), which are connected through a shared database. The side of the figure illustrates the cross-enterprise functions which ERP has (such as multi-lingual, workflow automation etc.). These cross-enterprise capabilities lever the ERP system multifunctionality, enabling unhindered data exchange across business functions, borders and language barriers. The other two ERP components are strategic and business planning of materials and resources and operational planning and execution of materials and resources, with the former fulfilling strategic functions (like change management, long range forecasting etc.) and the latter fulfilling operational functions (like distribution, order processing, payroll etc.). Through its structure and way of functioning, ERP enables translating strategic objectives to operational activities, fulfilling a total/core solution purpose.

2.2.2 Vendors, Commercial off-the-shelf and customization of ERP

As previously mentioned, ERP consists of entities called modules, each serving a specific function. Depending on vendor, the offered modules and structure varies. Generally, ERP modules can be divided into basic ERP modules, optional ERP modules and vertical modules. Basic modules are the standard modules that are provided by an ERP vendor, which are required in order to achieve the basic ERP functionality. The basic module offer tends to be similar from vendor to vendor, with nomenclature and module organization slightly varying. Optional ERP modules are extra modules, which a company can acquire to achieve extra functionality and integration for business processes, which initially were not covered by the basic ERP modules. These are sometimes purchased during the evolution life cycle of an ERP system, when an organization's needs grow. Lastly, there are vertical ERP module, which are like optional ERP modules, but distinguish themselves by being industry specific.
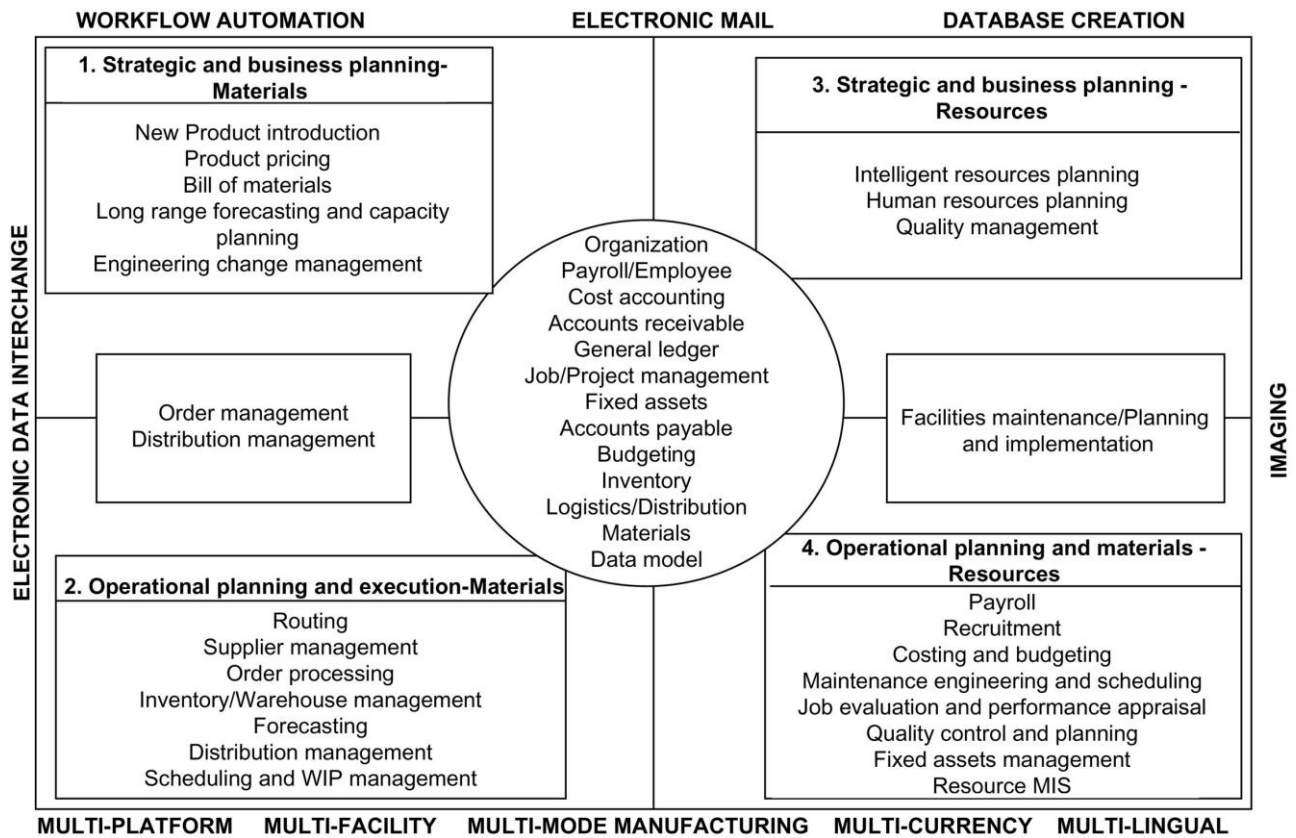
Figure 6 – General model for ERP (Siriginidi, 2000)

For example, construction ERP modules (vertical) will offer functionality within cost estimation, bidding, real estate   etc.
Table 2 illustrates some of the most common ERP modules and a brief description their function (ERP News, 2018), (ERP Focus, 2018), (IT Business Edge, 2018), (Jeeves ERP, 2019). These can be either basic or optional modules, depending on vendor. On the other hand, Table 3 illustrates vertical modules, which are specific to the construction sector (ACG Infotech Limited, 2019), (Cosmo Consult AG, 2019), (Sage, 2019), (MTWO, 2019), (CIMS, 2019). Hadidi (2017) have developed and tested a model for ranking ERP modules in the Saudi construction contracting sector, which uses six parameters for weighing the importance of the modules. Thirteen modules are identified and ranked from most important to least important – Table 1.

Table 1 – Ranking of ERP modules used in construction sector

Rank	Module
1	Inventory Control and Logistics
2	Procurement
3	Project Finance and Accounting
4	Project Management and Budgeting
5	Time, Expenses & Invoicing
6	Human Resources
7	Sub-Contractor Management
8	Resource Management
9	Contract and Change Management
10	Collaboration
11	Data/Document Management
12	Tendering/Bid Management
13	Sales and Marketing

Table 2 – ERP modules

ERP module	ERP module description
Supply chain management (SCM)	Management of the flow of materials, finances and information from and to trading partners – suppliers, distributors, manufacturers etc. Real-time data collection and predictive analytics are assisting tools that improve accuracy.
Purchasing	Closely linked to SCM. Invoice management, contracts, billing etc.
Customer relationship management (CRM)	Customer information, communication history, purchases, feedback etc.
Human resource management (HRM)	Managing employee information, performance, payroll etc.
Finance & Accounting	Cash flow, balance sheet, budgeting, taxes, invoices, expenses etc.
Sales and order management[2]	Sale orders, quotations, customer management, sales targets. marketing
Supplier relationship management (SRM)	Used for request for quotations, tracking pricing history, storing/controlling/tracking quality standards and certifications
Operations and production management[3]	Specific to the manufacturing industry – production planning, forecast/actual production reporting, material usage, machinery scheduling etc.
Inventory control[4]	Management of the inventory
Business intelligence, reporting and dashboards	Quite new addition to the ERP family. Used for data-driven decision making, collection and analysis of big data, reporting and visualization
Project management	Costs, budgeting, scheduling etc.

Table 3 – ERP construction-specific (vertical) modules

ERP construction-specific module	ERP module description
Bid and tendering	Document management – contracts, drawings, invoices, request for information etc.
Subcontractor management	Contractor billing, material movement, labor activities
Project management[5]	Budgeting, forecasting, estimates, planning, site management and production control, work breakdown, machinery/equipment usage, costs and maintenance etc.
HRM[4]	Labor attendance management and other construction-related HR functions
Scheduling	Project scheduling[6]
2D/3D Quantity take-off and estimating, 3D BIM Design, 4D/5D/6D/7D BIM Modelling	Bill of quantities etc., Standard 3D BIM software (like Revit, ArchiCAD etc.), Additional BIM dimensions, where 4D represents scheduling, 5D estimating, 6D facility management, 7D sustainability (Exigo A/S, 2019)
Risk Management	Compliance, project-based risks and insurances related to own organization and business partners such as subcontractors/subconsultants and suppliers
Reporting and dashboards[4]	Real-time visualization of construction project metrics to allow better project control and deviation avoidance – integration with Internet of Things (IoT) field data and business intelligence to enhance quantification of lead indicators

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[2] Also called sales and marketing – might be integrated in CRM in some instances
[3] Also called manufacturing or engineering management
[4] Also called material management or inventory management system; sometimes part of SCM
[5] Project management and HRM modules more specific to the needs of the construction sector
[6] Can also be offered as an integrated project management or BIM part

2.2.3 Cloud computing (Cloud ERP)

2.2.3.1 Introduction

The advent of computing power, fiber internet and cloud storage in the last decade has opened for new possibilities in the field of traditional on-premises ERP systems, giving companies the opportunity to partially or fully migrate their ERP system from on-premises or private cloud to cloud service providers. Cloud computing offers new benefits when implementing an ERP system, as well as new challenges, depending on the chosen cloud architecture (model). Cloud computing is defined as:

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."
(Weis & Alves-Foss, 2011)

2.2.3.2 Cloud service models and cloud computing deployment models

The cloud computing models can be divided into three main categories or models (Figure 8): Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). The three cloud service models can be depicted as three layers, with SaaS as outermost layer and IaaS as innermost layer, where SaaS provides the highest security for both user and vendor, but also least control for the user. As one moves inwards, the security decreases, but the user control increases (see Figure 7).

Table 4 gives a summary over the three cloud models, as well as some examples of vendors offering such services, while Figure 3 aims to make a comparison between the functionality offered by on-premises software and cloud computing (software). Figure 8 illustrates the three cloud models as three different layers on a pyramid.
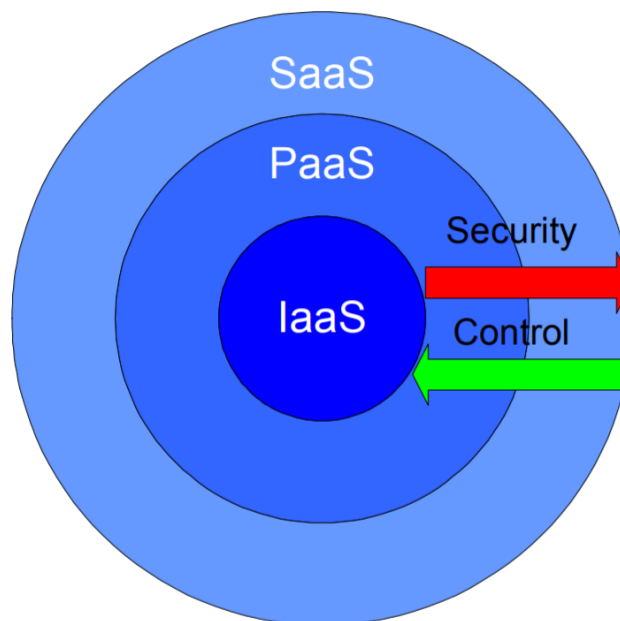
Figure 7 – Cloud service models related to security and user control (Ludwig & Coetzee, 2010)

Table 4 – Cloud computing models

Cloud computing model	Description	Examples
SaaS	Also called on-demand software, SaaS is the most common form of cloud option, where the service is offered by vendors through the interface of an application. The offered applications are either browser-based, or desktop-based and are fully managed by the vendor, including installations, technical assistance, maintenance etc. The user cannot make any changes to the infrastructure. For what regards ERP software, these are typically offered as SaaS solutions, where the client is regarded as end-user (Watts, 2017), (Rani & Ranjan, 2014).	Google Apps, Dropbox, Office 365, GoToMeeting (Watts, 2017)
PaaS	PaaS provides a computing platform for developers and deployers, where applications can be created and deployed, without the need to worry about hardware and software requirements, which the vendor will instead provide. Tools and libraries are also provided (Rani & Ranjan, 2014). Just like an on-premises ERP, PaaS gives the user more freedom in terms of ERP usage, due to the possibility of higher customization and integration with own systems, as well as data management control.	Windows Azure, salesforce, Google App Engine (Watts, 2017)
IaaS	If SaaS is regarded as a "consume" and PaaS as a "build on it", IaaS is regarded as a "migrate to it". The degree of abstraction increases from SaaS to IaaS, where IaaS is the most abstract model and offers highest degree of freedom for the user (Rani & Ranjan, 2014). IaaS is the most scalable among the three cloud computing models, due to it being fully self-service and putting almost all responsibility on user, including virtualization. Therefore, managing IaaS will require extensive IT expertise. What IaaS offers is a virtual server as a service, where the user pays for the resources it uses (Rani & Ranjan, 2014).	Microsoft Azure, Amazon Web Services, DigitalOcean (Watts, 2017)

Table 5 – Comparison on-premises and cloud computing models (SaaS/PaaS/IaaS) partially based on (Watts, 2017), (Achargui & Zaouia, 2016)

Attributes	On-premises	SaaS	PaaS	IaaS
Runtime management	Internal (Customer/Developer)	External (Vendor)	External (Vendor)	Internal (Customer/Developer)
Data management	Internal (Customer/Developer)	External (Vendor)	Internal (Customer/Developer)	Internal (Customer/Developer)
Application management	Internal (Customer/Developer)	External (Vendor)	Internal (Customer/Developer)	Internal (Customer/Developer)
Data storage	Internal (Customer/Developer)	External (Vendor)	External (Vendor)	External (Vendor)
Server management	Internal (Customer/Developer)	External (Vendor)	External (Vendor)	External (Vendor)
Cloud type	Private	Private/Public	Public/Community/Hybrid	Public/Community/Hybrid
Financial model	Capital expense	Operational expense	Operational expense	Operational expense
Software license	Purchased and owned	Purchased and owned	Purchased and owned	Rented from SaaS vendor
ERP Implementation Partner	ERP Implementation Partner	ERP Implementation Partner	ERP Implementation Partner	ERP Vendor
Used by	End users	End users	Developers and deployers	IT administrators
Number of providers	Large number of ERP vendors	Large number of applications in the cloud	Few cloud platforms	Few cloud platforms
Managed internally by customer or hired developer/deployer			Managed externally by vendor	
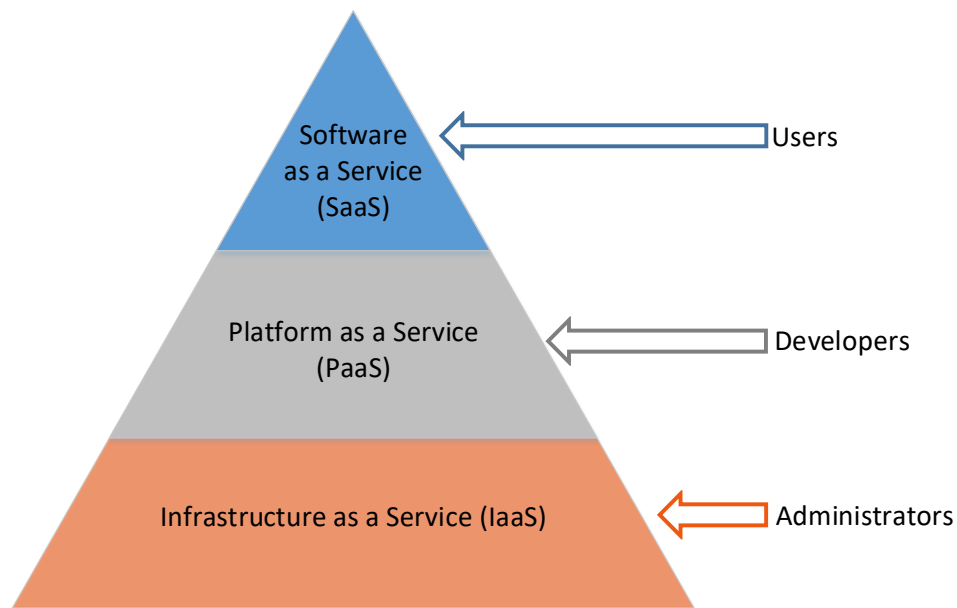
Figure 8 – Cloud service models, based on (Elmonem, et al., 2016), (Muslmani, et al., 2018)

Distinction is also made between the chosen deployment models, where four main deployment models are identified: public clouds, private clouds, community clouds and hybrid clouds. A brief description is given in Table 6.

Table 6 – Cloud computing deployment models based on (Rani & Ranjan, 2014)

Cloud computing deployment model	Description
Public cloud	Not dedicated to a specific target group/organization. Accessible to the general public.
Private cloud	Owned and controlled by customers but can be built and installed by third parties. They are also called internal or corporate clouds. They are more secure than public clouds, but they are far from scalable, because the company assumes full responsibility for expenses related to hardware, software and maintenance.
Community cloud	Shared and managed by a group of organizations, which have for example common business activities and objectives and share same concerns (for example security). It can be used by companies working on joint projects, which makes it suitable for construction projects.
Hybrid cloud	Combination of public, private and community clouds, combining the advantages of all three. It requires companies to divide data into mission-critical and non-mission-critical.

The move towards cloud solutions is happening at a fast pace. Ruivoa et al. (2015) found in 2015 that even though over 45% of respondent ERP user companies were still using on-premise solutions, a considerable percentage was currently moving to cloud solutions (32%), while others already had adopted a hybrid solution (17%). However, only a small margin was currently outsourcing their ERP (5,7%), which could be for example the use of SaaS. The overview for 2015, 2020 forecast and 2025 forecast for on-premises, outsourced and hybrid ERP models is illustrated in Figure 9.
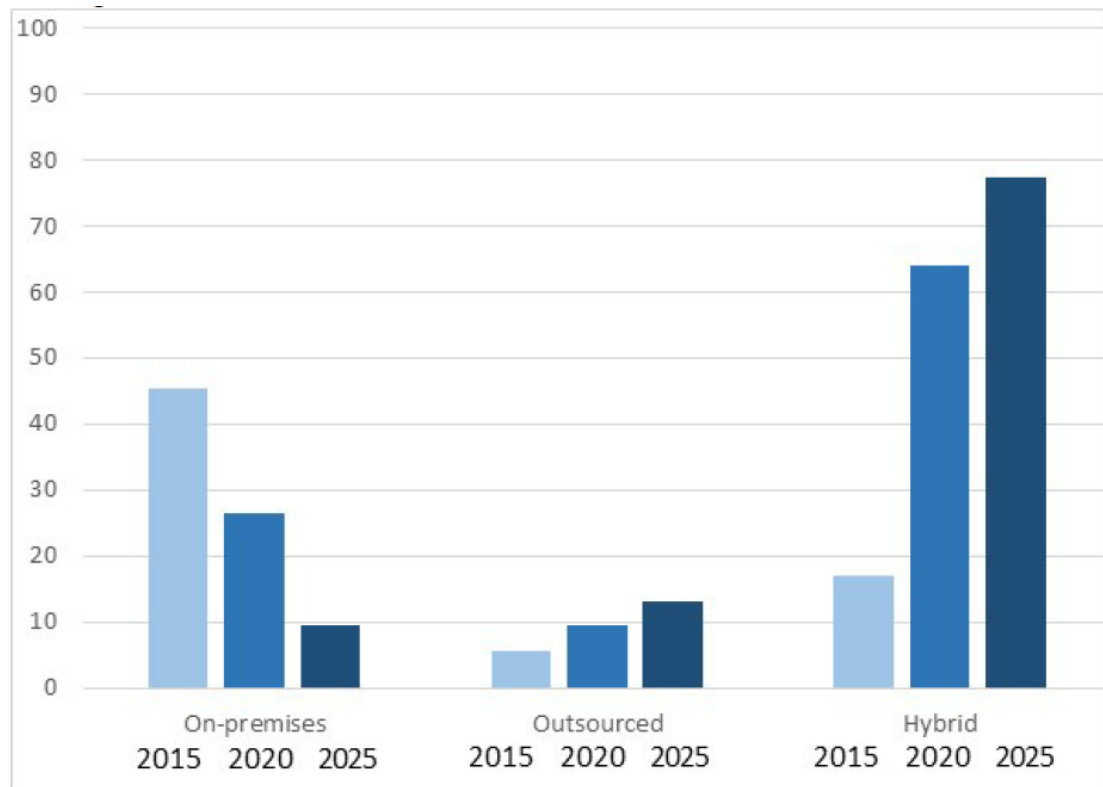
Figure 9 – ERP model evolution, from today to 5 years, to 10 years (Ruivoa, et al., 2015)

2.2.3.3 Benefits and challenges of cloud enterprise resource planning

Elmonem et al. (2016) identified through a literature review, the benefits and challenges linked to cloud ERP. These are illustrated in Table 7 and Table 8 respectively.

Table 7 – Top five cloud ERP benefits (Elmonem, et al., 2016)

Benefit no.	Benefit name	Benefit description
1.	Lower upfront costs	The company only pays for the end-service and not for setting-up the computing environment etc.
2.	Lower operating costs	Cloud services are provided and operated by CSPs at lower costs, than if a company would operate inhouse.
3.	Improved accessibility, mobility and usability	Choosing an open cloud environment will increase the accessibility, which in turn, will increase usability. Mobility can also be improved. Improvements in these factors will, however, depend on the chosen cloud service model.
4.	Rapid implementation	Cloud ERP implementation is rapid because CSPs offer a wide range readily available ERP solutions.
5.	Scalability	Cloud services are highly scalable due to being externally offered. Therefore, the company can scale their costs up and down to match the current need of the organization.

Table 8 – Top five cloud ERP challenges (Elmonem, et al., 2016)

Benefit no.	Benefit name	Benefit description
1.	Security risks	By migrating to the cloud, security risks increase, making the cloud ERP prone to external attacks.
2.	Customization and integration limitations	The degree of customization and integration, which a company wishes to have is limited by the CPSs' offer, contrary to on-premises offer, where such limitations do not exist – especially true for SaaS.
3.	Performance risks	Issues associated with CSP downtime and network failures affect ERP performance, leading to as much as totally freezing a company's work, when unable to access the system.
4.	Service Level Agreements issues	Involves agreement between CSP and company regarding the provided services. Responsibilities will typically vary across the different cloud service models.
5.	Data ownership	Like security risks, data ownership poses a problem to companies, which believe that their data should not be stored outside the company's boundaries.

2.3 Change management and People dimension

2.3.1 Organizational culture

ERP systems integrate an organization's business units, enabling information to flow across the organizational boundaries, due to the fact that business processes are independent of formal organizational structure (Davenport & Short, 1990), (Morton & Hu, 2008), (Al-Nafjan & Al-Mudimigh, 2011). In addition to process changes (which are discussed later in section 2.4), the organizational structure is also likely to undergo changes when a best fit is attempted to be to be achieved between it and the ERP system (Morton & Hu, 2008). A brief introduction is made to organizational configurations and organizational structures. The core structure of Mintzberg's organizational configurations consists of five elements (or building blocks). These elements are described in Table 9. The core structure of the organizational configurations is illustrated in Figure 10. Mintzberg defines five different configurations (Kousholt, 2014). These are:

1. Entrepreneurial
   o Known for their small corporate functions, strong top management, few middle managers and where the company is directly controlled by the top manager. This type of structure is typically encountered in new organizations.
2. Machine bureaucracy
   o Known for the large corporate functions, many middle managers and heavy decision processes. Typically encountered in large, old, production or service organizations, where the Operating Core is linked to many rules and standards
3. Professional bureaucracy
   o Known for its flat structure, few middle managers, large Support Staff, but low Techno Structure, due to the employees' high degree of independence
4. Divisional form
   o Based on autonomous divisions, which is supported from a central office, but which is decentralized. It is not considered an organizational form by itself, but rather an addition to the entrepreneurial, machine and professional bureaucracy
5. Adhocracy
   o Organized based on the types of tasks that must be solved. Typical for companies that work project-based, innovative and experimental organizations etc.

Moreover, six types of organizational structures are defined: function-divided structure, division-divided structure, matrix organization, project organization, virtual and network organization and hybrid forms. While the first two organizational structures are regarded as classic, the last four are regarded as modern. In the function-divided structure the organization's activities are divided into functional departments, each serving a specific function, while in the division-divided structure – the organization's activities are divided into business units, each capable of doing business on its own. These structures can be product-divided (books, movies, music etc.), geographical-divided (like Funen, Zealand etc.) or market-divided (public customers, private customers etc.).

The matrix organization and project organization are modern organizational structures that have an improved horizontal communication between departments, which function- and division-divided organizations have challenges with. The matrix organization consists of functional departments in which employees are employed in, but where interdisciplinary teams or projects are established by project managers, which then loan these employees from the respective functional departments. The project organization is similar to the matrix organization, although divisions are eliminated, and the organization is purely project-based. This organizational structure will however have challenges with regards to share of information and knowledge across projects. Virtual and network organizations are supported by technology and globalization and allows organizations to become global, regardless of size, by adjusting the amount of insourcing and outsourcing and forming strategic alliances with other companies.

2.3.2 Organizational culture in an ERP context

As previously mentioned, due to the inbuilt integration and native cross-functional capabilities of ERP system, business processes and flow of information are independent of formal organization. This forces companies to adjust their organization by migrating from a function-based system to a process-based system, increasing the interdependencies between business units and requiring increased coordination across business units as a result (Morton & Hu, 2008). Structural contingency theory is an organizational theory which postulates that the performance of an organizational structure is bound by several factors, such as strategy, size, uncertainty etc. referred as contingencies. The better the organization fits these contingencies, the better performance. These factors can be both internal and external (Donaldson, 2015).

Table 9 – The five elements of Mintzberg's organizational configurations, based on (Kousholt, 2014)

Element name	Description	Examples
Strategic Apex	Line function which has the overall responsibility for the organization	Board of directors and CEO
Middle Line	Line function which connects top management with the Operating Core through a hierarchy of middle managers	Functional and regional directors, development manager, sales director etc.
Operating Core	Line function which consists of people, which perform the work that generates the organization's products and services	Salesmen, programmers, engineers, designers, client consultants etc.
Techno Structure	Corporate (Support) function which works with optimization of the organization's work	Controllers, strategic planning, production planning, personal training, work optimization etc.
Support Staff	Corporate (Support) function which supports organization's units	Legal department, marketing, development, reception, canteen etc.
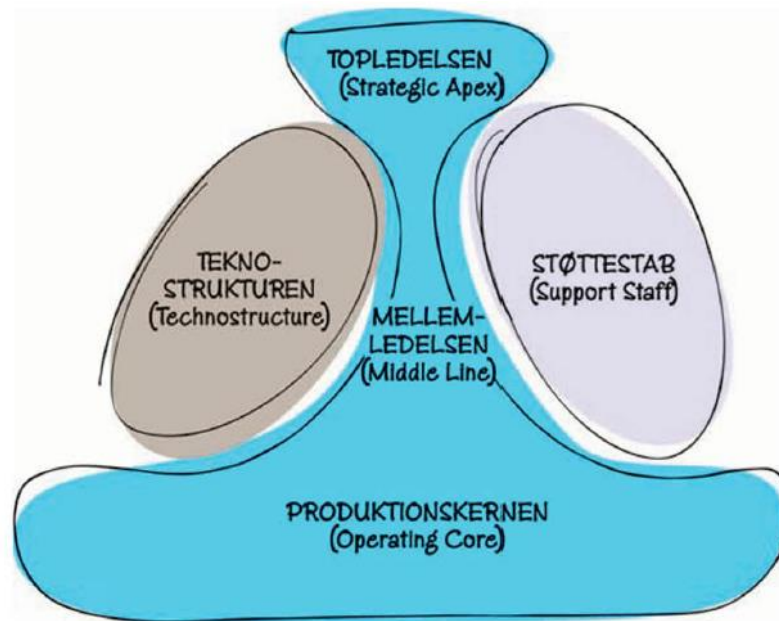
Figure 10 – Mintzberg's core structure for organizational configurations (Kousholt, 2014)

The fit between ERP and organizational configuration is investigated by Morton & Hu (2008) using a structural contingency approach and looking into Mintzberg's five organizational configurations, plus two extra defined components – professional bureaucracy support staff component and administrative adhocracy operating component and then rating each of the seven configuration based three defined parameters (contingencies). Three contingencies are defined and used in Morton & Hu's (2008) study: formalization, structural differentiation and decentralization. Morton & Hu (2008) defines formalization as "the standardization of work processes and documentation", structural differentiation as "the difference in goal orientation and in the formality of the structure of the organizational units" and decentralization as "the extent to which power over decision-making in the organization is dispersed among its members". Therefore, a good fit between organizational configuration and ERP system is achieved when these contingencies are achieved. Morton & Hu (2008) claims that by standardizing and integrating information flows in real time, ERP software reduces task uncertainty, characteristics which describe organizations with low levels of formalization, low structural differentiation and high levels of decentralization. Moreover, low formalization is required in the company, because ERP is highly formalized beforehand, so that it is indicated for a company to adjust their business processes to the formalized form of ERP instead of vice versa. Low structural differentiation is recommended because it is the equivalent of high integration, meaning little adjustments need to be made to this part of the organization. Lastly, high decentralization aids the beforementioned information flow to travel unhindered in the organization (Morton & Hu, 2008).

Figure 11 illustrates the results which indicate that best fit between ERP and organizations is achieved by organizations that are formed as machine bureaucracy. The two additional components – professional bureaucracy support staff component and administrative adhocracy operating component, also achieve best fit with ERP. It is therefore unsurprising that manufacturing companies have achieved high success with ERP (and ERP implementation), considering machine bureaucracy is common in these companies. It should be noted that even though Morton & Hu (2008) point out that low formalization is required in organizations, Figure 11 shows that high degree of fit and likelihood of ERP success can still be achieved in highly formalized organizations. Moreover, as it will be discussed in section 2.4, as well as in chapter 5 (Data analysis) and chapter 6 (Discussion), process formalization is an important requirement in achieving ERP success. Something also discussed in these sections/chapters is that the diversity of ERP solutions allows companies finding an ERP system that closely matches the organization (structure, processes etc.), making formalization requirement potentially unnecessary.

Table 2
A framework of contingency fit between ERP and organizational types

Organizational type	Structural dimensions			Degree of fit and likelihood of ERP success
	Formalization	Structural differentiation	Decentralization	
Machine bureaucracy	High	Medium	Low	High
Professional bureaucracy	Low	High	High	Low
Professional bureaucracy support staff component	High	Medium	Low	High
Divisionalized form	Medium	High	High	Low
Adhocracy	Low	High	High	Low
Administrative adhocracy operating component	High	Medium	Low	High

Figure 11 – A framework of contingency fit between ERP and organizational types (Morton & Hu, 2008)

2.3.3   Technical capabilities in organizations

Danish construction sector lacks IT specialists, with only 9% of the construction companies in Denmark employing IT specialists in 2016 (Danmarks Statistik, 2017, p. 18). Moreover, a clear relationship between high level of digitalization and employment of own IT specialists is observed. In 2017, as little as 14% of the companies on the Danish market employing IT specialists experienced low and very low levels of digitalization, whereas 71% of the companies that do not employ IT specialists, experienced low and very low levels of digitalization (Danmarks Statistik, 2017, pp. 23-24). Moreover, the IT expenditure per capita in the Danish construction sector is the lowest among all surveyed sectors, accounting for merely 1,52% in 2016 (Danmarks Statistik, 2016). The causes of low digitalization levels are further discussed in section 5.6.1 (Company profile and perspectives) and section 6.1 (Introduction to discussion).

Even though Danmarks Statistik (2017, pp. 23-24) reported high levels of outsourcing of IT services in Denmark, in the study performed by Ruivoa et al. (2015) in multiple Western European countries, it was found that only a small percentage of companies were outsourcing their ERP systems, with low increase trends for five and ten year forecasts as well. Nwankpa (2015) states that the opinions are divided with regards to outsourcing IT resources, where most literature supports the importance of in-house technical knowledge in organizations, while Aubert et al. (2004) claims that organizations that outsource IT resources, choose it to enhance their technological agility in a dynamic business environment.

Moreover, Aubert et al. (2004) also found a clear link between low uncertainty and low measurement problems and the positive decision to outsource IT resources. Uncertainty and measurement are based on transaction cost theory, which is based on two assumptions: bounded rationality and opportunism, the first translating to a person's inability to comprehend all the information involved in a transaction, which results in uncertainty, while the latter is related to taking advantage of the given circumstances. In practice, the combination of these results in transactions where the vendor will withhold information about a software's flaws and downsides (measurement), while the buyer will withhold information about price offer, the parties attempting to strategically use these principles against each other. Therefore, conditions where these factors are low will make the decision to outsource more likely. Nonetheless, these rationales seem to be outdated in modern context, where external IT consultants can used in relation to selecting ERP systems, since these consultants provide price and specifications catalogues. Moreover, ERP systems offered as SaaS have the non-binding advantage.
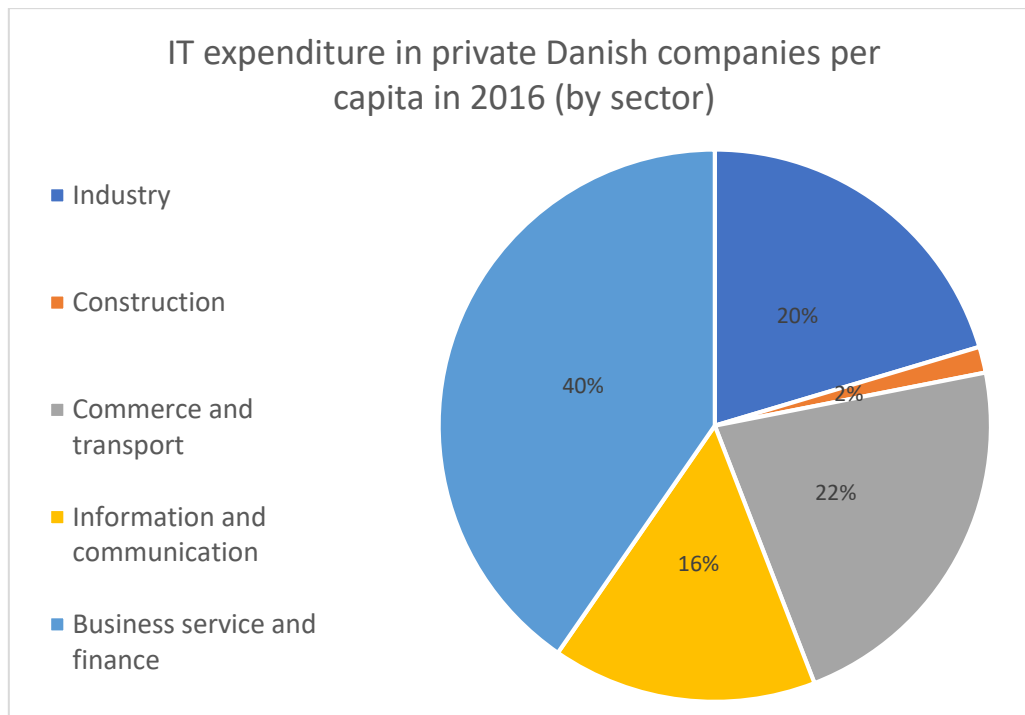
Figure 12 – IT expenditure in private Danish companies per capita in 2016 (by sector) (Danmarks Statistik, 2016)

2.3.4 Change management

2.3.4.1 Introduction and change management strategies

Implementation of technology affects not only a company's organizational structure, but also the way it does business, changing both business processes and the users' tasks and way of working. Redundant legacy processes and systems are eliminated, replaced by optimized and better integrated ones, ultimately affecting the people that work with them. This results consequently in resistance to change from the employees who hold fast to their old ways of performing the job, instead of adapting to the new circumstances. Such attitude threatens the success of the ERP adoption, risking that the ERP system will be used either incorrectly, insufficiently or not at all used in the organization. The degree of resistance to the ERP implementation is related to the position the employees occupy in the organization, with lower level employees expressing highest resistance, followed by low management, middle management and lastly top management. Implementation of ERP systems can lead to uncertainty and insecurity for employees (Hau & Kuzic, 2010).

Moreover, considering that ERP adoption is the result of a top management decision, the understanding of such a system's purpose and functionality is highest among top management and decreases as one goes down the organization, unless initiatives are taken to change the level of understanding among employees. Therefore, a good correlation exists between uncertainty/insecurity and lack of understanding of the system, reason why it is important to use a change management strategy in the implementation process to ensure ERP success. Hau & Kuzic (2010) define change management as the process through which an organization's business processes, systems and employees are managed in such way so that the company's transition from the current state to a new one takes places as effortless as possible.

Žabjek, et al. (2009) indicates that there are two components associated to change management and which are critical for its success: human resource management (HRM) and social changes. An important component of HRM is employee training, which should focus on educating employees to cope with the changes on a physical, mental and emotional level. Employees must acquire new skills and knowledge to be able to work in a new environment involving changed business processes and systems. The social aspect of the change involves decreasing the employees' reluctance to changes through effective communication and education, so that employees become more flexible and versatile, both in terms of attitude, as well as task solving.

Aladwani (2001) also underlines the importance of effective communication. Moreover, efforts should also be concentrated on making employees understand their roles and responsibilities in the business change process (the concept of business process reengineering is defined later), both in the implementation stage (transition), as well as during use/operation of the newly implemented ERP system (Žabjek, et al., 2009).

Aladwani (2001) identifies two sources of user resistance: perceived risk and habit. The study proposes avoiding these sources through a change management model which leads to successful ERP implementation, by developing a framework, which draws on marketing strategies which aim to overcome buyer (user) resistance. There phases are proposed in the framework: knowledge formulation, strategy implementation and status evaluation. In knowledge formulation phase, the top management investigates the attitude of users and influence groups regarding introduction of a new technology, which then leads to determining reasons for user resistance. Aladwani (2001) describes "employee-raised facts, beliefs, and values are good indicators of what may cause their resistance to change". These are later described in section 2.3.4.2 (Technology acceptance model).

Strategy implementation consists of three steps, each involving different strategies which decrease user resistance, partly based on findings from the first stage and partly based on different principles proven to work by the literature, such as for example effective communication and user training. The first step involves awareness strategies – focusing on raising awareness about the ERP project through communication (for example ERP benefits), the second step involves feelings strategies – appealing to the users' affective component of attitude (for example ERP interface quality), while the third step involves adoption strategies – appealing to the users' conative component of attitude by securing support from opinion leaders. Status evaluation phase focuses on evaluating the performance of the implementation strategies and tracking the change management efforts in the post-implementation life cycle phases of the ERP system, to ensure no negative variances occur in the user acceptance (Aladwani, 2001). Figure 13 illustrates the three phases framework, while Figure 14 illustrates phase two with its three different steps. ERP implementation projects are essentially change management projects, and are consequently dependent on top management support and commitment, something underlined by numerous studies, including by Žabjek et al. (2009) and Aladwani (2001). The importance of the top management support is also underlined in Figure 14.
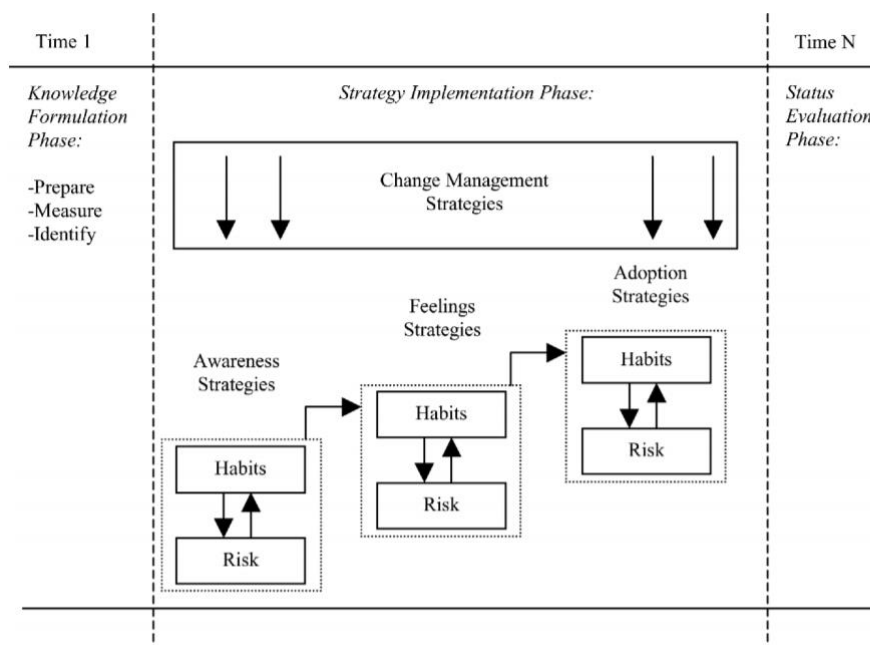
Figure 13 – A suggested framework for managing change associated with ERP (Aladwani, 2001)
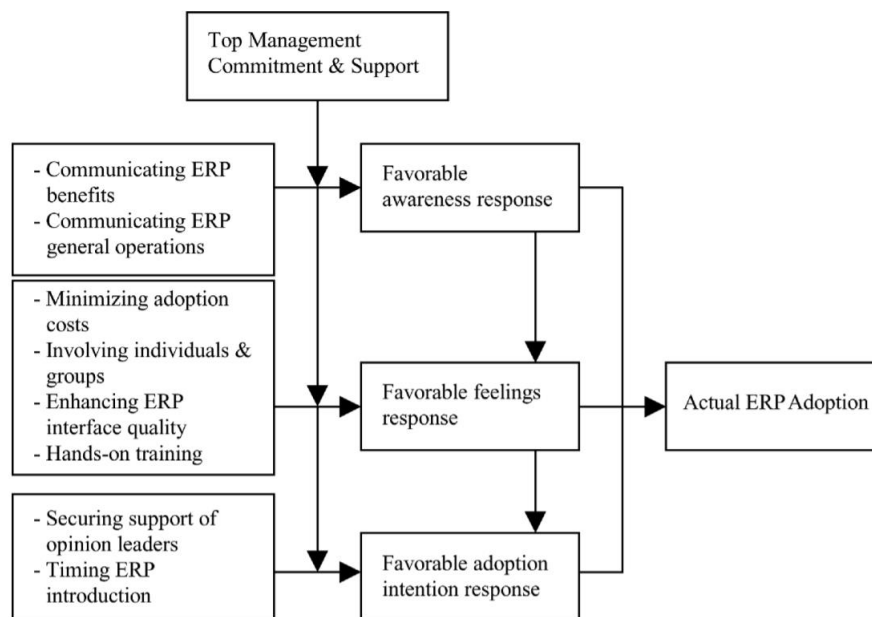
Figure 2.
A model of successful
ERP adoption

Figure 14 – A model of successful ERP adoption (Aladwani, 2001)

2.3.4.2   Technology acceptance model

A widely recognized model that investigates user acceptance of information systems (IS) is the technology acceptance model (TAM) (Davis, et al., 1989). TAM and user acceptance can be perceived as subsets of change management, as these concepts are employed in relation to ISs implementations, where users will express resistance to the change (Al-Nafjan & Al-Mudimigh, 2011). It is therefore the aim of TAM to predict such resistance and consequently technological success, while also giving top management the possibility to adequately plan based on the success determinants that TAM builds on (Salovaara & Tamminen, 2009, pp. 157-173). However, even though TAM employs change management concepts in its approach, the model has its roots on the influential Theory of Reasoned Action (TRA) within the field of psychology, which was developed by Fishbein & Ajzen (1975), (1980).

TRA investigates how two factors, attitude and subjective norms, influence the behavioral intention of an individual, which in turn influences its behavior. The first factor, subjective norms, appears as a result of normative beliefs, which represent an individual's perceptions about what a referent individual or group of individuals expect of the individual to behave like. The referent's expectation can be translated to social pressures (for example friends, family, coworkers etc.) to which an individual attempts to comply with. The latter factor, attitude, is the result an individual's own beliefs about an object. An individual's beliefs are numerous, but they are still limited in number at a given point, which then represents the base for forming an attitude (Al-Suqri & Al-Kharusi, 2015), (Ajzen, 2012). Ajzen (2012) also specifies that despite the fact that individuals do not always gather the information used to forming beliefs in an impartial manner, as well as making logical deductions, the model accounts for these deficiencies. Once these beliefs are formed, the process that leads to forming a behavior occurs in a consistent manner. Figure 15 illustrates the previously described process of behavior forming.
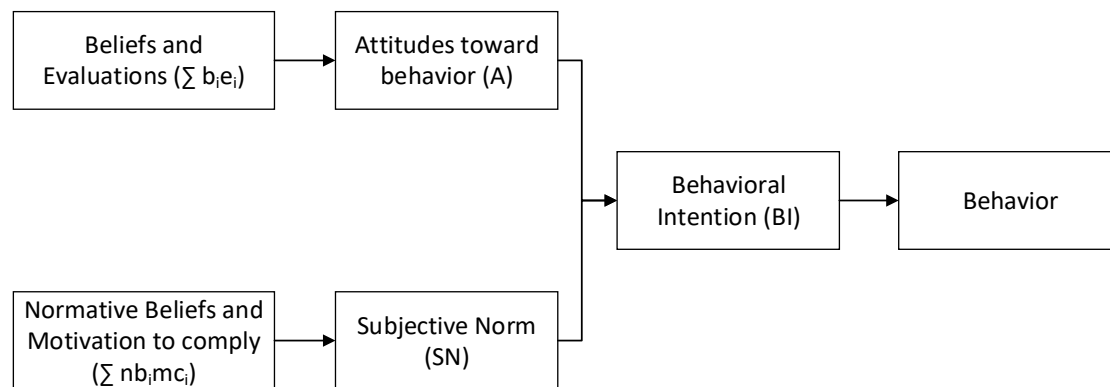
Figure 15 – Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975)

The development of TRA led to the theory eventually being expanded to the Theory of Planned Behavior (TPB) (Ajzen, 1991), (Ajzen, 2005), while both TRA and TRB were expanded to include elements from other key behavioral theories resulting in the Integrated Behavioral Model (IBM) (Fishbein, 2000), (Fishbein, 2008). TAM was first introduced by Davis (1986) and quantitatively tested by Davis et al. (1989). According to a Google Scholar search, the TAM has been cited over 21000 times. TAM builds on TRA, being an adaptation of the latter and defines two key measurable scales, linked to IS usage behavior:

- Perceived usefulness (PU)
- Perceived ease of use (PEOU)

TAM is more specific and narrower in application than TRA, attempting to justify user intention to use technology and software. Moreover, TAM is intended to aid practitioners not only predict the user behavior regarding use of an IS, but also explain such behavior, aiding in diagnosis and adjusting course of action for successful IS implementation (Al-Suqri & Al-Kharusi, 2015), (Davis, 1989), (Davis, et al., 1989).

PU relates to the extent that a user believes that a software or technology is likely to increase the user's job performance, while PEOU relates to the extent of effort put by a user when using a software or technology. The two defined constructs, PU and PEOU, are influenced by external variables, which vary from IS to IS. The external variables specific to ERP usage are defined later in this section. TAM is not only more specific, but also includes more complex relationships between constructs. Following relationships are (not) defined in TAM:

- *SN as a determinant of BI*

Due to lack of understanding regarding SN in TRA (Fishbein & Ajzen, 1975), as well as uncertainty regarding its influence from theoretical and psychometrical standpoints (Davis, et al., 1989), SN was not included in TAM. However, Davis et al. (1989) found that the effect of SN on BI is insignificant from a psychometric standpoint, although better models to evaluate SN are still required. The concept of social forces and SN were only introduced and investigated by Venkatesh & Davis (2000) in TAM2 (TAM2 is not discussed in this study).

- $A = PU + PEOU$

Instead of using beliefs and evaluations as a general determinant of attitude, Davis et al. (1989) replaces this concept, by defining the two more specific constructs, PU and PEOU, which together are determinants of attitude.

- $BI = PU + A$

The fact that PU is a direct influencer of BI (in addition to attitude) is explained by the fact that if a user finds a software or technology likely to increase performance, the user will express a behavioral intention to use, regardless if the attitude toward this behavior is perceived as positive or negative. This behavior is linked to a user's perception regarding positive outcomes when her efficiency is increased as a result of using the software or technology.

- $PU = PEOU + External\ Variables$

Davis et al. (1989) indicate that even though PU and PEOU are different constructs, they are also related, where PU can be influenced by both external variables and PEOU. The reason for this is that usefulness is considered a more significant and better indicator for quality of a system than ease of use.

- PEOU = External Variables

If PU is influenced by both external variables and PEOU, then PEOU is independent of PU and only influenced by external variables alone. Figure 16 sums up the different relationships described in this section regarding TAM, as well as the process which leads to user acceptance and use of a system. Davis et al. (1989) conclude the following about the research findings:

"Perceived usefulness (PU) is major determinant of people's intention to use computers, while perceived ease of use (PEOU) is a significant secondary determinant of people's intention to use computers", as well as that *"People's computer use can be predicted reasonably well from their intentions."*
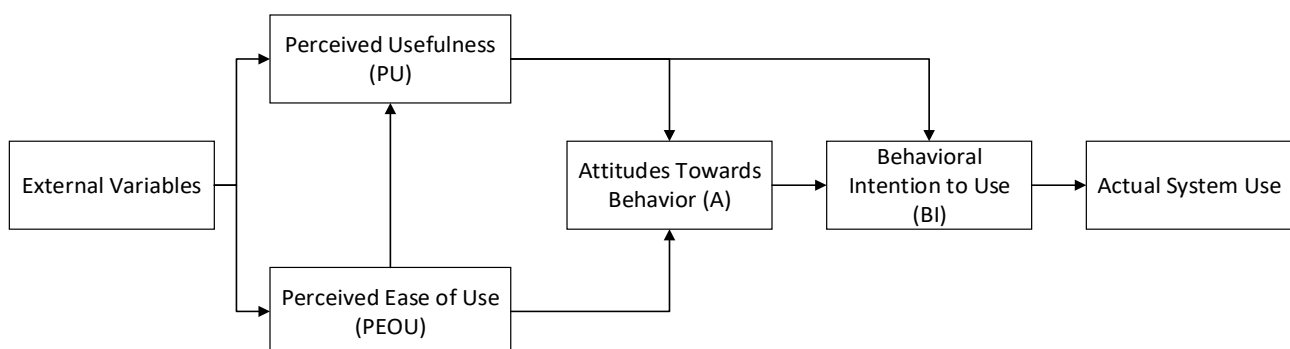
Figure 16 – Technology acceptance model (Davis, et al., 1989)

2.3.4.3   Technology acceptance model application for enterprise resource planning

The use of TAM has been extended by Amoako-Gyampah & Salam (2004), so that it can readily apply to ERP. External variables have been replaced by three ERP-specific constructs which have been tested and validated:

- Shared belief in the benefits of ERP system
- Project communication related to ERP system
- Training on ERP system

The choice of shared belief in the benefits of ERP system construct is motivated by the fact that ERP is a cross functional and organization wide IS, which involves users from multiple organizational levels, as well as the fact that ERP has the function of replacing legacy systems with a unified view on organizational processes. This requires the users not only to form individual beliefs about the ERP system, but also share them on a group level, where "mutual trust and commitment" is established (Amoako-Gyampah & Salam, 2004). Amoako-Gyampah & Salam (2004) theorize that due to the fact that users form beliefs on a group level, these beliefs can be formed both from sparring with fellow users, but also with managers, which then gives management the opportunity to positively influence the chances that users will use the newly implemented ERP system, based on the input they receive. This is done through the two previously defined constructs,

project communication related to ERP system and training on ERP system, both directly influencing the users' shared belief in the benefits of ERP system. Both Žabjek et al. (2009) and Aladwani (2001) employ the concepts of (project) communication and (employee) training in relation to change management success (as detailed in section 2.3.4).

Amoako-Gyampah & Salam (2004) link project communication to various enabling activities, such as share of critical information between employees from different functional parts of the organization, flow of information between employees about the benefits of the ERP system, purpose of effective communications as a means of uncertainty reduction and trust development etc. It should be noted that in the model developed by Amoako-Gyampah & Salam (2004), a direct relationship between training on ERP system and perceived ease of use of ERP system is also theorized. This is motivated by stating that previous research supports the idea of "perceptions of ease are affected by training during the early stages of learning", although exact reference to previous research is unclear in the study.

Amoako-Gyampah & Salam (2004) note that use of behavioral intention (BI) in an ERP context can be disputed, when top management's decision to replace a legacy system with ERP makes the ERP usage mandatory, resulting in the users having no choice other than to use the new IS. However, it is claimed that ERP usage involves both mandatory and discretionary parts, where the mandatory part includes the minimal level required to perform one's job, while everything beyond is discretionary, considering the complexity of a large multifunctional IS such as ERP. Moreover, it is affirmed that BI might still be relevant, where usage is completely mandatory, due to users' perception that the system offers them the ability to have control over the outcomes of their work with the IS. With other words, users might still manifest a behavior to use ERP, even when they do not have other choices. Figure 17 depicts the extended TAM model. The TAM core on which this ERP-specific model is based, is marked with a blue box in Figure 17.
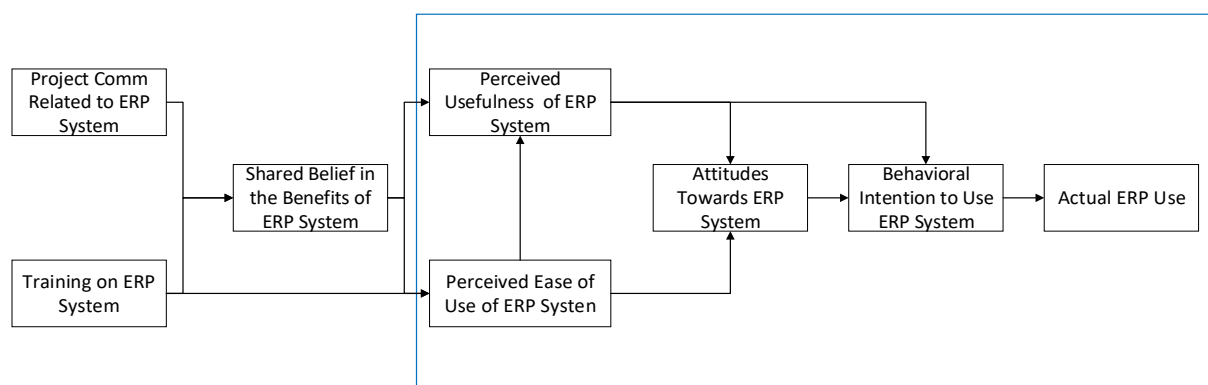
Figure 17 – Technology acceptance model adjusted for ERP use, based on (Amoako-Gyampah & Salam, 2004)

2.3.4.4   Technology acceptance model criticism

Technology acceptance models are not without criticism. Salovaara & Tamminen (2009, pp. 157-173) remark that there are several issues associated with the concepts and theories used by the different TAMs, including those discussed in this section by Davis (1989), Davis et al. (1989), Venkatesh & Davis (2000) etc. TAM is criticized for various constraints. Lack of longitudinal studies constitutes an issue because user acceptance and usage can change across time and phases of a software. Generalization of a user's profile proves to be problematic since it only investigates the average user and does not account for other factors such as work division, work roles etc. Oversimplification of the measuring system (for example measuring only the frequency of use) prevents TAM from reflecting the full complexity of the system usage, because it only focuses only a specific mode of use.

Other criticism also involves use contexts, where TAM, in contrast to TRA, claims that PU and PEAU are postulated a priori, meaning the relevance of these constructs is predetermined and they represent general determinants of user acceptance. However, Salovaara & Tamminen (2009, pp. 157-173) claim that use context is a dynamic concept, where technology can be initially adopted and later abandoned or vice versa, meaning TAM's a priori formulated user acceptance determinants might not be able to help predicting technology success. It is technology success that one aims to predict and achieve by measuring user acceptance. However, Salovaara & Tamminen (2009, pp. 157-173) also remarks that, despite the inherent limitations of TAM, some of the criticized parts of it have been addressed, although in some respects insufficiently.

2.3.5 Top management

A primary issue related to top management is its generally inadequate perception and understanding of IS, both in terms of its scope, purpose, financial benefits and responsibility, as well as in terms of its implications for the business processes in an organization. Based on a literature review performed by Žabjek et al. (2009), top management support is evaluated as being the leading CSF in ERP implementation. Žabjek et al. (2009) also underline that the lack of top management involvement and hand over of implementation responsibility to the technical department will lead to unsuccessful implementation. It is therefore critical that top management involvement, as well as collaboration between technical department and top management takes place on all stages of the ERP project. The gap between top management and IT specialists in the organization adds to the difficulties of achieving successful ERP projects, many managers being unaware of the activities in the IT department (Žabjek, et al., 2009). However, the overall success of ERP projects does not solely depend on the technical success of the project, where studies have shown that an ERP project can still be successful, even though time, cost and scope goals are not fully achieved (Wateridge, 1998), (Zhang, et al., 2005).

According to Žabjek et al. (2009), top management perceives IS merely as a tool or a support function, rather than a core function meant to create a long-term strategic impact by enhance business performance and innovating business processes. Instead of seeing IT systems as an expense, top management should shift its mindset by seeing IT systems as an investment and integrate it to become a holistic part of one's organization. Žabjek et al. (2009) also note that by wishing to use IT systems as a means of optimizing business processes, top management ends up keeping redundant legacy processes instead of completely reengineering them prior to implementing the new system.

The fact that ERP is a business and organizational initiative is strengthened by the case of Bharat Petroleum Corporation Limited (BPCL), company which has won the CIO Global 100 award for technology and forward-looking human resource policies. BPCL has engaged in the successful implementation of an ERP system in over 200 locations across India, all this as early as 1996, when Internet was still limited to dial-up speeds. According to the head of IT in BPCL, the IT department has "just performed the necessary catalytic role". Moreover, the planning phase was headed by an HR person and had only 10 IT employees associated to the planning process, while 60 others were employed in other departments in the supply chain. However, the two-phase implementation process involved a larger number of SAP specialists, both from SAP India and PwC accounting firm (Teltumbde, et al., 2002). The importance of top management involvement and organizational efforts related to the change management in BPCL are acknowledged by Teltumbde et al. (2002).

2.4   Process and strategic dimension

2.4.1   Business processes

2.4.1.1   Introduction to business processes

Business processes are key activities performed in an organization. Processes can be manual or automated. A set of processes form a business system (Davenport & Short, 1990). A business process can be defined as "a set of logically-related tasks performed to achieve a defined business outcome" (Davenport & Short, 1990). Business processes are of three types: management processes – processes which administrate the operational processes (for example corporate management), operational processes – core processes, which create value stream in the organization (such as manufacturing or sales) and supporting processes – which support the core processes (for example accounting or legal departments) (Toor & Dhir, 2011).

Davenport & Short (1990) mention two important characteristics processes have:
- Customers – customers are the target of business processes' outcomes
- Cross organizational boundaries – processes are independent of organizational structure

Davenport & Short (1990) state that organizations do not benchmark their processes with the aim of increasing their efficiency and effectiveness and neither do they attempt to reengineer them. Moreover, many business processes have been designed and existed in organizations prior to the advent of IT systems. This might be particularly true to the construction sector, where digitalization levels are low. Even though some organizations do attempt reengineering, they do not account for IT capabilities of the reengineered business processes when doing so (Davenport & Short, 1990).

2.4.1.2   Process maturity

In order to describe the maturity of processes in an organization, the capability maturity model integration (CMMI) staged model can be used. CMMI was developed by Carnegie Mellon University and "provides a framework for improving the processes organizations use to develop and deliver products for their customers" (Gallagher, 2002). Being initially developed by the software engineering institute at Carnegie Mellon, a lot of the research literature is directed at software organizations. This does not restrict the framework only to the field of IT though. Nonetheless, the focus of this section is not CMMI itself, but rather the provided model which can be used to identify the processual maturity in an organization. From a process point of view, organizations can be described as immature and mature, where immature organizations are characterized by a reactionary attitude to situations, lacking long-term perspective and focusing on solving immediate issues. Processes are likely to be improvised in such organizations and lack standardization or any formal definition, and even when they are specified, such specifications are not evenly enforced or respected throughout the organization.

CMMI staged model is a model which can be used to describe and measure the process maturity in organizations, and where a scale from one to five is used, where one is least mature process status and five is most mature: initial, managed, defined, quantitatively managed and optimizing (Figure 18). The initial level (level 1) is characterized by processes which are impromptu and situational, where despite some successes, the success cannot be consistently reproduced across the organization, due to lack of standardization. The managed level (level 2) is described by the organization's awareness over the processes, the fact that these must be planned, controlled, executed and measured. Processes begin being routinized at this level. The defined level (level 3) is characterized by processes which are not only understood, but also adequately defined through standards and procedures and aligned to the company's needs and strategy, whereas in level 2, even though processes might be defined to some degree, they are also not aligned across the organization. The quantitatively managed level (level 4) statistical or quantitative measures are employed to measure the process performance. Objectives are also defined in this regard. At highest level, optimizing (level 5), the company has achieved a high degree of maturity and is continuously improving its processes (Mahmood, 2015), (Software Engineering Institute, 2010).
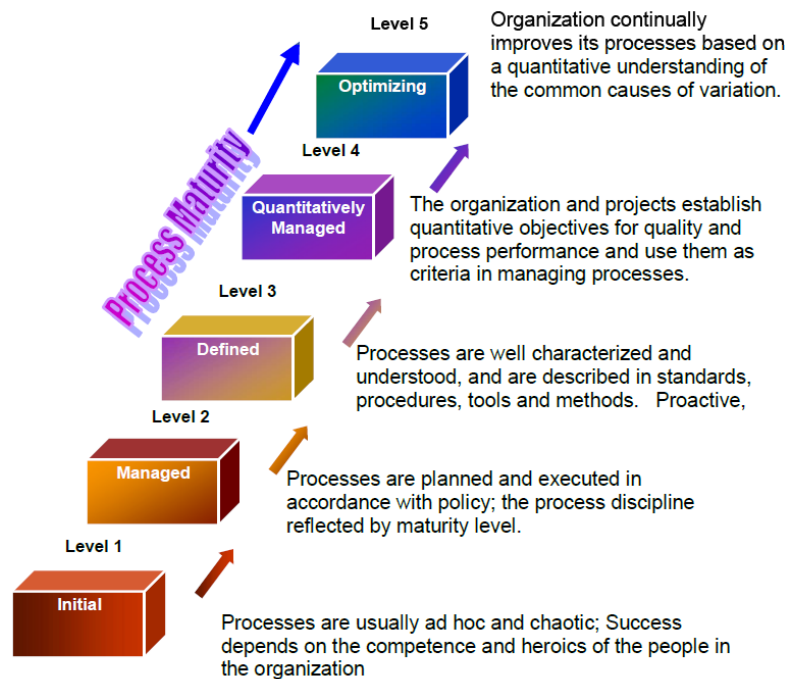
Figure 18 – The five levels of process maturity (Mahmood, 2015), (Software Engineering Institute, 2010)

2.4.2 Business process reengineering

2.4.2.1 Introduction to business process reengineering

According to Attaran (2004), the term 'reengineering' originates from the 1980s from the field of IT, where the process was undertaken by companies in the US to increase the organizations' efficiency and competitiveness, and where the need to react fast to the dynamic and ever-changing modern business environment led to a wider interest and adoption of business process reengineering (BPR). BPR can be defined in a very simple way as: "the analysis and design of workflows and processes within an organization" (Davenport & Short, 1990). However, Hammer & Champy (1993) claim that BPR involves radical design of business processes in order to obtain considerable process improvements, while Petrozzo & Stepper (1994) claim that the reengineering should occur concurrently and not incrementally, where one process would be redesigned at a time.

Both BPR and ERP evolved from different sources – BPR in the late 1980s, as a result of changing business environment, as well as the need to maintain competitive advantage over competitors – ERP in the early 1990s, but originally from the 1960s in the manufacturing industry, which was increasingly automated and required better tools to plan resources and inventories (O'Neill & Sohal, 1999), (Rashid, et al., 2002). Even though BPR research literature has been less abundant lately, BPR is characterized by so little standardization, that even its nomenclature greatly varies across the literature – business process improvement, renovation, change or redesign being only few of the variations. As Crowe & Rolfes (1998) notes, BPR originates from the business world, with the research world picking up the topic only afterwards, on a lower scale.

Harmon (2010) points out that today BPR is regarded as a failure by many, but that might actually be not true at all in spite of the high failure rates linked to it. Looking retrospectively, BPR was developed in the early 1990s when Internet was still a foreign concept for most organizations, most software was proprietary and technology implementation costs much higher than today. Yesterday's movie rental store and analog photography are today's online subscription-based movie database and digital or phone cameras, changes that have occurred within brief periods of time and has led companies that refused to change and reinvent themselves, to bankruptcy on the long run.

Consensus generally lacks about the scope and degree of organizational change, as well as the tools used to assist the BPR implementation. BPR is not characterized nor bound by any specific methodologies, and it is therefore up to the practitioner to combine different management principles to ensure the success of the BPR project (Crowe & Rolfes, 1998), (O'Neill & Sohal, 1999). Some BPR tools and techniques are:

- Process visualization (for example workflows);
- Process mapping (for example data flow diagrams (DFD), Object-oriented analysis (OOAD));
- Change management;
- Benchmarking;
- Process and customer focus (O'Neill & Sohal, 1999).

2.4.2.2   Link between business process reengineering, IT and strategy

O'Neill & Sohal (1999) claim that most of the literature states that what is essential to BPR is the strategic approach. With other words, BPR describes a variety of activities, which aim to improve processes, but which require top management involvement, who sets the strategic direction and outcomes. BPR should therefore be perceived as an outcome-driven procedure, where the set outcomes dictate the scope of the BPR project. Such outcomes include cost reduction, head count reduction, increased efficiency and quality, higher customer satisfaction, core and non-value adding process identification (Al-Mashari & Zairi, 1999), (O'Neill & Sohal, 1999).

More than often, IT is seen as a mere automatization tool in a business context. However, in the modern dynamic business environment, characterized by continuous changes, this perspective is changing and technology and BPR go hand-in-hand, with technology changing processes radically, rather than only supporting them (Davenport & Short, 1990), (Siriginidi, 2000). Harmon (2010) attributes this paradigm shift to Champy, Davenport and Hammer, which in the start of 1990s have promoted the idea of radical organizational improvements through use of IT, which changed from fulfilling a support function to being a method of radically transforming business processes. O'Neill & Sohal (1999) underline that IT changes need to be aligned to the soft part of an organization – culture, strategy and structure, otherwise organizations would risk falling into the pitfall of adopting IT solutions that are not supported by the organization. Companies can only achieve automation of already defined processes, where IT is only an enabler of BPR, yet a powerful one. Furthermore, O'Neill & Sohal (1999), Al-Mashari & Zairi (1999), Habib (2013) and others cite Hammer & Champy (1993), who claim that the reason for why BPR projects are linked to failure rates as high as 50-70%, is that companies have tried to use reengineering through IT solutions as a substitute for strategic thinking. O'Neill & Sohal (1999) points out that the purpose of BPR is "the implementation of organizational change and the visioning involved in the change, rather than the technology itself", where IT specialists would claim it is the latter that is the focus.

Toor & Dhir (2011) define BPR as a cyclic procedure, consisting of four steps: process identification; AS-IS review, update and analysis; TO-BE design and TO-BE testing and implementation (Figure 19). This BPR cycle illustrates the pure BPR procedure and has no technology associated to it. Being a cyclic procedure, BPR essentially also consists of a fifth step which can be described as continuous improvement of the reengineered business processes (Hammer & Champy, 1993). Davenport & Short (1990) links BPR and technology together and suggest a recursive relationship between IT and BPR, where organizations transform business processes using IT capabilities, but also where new IT capabilities would lead to new business processes (Figure 20). Davenport & Short (1990) propose a number of five steps that organizations should follow when engaging in BPR (Figure 21). These steps link the BPR approach to IT. However, just as Hammer & Champy (1993) and O'Neill & Sohal (1999) also indicate, it is strategic thinking that has to come first. Therefore, when following these steps, organizations have to take their starting point in their business processes and not IT capabilities, and first develop a vision and objectives for the processes that have to be reengineered, before identifying any potential IT solution candidates that can support the newly reengineered processes.
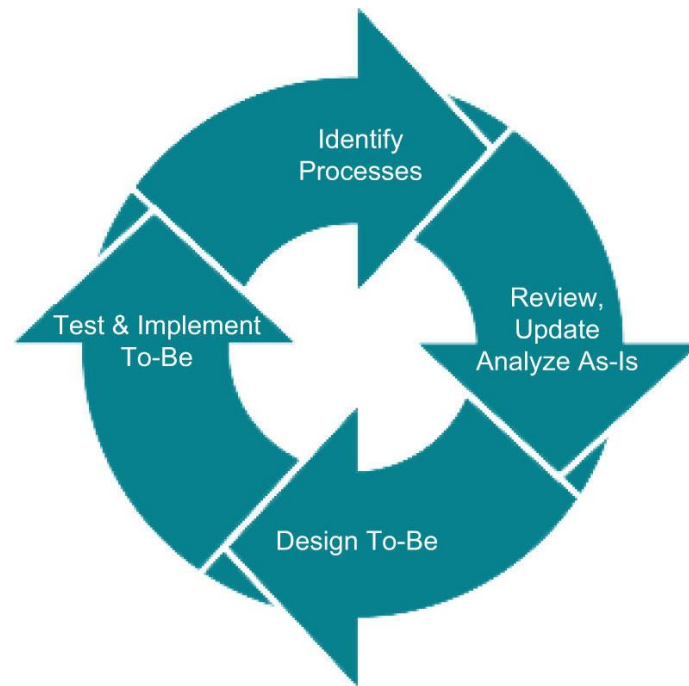
Figure 19 – Business process reengineering cycle (Toor & Dhir, 2011)
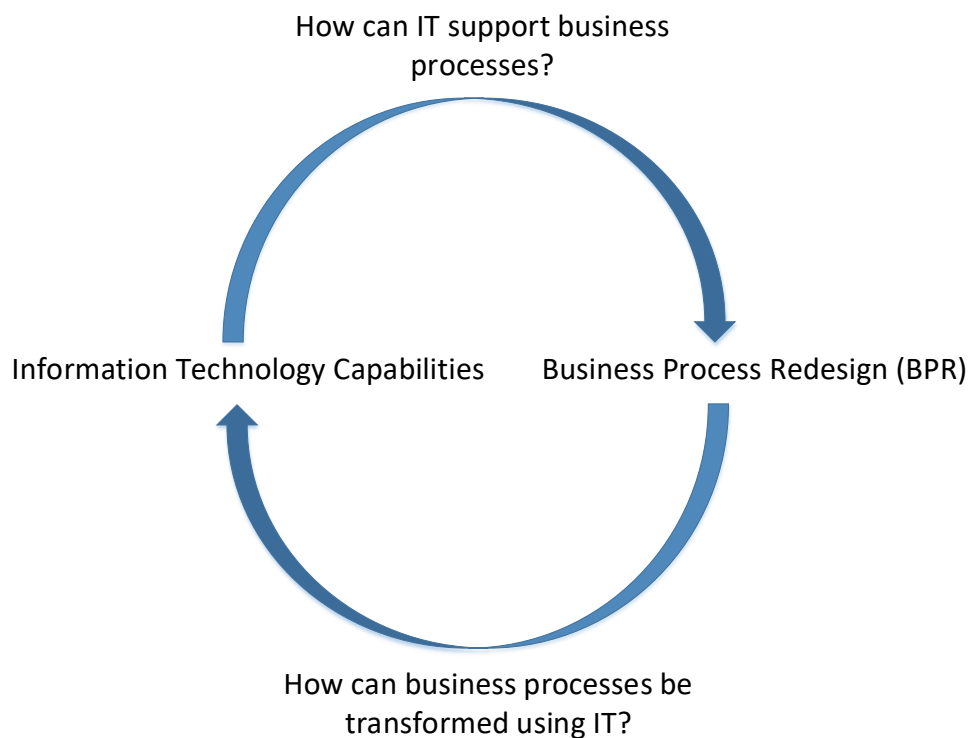
Figure 20 – The recursive relationship between IT Capabilities and Business Process Redesign (Davenport & Short, 1990)

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┌─────────────────────────────────────────────┐
│ Develop Business Vision and Process Objectives │
│   • Prioritize objectives and set stretch targets │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│ Identify Processes to Be Redesigned          │
│   • Identify critical or bottleneck processes │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│ Understand and Measure Existing Processes     │
│   • Identify current problems and set baseline │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│ Identify IT Levers                            │
│   • Brainstorm new process approaches         │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│ Design and Prototype Process                  │
│   • Implement organizational and technical aspects │
└─────────────────────────────────────────────┘
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Figure 21 – Five steps in process redesign (Davenport & Short, 1990)

2.4.2.3   Business process reengineering execution

In terms of execution, BPR can be initiated through a project approach, where a team is created for the purpose of reengineering a process and disbanded when the process is successfully reengineered. It is recommended that one process is reengineered at a time, followed by a new process once the first is completed, in order to avoid negative impacts on the organization. For this very reason, major BPR projects can be lengthy and require long-term commitment (O'Neill & Sohal, 1999).

Žabjek et al. (2009) emphasizes the importance of process ownership in an organization, where from an organizational point of view, even though decisions to reengineer processes must come from the top, it is the employees themselves that have to perform these changes. An import part in this process represents filling the existing gap present in many traditional organizations between top management and employees, by use of process owners. Žabjek et al. (2009) defines process owners as "the persons of trust and confidence with quite high reputation, respect, toleration and readiness to change", whose task "is not to do business reengineering, but make it happen". Process owners take ownership of processes and follow the change of critical business processes to the end, reason process owners require empowerment from top management and recognition from fellow employees. It should be noted that Danish organizations are rather flat – Denmark scores low in power distance dimension, being known for high employee autonomy (Hofstede, 2019), which makes leaders such as process owners, quite informal leaders. However, this does not change the fact that an organization must be process-oriented, and couching is required in order to ensure successful reengineering of processes. Danish construction sector is known to be traditional, lack innovation and competitiveness, which makes changes less likely to happen (Kuben Management, 2016).

2.4.3   Enterprise resource planning implementation approaches

An important prerequisite for initiating an ERP implementation process is ensuring that alignment between the organization's business processes and the ERP system of choice is achieved. Careful evaluation of this critical pre-implementation step is required, as the choices can a double-edged sword – standardizing critical business processes in order to fit ERP might compromise an organization's competitive advantage, while on the other side failing to sufficiently standardize business processes to make use of an ERP system's

streamlined processes might result in a costly, risky and inefficient implementation, which as discussed in section 2.3.5 (Top management), an organization would end up keeping redundant legacy processes that are not value creating (Panayiotou, et al., 2015), (Žabjek, et al., 2009), (Kovacic, et al., 2002), (Kovacic, 2004). Dezdar (2012) notes that companies are likely to be required to reengineer at least their core processes when attempting to implement ERP, due to the fact that their processes and organizations do not match the ERP system's way of operating. However, Dezdar (2012) found a negative correlation between BPR and ERP implementation success and concludes that this result might owe to the fact that Asian companies are less willingly to pursue radical process changes through BPR compared to their Western counterparts. Panayiotou et al. (2015) describes three possible paths that can be undertaken in order to align an organization's business processes to the standard ERP processes:

1. Technology-driven (also called IT-driven or ERP-driven) approach involving adaptation of an organization's business processes to fit the ERP system;
2. Process-driven approach involving adaptation of ERP systems to the organization's business processes;
3. Hybrid approach (requirement-driven) involving a combination of the other two approaches.

Panayiotou et al. (2015) indicates that the technology-driven approach to BPR is regarded as the best-in-class practice and that numerous methodologies are present in the literature, making this approach widespread and widely recognized. Using this approach will require the company to perform major process changes in order to align the organization's processes to the ERP system (Panayiotou, et al., 2015). Although the focus of this approach is minimizing the customization of the ERP system, Panayiotou et al. (2015) points out that this can be unavoidable in many cases, due to the specific business processes a company has, which create competitive advantage. Altering such processes might compromise the competitive advantage, hence ERP customization is required instead. Furthermore, it might not be desirable to standardize these business processes at all, if the competitive advantage is affected.

ERP success can also be achieved through a process-driven approach, which requires companies choosing the ERP system, based on the needs of the organization. This is done by reengineering/improving processes prior to ERP implementation or even choice of ERP system and vendor. Process-driven approach involves adjusting a company's business processes in line with its strategic objectives (Panayiotou, et al., 2015). The technology-driven and process-driven approaches are summed up in Figure 22. Both approaches share a number of common steps, which involve the company performing a preliminary investigation of the current organization, defined as AS-IS study, where the current business processes are mapped, followed by a preliminary investigation on how the company wishes the system to look like in the future, defined as TO-BE study. After performing the preliminary TO-BE study and having a preliminary overview over how business processes should be modelled and how these will look after reengineering, the company selects one of the two approaches – technology-driven or process-driven, where the first will limit a company more to the ERP package constraints, while the latter will allow selecting an ERP package matching the reengineered processes.

The third approach, hybrid, is an alternative to the two previously described approaches, being the least researched and applied, as well as the least supported by frameworks and methodologies. The hybrid approach involves combining technology-driven and process-driven by simultaneously applying the two through concomitant implementation of BPR and ERP (Panayiotou, et al., 2015). However, this take on the hybrid approach is not without issues, reason why Panayiotou et al. (2015) underline the importance of a requirement-driven alignment approach within the hybrid approach, with special focus on requirements engineering (RE), due to the fact that too much focus is placed on the implementation phase of ERP systems and the issues associated with it, rather than on the planning/selection phase where RE play a vital role. RE is defined as:

"the process of closing the gap between a specific problem and the solution for that problem" and *"consists of the development and management of the set of requirements for a computer-based system" (Panayiotou, et al., 2015)*
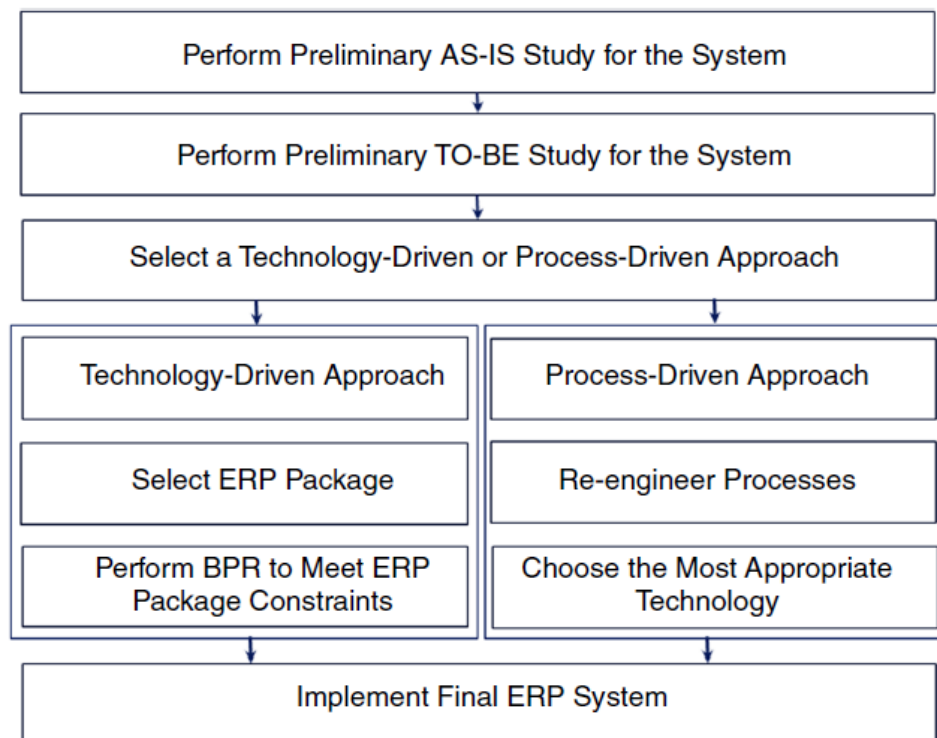
Figure 22 – Enterprise resource planning implementation approach (Panayiotou, et al., 2015)

By using this approach, it is possible to bridge the gap between software functionality and organizational requirements (Panayiotou, et al., 2015). In their framework, Panayiotou et al. (2015) underline the importance of request for interest (RFI) as part of the planning process, due to the fact that the reviewed literature overlooks RFI and does not distinguish between RFI and request for proposal (RFP). RFI plays an important role, as it is part of the base which the company uses when planning their BPR prior to sending an RFP to the chosen ERP vendors. There are several issues associated with lack of knowledge in requirements definition:

- Requirements are not included in the RFP;
- Requirements are included in the RFP, but they are redundant;
- Requirements are not properly understood, hence incompletely/inappropriately described.

These issues create two negative outcomes – definition of inappropriate functional specifications and misunderstanding these specifications in the implementation phase, which would ultimately influence the success of the latter. The described framework aims to eliminate the two outcomes and consists of four stages (as illustrated in Figure 23):

- Stage 1 – In this very first stage, the company creates the AS-IS model of the organization's current business processes and IS. This is performed by using process modeling, which aids the company in identifying problematic areas such redundant and inefficient processes, processes that lack of standardization, processes that can be IT-enabled, information islands. Based on the identified problem areas, an RFI is sent to potential ERP vendors, which are inquired about software functionality. This allows the company to gain insight into the ERP market, products and functionality, without researching the

market themselves, which they might or might not be acquainted to. Panayiotou et al. (2015) points out that contrary to common practice, where RFP is prepared right after an ERP vendor announces its intention to participate, in the proposed framework RFP takes place only in Stage 3, so that the management has better capacity to plan the organizational change/readiness, as well future strategies and process change which leads to development of the TO-BE model (Stage 2);

- Stage 2 – BPR/business process improvements (BPI) are performed at this stage based on ERP functionality (RFI received from vendors) and the strategies and goals defined in Stage 1. The outcome of Stage 2 is the creation of the TO-BE model. Based on available resources, the company can choose which processes are critical to undergo BPR/BPI and prioritize as such, performing the first gap analysis in the process;

- Stage 3 – This stage involves sending the RFP containing functional specifications to the vendors, which are extracted from the newly developed business processes in the TO-BE model;

- Stage 4 – Also called RFP stage, it involves developing the second gap analysis based on vendors' RFP replies, where the requirements in the TO-BE model are compared to the functionality that can delivered by the ERP system and its eventual customizations. The ERP is finally selected while accounting for the gap analysis' results and costs.

Panayiotou et al. (2015) notes that the final implemented functionality might differ from what it was initially planned, resulting in different final business processes, then those planned in the BPR/BPI. Therefore, evaluation of the new system can be applied and a new AS-IS model developed, so that the planned versus implemented can be compared, followed by a last gap analysis, where the current business processes can be aligned with the planned ones.

In order to bridge the gap of process understanding between business analysts and software implementers, as well as to connect business and IT together with the goal of generating functional requirements for the ERP implementation, a business process modeling approach is required. This approach proposes three interconnected views – an organizational view, a business process view and information systems view (Figure 24). In order to link the organizational view with the business process view, it is first required to develop function trees (which are trees illustrating all the functions a business process has and connect them in their logical order). From a function tree, context diagrams are developed (these depict the relationship between processes and are developed for process groups) and lastly detailed process diagrams for each process. When process diagrams are completed, the organization can connect the organizational charts to the process diagrams, by essentially putting employee names on the processes. Functional requirements can be generated, and the mapping of the information system start. Functional requirements are the basis for RFP send to ERP vendors.

Koch (2001) defines four ideal types of BPR variations typical in Denmark – redesign; top down, radical BPR; IT-driven BPR and participative BPR. While BPR is normally associated with radical process changes – top down, radical BPR – Panayiotou et al. (2015) refers to it as process-driven BPR (this approach does not account for a specific IT), redesign is instead associated with minor adjustments. IT-driven BPR involves, as previously described, execution of process reengineering to fit the characteristics of an IT system (in this case ERP). Participative BPR is a BPR variation found in Denmark, where employees are involved in the reengineering. However, as Koch (2001) notes, this variation is not very common.
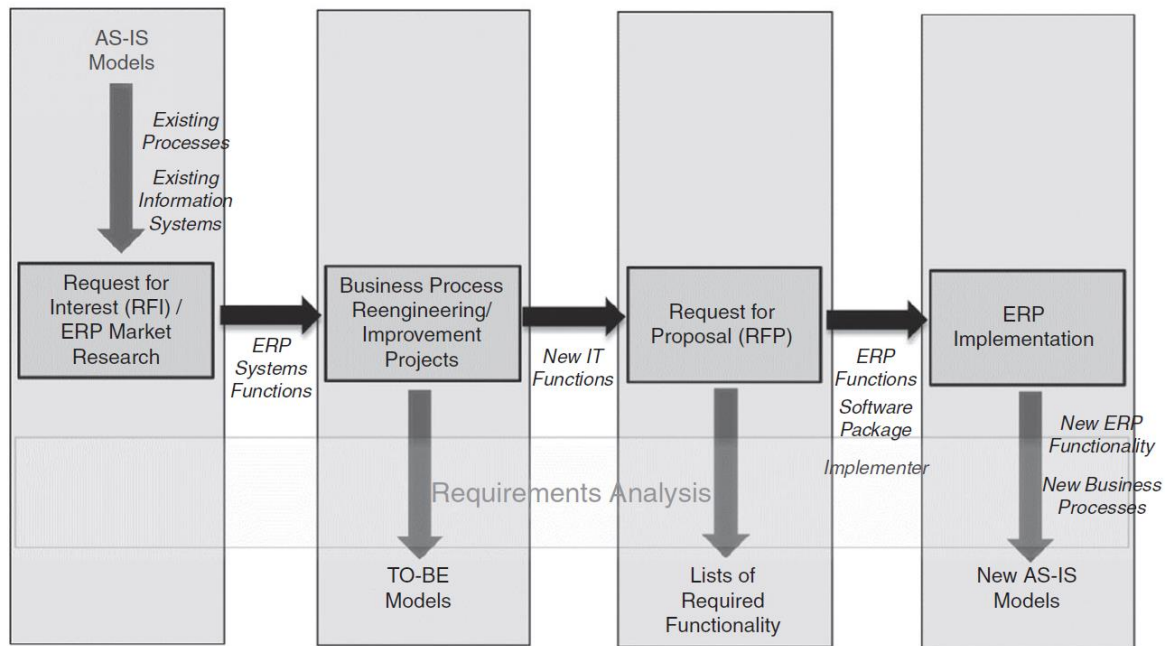
Figure 23 – Requirements engineering for ERP systems development lifecycle framework (Panayiotou, et al., 2015)
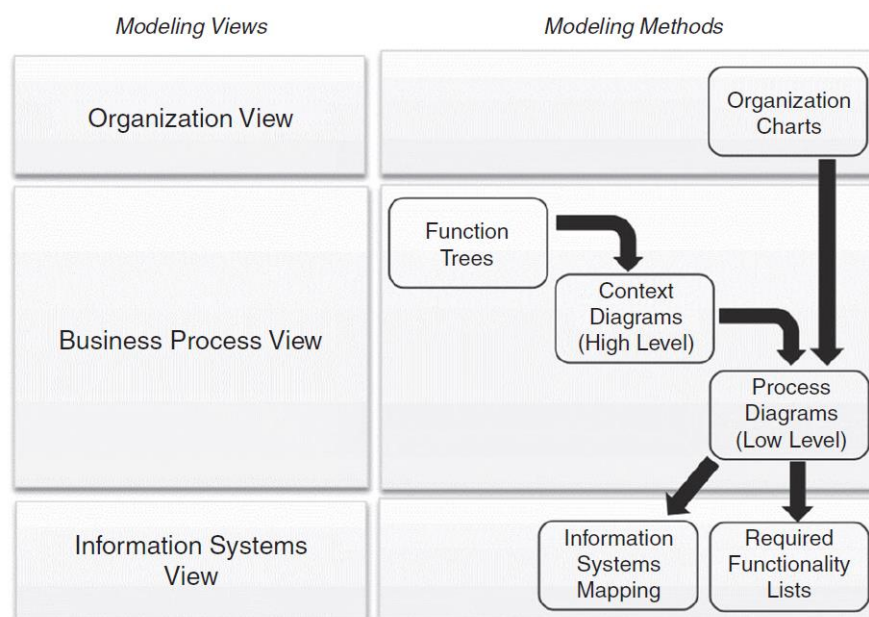
Figure 24 – Modeling views and methods of the process modeling approach (Panayiotou, et al., 2015)

2.5   Literature review summary

This chapter has covered the main areas and issues within the ERP topic – it presents the basic concepts of ERP, its history, CSFs associated with ERP, ERP life cycle phases and ERP dimensions. Each of these dimensions are then described in detail and issue areas identified. Product dimension describes the components and capabilities of an ERP system, trends, as well as advantages and disadvantages of different solutions. Special focus is placed on cloud ERP, which is an emerging area. Change management and people section presents the different organizational structures and the issues related to them, change management strategies, as well as the principles of technology acceptance models and these can be used to overcome user resistance. Lastly, the process and strategic dimension discusses the importance of business process maturity, the link between strategic planning, AS-IS and TO-BE mapping in relation to BPR approach, as well as the different ERP implementation approaches companies can choose from.

3   Problem identification

Through the literature review it was found that both BPR and ERP initiatives are linked to high failure rates and that a close link exists between strategic planning, technology implementation and processual change. As a result, this study sets out to investigate the ERP implementation readiness in four different large Danish contracting companies. Considering that the ERP implementation rate is hypothesized to be low and most if not all the investigated companies do not have a (fully) operational ERP system into place, the study will instead focus on the pre-implementation phase of ERP (adoption decision/ acquisition phase). What it is clear is that during the pre-implementation phases, companies question the need for ERP and must undertake strategic planning and mapping of processes through development of AS-IS and TO-BE models in order to establish ERP implementation readiness. The process of achieving ERP implementation readiness involves use of BPR, which is then investigated in this study through the following research question (RQ):

RQ1. *What is the link between business process formalization and ERP implementation readiness?*

Moreover, three additional working questions (WQ) are defined to support the main research question:

WQ1. *Are companies required to undertake AS-IS and TO-BE process mapping in order to achieve ERP implementation readiness?*

WQ2. *How does the process maturity level corelate with the companies' ERP implementation readiness?*

WQ3. *Can ERP implementation readiness be achieved through varying degrees of BPR?*

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4 Research methodology

This chapter discusses the research methodology which underpins the present study and aims to document and support the research assumptions that are taken regarding research philosophy, approach, strategy, choices, time horizons, and techniques and procedures. The content of this chapter is structured based on Saunders et al.'s (2009, p. 108) research 'onion', a research process, which consists of multiple layers, with the outermost layer (research philosophy) as the most abstract, and the innermost layer (research techniques and procedures) as least abstract (Figure 25). However, the research model is first presented.
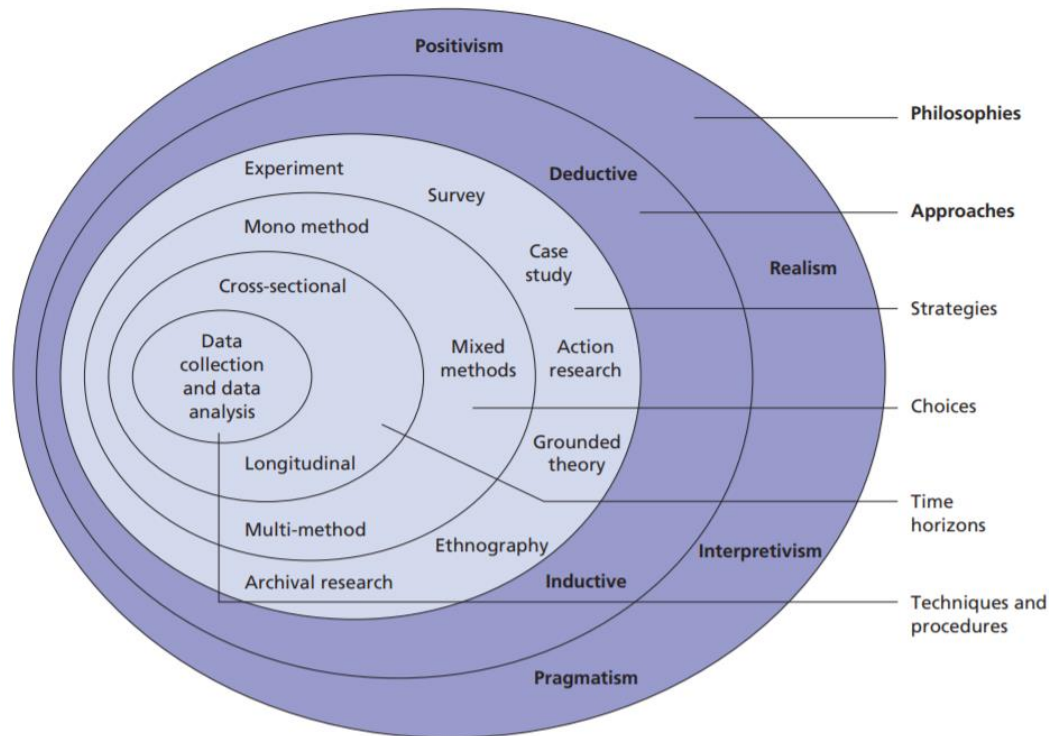
Figure 25 – The research 'onion' (Saunders, et al., 2009)

4.1 Research model

This study is structured based on an hourglass approach (University of British Columbia, 2012) and divided in three main parts: initial situation, intervention situation and final situation (Figure 26). The initial situation covers a broad narrative which introduces the reader to the ERP topic (Introduction chapter), followed by a in depth description of its main constituents, where the four main ERP dimensions are covered from a theoretical point of view (Literature review chapter) and concludes with a problem statement (Problem identification chapter), which identifies a focus area from the literature review, narrowing down to one specific ERP dimension and problematizes it by iterating a number of questions the study has to answer in the intervention situation. The intervention situation represents the main body of this study and it is where the study's findings are described and analyzed (Data analysis chapter). Lastly, the final situation gradually broadens the ERP topic, first by putting the theory and findings together and discussing in depth how the research questions are answered (Discussion and L chapter), and second by discussing the study's weaknesses and gaps, as well as ideas that were not (fully) covered in current study and which can be further developed and investigated (Further research chapter).
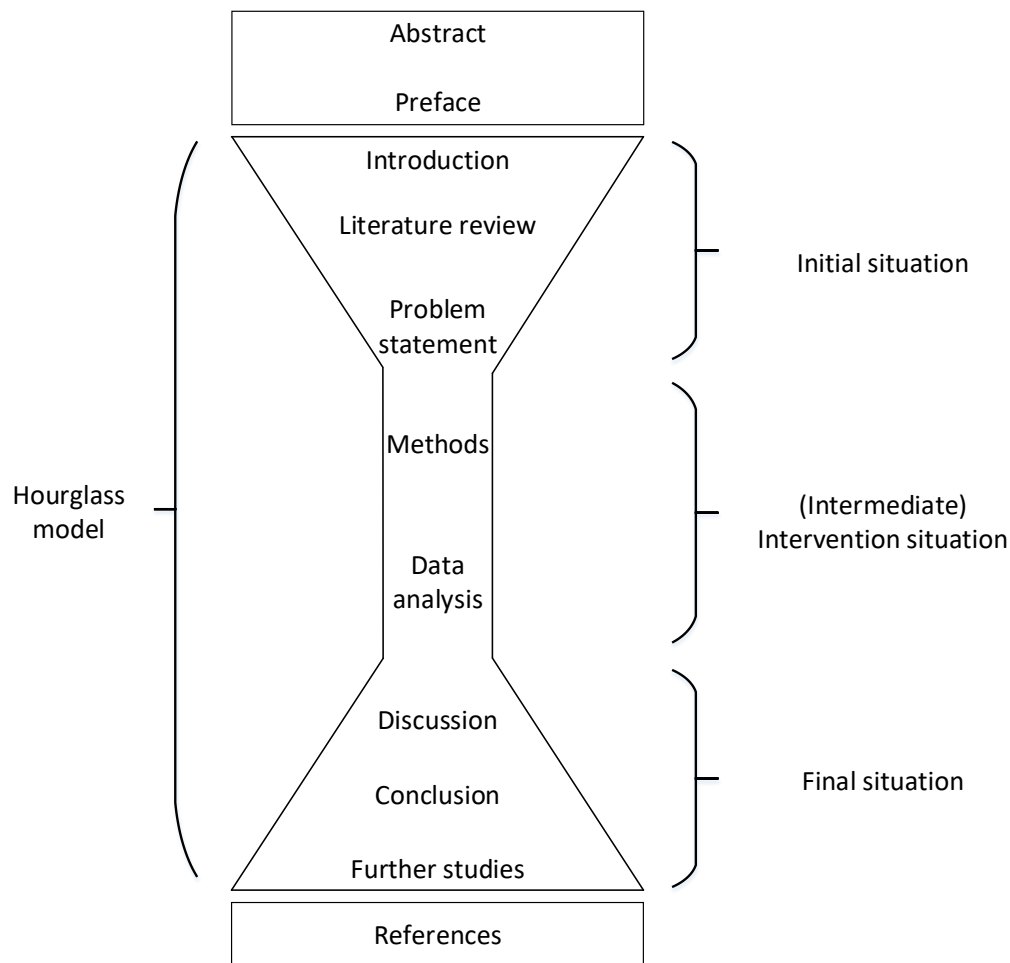
Figure 26 – Research model

4.2 Research philosophy and approach

4.2.1 Research philosophy

This study chooses the ontological objectivism (as opposed to subjectivism) as its research philosophy, which claims that social phenomena are independent of social actors. On a more relatable context, this study studies information systems in organizations, where from an objectivist standpoint, various management subsystems (such as organization) are defined as variables, which the management can model to generate the wished outcome. Thus, management principles are defined with emphasis on their structural side, meaning they universally apply to all organizations. Within the objectivist and subjectivist philosophies, four different paradigms can be defined. It is found adequate to select the functionalist paradigm for this study; the functionalist paradigm concerns with finding rational explanations to organizational problems to which recommendations can be developed afterwards for the management to apply (Saunders, et al., 2009, pp. 110-111). According to Saunders et al. (2009, p. 120), the functionalist paradigm is the most common research paradigm in the field of business and management.

4.2.2 Research approach

The field of IT and technology in the construction sector was the initial starting point for this study. Gradually, this field was narrowed down, and ERP was identified as topic candidate. Following a detailed literature review of the topic, the student found the process management and more specifically, BPR, as interesting and relevant for further investigation in relation to ERP. Based on theories and frameworks described in the literature review, a problem statement was formulated to test such theories and frameworks in practice and establish a causal relationship between theory and practice. This approach can be best described as deductive (Saunders, et al., 2009, pp. 124-125).

4.3   Research strategy

Case study strategy is regarded as most appropriate research strategy for this study. The initial two candidates for the research strategy were survey and case study. This study took its starting point in ERP implementation statistics, which were initially used to select the current topic. There are several arguments for why it was deemed as more relevant to pursue a case study approach from this point onwards. Firstly, by choosing the case study strategy, the topic can be investigated in depth with the purpose of gaining a rich and holistic understanding of a limited sample population, which despite the fact that it cannot be generalized to the whole population as in a survey research, the former gives the opportunity to collect a wider range of data than the latter. Moreover, by using semi-structured interviews, additional questions can be asked in order to investigate possible relationships, which initially could not be explored by the predefined interview guide, something that is a limitation in survey strategy. The case study is organized as a holistic multiple case (multiple case + holistic case), which means that instead of focusing on a single enterprise, multiple enterprises are interviewed in order to better enhance the understanding, as well as cover possible gaps which can occur when only when enterprise is interviewed. The holistic aspect means that the focus is placed on the enterprise as a whole and not on individual sub-units of the organization. Moreover, holistic focus also means that the cases are not treated as individual, but added up together, with the aim of identifying common differences and similarities (Saunders, et al., 2009, pp. 145-147).

4.4   Research choices and time horizon

4.4.1   Research choices

The chosen research choice is mono method, which means a single data collection technique is employed, together with its associated data analysis procedure. Therefore, only qualitative data is collected and analyzed in this study through use of in-depth semi-structured interviews (Saunders, et al., 2009, pp. 151-152).

4.4.2   Time horizon

Cross-sectional study is chosen in terms of time horizon. This means that the phenomena is investigated at a fixed point in time, with all interviews conducted over a short period of time (approx. 3 weeks) (Saunders, et al., 2009, p. 155).

4.5   Techniques and procedures

4.5.1   Credibility of data and findings

Being a qualitative study, the notions of credibility, transferability and confirmability are used to replace the notions of internal validity, external validity and reliability, where the former notions are associated with qualitative studies and the latter with quantitative studies. The qualitative terms are used in this section, with the quantitative terms indicated in brackets (Lincoln & Guba, 1985).

4.5.1.1   Credibility (Internal validity)

The study's credibility is achieved by ensuring that cause-effect inferences are made in a correct manner, where the effects' correct causes are identified and selected from among multiple possible causes. This is particularly important for the discussion where theory is compared to primary data. Errors and biases are avoided by stating where uncertainty regarding cause-effect relationships exist (Trochim, et al., 2016).

4.5.1.2   Transferability (External validity)

This study does not make any claim about the possibility of directly generalizing the findings outside the current research settings. Instead it assumes that the findings can only be used as indicators for further studies aiming to generalize such findings (Saunders, et al., 2009, p. 158). As Given (2008) notes, the principle of transferability assumes that the study's findings are only working hypotheses which have to be tested when applied even applied to similar contexts and that it is only up to researchers to evaluate whether present findings can be transferred to their specific context.

4.5.1.3   Confirmability (Reliability)

This study aims to avoid the four types of confirmability (reliability) errors and biases: participant error, participant bias, observer error and observer bias, the former two related to the interviewee and the latter two related to the interviewer. Participant bias can, among others, occur as a result of the following things:

- Interviews being recorded;
- Interviewee trying to impress the interviewer regarding the company's competences and capabilities, essentially hiding flaws or altering the reality;
- Interviewee trying to please his/her employer or being afraid of repercussions should company secrets be disclosed.

However, recorded interviews are considered the best solution to manage and analyze the collected data due to their ease and efficiency. All interview data is anonymized, and the interviewees are well-aware of this fact. This is done both as a requirement to obtain interviews with some of the companies, as well as to ensure participant bias does not occur or at least is reduced. Moreover, a connection is established with the interviewees on a personal level to create a sense of trust and prove the interviewer's credibility. Informal unrecorded discussions are to be carried out at the start of each interview. Participant bias is also mitigated or corrected through follow-up questions whenever bias is detected during the interviews, as well as through the data analysis itself. This can occur for example when the use of a leading question is detected (Saunders, et al., 2009, pp. 156-157, 331-332).

Participant error can occur when the researcher chooses interviewees which deviate from the normal study population. Since this study concerns with investigating processual and strategic aspects, it is of high importance to identify experienced interviewees, which also occupy management positions in their organizations. It is aimed, to the extent that it is possible, to interview interviewees which fulfill these two conditions (Saunders, et al., 2009, pp. 156-157, 340). Observer error can occur when there are variations in the way the interview questions are formulated from an interview to another. This would influence the answers each interviewee would give. As a starting point, semi-structured interviews are used for all interviews, so that a basic rigorous structure is achieved throughout all interview rounds. In addition to that, some additional questions are expected to be asked, the content of these depending on a case basis (Saunders, et al., 2009, pp. 156-157).

Observer bias can occur when the researcher has a prejudice when interpreting the data. A situation when this can occur is when the researcher has either subjective feelings or prior knowledge about the investigated topic (for example knowledge gained from previous interviews). This will result in the data being incorrectly interpreted, so that it fits the researcher's personal interest, instead of the study's interest, should these two be divergent. To eliminate/mitigate the observer bias, the analysis will be quality assured by comparing it with the raw data (Danish interview recordings) and transcripts (English transcribed interviews). In this way it is ensured that no meaning is lost, as well as no bias occurs (Saunders, et al., 2009, pp. 156-157).

4.5.2   Data and data analysis

Two types of data are used in this study – qualitative data and quantitative data. These two can be further divided in primary data and secondary data. Being a mono method study, qualitative data is the main data of interest. The primary data is collected through semi-structured interviews, which are conducted in Danish. Three different interview guides are developed in this regard – one interview guide for the four case companies which are interviewed, a follow-up interview guide for the IT manager in case company 3 and one interview guide for the third-party company. Given that the research approach is deductive, the interview guides' questions are based on the literature review. During the interview rounds additional open questions are addressed to the interviewees in order to elaborate and explore relevant areas not covered by the structured questions. Interviewees are provided with the general interview themes prior to interviews, in order to achieve a reasonable interviewee preparedness and increase the interviewer's credibility.

As described in section 4.5.1.3, three criteria are equally valued in the interviewee selection process: experience in the company, experience with the topic (ERP field) and position in the organization. When a criterion cannot be (fully) fulfilled, more weight is placed on the other two. Ideal minimum criteria are employees with at least a couple of years' experience in their organizations, equal experience with the topic (in general) and occupying at least a medium management position, which grants them insight in strategic decisions such as ERP. In addition to interviewee selection, company selection is also important. Considering that this study focuses on large Danish construction contractors (≥ 250 employees and turnover ≥ €50m[7]), it is natural to select companies from among this population so that it is representative enough for the study. However, the focus is not (only) high transferability, but also ensuring that as many segments of the contracting sector are covered (for example buildings, roads, environment, building services etc.), as well as companies with diverse organizational structures. With other words, diversity is a key criterion.

The referencing style for interview transcript citation within the main report is: ('Answer x.y', 'Appendix'), where 'x' indicates the answer's sequential number and 'y' indicates the case company's associated number (1, 2… 5, where 5 represents the third-party company). The answers usually cover several dialogue lines between interviewer and interviewee. The interview transcripts are coded to improve the workability in relation to data analysis and discussion, chapters which are structured based on topics that are investigated based on the defined problem statement. Refer to chapter 10 (Appendices) for the interview guides and transcription codes and to chapter 5 (Data analysis) for company descriptions/profiles.

The secondary data is presented through a literature study. Different databases, journal publishers, books etc., as well as search engines and websites are used. For what concerns use of websites, the amount of these sources is limited and mainly used for investigating software capabilities (for example software vendors and related technical websites), so that the newest information can be acquired. Articles published on ResearchGate are traced back to original publishing journal to the extent that it is possible to ensure high quality sources. See Table 10 for data overview.

Table 10 – Project data (overview)

	Primary data	Secondary data

Qualitative data	• Semi-structured interviews conducted with:
	   o Four construction contractors case companies;
	   o One third party company.
		• Books;
		• Databases:
		   o Scopus;
		   o ScienceDirect.
		• Journal publishers:
		   o Emerald Insight;
		   o Elsevier;
		   o SAGE.
		• Search engines:
		   o Google Scholar;
		   o Different search engines.
		• Research social networking websites:
		   o ResearchGate.
		• ERP Vendor and technical websites;

Quantitative data	• N/A.	• Industry statistics and reports; • National/International statistics and reports;

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[7]Based on European Comission SME classification https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en

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5 Data analysis

5.1 Introduction

The studied case companies are all large Danish or international companies with activities both in Denmark and outside of its borders. They all have national coverage in Denmark in terms of offices and business activity. The interviews took place with different key representatives from the organizations in Jutland. Four interviews were organized in total, each with a different large contractor. Each of the investigated cases presents their unique set of intrinsic and extrinsic characteristics. Besides unique characteristics, similarities are also identified across the case companies. Both are important for picturing the complex reality and identifying patterns or lack thereof, which leads to answering the problem statement.

In addition to the four interviews with the case companies, an additional interview was held with a third-party organization – a company offering IT consultancy services for contractor companies in the construction sector. While each of the four interviews held with the contractors provides detailed insight about their organizations and processes, the findings from the interview with the consulting company provides insight from an implementer's perspective, with long experience with different client organizational structures and technological and processual maturity. This ultimately enhances the understanding and richness of the study.

Being a cross-sectional study, this study focuses on the reality in the case companies at a fixed point in time. These characteristics/themes are directly related to the literature review and therefore, the present chapter is organized in such way to reflect the themes from the literature review, which were refined through the problem formulation. Each of the sections investigate the case studies from an individual perspective, as well as making cross-comparisons. The case companies are referred to as "Case company 1, 2, 3 and 4". The chapter concludes with a summary that gives an overview over all investigated case companies.

5.2 Case company 1

5.2.1 Case company profile and organizational structure

The interviewee in case company 1 has an IT engineering educational background and occupies a top management function in the organization, with responsibility for tasks such as company management, IT, strategy and company development. The interviewee has occupied a director position in the company for the last seven years and has considerable experience with ERP (Answer 1.1, Appendix).

Case company 1 has business activities within the field of civil works, both in Denmark and outside its borders. The company is Danish owned. The company has employees spread over the whole country, working project based. It targets small and medium sized civil works projects, with special focus on local projects and local community involvement, where apprentices and local workforce is hired. The interviewee describes itself as a flat organization, which is also "trying to make it as flat as possible" (Answer 1.8, Appendix). It is also mentioned that new systems implementation initiatives are challenging because there are "many people sitting in many different offices in Denmark" and indicates that "the biggest challenge is communicating it" (Answer 1.8, Appendix).

5.2.2 ERP and implementation approach

Case company 1 has been using ERP for over 20 years. The current used solution is a customized version of Microsoft Dynamics NAV, which the interviewee informs that has been used from the start. The version is heavily customized, with the company employing two full time software engineers that perform system customizations through visual programming. The ERP system covers all the business processes in the organization, both administrative and production (project management), being used as a "single system" and "core level system" (Answer 1.3, Appendix). Due to the long period of time since the ERP system was implemented, the interviewee cannot explain what the motivation for adopting was, but assumes it was for "ensuring the financial control in the company." (Answer 1.3, Appendix).

The interviewee indicates the following about system customization: "Typically we work to get the systems to function the way we are working." (Answer 1.6, Appendix). This is motivated by the fact that the interviewee considers that no standard ERP solution fits to the company: "There is no enterprise resource planning system that just fits to us." (Answer 1.6, Appendix). However, the interviewee admits the possibility of a middle way, which largely "depends [on] how big the process is and how big the change is." (Answer 1.6, Appendix). Generally, it seems that the company's approach to ERP can be described as situational, where the interviewee admits that "[they] are working with the concrete process" and "if the software has a process that is better than our process, so it makes a lot of sense to change the process [our process]." (Answer 1.6, Appendix). This can, however, be problematic from a strategic point of view, as it indicates lack of clear strategic intent.

5.2.3 Processes, business process reengineering and strategic link

5.2.3.1 Strategic planning and alignment

Case company 1 has defined an IT strategy. The strategy is defined by the IT department and approved by the top management. When inquiring about the alignment between business strategy and IT, the interviewee admits that the two are connected. However, IT strategy seem to be the sole work of the IT department, since the rest of the management was not directly involved in the IT strategy definition process (Answer 1.2, Appendix). Moreover, as described in section 5.2.3.3, the company's ERP system undergoes numerous modifications, which eventually leads to scope overrun, where non-value creating system functions need to be adjusted/removed by performing system/process scope analysis.

5.2.3.2 Process definition and maturity

The company's business processes are all formalized, the company having process descriptions. When inquired about the procedures for improving underperforming processes, the interviewee indicates that "Typically, [we] are doing it stepwise". (Answer 1.4, Appendix). The interviewee states that she is familiar with the concept of BPR and claims to use it "in relation to company development" (Answer 1.5, Appendix), where administrative processes are regularly optimized. However, no indication is given that a more radical process improvement has been undertaken prior to the current ongoing optimizations. Moreover, the interviewee also indirectly indicates that the company's business processes are in fact not optimal (Answer 1.6, Appendix).

5.2.3.3 Business process reengineering

Business process improvements also occur in the company as a result of user suggestions, where based on these suggestions, the management "is going to do an analysis of it, and if [they] agree on it, then [they] make an adjustment to the system." (Answer 1.7, Appendix). For this to happen, the proposal needs to concern a non-trivial issue. The interviewee notes that "If it's a very small change then it will happen by itself." (Answer 1.7, Appendix). When inquired about whether the multitude of system modifications does not render the ERP system too heavy or counter intuitive, the interviewee does admit that these changes often run out of control and then a change analysis is required to adjust the system: "Yes, it becomes like that sometimes… too heavy. Then we say that now we have made too many changes and we make an analysis of what actually is used and what not" (Answer 1.7, Appendix). The often occurrence of these change analyses is also strengthened by the following statement:

Q: So that's something that you're making regularly [an analysis of]?

A: Yes. (Answer 1.7, Appendix)

5.3 Case company 2

5.3.1 Case company profile and organizational structure

The interviewee in case company 2 has a civil engineering educational background and fulfills a double role in the organization – is part of the company's national management group and is regional director for the company's production for Funen and Central and Southern Jutland. The interviewee has almost 20 years of experience in the company and no experience with ERP. However, on the second instance ERP is mentioned during the interview round, the interviewee indicates knowledge of such a system which is planned to be implemented within next years:

Q: "So, you're considering implementing it [ERP]?"

A: "Yes, it's been decided. It just hasn't been implemented yet." (Answer 2.3, Appendix)

Case company 2 has business activities within the field of civil works, being specialized in a specific branch of this field. The company is international, with headquarters in another EU country. It has business activity in many countries. The interviewee describes the organizational structure as "quite heavy and many times not very good for the efficiency" (Answer 2.8, Appendix). Moreover, the interviewee attributes the long decision-making process to the fact that the mother company is foreign and approval must be sought there, whereas Danish companies would have a shorter decision-making process: "because they are Danish and they're taking decisions themselves […] their implementation will be much faster than ours, […] we need to seek approval from the top management in the mother company, before we have any chance that they will accept it." (Answer 2.7, Appendix). Despite its high hierarchical organization, case company 2 has recently migrated to the cloud, with the data being easily accessible by everyone in the organization, which removes silo organization challenges.

5.3.2 ERP and implementation approach

Case company 2 does not currently have any ERP system implemented. Despite the interviewee's lack of knowledge within the ERP field, it was found during the interview, that the company has a 4-year plan to implement such a system, with the current implementation date being 2023: "They have a good corresponding system that they are about to implement. […] They expect it to be ready in 4 years – in 2023." (Answer 2.3, Appendix). The company has also recently migrated to a full cloud solution in terms of data storage, which might indicate that the planned ERP system will be cloud based.

Currently, the company uses IT systems, some of which are internally developed. These systems have data exchange capabilities, but in spite of that, the interviewee admits that, employees sometimes struggle with the data exchange due to interoperability issues, situations where they are required to work around the system: "And then there's something where we are required to do things in an inappropriate way because that's how our system functions." (Answer 2.6, Appendix). The interviewee believes that when new software must be implemented "optimal is to choose a software that functions the way we are working" (Answer 2.6, Appendix).

5.3.3 Processes, business process reengineering and strategic link

5.3.3.1 Strategic planning and alignment

Case company 2 has defined an IT strategy, with clear policies defined both on a corporate level – concern level and national level (Denmark), as well as business level (for example within the national level).

5.3.3.2 Process definition and maturity

All of company's core processes are defined on a national level according to the management plan and the company uses flow diagrams for decision-making, the degree of formalization being described by the statements: "So, you could say that all our processes are described to the smallest detail", "Everything is planned." (Answer 2.4, Appendix). Eventual ease of ERP implementation is attributed by the interviewee to

the fact that the company has "used an enormous amount of energy on that [processes] and to describe them and if such a software has to be implemented [ERP], then it is significantly easier to implement it, when you have written them down" (Answer 2.9, Appendix). Moreover, the interviewee states that the business processes are constantly improved and adjusted to the dynamic business environment: "The intention is that it has to be an ongoing [improving] process, which moves towards the direction where the world currently is." (Answer 2.5, Appendix). The interviewee indicates the following about the process-software relationship in the organization: "Yes, our processes are optimal. We make our processes as optimal as possible and we would like a system that can work with that." (Answer 2.7, Appendix). It is likely that through this statement, preference is expressed for identifying a system that match the exact needs of the organization, without any further adjustments being necessarily performed to the system.

5.3.3.3   Business process reengineering

The interviewee is not familiar with the concept of BPR and is therefore introduced to it. The interviewee indicates that no inefficient/ non-optimal processes were identified in the organization: "No, I do not believe that we have, simply because we are continuously trying to… I mean it has to be a living system and develop it [ongoing]." (Answer 2.9, Appendix).

5.4   Case company 3

5.4.1   Case company profile and organizational structure

Two key employees were attempted to be interviewed in case company 3. Only the first interviewee responded positively to the request. She will be further referred as "interviewee" in lack of a second interviewee. The interviewee has a civil engineering educational background and works as a tender director in the organization, fulfills a double role as a chief project manager – a leadership role involving employment/recruitment, organizational and IT changes and implementation of such changes and a production role involving project tenders. The interviewee has experience from industry organization involving consulting construction companies regarding different topics such as law, business policy, as well as IT tools and IT implementation. However, the interviewee has no prior knowledge nor experience with ERP systems (Answer 3.1, Appendix). The second interviewee is involved in top management decision-making and occupies among others an IT manager function in her company. Follow-up questions were sent to her by e-mail to inquire about ERP and strategic decisions in the organization, but these have not been answered.

Case company 3 has diversified business activities within the field of civil works, with the interviewee being hired in one the company's divisions, which is specialized in a specific branch of civil works. The company is Danish owned and has business activities both in Denmark and abroad (Answer 3.2, Appendix). The interviewee describes the organization having "a quite flat structure" and "quite agile" with "no big hierarchical structure" and "a short path from the top to the bottom." (Answer 3.3, Appendix). The interviewee admits that the company cannot compete on price with its competitors, reason why it does not make a strategy out of this, and instead chooses to focus on developing its soft attributes: "And we have a goal with respect to that, that in this area we simply have to be strong. We have to be strongest on soft values. And that is something that some clients also require, that we have to have organization and a lot of administration…" (Answer 3.3, Appendix). The reason for this inability might be the lack of standardization in the company, which would result in optimization of processes associated to production: "…we work a lot in silos. We are quite independent in each of these units and use the systems which we use there. And that's why we need to streamline the things a bit". The interviewee describes the company's support structure as being middle sized and focused on supporting the production (Answer 3.3, Appendix).

5.4.2 ERP and implementation approach

The extent to which case company 3 uses ERP proves difficult to evaluate. All administrative functions are essentially covered by two different systems – one system used for payroll management (DAR) and another system used for finance and accounting (DocuBizz). These systems exchange data with each other. The finance and accounting system are also implemented on project level, however, to an extent which only covers direct costs. It is assumed that client payments are managed directly through the client's own systems, especially given that case company 3 works primarily with public customers. Besides these two systems, the company is currently involved in implementing a document management system (DocuNote), which they are experiencing different challenges with. The latter does not benefit from integration with the other two systems yet (Answer 3.9, Appendix). The interviewee lacks knowledge about ERP systems, but for what concerns new system implementations, she believes that it is desirable to implement standard systems, instead of having the system adjusted to the way people work. She motivates this by arguing that the issue is related to changing the users' mentalities and top management acknowledging that it should not give in to user requests (Answer 3.11, Appendix). The following statement indicates that the interviewee believes that new systems should be selected based on system capabilities:

> *"I believe that if we are 10 companies that do, at least roughly the same thing, then we should use the same system and get the employees to fit to the system, instead of the system to be adjusted to the people or employees." (Answer 3.11, Appendix)*

5.4.3 Processes, business process reengineering and strategic link

5.4.3.1 Strategic planning and alignment

The interviewee cannot precisely state whether the company has an IT strategy defined, since she lacks knowledge thereof: "I don't know the IT strategy to be honest." (Answer 3.4, Appendix). However, she indicates that in terms of IT "All the administrative systems are implemented in the whole organization." (Answer 3.5, Appendix), while there are some systems, which only the individual daughter companies use. Although it is not completely certain that the company lacks a clear IT strategy, even though such a strategy has been defined, it seems that the IT objectives are not congruent with the business/corporate strategy. The interviewee gives a practical example in this sense, which strengthens this assumption. The example, a previous software implementation attempt initiated by the IT department was deemed a fail a few years after it was initiated, because the initiative was the sole decision of the IT department, where top management involvement and support, as well as a clear implementation plan lacked (Answer 3.6, Appendix). In lack of answers from the second interviewee, no further description or analysis can be performed regarding this case company's strategic part.

5.4.3.2 Process definition and maturity

The company's business processes are not fully formalized yet. These have been defined on a higher management level (although interviewee 1 is unsure about it), but not implemented yet. The interviewee describes it in the following way:

> *"It wasn't my responsibility to develop it, but I will be responsible for its implementation here on Jutland." (Answer 3.1, Appendix)*

The interviewee indicates that through the adoption of the newly defined business processes, it is aimed to streamline the company's way of doing business (Answer 3.1, Appendix). She admits that company's competences and values such as agility and lack of fixed frames are a double-edged sword. Moreover, she indicates that they are the reason the company lacks structure, leading to situations where "[…] you can't figure out things, you can't find contracts […]" (Answer 3.9, Appendix).

5.4.3.3 Business process reengineering

The interviewee is not familiar with the concept of BPR and is therefore introduced to it. She states that the answer to the way they are currently doing business "[…] depends who you are asking." (Answer 3.10, Appendix), because the employees are currently doing their work in different ways in the company. Moreover, she indicates that "[they] just need to adjust a bit. There's a lot of small things", meaning the interviewee does not believe radical changes have to be performed in order to standardize the company's business processes. However, she also indicates that the company has currently "400 ways of working and [they] need to get everybody to work in the same way." (Answer 3.11, Appendix). Although merely just a figure of speech, numerous ways of working are still present in case company 3, which as previously described, is characterized by silo organizational structure, where information and knowledge is retained within the borders of the individual department. However, in lack of a more quantitative opinion from the interviewee regarding the differences or even an actual benchmarking of the inter-departmental processual differences, it is difficult to make further comments on this part. Moreover, as previously mentioned, the fact that the interviewee has not participated in the process of defining the new processes makes it difficult to evaluate the base for their definition.

5.5 Case company 4

5.5.1 Case company profile and organizational structure

The interviewee in case company 4 has a civil engineering educational background, supplied with management masters. In addition to that, the interviewee has several years' experience in execution of construction projects, and she fulfills functions as both site manager and BIM coordinator on her projects. In relation to the implementation of a new ERP system in the company, the interviewee has received ERP courses and has been appointed as ERP superuser to assist others with the new system. The interviewee is also using the company's current ERP system in her daily work (Answer 4.1, Appendix).

Case company 4 has diversified business activities within both buildings and civil works, however, identifying buildings as their core competence. It identifies concrete structures as their strengths, and it focuses on competing on new construction. The company has operations both in Denmark and abroad, with multiple daughter/sister companies (Answer 4.2, Appendix). The interviewee describes the company's organizational structure as highly hierarchical, with a long path from top to the bottom and where there is no direct chain of command between the concern's CEO and the interviewee, with a "long way from people on the project to people on the top", something the interviewee attributes to the large size of the company. The interviewee indicates that even though the project organization is flat, "just as fast we go further from it, it is probably not as flat." The speed of decision-making is also affected by the high hierarchical organizational structure: "When it's something that doesn't run on project level, then there is a long decision-making process." (Answer 4.3, Appendix).

5.5.2 ERP and implementation approach

Case company 4 has been using ERP for over 20 years. The initial ERP software adopted by the company was an in-house developed system, which was being developed and maintained by the company's 40-70 software engineers. As a result of the company's decision to focus on their core competences – construction, the large IT department was disbanded, and the ERP system outsourced. Lotus Notes, developed by IBM, was chosen as the new ERP solution. This ERP was customized by IBM at the company's request and the system has been used in the concern for the last 15-20 years (Answer 4.4, Answer 4.7, Appendix). The company is currently involved in implementing a new ERP system (Unit4), which has been decided by the top management to be a standard system: "We became smarter and realized it's very expensive to maintain it. Because the system we are using now, it's not updated, it's very 90ish, very old school…" (Answer 4.7, Appendix). The new system (Unit4) is planned to go live through a big bang approach, where the old system is completely discontinued at the date the new system goes live, but where current projects are allowed to continue using the old system until their completion (Answer 4.8, Answer 4.9, Appendix).

The interviewee indicates that she supports the idea of a middle way approach to ERP – "A bit of both" (Answer 4.13, Appendix). The new system was selected based on a market analysis performed by the company, where the aim was to find the system that matches closest to the company's business processes: "So, they've talked with many different vendors in order to find the system that fits best to our business." (Answer 4.13, Appendix). The company's position clearly leans towards a standard ERP system, something which is made clear in several instances throughout the interview, including following:

> *"[…] they were well aware that they cannot get everything that we want. Then we would need a customized system. So, they chose the system that they felt is best to what we can, and then we should try to adjust ourselves to the system afterwards." (Answer 4.13, Appendix)*

5.5.3 Processes, business process reengineering and strategic link

5.5.3.1 Strategic planning and alignment

Case company 4 describes IT and ICT among their competences, claiming "[they] are leading in the [construction] industry" in terms of IT and ICT (Answer 4.2, Appendix). Moreover, digitalization is part of the company's vision and helps the company achieve goals such as working more efficiently and be more cost efficient, ultimately increasing the company's ability to win projects (Answer 4.10, Appendix). The interviewee confirms that the company has defined an IT strategy and indicates that the company is intensely working with it in relation to the implementation of the new ERP system (Answer 4.4, Appendix), without indicating how the company does this. It could be assumed that this is done by focusing on achieving the ERP goals and implementation plan. The company's IT department employs infrastructure managers, who "[…] decide which software [they] should have for the company, so that it functions most optimally." In addition to that, the infrastructure managers were also involved, together with concern managers and representatives from the different production departments, in deciding the characteristics of the new ERP system (Answer 4.5, Appendix). These different representatives are organized in steering groups, so that everybody's opinion is heard (Answer 4.6, Appendix). The company does have interoperability issues though, something the interviewee also admits (Answer 4.4, Appendix).

5.5.3.2 Process definition and maturity

The company's processes are well defined through process descriptions and checklists. The interviewee indicates that the company uses knowledge catalogues for execution of construction work, making project offers etc. (Answer 4.10, Appendix).

5.5.3.3 Business process reengineering

The interviewee is not familiar with the concept of BPR and is therefore introduced to it. The interviewee agrees that as a result of the implementation of the new standard ERP system in the company BPR needs to be performed in order to align the company's processes to that new system: "We had a way of doing it before. Now it's disappearing so we need to find new ways of doing it." (Answer 4.12, Appendix). When inquired about the possibility of system customization, the BPR path is reconfirmed by the interviewee:

> *"I don't believe that there are many changes that come to the system. I believe that we will have to get used with the idea that the system is as it is and then we have to find our own ways or methods to get it to work." (Answer 4.12, Appendix)*

Legacy systems are currently used to supply the missing capabilities of the ERP system, something the company hopes to avoid with the new standard ERP system:

> *"Yes. That also happens once in a while, that we are required to make our own Excel spreadsheet, for example, to manage something. It happens sometimes. But that's something that we hope we can avoid with the new system." (Answer 4.11, Appendix).*

BPR initiatives are also confirmed by statements about planning and organizing the company, so that the new ERP system is supported:

"But we need to make the compromise that it is not specifically developed for us, it's for many others, so we also need to plan and organize for this system." (Answer 4.4, Appendix)

5.6   IT consulting company

5.6.1   Company profile and perspectives

The interviewee in the IT consulting company has occupied a CEO position in his organization for the last 12 years. The company has been operating on the construction market for same amount of time and is specialized in consulting construction contractors regarding IT tools, including ERP solutions, where the company has assisted with approximately 300 ERP implementations. The company's focus group in terms of ERP are medium sized contractors with 30-250 employees (Answer 5.1, Appendix).

The interviewee arguments that with regards to digitalization of the construction sector, comparing the construction sector with other sectors based on its implementation levels of ERP and IT tools is irrelevant, because of the construction sector's supply chain, as well as value chain. The interviewee claims that the construction contractor companies' value chain relies on physical execution of on-site work, where value does not lie in use of technology and where usage thereof would decrease the productivity (Answer 5.11, Appendix). This claim might particularly be true for small contractors, which the interviewee described as lacking the time to focus on IT tools due to the managers being focused on operations (Answer 5.1, Appendix). However, larger contractors might rely on an increasingly higher degree on on-site digitalization through use of sensors, virtual reality or augmented reality which are transmitting real-time data to the ERP system, technologies which the interviewee associates to facility management phase, rather than execution phase (Answer 5.11, Appendix).

5.6.2   ERP and implementation approach

The interviewee describes two approaches for selecting ERP – best of breed and best of suite, where best of breed represents the selecting best software available within a specific business function (for example project management or document management) and gradually connecting these through a common database creating an ERP system out of distinct components. This is indicated by the interviewee to be the preferred method in the construction sector. Best of suite on the other side involves selecting total solutions offered by one single vendor (for example SAP or Axapta) (Answer 5.2, Appendix).

The interviewee confirms that there is a considerable amount of ERP solutions that are available on the market for the construction sector and indicates that within the last 10-15 years many others have been developed to cover software needs that were previously not covered. These are standard solutions, but which have been designed specifically with the construction sector in mind. Moreover, she indicates that the implementation process approach has changed, and it is easier to get a solution that fits the needs and requirements of the company: "There's a vast amount of possibilities that are found for implementing tools that fits to the way you are working." (Answer 5.10, Appendix). Furthermore, given the availability of specialized tools, companies are also given the opportunity to choose something tailored for their niche: "There's different solutions, not only construction sector, but also specialized for EL and HVAC." (Answer 5.7, Appendix). The interviewee believes that ERP system customization is required only to the extent where the available standard solutions do not match the way the company works: "[...] of course if you can't find anything that fits, then you can adapt it to that degree you can find something." (Answer 5.8, Appendix). This can be the situation in very specialized or niche industry companies.

5.6.3 Processes, business process reengineering and strategic link

5.6.3.1 Strategic planning and alignment/Process definition and maturity

The interviewee indicates that when a company is considering implementing ERP, the needs and requirements have to result from inside the organization and that processes have to be formalized, before the company even looks into the IT market: "The processes have to be into place […] You start IT projects without even looking into IT tools" (Answer 5.5, Appendix). The interviewee states that even though process "Standardization is maybe too much said", the business processes' needs and requirements have to be clarified before implementing IT, otherwise there will be the risk that companies will make the wrong IT choices and have to live with improper solutions (Answer 5.5, Appendix). The reason for the IT consultancy company claiming that standardization is not required might be that the company is only working with small and medium sized clients, with organizations small enough that it is unlikely that the differences across departments are considerable.

5.6.3.2 Business process reengineering

When inquired about process changes in relation to ERP implementation, the interviewee indicates that the performed process changes should be on the normal end of changes, rather than on the radical end: "I wouldn't say radical process changes. It's more within the frame of normal adjustments." (Answer 5.9, Appendix), motivating this by the fact that her company attempts to help their clients match their processes with the IT instead the opposite: "It's more the systems that have to be configured to the processes, than the other way around." (Answer 5.9, Appendix). The first step consists of the company defining/mapping their current business and looking how the current ERP/legacy systems support the company's business processes, followed by the company defining how it wishes to deliver its value proposition to its customers in the future, including investigating how IT can support this (Answer 5.4, Answer 5.5, Appendix). The interviewee indicates that this process is iterative: "You define the requirements and look into the market, define the requirements, look into the market." (Answer 5.8, Appendix).

5.7 Cross-case analysis

5.7.1 Organizational structure and interviewee experience

The introduced cases have many similarities as well as dissimilarities with regards to the organizational structure. While case company 1 and 3 have organizational structures, which are flat on all levels, case company 2 and 4 have organizational structures with long hierarchical structure. Case company 2 interviewee attributes this to the fact that the mother company is international and to the large size of the company, while interviewee in case company 4 attributes this to the fact that the company is large. However, case company 4 still has a flat project structure. Although the project structure in case company 2 was not discussed during the interview, it is likely that it presents with similar flatness levels like the other case companies. The interviewees have all varying work experiences which range from 4 years to 20 years, as well as varying profiles which range from site manager to CEO. What is essential and common for all interviewees is the business process insight, as well as general business/organizational insight which they provide.

5.7.2 ERP and implementation approach

Both case company 1 and case company 4 have been using customized ERP systems for over 20 years to IT-enable their business processes. While case company 1 has been using Microsoft Dynamics NAV, case company 4 has been using Lotus Notes (IBM Notes). Both systems have undergone considerable customization. The major difference between these two companies is that case company 1 has decided to keep software development inhouse, while case company 4 has outsourced it to their ERP vendor. Outsourced maintenance and software development have proved to be an expensive deal for a heavily customized system, and this probably explains why ERP does not cover all business functions in case company 4, compared to case company 1.

Case company 1 has been using its software engineers to consistently make system adjustments throughout time. These adjustments range from minor to major and are usually the result of user improvement suggestions, where minor adjustments are implemented without further analysis and major adjustments undergo a cost/benefit analysis performed by the management before they approved. Despite of the analysis, scope overruns still occur and require scope analysis to readjust the ERP system. Case company 1 prefers customized systems over standard systems, arguing that there are no standard systems that match their organization's needs and requirements. Technology-driven approach seems to be the most appropriate approach to describe case company 1 and 4, because both are using best-of-suite solutions.

A multitude of factors such as ERP system outdating, lack of updates and high maintenance costs, has made the top management in case company 4 adopt a paradigm shift and decide to implement a new ERP system in the form of a standard system. Case company 4 interviewee indicates that even though the management has selected a standard ERP system, the selected solution matches best the company's process needs and requirements. The interviewee indicates that she supports the idea of a middle way, opinion which seems to reflect the approach undertaken by the company and not only the interviewee's personal belief. The middle way approach is something which the IT consulting company also recommends – requirements definition followed by ERP market investigation, where these two steps are executed in an incremental manner until the right solution is identified. Therefore, hybrid approach seems to best describe the perspectives in the IT consulting company, as well as in case company 4 (regarding the new ERP system, not the current).

Lastly, the implementation approach supported by case company 2 and 3 matches the process-driven approach. However, the reason for this is different for each of the companies. Case company 2 interviewee supports the process-driven approach because she believes that the company's processes are optimal, therefore a system that matches the company's processes needs to be selected. Case company 3 uses an ERP system made of individual systems set together, something that fits the best-of-breed approach described by the IT consulting company. This would furthermore mean that case company 3 selects systems that match the company's processes, even though these are not formalized. Neither case company 2 nor 3 seems to support software customization.

5.7.3   Processes, business process reengineering and strategic link

5.7.3.1   Strategic planning and alignment

Despite the fact that case company 1 interviewee states that the company has an IT strategy defined, the numerous system changes the company performs indicates that even though company might have aligned its strategic objectives with its IT capabilities, this alignment fails to occur in practice when different system modifications are made (as a result of user suggestions or else), requiring realignments through scope analysis. Lack of business IT strategic alignment is also encountered in case company 3, where this occurs not because of excessive system customization, but rather from the company's too loose organizational frames and lack of standardization across departments, which raises question marks not only about business IT alignment, but also about the execution of the business strategy itself.

Case company 2 interviewee claims that the company has a clear IT strategy, but the company experiences issues with data exchange between its systems. Moreover, given the interviewee's claims that the company has optimal business and that systems should match the way the company is working, question marks are also raised in this case company about the alignment. Lastly, case company 4 gives an impression that it is positioned on the opposite side of the pole, claiming to have a clear IT strategy defined and ambition to be leading in IT in the construction sector, where IT is used as a lever to achieve its business goals and win projects. The business IT alignment is supported by the company's latest ERP initiative, in which the company is currently engaged. The new system was decided based on a joint decision between top management and IT management. Issues related to software interoperability like case company 2 are also encountered in case company 4.

5.7.3.2   Process definition and maturity

Case company 1 has formalized their processes, has descriptions of their business processes and is performing constant process improvements. However, the interviewee does no regard their processes as optimal. Case company 2 has taken process formalized to a much higher level by having developed detailed descriptions and flow charts that must be used for decision-making. Moreover, compared to case company 1, case company 2 considers their business processes optimal, as well as claiming to constantly optimize them to match the business environment in which the company competes in. Not a lot of information is provided about the processes in case company 4, but the interviewee informs that these are defined through descriptions, checklists and knowledge catalogues.

On the other side, case company 3 is the only among investigated, which has not formalized their business processes. The company has recently managed to define their business processes by preparing business process descriptions for all their production processes. However, the processes are not implemented in practice yet. Furthermore, the interviewee cites challenges with the process implementation. It is unsure whether the administrative processes are formalized, or the employees just simply follow the processes dictated by the ERP systems (DocuBizz/DAR). The IT consulting company's interviewee underlines the importance of formalizing a company's business processes prior to ERP adoption decision phase. This is motivated by the fact that companies must know their current business and IT capabilities, because setting to plan future business and IT capabilities, which are to be used as requirements.

5.7.3.3   Business process reengineering

The interviews' findings indicate that the only company claiming familiarity and BPR usage is case company 1, where BPR is used in relation to the company's administrative business processes optimization. Case company 1 interviewee indicates that the company uses BPR to perform gradual business process adjustments, but no radical adjustments. Nonetheless, it appears that the other three case companies are also using BPR although they are not aware of it. The interviewees in case company 2, 3 and 4 and the IT consulting company also believe that business process changes should be performed gradually and be within the normal side of adjustments, rather than on the fundamental side. Therefore, the preferred process change method in the investigated companies is the gradual/incremental approach. Case company 2 interviewee indicates the reason behind this is that the company's business processes are handled as a living system, which is constantly adapting to the company and market needs. Case company 3 interviewee also believes in the use of gradual improvements over radical improvements, because as the interviewee claims, even though the processes are not optimized and/or standardized in the company, the differences between the different departments is not that big that radical adjustments are required. As previously described, the IT case company believes in matching the company's business processes with the system's capabilities based on incremental adjustment approach between the two.

5.8   Summary data analysis

The findings and data analysis discussed in chapter 5 are summed up through use of key points illustrated in Table 11, Table 12, Table 13 and Table 14. Table 11 and Table 12 illustrate general information regarding the companies' organizations, projects etc. including the interviewees' experience, position and roles in their organizations, while Table 13 and Table 14 illustrate highlights regarding ERP implementation approach and different strategic and processual considerations.

Table 11 – Case companies' characteristics and interviewees' profiles

	Case company 1	Case company 2	Case company 3	Case company 4
Company size	+250 employees	+250 employees	+250 employees	+250 employees
Activity field	Civil works	Civil works	Civil works	Buildings and civil works
Country of origin	Denmark	International	Denmark	Denmark
Operating countries	Denmark and international	Denmark and international	Denmark and international	Denmark and international
Focus area	Small and medium sized projects	Specific civil works branch (manufacturing and construction)	Specific civil works branch	Construction of new building projects
Organizational structure	Flat on all levels	Long hierarchical structure	Flat on all levels	Flat on project level; Long hierarchical structure otherwise
Interviewee position	Co-owner and director	Regional manager	Chief project manager	Site manager, BIM coordinator and ERP superuser
Interviewee experience in the company	7 years	20 years	6 months	4 years
ERP experience	Yes	No	No	Yes
BPR familiarity	Uncertain	No	No	No

Table 12 – IT consulting company's characteristics and interviewee's profile

IT consulting company	
ERP experience	300+ ERP implementations
Area of expertise	Small and medium sized construction contractors
Country of origin	Denmark
Operating companies	Denmark
Interviewee position	CEO
Interviewee experience in the company	12 years

Table 13 – Overview findings in case companies

	Case company 1	Case company 2	Case company 3	Case company 4
Uses BPR	Yes	Yes	Yes	Yes
Uses ERP	Yes	No	Yes	Yes
Business IT strategy alignment	Uncertain	Uncertain	No	Uncertain
Business functions ERP is used for	Administration and production	N/A	Administration and partly production	Administration and (partly)[8] production
Process formalization	Yes	Yes	No (must be implemented)	Yes
In favor of radical process changes	No	No	No	No
Process formalization cont.	Process descriptions	Process descriptions, Flow charts	Process descriptions (must be implemented)	Process descriptions, Checklists, Knowledge catalogues
ERP implementation approach	Technology-driven	Process-driven	Process-driven	Technology-driven[9] Hybrid[10]
In favor of system customization	Yes	No	No	No(t) (any longer)[11]

Table 14 – Overview findings in IT consulting company

IT consulting company	
In favor of Business IT strategy alignment and process formalization	Yes
In favor of radical process changes	No
ERP implementation approach	Hybrid
In favor of system customization	No

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[8] New ERP system will cover all business functions
[9] Current system
[10] Interviewee's opinion + new system
[11] New ERP system will be implemented as a standard solution, something which the interviewee also supports

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6 Discussion

6.1 Introduction to discussion

This chapter discusses the implications which decisions within areas such as (AS-IS/TO-BE) process mapping, strategic planning and alignment, BPR and implementation approach have for achieving ERP implementation readiness. Firstly, some more general observations related to ERP and ERP implementation are presented. Despite the fact that statistics point out that ERP implementation and IT usage levels in general are lower in the construction sector than in other sectors (Danmarks Statistik, 2016), (Danmarks Statistik, 2017), the data analysis indicates that such comparisons might actually not say much about the actual need of achieving higher implementation levels in the construction sector, as well as that ERP implementations are based on the companies' actual needs, which implement ERP modules through a phased roll-out as they see fit (Answer 5.11, Appendix). That means these companies are implementing standalone software fulfilling individual business functions (f.eg. finances and accounting, project management etc.) only to later integrate these functions through a common database in order to achieve a system that can be regarded as ERP. The data analysis indicates that due the construction sector's value chain, small companies are bad candidates for ERP implementations, but on the other side, medium and large sized companies are good candidates (Answer 5.11, Appendix. However, these assumptions cannot be freely generalized, and some further considerations must be made to evaluate the actual ERP readiness in an organization. These considerations and discussed in the following sections of this chapter.

6.2 ERP and implementation approach

6.2.1 Section discussion

BPR literature outlines three possible paths which organizations can pursue in order to implement ERP systems. These approaches are technology-driven, process-driven and requirements-driven. As Panayiotou et al. (2015) points out, technology-driven is the most widely adopted and accepted, with process-driven ranking second and hybrid ranking third. The data analysis indicates that all three approaches are supported by the interviewed companies, without any of them emerging as dominating. It should be noted that the companies' support of a specific implementation approach is linked with some degree of uncertainty. This is particularly because it proves quite challenging to accurately link the theoretical ERP implementation approaches to the practical ERP implementation approaches identified through the data analysis. The hybrid approach leaves no place for doubt because of its clear pattern consisting of incremental market research and requirements definition, something that was also consistently identified in the data analysis. However, the technology-driven approach and process-driven approaches are quite similar, with the only element that distinguishes them is the time when BPR takes place – before ERP selection for process-driven and after ERP selection for technology-driven, something that was identified from the context in the interviews.

For example, it can be observed from data analysis that the choice of a best-of-suite ERP system is linked to technology-driven approach, while choice of a best-of-breed ERP system is linked to process-driven approach. Moreover, what it is interesting is that the literature does not support the idea of system customization through any of the three implementation approaches, nor on a general level, although the literature does acknowledges it, as well as the advantages and disadvantages associated with it (Panayiotou, et al., 2015), (Kovacic, 2004), (Kovacic, et al., 2002). However, considering that best-of-suite are standard ERP systems that are offered by large, well-known vendors (Answer 5.2, Appendix), which have to cater for numerous clients from different businesses, it is not surprising that the companies that have adopted such systems (Microsoft Dynamics NAV in case company 1 and Lotus Notes in case company 4) were required to perform customizations in order to make the systems match their business processes.

Another explanation for that might be that the investigated companies are unwilling to invest in change management and perform process adjustments to align the organization to the system. As previously mentioned, system customization is not supported by the literature and as it was observed in the data analysis, the consequences of customization are scope creep and excessive maintenance costs (Answer 1.7, Answer 4.4, Answer 4.7, Appendix). Best-of-breed ERP systems involves creating an ERP system by selecting software from different vendors in order to achieve the best resulting ERP system (Answer 5.2, Appendix), reason it is assumed that it can be directly linked to process-driven approach which involves choosing the most appropriate technology (Panayiotou, et al., 2015).

Lastly, it appears that the hybrid approach is gaining considerable ground, with case company 4 intending to implement a new ERP system using this approach, while the IT consulting company assists their customers using solely this approach. It also appears that a paradigm shift is occurring in the ERP world, with numerous industry-tailored solutions having appeared in the last years, which essentially makes system customization redundant, as well as the need for more serious process change/BPR (something also discussed in section 6.5). It should be noted that while technology-driven and process-driven approaches involve engaging in business process reengineering either prior or after ERP system selection, Panayiotou et al.'s (2015) hybrid approach tones down the degree of process change that is required to be performed by the implementing companies, listing business process improvement as an alternative to business process reengineering. The findings from the interview with the IT consulting company can be directly correlated with the hybrid approach developed by Panayiotou et al. (2015). Both the interview and the literature agree on the steps that need to be followed, with the mention that the IT consulting company does not indicate any post-implementation AS-IS model development to ensure that what was implemented matches the TO-BE model. No concrete conclusions are drawn in this section; these are presented in section 6.5 instead, due to the interrelatedness between implementation approach and BPR.

6.3 Strategic planning and alignment

6.3.1 Section discussion

The literature clearly establishes the importance of strategic planning as a prerequisite to BPR procedure. Moreover, part of strategic planning is the business IT strategy alignment, which ensures that a company's IT decisions are in line with its strategic objectives. Lack of business IT strategy alignment seems to be a recurring theme in the data analysis. Three out of the four investigated companies claim to have an IT strategy defined, with only one company expressing clear doubts about the definition of an IT strategy (Answer 1.2, Answer 2.2, Answer 3.4, Answer 4.4, Appendix).

Case company 1 has proven that IT decisions are taken by the IT department and that ERP customizations can often run out of control (Answer 1.7, Appendix). This is common to the failed implementation attempts in case company 3, which are regarded as consequences of lack of top management involvement and commitment and sole participation of the IT department (Answer 3.6, Appendix). Žabjek, et al. (2009) associate issues encountered by case company 1 and 3 to two main factors – lack of top management support (also a leading ERP CSF) and the gap between top management and IT specialists. The first factor involves the top management which does not follow the system implementation process from idea phase to actual use phase, while the second factor involves the gap between top management and IT specialists, where the two groups do not have proper understanding of each other's work. This also results in top management seeing IT as a support function to which certain costs are associated and which makes IT systems selection and implementation the result of an optimization focus, rather than the result of strategic planning. The importance of strategic planning is continued by Hammer & Champy (1993) in a BPR context, which affirm that companies BPR failures are the result of companies using IT to replace strategic planning. This also seems to be the situation in case company 1 and 3, where top management gives in to user suggestions, which leads to the systems' scope overrun (Answer 1.7, Answer 3.9, Appendix). The process objectives in these companies appear to lack linkage to a proper congruent strategy.

Case company 2 and case company 4 share their own set of similarities with regards to IT issues. These are related to working around the defined processes and systems due to interoperability issues (Answer 2.3, Answer 4.11, Appendix). Once again, seen from a BPR perspective, these organizations should have developed a business strategy and process objectives, which would consequently result in the companies identifying bottleneck processes, in this case the data exchange between the legacy systems (Davenport, 2000). These issues seem to have been directly addressed. Case company 2 is about to implement its first ERP system in the concern, while case company 4 is migrating to a new, more modern and more comprehensive ERP system.

6.3.2 Section conclusion

The conclusion of this section is that some issues strategy related issues have been identified in the investigated companies, but despite of that, these issues represent only an indicator of a lack of strategic planning and alignment, where a more focused and comprehensive approach and data collection are required to investigate and confirm such hypothesis. Another conclusion is that while the issues in case company 1 and 3 are the consequences of what can be regarded inadequate strategy, the issues in case company 2 and 4 are merely the results of growing business and IT requirements in the organization, which has ultimately mobilized these two companies to adopt new ERP systems.

6.4 Process definition and maturity

6.4.1 Section discussion

Using the five process maturity levels defined by CMMI (Mahmood, 2015), the case companies were placed on the model, together with a baseline requirement defined based on the data collected from the IT consulting company (Figure 27). It was found in the data analysis that case company 1, 2 and 4 have mapped their business processes (Answer 1.4, Answer 2.4, Answer 4.10, Appendix). Furthermore, it was also found that case company 1 and 2 are performing ongoing process optimizations (Answer 1.4, Answer 2.5, Appendix). However, it was not possible to place any of these companies in a specific level (between 3-5) in lack of more information (for example information about whether the company has defined quantitative objectives prior to optimization). Case company 3, on the other side, has just completed mapping its business processes, but has not reached as far as implementing them throughout the organization (Answer 3.8, Appendix). Therefore, this company is placed between level 1-2. Some procedures are formalized in the company, but are restricted to the specific departments', project managers' and chief project managers' management styles (Answer 3.9, Answer 3.11, Appendix). This would indicate that the organization is closer to level 2 than level 1. Lastly, a maturity level baseline is defined, which is defined as the minimum process maturity a company should have prior to initiating an ERP implementation project. This baseline is based on the IT consulting company's statements, which claims that the processes need to be formalized prior to companies even investigating the IT market (Answer 5.5, Appendix). Therefore, the minimum process level maturity required is set to be equivalent to level 3 maturity level in CMMI. Moreover, case company 2 interviewee is also of opinion that process mapping is important and believes that it makes it considerably easier to implement an ERP system when processes are defined (Answer 2.9, Appendix).

6.4.2 Section conclusion

To conclude this section, some few final observations are made. Firstly, it was observed that three out of the four investigated companies have their processed mapped and can be placed in a maturity level equal or higher than 3, with the fourth company (case company 3) being placed in a level lower than that because it has not implemented its newly mapped processes yet. Secondly, good correlation is observed between process maturity and ERP readiness. The three companies with a maturity of level 3 or higher have either implemented ERP or are currently involved in such an implementation project. The exception from the rule is case company 3, which has a functional ERP system, although its processes are not formalized yet. This can be explained by the fact that the company undertook a best-of-breed implementation approach, likely using a phased roll-out, where individual standalone systems were implemented non-concomitantly and

integration between these independent systems was later achieved. Another explanation for this might be that the ERP system is used to IT-enable the company's administrative business processes, covering the production to a much smaller degree. As indicated in the analysis, it is possible that the administrative business processes are formalized across the whole concern, something that the interviewee is not aware of.
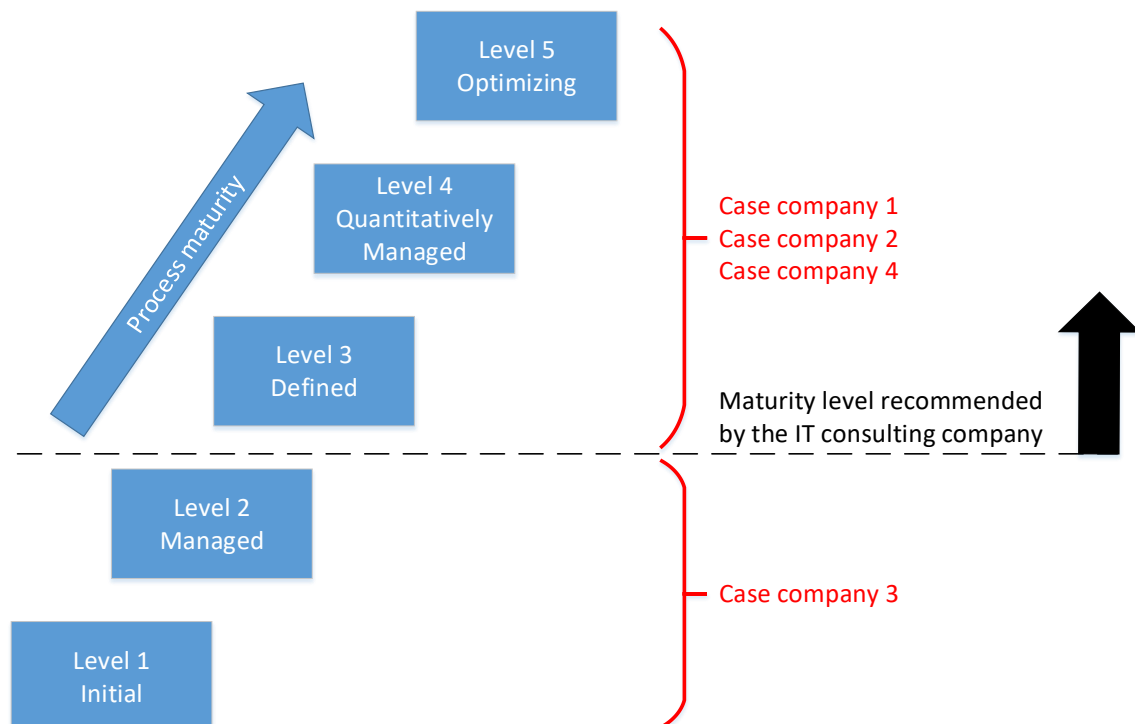
Figure 27 – Case companies' maturity levels vs. recommended maturity level, based on (Mahmood, 2015), (Software Engineering Institute, 2010)

6.5   Business process reengineering

6.5.1   Section discussion

The data analysis reveals that at first sight, none of the interviewed case companies apply BPR in practice. However, on a second look, it appears that BPR is used in one form or another in all case companies, despite that only one out of four interviewees claim knowledge of BPR. As Hammer & Champy (1993) point out, the essence of BPR is the radicality of the process change, which is the key in achieving substantial improvements. Petrozzo & Stepper (1994) recommend that BPR is undertaken on multiple critical processes concurrently, instead of redesigning each process incrementally. However, not all definitions are so specific, the literature studies generally listing up the different definitions due to lack of consensus. Koch (2001) defines four different BPR variations:

- Redesign;
- Top down radical BPR;
- ~~IT-driven BPR~~;
- Participative BPR.

IT-driven BPR is disregarded as a valid BPR variation in this study, because no valid arguments are found to support IT-driven BPR as a standalone BPR approach. The IT-driven term attached to BPR simply indicates that BPR should take place after the IT/ERP system was selected (Panayiotou, et al., 2015). This leaves three other valid BPR variations. Participative BPR consists of involving the users in the BPR process, where users can bring their contribution to how the processes should look like. This BPR variation is not bound by a specific BPR approach – radical or redesign (incremental). Therefore, participative BPR could be further classified as

participative redesign and participative radical BPR, which would automatically make the simply redesign as a top down BPR. The BPR variations are defined again:

- Top down redesign;
- Top down radical BPR;
- Participative redesign;
- Participative radical BPR.

All the interviewed companies (incl. IT consulting company) indicate that they support the redesign variation of BPR, where process changes are made incrementally/ongoing, with no companies believing radical BPR is necessary in relation to implementation of new systems. Furthermore, as the IT consulting company confirms, a paradigm shift has occurred in the ERP world since the mainstream emergence of BPR and ERP in the 1990s (Answer 5.10, Appendix). The appearance of numerous specialized ERP vendors, which develop systems tailored to specific industries and the specifications, needs and requirements of such industries, has waned the interest for performing drastic process changes in companies, such as top down radical BPR, motivating enterprises to opt for improving their business processes through either a top down or participative redesign BPR variation. As previously stated, all interviewed companies support the redesign variation, although except for case company 3 which is clearly in favor of a top down redesign (Answer 3.7, Answer 3.11, Appendix), the other four companies do not indicate whether they support top down or participative. However, case company 1, 2 and 4 all indicate that business process improvements also occur as a result of user suggestions (hence the participative assumption) (Answer 1.7, Answer 2.5, Answer 4.14, Answer 4.15, Appendix), but no indication is made that this is made in an organized way in these organizations, so that this can be generalized across cases. Table 15 sums up the BPR variation approach used in the investigated companies.

As a result of the paradigm shift, the choice of preferred implementation approach also seems to be shifting from technology-driven and process-driven to hybrid (requirements-driven), with both case company 4 and the IT consulting company opting for the latter (Answer 4.13, Answer 5.8, Appendix). This can be explained by the fact that the hybrid approach offers a more balanced alternative to technology- and process-driven approaches. The hybrid approach inherently involves the use of redesign in its implementation, where the process improvement and the ERP system selection process occur concomitantly and in an incremental manner (Panayiotou, et al., 2015). On the other hand, opting for technology-driven or process-driven might result in a more radical BPR process, due to the one-directional process. However, these two approaches are not constrained to a radical BPR process, something which is also proven by the data analysis, two cases being characterized by a customized best-of-suite ERP systems and one case being characterized by a best-of-breed.

Table 15 – Business process reengineering variation by company

Company	Used BPR variation
Case company 1	Redesign (top down or participative)
Case company 2	Redesign (top down or participative)
Case company 3	Not used – Has not implemented its processes yet; Supports top down redesign though
Case company 4	Redesign (top down or participative)
IT consulting company	Redesign (top down or participative distinction not made)

AS-IS and TO-BE studies are integral parts of the BPR/ERP implementation, as described by both Toor & Dhir (2011), Panayiotou et al. (2015) and others. As previously described, the AS-IS model represents the model describing company's current business processes and IT capabilities, while the TO-BE model represents the target model for the business processes and IT capabilities. Although the case companies provide no

information regarding the importance of developing AS-IS and TO-BE mapping, useful information is provided by the IT consulting company, which can be regarded as an authority in this matter with its 300 ERP implementations (Answer 5.1, Appendix). The company's interviewee defines the steps which need to be undertaken by a company when wishing to implement an ERP system. These steps fit to the requirements-driven procedure, which the IT consulting company uses in its implementations. Moreover, the IT case company points out that many companies do not undertake AS-IS mapping, due to lack of patience (Answer 5.5, Appendix). However, no indication is made by the company that this omission would lead to ERP implementation failure.

It is important to point out that the requirements-driven approach applied by the IT consultancy company deviates in some small regards from the theoretical requirements-driven approach proposed by Panayiotou et al.'s (2015). This variation occurs as a result of the fact that the IT consultancy company acts as a middleman between ERP vendors offering construction sector solutions and customers, which essentially makes both RFI/ERP market research and RFP unnecessary. This owes to the fact that the IT consultancy company has a list of collaborating ERP vendors, including their systems' capabilities and functions and the gap analysis between client company requirements and system capabilities can be performed in a collaborative manner between IT consulting company and client organization. Furthermore, this collaboration allows for an approach that is more recursive in nature than defined in the theoretical model. The idealized procedure applied by the IT consulting company is illustrated in Figure 28.

6.5.2   Section conclusion

Two conclusions can be drawn in this section. Firstly, it appears that if radical BPR was the preferred BPR variation previously, this has now been replaced by a more moderate approach – redesign (with its top down and participative variations). The current tendency seems to be leaning towards minimizing the degree of process change, while simultaneously selecting the ERP system which fits best to the companies' requirements. Furthermore, it was also found that redesign can be associated with all three implementation approaches. Radical BPR might be a valid approach, but no data supports this claim and no reason exists to further investigate this, provided the current ERP market evolution. In short, it can be said that ERP implementation readiness can be achieved by choosing any of the three implementation approaches and using varying degrees of BPR, although with the mention that companies should not be focused on performing drastic business process changes, since this does not seem to serve any immediate purpose and is likely to incur high costs in the organizations. This might have made sense for 20 years ago when best-of-suite ERP solutions were the only available choices and perceived as highly innovative given the low IT maturity in companies, which had to take high leaps to be able to adopt such systems.

Lastly, it can be said that TO-BE mapping is a prerequisite that needs to be fulfilled prior to selecting the final ERP system, which the company wishes to implement and not something that can be skipped. Therefore, TO-BE mapping is required in order to achieve ERP implementation readiness/success. Regarding AS-IS mapping, not enough direct data is provided which to support the necessity of performing this mapping. Moreover, the data also indicates that companies tend to skip AS-IS mapping. However, it is safe to assume that AS-IS is still required for two different reasons. AS-IS and TO-BE mapping are always present in the literature as a couple. Then, the findings regarding process maturity indicate that a certain level of maturity corresponding to defined processes (level 3) is required in the company, which means that by defining their processes, companies automatically perform some sort of AS-IS mapping provided that mapping of IT capabilities (which is associated with the AS-IS mapping) also takes place in the organizations. By undergoing a proper mapping, a baseline can be defined in relation to future requirements making the TO-BE mapping more realistic, being as a result based on documented capabilities and processes.

Who?	Step	Activity		Step
1a: Client company 1b: IT consulting company	(1a)	AS-IS model is developed	ERP catalogue with ERP systems and capabilities is provided	(1b)
Client company	(2)	Preliminary ERP system requirements and goals are formulated		
IT consulting company	(3)	Further ERP system capabilities investigation	Recursive process repeated as much as necessary to identify the right ERP system	
Client company	(4)	BPR modelling is performed		
Client company	(5)	TO-BE model is developed		
Client company with eventual support from IT consulting company	(6)	Final ERP system is selected		

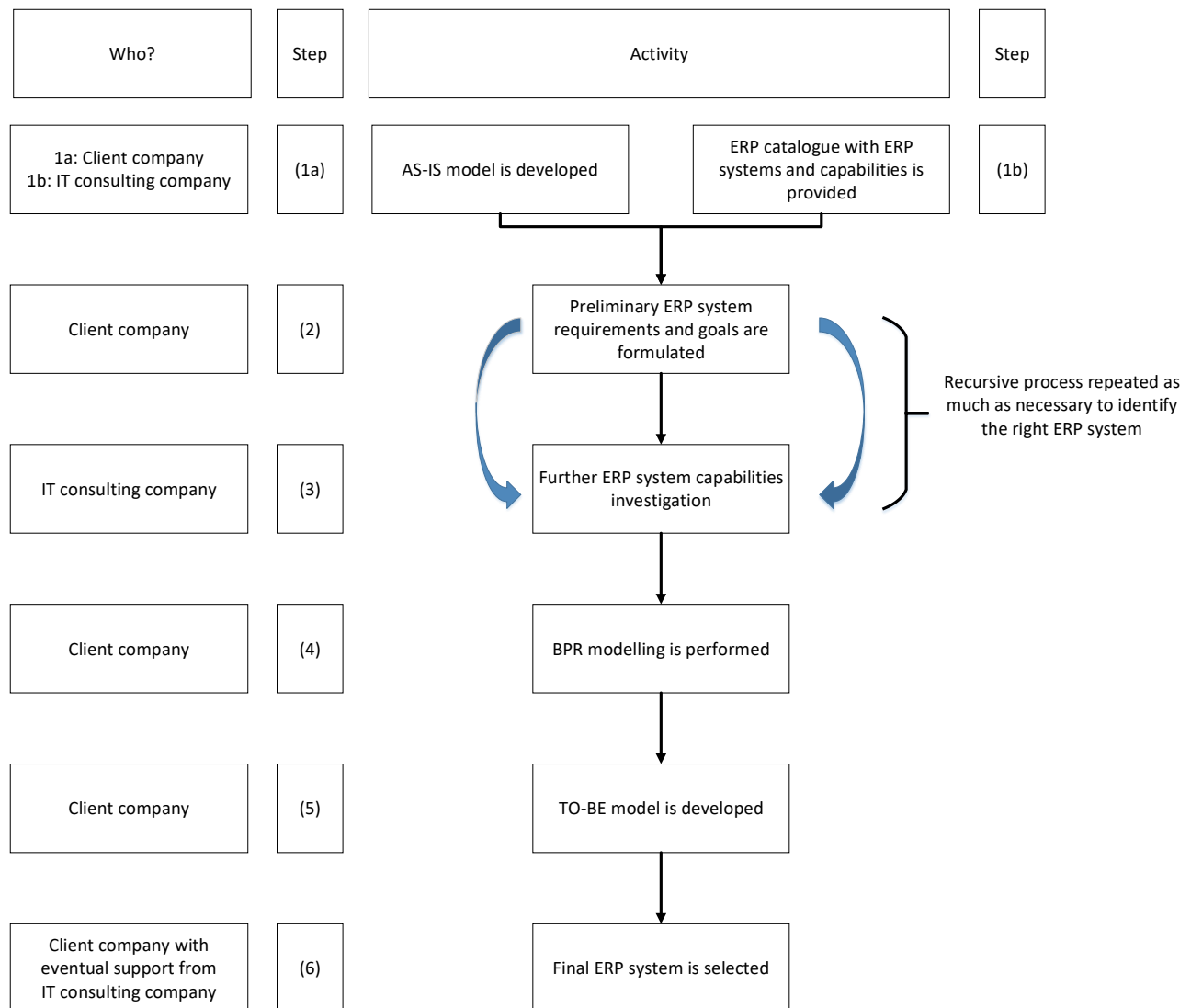*Figure 28 – Hybrid (requirements-driven) approach applied by the IT consulting company (idealized model)*

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7 Conclusion

This report concerns with investigating the issue of low enterprise resource planning (ERP) implementations in the Danish construction sector. When fully implemented in organizations, ERP systems fulfill core system functions, essentially linking every business function to each other through a common database and providing real-time analytics and status of the company for both normal users and key decision-makers. ERP systems are technologies which have been consistently associated with high risks and low rewards in terms of return on investment (ROI) success. This means that traditional targets such as cost but also time and scope are overrun in most ERP implementations. It is such issues that this study has set out to mitigate and even resolve. To do so, underlying issues must be first identified. This is done by first presenting the topic through a broad literature study, where the reader is introduced to the ERP systems' two main perspectives – ERP dimensions and ERP life cycle phases.

Each of these dimensions are described in detail in the remaining part of the literature, essentially covering the ERP topic from all angles. From a product point of view, challenges such as increasing technological variables and solutions, service models, deployment models as well as ERP module selection, need to be taken into consideration by organizations during the ERP selection process. Regardless of the degree of change involved, ERP projects are in essence large change management projects, which have an impact both on individual level – the users and the collective level – the organizational structure. The literature indicates that different change management strategies can be undertaken, that some organizational structures are better at embracing ERP systems than others and that users can manifest resistance to change, something that can be predicted and improved through technology acceptance models. Common in the change management and people dimension is the importance of communication and top management's commitment and support, which are key elements in achieving ERP success.

Lastly, from a processual/strategic point of view, the literature describes three different ERP implementation approaches which can be undertaken by companies – technology-driven, process-driven and requirements-driven. Common for these approaches is the use of business process reengineering (BPR), which is used to achieve alignment between a company's business processes and the ERP system's business processes or way of operating. As a result of this, BPR occupies a central role in ERP adoption. Although BPR is not standardized by frameworks, the literature identifies several common steps which need to be undertaken when performing BPR in relation to ERP implementations, among which AS-IS and TO-BE process mapping. However, what is central for BPR is the strategic planning and thinking, since both BPR and ERP are strategic initiatives, something that needs to be reflected through the companies' readiness on both processual and strategic levels. Given the importance of these elements within the process/strategic dimension, as well as underlying influencers of ERP success, this study defined a problem statement with the following questions which the study has set out to further investigate:

RQ1. *What is the link between business process formalization and ERP implementation readiness?*
WQ1. *Are companies required to undertake AS-IS and TO-BE process mapping in order to achieve ERP implementation readiness?*
WQ2. *How does the process maturity level corelate with the companies' ERP implementation readiness?*
WQ3. *Can ERP implementation readiness be achieved through varying degrees of BPR?*

These questions have been addressed through a case study strategy, where the primary qualitative data was collected through semi-structured interviews with Danish contractors and a consultancy company. While the contractors are used as primary investigation field, the consulting company is used to supplement the understanding in terms of ERP and process trends, ERP solutions, basis for decision-making etc. Being a holistic multi case study, the analysis uses narrative approach to describes the situation in each case company, followed by a cross-case analysis which focuses on similarities and dissimilarities and ultimately adds the holistic element to the analysis.

The discussion aims to combine and compare the secondary and primary data with the goal of ultimately answering the research question. The findings in this chapter indicate that implementation readiness can be achieved through varying degrees of BPR and using different ERP implementation approaches. Nevertheless, there is also an indication that both ERP and BPR have evolved throughout time, triggered by an explosion in digitalization, which has made ERP systems more readily available and diverse and where there is less need for customization and radical process changes. If radical process changes were the original trademark of BPR in the early 1990s, present interview findings indicate that this is no longer the case in present time and that radical changes have been replaced by a moderate approach which can be best described as redesign. Redesign can be initiated either as top down approach, where top management dictates the direction or as a collaborative approach, where employees are involved in the process redesign. As a result of more vendors appearing on the market, the ERP systems have diversified and a tendency to implement ERP using a requirements-driven approach, with incremental adjustments on software and organization side, are becoming increasingly common.

AS-IS and TO-BE process mapping are central parts of BPR, as both literature and findings clearly point out. These are required to be performed by companies in order to achieve implementation readiness. Additionally, good correlation is found between high maturity process levels and ERP implementation readiness, with a level corresponding to 'defined' (or level 3) on CMMI scale being required. By having high process maturity, business processes are mapped and AS-IS mapping also achieved. Even though companies might tend to skip the AS-IS mapping, some sort of mapping is still likely to occur on a more informal level in smaller organizations, where no very formal mapping is required.

8 Further research

This study focuses on investigating the relationship between BPR and ERP in the construction sector. However, just like in any other research, some limitations are present. Given that this study focuses exclusively on process management, it would have been ideally to dedicate more space to process management in the literature review, so that more papers from this area can be reviewed and a broader perspective achieved. Moreover, the strategic part of BPR requires more consideration and it is something that can be treated in a separate study. Better ways to measure strategic planning and business IT strategy alignment are required for these to be used for more than indicators for ERP implementation readiness. Given that BPR is an old concept and does not follow any standardized procedures, in lack of any baselines it is difficult to make an analysis where literature is compared to practice. It is likely that better methodologies and frameworks exist and can be investigated in relation to ERP and how ERP implementation readiness can be achieved. Such movements can be found either in the management tradition (for example business process management), or in the IT tradition (for example BPMN or business rules).

In terms of data collection, some bias is likely to be present in the data collected from case company 1 because this interview was performed via phone call and no prior trust relationship was established with the interviewee. This is also reflected by the length of the interview and the shortness of answers. Lastly, doubts are expressed about what defines an ERP system. Although thorough definitions were given in the literature review, it is still uncertain how many and which modules are required in order to call an IS system an ERP system. This issue is particularly important in the construction sector, where companies undertake a best-of-breed approach, where several standalone ISs are connected to form an ERP system. The resulting size of an ERP system created using this procedure might be considerably smaller than the size of a standard system provided from a best-of-suite vendor.

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10 Appendices

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10.1 Interview transcripts

10.1.1 Interview case company 1

[Answer 1.1], [Background]

Q: I would like to ask you to present yourself – your position, your experience.

A: I am director for IT and company development in [company name anonymized]. My background is in IT engineering. I have been director for 7 years in the company.

Q: What are your daily tasks?

A: It is management of the company, strategy and company development and IT.

Q: Together with the others from the management board?

A: Yes, primarily executive board.

Q: What are [company name anonymized] core competences and core values?

A: Our core competences are execution of civil works projects. Typically, smaller and medium sized projects.

Q: And you do not limit yourself only to this type of work? For example, if an interesting opportunity arises...?

A: Yes, we do primarily civil works projects, not really much construction. And no large projects, is there a small or medium sized projects.

Q: Across all Denmark, right?

A: Across all Denmark and [other countries anonymized].

Q: And your core values?

A: Our core values is to deliver the promised quality in promised time. But is mostly based on delivering a good to work at the promised time and in an appropriate way. We work locally a lot and then there is a lot of focus on working locally for others, be responsible for the local places we work in, use local workforce, educate apprentices and be a part of the local community where we are. That's something on which there is considerable focus.

[Answer 1.2], [Strategy]

Q: Have you defined an IT strategy in the company?

A: Yes, we have an IT strategy.

Q: Ok, and who has defined this strategy?

A: I have, together with the IT department.

Q: And has the management board also been involved in defining it?

A: They have approved it, yes.

Q: So, you could say that your IT strategy is derived from your company strategy?

A: They're connected, yes.

Q: You have an IT department in the company, right? Which role does the IT department fulfill?

A: It ensures that the IT systems function and that we have a high up-time for our systems.

Q: And it [IT department] also supports implementation of new systems and changes and...?

A: Yes, they do that as well.

Q: So, you are doing it internally, not by outsourcing competences and resources.

A: We have a lot of outsourcing. We don't have a very large IT department. Many things are outsourced.

Q: How do you decide what has to be outsourced [and what not]?

A: We decided based on the fact that everything that is directly connected with the user, we keep it internal. And then we have some key competences [in the company] that have overview over our IT systems. Everything that is standard is outsourced.

Q: Do you have any challenges with IT, or do you think it works well?

A: I believe it works well, but of course there's always challenges with IT. But not some big challenges.

[Answer 1.3], [Product (ERP, General)] [Strategy]

Q: Are you familiar with the concept of enterprise resource planning?

A: Yes.

Q: Do you use such a system in the company?

A: Yes, we use Microsoft Dynamics NAV.

Q: Why have you chosen to use enterprise resource planning? Is it as a result of your IT strategy or strategical planning or because it fulfills some functions... [you need]?

A: I don't know. It's something that we have implemented for many years ago. I don't know what the motivation was back then. But of course, we use it to ensure the financial control in the company.

Q: For how long time have you been using it?

A: For around 20 years. Since 1990s.

Q: For what purposes are you using it in the company? For what processes? You said something about finances, but HR, logistics, your core areas, project management [do you also use it for that]?

A: Yes, we do.

Q: So, you have implemented this across the whole organization, so that everything is interrelated and communicates with each other?

A: We use it as a single system. It's a core level system.

Q: Your newest enterprise resource planning system, Microsoft Dynamics, for how long time have you been using it?

A: That's what we have been using all along. We have been continuously updating it.

[Answer 1.4], [Process maturity], [BPR]

Q: Can you please tell me a bit about your processes? Have you formalized them in the company?

A: Yes, we have process descriptions of our [system?] processes.

Q: Your process development, have you been now only performing smaller adjustments, or were you required to make some radical changes, like for example, some processes that are not efficient enough, such changes... more radical?

A: Typically, we are doing it stepwise.

[Answer 1.5], [BPR]

Q: Are you familiar with business process reengineering?

A: Yes.

Q: Is it something that you have been working with in the company?

A: We have in relation to company development.

Q: Can you please explain me in relation to which processes you have been working with it?

A: We do it in relation to administrative processes and other things, which we regularly optimize.

[Answer 1.6], [BPR], [Implementation approach]

Q: Do you believe that when a new software has to be implemented, the processes have to be adapted so that they match the way the software work, or that a software needs to be picked so that it matches the way the company work?

A: Typically, we work to get the systems to function the way we are working.

Q: So, you would say that you are more of a supporter of software customization rather than process change?

A: Both things. It depends how big the process is and how big the change is. So, we are working with the concrete process. But as a starting point, we prioritize getting the systems to match the way we are working.

Q: But your opinion about this, is based on the fact that your processes are optimal, so there is no need to make adjustments to the processes so that they match the way the software works?

A: No, I would actually say that... It's not necessarily... if the software has a process that is better than our process, so it makes a lot of sense to change the process [our process]. But it should be for this reason, not just because the system thinks we should do it another way and we will just do it in that way.

Q: I am also asking about this, because enterprise resource planning has its own processes, its own way of functioning and then it has integrated some best practice from the industry, from the vendor's experience. Therefore, in many situations, if you want to use the software, then you are required to make adjustments of your processes, before you can use the system, unless you make a lot of system customization.

A: That's right.

Q: And then how this apply to your situation with regards to enterprise resource planning?

A: There is no enterprise resource planning system that just fits to us.

Q: So, your enterprise resource planning system is a customized Microsoft Dynamics system?

A: Yes.

Q: Which adjustments have you implemented?

A: Many. For example, our project management, invoice management. We have two full-time employed that work with visual programming. And they work every day with that so... there's many changes.

[Answer 1.7], [BPR], [Implementation approach], [Strategy]

Q: And these needs for change where do they come from?

A: They come from the organization for operations... When we are considering to implement something smarter or appropriate or we need new analysis or reports... From many different places.

Q: So, it's not just visualization or reporting at many other things... Like the way you are invoicing you or...?

A: Yes, exactly. It's many things.

Q: But if for example, an employee says, "this doesn't function as it should", or "we can't work with this" or how are decisions made [with regards to this]?

A: There is usually some employees that says: "we should do it in this way, or that this way smarter", then we are going to do an analysis of it, and if we agree on it, then we make an adjustment to the system.

Q: So, you are making this analysis on a management level, before you implement something?

A: Yes, we investigate if it makes sense. If it's a very small change then it will happen by itself. If it's bigger than we will make an analysis to see if it will pay off to implement it.

Q: Then I would like to ask you how you ensure that when you are making too many changes, it will not run out of control and become too heavy and you counter intuitive.

A: Yes, it does become like that sometimes... too heavy. Then we say that now we have made too many changes and we make an analysis of what actually is used and what not.

Q: So that's something that you're making regularly?

A: Yes.

[Answer 1.8], [Organizational structure], [Change management and people (General)], [Strategy]

Q: I would to ask about your organizational structure. How are you organized? Is it a flat structure or is there a long way from the top to the bottom?

A: It's flat.

Q: So, if you're saying that it's flat, does that mean that changes spread quickly from the top to the bottom?

A: [unintelligible speaking]. We're trying to make it as flat as possible.

Q: When you're considering implementing something new, does it take a short period of time before it gets implemented?

A: No, it takes a long time to get the things to everybody.

Q: Even though the organization is very flat?

A: Yes, there's many people.

Q: Ok, so where would you say the challenges are in this regard? Is it with regards to resistance and change management?

A: No, the biggest challenge is communicating it. We are many people and we are spread everywhere. Many people sitting in many different offices in Denmark. So, it's the communication.

10.1.2 Interview Case company 2

[Answer 2.1], [Background]

Q: I would like to start by asking you to present yourself – how long have you been working here, your experience?

A: I'm working as department manager and I'm responsible for everything from Randers down to the German border and the entire Funen [specific activity field anonymized]. I have been working in the company for 19 years. So yes, long time...

Q: What would you say that are your company's key competences?

A: Company has activity within the field of [civil works] [exact competences anonymized].

[Answer 2.2], [Strategy]

Q: Does the company have an IT strategy defined?

A: Yes, we have.

Q: And who is that has defined this IT strategy for Denmark? Is it the mother company or is it the Danish division? Does it vary from country to country or...?

A: Most of it comes from the mother company in [country anonymized], but they're of course of a lot of things like special website, which we can't access because they are locked. There are rules that you can't use Facebook and such things so they're coming from mother company. But there is also a local or how can I say national IT... In the start for example, Denmark's Radio [DR] was locked and that's where we searched for a lot of information and it didn't make any sense, so that's something they had to open, but otherwise they aren't interested in allowing using time on something that's not relevant. Then we have a lot of strategies about how you're supposed to save the data due to data protection regulation. That's something we have use a lot of energy on.

Q: What about the people that are responsible for deciding what software you should use?

A: Well, there's a lot of standard programs, there's AutoCAD, there's the Office pack and if they're someone that has to use some special software ask, then we can ask to get the software. Our department [actual department name anonymized] uses a lot of special programs so it's the individual department managers that approve this and then a request is made to the IT department.

Q: Which function does your IT department have?

A: So, it's a support function, which primary is responsible for helping getting the systems to run, but they also have if... we should have a new mouse or keyboard, new computer, you send the ticket [application] where after it gets sent automatically in the system.

Q: So, it's a proper IT department? Not just technical support...

A: Yeah, it's proper IT department. They set up our systems. There's four employees there.

Q: Do you have any challenges with IT, or do you think that it goes alright?

A: I believe it goes quite well. Of course, when there's something that crashes there's a problem, but we have an up-time time of approximately 99,8% so it goes quite well, I believe. There aren't any big issues.

Q: What about your file... storage system, have you migrated to the cloud?

A: We have migrated to the cloud. We are not allowed to store anything locally on the computer. We have recently migrated to the cloud.

Q: So, it's quite easy to access the data, right? It's not organized department wise?

A: No, no. We can access everything from home using VPN. But we have access to everything from everywhere.

[Answer 2.3], [Product (ERP, General)], [Business processes (General)]

Q: Are you familiar with enterprise resource planning?

A: No, I'm actually not [interviewee is then introduced to the concept of enterprise resource planning].

Q: So, it's not something that you are using?

A: No, we aren't using it.

Q: So, each department uses their own software?

A: No, they don't. We have our economy system, our tender system, they are not connected. But they exchange of course data, but it creates a lot of challenges because data needs to be processed manually or run through a converter or another program that can understand it. And it creates some challenges and this software you're talking about I know it is planned to implement it, but it has to be a system that our mother company uses, because we have offices in [number anonymized] countries and we are basically interested in using the same system in all these countries, so that we can receive all this data live as you are saying.

Q: Yes, and it's something that you can use across countries, it's a long process and it creates many challenges and high costs when you're implementing it. It's not something you are implementing overnight.

A: Now it's definitely not something you are implementing overnight. They have a good corresponding system that they are about to implement. I don't know if that's the correct name, but internally they call it [name

anonymized]. That's the code name they are using for it and they are expecting it to be ready in 4 years - in 2023.

Q: Yes, that sounds reasonable if you're thinking how many countries there are.

A: Yes, there's over [number anonymized] employees.

Q: So, you're saying you have considered implementing it [ERP]?

A: Yes, it's been decided. It just hasn't been implemented yet.

Q: And right now, you're using some other systems that aren't... all the time...?

A: We are using some system that are exchanging data.

[Answer 2.4], [Process maturity], [BPR], [Strategy]

Q: Can you please tell me a bit about your processes? Have you formalized them?

A: Yes, we have. We have a flow diagram over everything we are doing. And then we have process descriptions. But then we have flow diagrams for all our core processors and if you need to make a decision you can for example choose A or B. So, you could say that all our processes are described to the smallest detail. What do you need to do when you're receiving something, if it doesn't look right or if it does look right what do you do then? So, there's processes for reception control, production, delivery, customer contact - how long does it have to go before we call back. Everything is planned.

Q: Ok, and these processes, how are they defined? Is it on department level or...?

A: No, they are nationwide. They are defined in our management system. There can you go away download a process description.

[Answer 2.5], [Process maturity], [BPR], [Strategy]

Q: And do you do ongoing optimizations? For example, now we believe that this process takes too long time or it's too complicated...?

A: Well it's organized in such a way that... We've got a new management system 2 years ago and at that point we've gathered a lot of people with hands on experience to define this [processes]. I, for example, have responsibility for the production in the whole country [Jutland?] and if someone has some improvement proposals, then they have to write it on a form, where after I will consider if the proposal is reasonable. If the proposal is reasonable, then it should be implemented. The intention is that it has to be an ongoing [improving] process, which moves towards the direction where the world currently is.

Q: So, if the proposal is good, then it is implemented in the whole country?

A: Then it is implemented in the whole country, yes.

Q: So, you are doing this in a very organized way?

A: Yes, we do.

[Answer 2.6], [BPR], [Implementation approach]

Q: Do you believe that when a new software has to be implemented, the processes have to be adapted to match the way the software functions, or that you should pick a software that functions the way you are working?

A: Optimal is to choose a software that functions the way we are working. It's just difficult. We have developed a part of our planning system... It's connected to our hour registration system. And this functions very good for us, but I have to admit that when you are developing some programs yourself, then there's all the time some things that are not appropriate. That's something you are learning when you're working with the software or ending up working around the software and that's something that's not the appropriate. But that's difficult when that's the program that you are developing yourself due to the fact that there's a lot of costs associated to it. Each time we have such an IT project going on, the budget is overrun. It's hard to say how much it will cost. And you can have a lot of descriptions and have the program's characteristics described in the smallest details, but there is all the time something that comes up, which you weren't initially aware of. So, it's all the time best to have a software that matches the way you are working, and that's something we do 90% of the time. And then there's sometimes where we are required to do things in an inappropriate way because that's the way our system functions. And I would say that this occurs when some software has to deliver some data to another software. And it's fine that you're developing a lot of things that you can

transfer, but if the software that has to receive it cannot do that, so doesn't make any difference. So there where we usually encounter issues is where you have to exchange data between software.

[Answer 2.7], [BPR], [Strategy], [Organizational structure]

Q: So, you are saying that the software has to be adjusted to the processes, but that means that your processes are optimized? And your processes are derived from your strategy, right?

A: Yes, our processes are optimal. We make our processes as optimal as possible and we would like a system that can work with that. So that's correct.

Q: I have planned interviews with following companies the following weeks...

A: But for example between us and [company name anonymized], there will presumably be some difference because they are a Danish company and they're taking the decisions themselves, and when they have a good idea, their implementation time will be much faster than ours, because if we, for example, find some program that we think it would be useful for us, then we need to seek approval from the top management in the mother company, before we have any chance that they will be accept it.

[Answer 2.8], [Organizational structure], [Strategy]

Q: Yes, this makes sense because your national strategy has to match the international strategy and you have a heavy organizational structure?

A: Yes, the organizational structure is quite heavy and many times not very good for the efficiency and when you have to find something, then it has to fit [for example] for both [country anonymized], [country anonymized] and [country anonymized]. It can be quite heavy and very time consuming.

[Answer 2.9], [Process maturity], [BPR]

Q: I was hoping that you are using enterprise resource planning, but it is good enough to get some insight about your processes, because some other companies for example, might not have their processes formalized...

A: We have used an enormous amount of energy on that [processes] and to describe them and if such a software has to be implemented [ERP], then it is significantly easier to implement it, when you have written them down. For everyday work it can be a bit heavy to work with, because every time you have to take a decision, then they have do such and such [check the flow diagram]. For new employees it is helpful, but you can also end up doing something wrong, because you do not have full overview.

Q: Have you ever found some processes that are quite bad or non-optimal which you had to completely change?

A: No, I do not believe that we have, simply because we are continuously trying to... I mean it has to be a living system and develop it [ongoing].

10.1.3 Interview case company 3

[Answer 3.1], [Background], [Strategy], [Process maturity], [Organizational structure]

Q: I would like to start by asking you to present yourself - your position, your experience.

A: I am employed as project director in our tender department. That means that I have responsibility for everything that has something to do with tender. That's one part of it. So, everything we give an offer, for goes through me. Then I have also received tasks regarding organization and leadership, employment of new employees. For example, our new department manager in Aarhus, I had the responsibility of hiring him. If new systems have to be implemented, or new ways of working, I will also get involved in that. Among others, we are currently involved in implementing [strategy] [specific company strategy name anonymized] – a system and methods about how we do the things from the tender phase up to the delivery phase - a process description. It wasn't my responsibility to develop it [process description]. That was [person name anonymized]. It is him together with others that have developed it, but I will be responsible for its implementation here on Jutland. And it's just not that easy to do that. That's because we work a lot in silos. We are quite independent in each of these units and use the systems which we use there. And that's why we need to try to streamline the things a bit. For example, when we mean that we want to make a contract with a contractor or a customer, then a contract has to be made. That's not something we always do today.

Q: You have mostly oral agreements...

A: Exactly. So, I need to help for putting these things on a structure. The structure of how we save the things and how we learnt the things. I have been working in the company for exactly half a year today, and it feels like I have been here for only 2 months. It has been just going very fast. But I have been involved already in a lot of things in the company. Before that, I have been working in an industry association for contractor companies, working with consulting our member companies regarding law, agreements, everything possible... professional things. And business policy, basically influence the politicians. Then I have been working with IT tools and implementing them in the industry. So that's it, briefly. I'm educated as a civil engineer from [university anonymized].

[Answer 3.2], [Background]

Q: I would like to know to ask what are the company's core competencies?

A: You mean... [interviewee makes reference to specific daughter company he is working in – name anonymized]. You know the organizational structure, right? Our core competencies is construction of [civil works projects] [specific subdomain anonymized]. Short and good. [discussion about this specific field anonymized]. And we don't do anything else other than this basically.

[Answer 3.3], [Background], [Organizational structure]

Q: What are your core values?

A: Besides our core value, which you need to give me a moment, so that I remember correctly, we have our core values which are purely organizational, if I should start with that. We have a quite flat structure; we have a quite agile structure. That's one of the things I have noticed since I've been here. We're quite agile, there's no big hierarchical structure. So, one of our core values is that there's a short path from the top to the bottom [of the organization]. Then we also have some core values about that we would like to her give offers and construct project which are within our defined frame, our main specialty. Then we would like to advise our clients on everything they ask. And then we would like to deliver good quality. And the reason that I say that, that's something that everyone says – that we would like to deliver good quality. But that's something we also have negotiations about. Sometimes the price competition is quite tough and sometimes you also compete on soft values. And in some areas, it can be that they offer quite low price [the competitors] compared to what we can produce for. But on the other side, they don't have much else to offer... Like soft values. And we have a goal with respect to that, that in this area we simply have to be strong – we have to be strongest on soft values. And that is something that some clients also require, that we have to have organization and a lot of administration... Just the fact of managing an order. And then they have others that work for them and they cannot manage it properly. On the other side, they're cheap. And that's something we have a target for – we do not want to be on that level, we would like to deliver some work that we can manage, the administrative part and equality in a reasonable way. We do not want to compete with those that compete on lowest price. But on the other side, our organization is built in such a way that we are effective – we are situated in the middle of the companies – there are some companies that have a flat organization and have challenges with the administrative part and then there's some juggernauts which have a lot of engineers employed in the company. We don't have that in our company. We don't have many engineers employed. We don't have a large amount of administrative personnel. Almost everybody that works in our company has something to do with the production. We don't have many support structures. The support structures we have, are in a smaller degree in the departments and assist with the production.

[Answer 3.4], [Strategy]

Q: I would like to ask about the IT strategy. Have you defined an IT strategy in the company?

A: I can't precisely answer if... We have an IT department in the company and [name anonymized] who is responsible for IT.

Q: My next question was actually about what role does the IT department have?

A: Yeah so, we have an IT department [name anonymized] as manager for that department. I don't know the IT strategy to be honest. But they are responsible for managing the things which have to be implemented.

It's because I have the feeling that you don't have a big IT strategy. We don't have a strategy that we have to be leading in IT tools. That's my perception.

[Answer 3.5], [Strategy], [Organizational structure]

Q: I'm not only thinking about the IT strategy, but also about how the IT strategy relates to the corporate strategy, if there's a proper correlation between the two. For example, the management decides that now we have to implement this system in the whole organization. And then the IT strategies which are strictly related to the business strategy.

A: There are some systems which have to be used in the whole company. And then there are some also for our specific daughter companies, which we are currently implementing right now. But to come with an example, it was decided to implement DocuNote – pathfinder system or document management system. That's what we are currently implementing. Then we have some systems that go all the way through [across organization], payroll system, finances system. We have a set of systems that function across [departments/daughter companies]. And that's the goal. And in addition to that, each individual department has a bit, some things. All the administrative systems are implemented in the whole organization. And then we have some other support tools, which can be quality assurance systems. For example, Ajour or Capture. There's many. They're implemented more aimlessly through the departments, because tender...

Q: It can be that a specific project requires a specific software.

A: Yes, exactly. Some of our agreements... Now I have a lot of work for [client name anonymized]. They have their own system [quality assurance]. We are using that - how are you planning things and how are you invoice things. On others such as [client name anonymized], we use Ajour for that. So, for example for that [quality assurance], we do not have a shared IT strategy, that we implement a shared quality assurance system throughout the whole company. We won't do that.

Q: No, because it is managed on a project basis.

A: Exactly.

Q: The IT department, does it only fulfill a support function, or does it also have responsibility for managing systems and implementing systems?

A: No, it's a support function.

[Answer 3.6], [Strategy], [Business processes (General)], [Change management and People (General)], [Organizational structure]

Q: No, but I mean with regards to for example if you have to implement a new system, do you use external consultants, or does everything take place internally?

A: Most of it takes place internally. It can't be that some of it takes place externally. We have just started on it now. That's DocuNote. We have big challenges implementing it. The mistake we've committed… now I'm only talking about this specific part of the company [company daughter company name anonymized], because I know the changes we have here. A decision comes from the IT department and some people appointed in the company, they received some courses, then nothing else happens afterwards. Then 2 years later after this should had been implemented... nothing has been implemented at all. When I have started [to work in the company], I've asked why is isn't it implemented. What are the challenges? What happens is actually that there's some people sitting with some software on their computer which they cannot use. [unintelligible speech] ... management that listens to their employees and who says that this has to be implemented, where everybody knew the software and decided that this has to be implemented. There is nobody that has asked us or has tried it. Then it is decided that the end-users have to receive courses, without anything else happening after. Thereafter the main department [?] starts [saying?] that they we are locked to this [system], it's way too difficult. Then we should see if we can solve this problem. Then we'll have to look into it, or otherwise we won't get anything implemented. Because we lack that connection, as you are saying, from the point where the implementation decision is made, to the point where it [the system] is fully implemented. It's extremely challenging. I can also see from my previous workplace, where I have been selling some of these systems. We weren't only selling the systems, but also advising [our customers]. The easiest and cheapest is to buy the system, the most expensive and most difficult is to implement the system.

The most expensive for the company [interviewed company] is to buy DocuNote. It can be that it will cost a few hundred thousands, but it is even more expensive to implement it. And if you do not use the time, the resources and the time implement it, then you have wasted all this.

Q: Then a new version is released.

A: A new version is released, and people become frustrated and you have wasted the money. You need to use some energy on how you are going to implement this... the implementation plan. I don't think we have a strategy for how to implement the things, I doubt it.

Q: So, it's a challenge you have with this...

A: It's a challenge, yes. A big challenge. We don't know who has to solve this yet. The other thing is, if we continue with the DocuNote example, we can't actually use it in some departments, it cannot manage all the processes in our departments... where documents are moved across.

Q: So, it's a challenge with the interoperability?

A: Yes. [side discussion about construction industry vendor company].

[Answer 3.7], [Product (ERP, General)], [Business processes (General)], [Organizational structure], [Strategy]

Q: Now I reached the core of my investigation. Are you familiar with enterprise resource planning?

A: No.

Q: [The interviewee receives information about what enterprise resource planning is and what it consists of; the interviewee also receives information about the real-time managing capabilities of such a system, where the interviewee then joins the discussion again].

A: That's something what we also can… on the finances part, that part of the system is interoperable. Both for invoicing and for when we are status reporting and case reporting. So, we have all the information from the systems that are connected. We can see what our expenses are, what invoices we have received, which labor cost we had, how much sick leave.

Q: But you haven't considered implementing something like this [ERP]?

A: No, I can't answer this question. And I believe that neither [project director name reference] nor [regional director name reference] can answer this question. You would have to contact the IT manager to get an answer about that. It's on that level, where such decisions lie.

Q: So, it's something that comes from the top management, right?

A: Yes, it would. It would be from the IT department. The wish doesn't come from below for such a thing with the way we are working. Because our organization... The people in Jutland, how can I say... the interest isn't there... it's not the way we are working.

Q: So, it is a top-down approach?

A: Yes, it is a top-down. That would be my opinion of it.

Q: It's a big initiative.

A: The decision is made by the management board, but the suggestion doesn't come from below.

[Answer 3.8], [Process maturity], [BPR], [Strategy]

Q: You talked a bit about your processes, that there was some initiative to formalize them in the organization. What's the current status?

A: It has just arrived. You can also see it, if it makes sense.

Q: Yes, I would like to [processes are then shown on screen by the interviewee]. [the intranet is presented, machinery availability function, work environment etc.], [process descriptions are presented]. Are the project finances connected to this centralized finances system?

A: Yes, we use DocuBizz for that and they are connected. We can extract all the project information at any time.

Q: Is it internally developed?

A: No, it's a standard system.

Q: Have you customized it?

A: Maybe some specific buttons are changed, but I can't really answer this. Otherwise it's a standard system.

Q: It seems that the system you are using reminds a bit of enterprise resource planning. Maybe not completely, but partially.

A: I believe that as well. And I think we also have this need, because it is quite important for us to know it. Because we are a production company, that works project based.

Q: Like most construction companies.

A: I have the impression that this part works very well.

Q: [detailed discussion about the company's different process descriptions and procedures]. It seems that DocuNote is quite new...?

A: In fact, it's not [fully] implemented yet. And then we have something that is called DAR, which we use as a payroll system.

Q: But this processes they are just for this daughter company, right?

A: Yes, that's right.

Q: And it's the management that has decided these processes or...?

A: I can't really answer this [unsure]. I believe so.

[Answer 3.9], [Process maturity], [BPR], [Organizational structure], [Change management and People (General)], [Strategy]

Q: I would like to ask what was the process [background for] of defining these process descriptions?

A: The background for implementing this is to set focus on it. It's a lot of this that we are doing today. Attention was drawn on the fact that we do not do things alike in the organization [daughter company]. Now only talk about this daughter company. We do not do things alike at all from one department to another. We use different documents; we have different ways of saving things. Then the management has decided that we need more structure. The people have worked in the company with the principle of agile, where large freedom is given to employees. There was fear for setting too tight frames in the organization. [short company history regarding organizational structure is given]. The structure was very rigid back then. And then the company went completely in the other direction. In practice, you can't figure out things, you can't find contracts, you can't figure out what agreement you have made, because they are located on some email in another structure there [project-based structure].

Q: Yeah, I believe it's hard to understand the structure.

A: There is none. And we haven't reached far with this. Now we have the plan which is located here [points at the screen at the process descriptions]. And now we have to start using it [implement]. [strategy name anonymized] is a structure. Now we have to implement this structure and get everybody within this frames. But it's a long way. Really long way. And it's down on a very practical level. Now I help making contracts... If we have to make a subcontractor contract after we have won a project... It's not me that has to request the offers from subcontractors, it's... Do you know [project manager] [name anonymized]?

Q: Yes...

A: Then the project manager calculates the offer and requests offers from subcontractors. Then I put all the pieces together and write the descriptions. And after I have to make the contract and I look in the subcontractor folder. And the files are not placed in there. They are placed on a folder on his computer in his mailbox. And it's like that for all of the cases. So, this doesn't have anything to do with the system. You can implement a fine system, but it won't help if you don't use the system. It's a huge challenge and it's very hard to get the people to do it right.

Q: Yes, because when you learn to do it in one way, you keep doing it...

A: We've started implementing DocuNote... Do you know it?

Q: Ehm...

A: It doesn't matter. DocuNote is a pathfinder which is locked in one way or another. There are many advantages. But that's what we started implementing, then the employees say... "I cannot create a new folder. I need a new folder. You have to create it". To which I answer: "You are not supposed to". To which I call the director and IT, which then unlock all the system. Then the system and structure ran out of control

and people started doing the same way as they used to, creating folders under their names. Some of the things... I have the perception that they have to be managed project-wise.

Q: Yes, but when you define it, you also have to define it properly.

A: But that's how I think it should be. These projects have their own life, because you don't have the need to see something across the cases necessarily. You can use the economy system for that. [interviewee draws some system structures on paper - detailed discussion not transcribed].

[Answer 3.10], [BPR], [Strategy], [Organizational structure], [Change management and People (General)], [Implementation approach]

Q: So, to be a bit technical... You have your AS-IS model which reflects the current way you are working and then you have your TO-BE for what you want to achieve. It's what you are aiming for...

A: Yes. It's what we are aiming for. But we will never end up using this 100%. Will come to pick up only what makes most sense out of this [process description, plan etc.]. It is also part of our culture. If it there is no need for it, then we shouldn't do it. And if we start doing long lists, which people have to tick. Does it create any value to tick?

Q: So, you have defined the TO-BE model. You just do not know how to get there yet, right?

A: This is the way, but how we get there and get the different departments to do it this way...we don't have the plan. You have tried to tell them many times that that's not the way you should do things. But this has to be implemented and it requires some resources and this resources are not found in the departments. That's us, the others, that have to help them in some way to get it implemented.

Q: Do you know what business process reengineering is?

A: No.

Q: [interviewee is introduced to the concept of business process reengineering].

A: And then you ask how we are doing things today. It's differs quite a lot. It depends who you are asking. It's not that we do things wrongly, but we aren't making things easy for ourselves. We do some things today the way we are doing today, but we don't do the last thing, so that they can be also used later on. And to get to that point we shouldn't be supposed to do something extra, just do things a bit different. You just need to adjust a bit. There's a lot of small things.

Q: So, you only need to slightly adjust the way you are working today?

A: Yes. That's what I would say. We need to get a grip on basic things. [side discussion – not transcribed]. It's such a process we need to have, to systematize things.

[Answer 3.11], [BPR], [Implementation approach], [Change management and People (General)]

Q: Now, as my last question - Do you believe that when a new software has to be implemented, the processes have to be adjusted to the way the software functions, or that the software should be adjusted based on the company's needs?

A: I have this opinion that if you want to implement a system, then you need to get the people to work according to the system. I do not believe that each company in the construction sector should have their own system. I believe that if we are 10 companies that do, at least roughly the same thing, then we should use the same system and get the employees to fit to the system, instead of the system to be adjusted to the people or employees. The best example I have is DocuNote, which are we are working on implementing right now, where we are required to fit to the way the system functions. Because if the system is simple right now, it will become complex [if changes are made]. If you have your needs and you have your needs, it doesn't matter if we are talking on user level or company level, it will just become very complex and expensive. That's my opinion about it. It's a leadership problem I believe, that the management has not came to acknowledge [this problem]. Because the problem is that, there comes a project manager which says that "he has this need and he can't use the system". But he does not have this need, because he can just change things on his side. He has to change not the software. [small side discussion not transcribed]. Today we have 400 ways of working and we need to get everybody to work in the same way. How do we do that? When people in over 10 years have got used to work in the way they do? I do not believe it is possible [to make achieve all this]. But that's not what an IT person will tell you. If you ask him, he will tell you that it's easy to achieve. The

hardest part is explaining an IT person what you want the system to do. He doesn't understand the way I am thinking, and I do not understand the way he is thinking.

Q: Matching of expectations is lacking...

A: Yes, and it's very technical. There are no limitations to IT systems today. It's a question of money, time and everything else. But it's so complex that I believe that it's not possible to adjust everybody under a standard system. But there are many things that go wrong when you try to find a system that fits exactly to the way a company works. So, I believe that from an IT strategical point of view, it's best to choose something that is tested. And that's something that [company] [company name anonymized] can help you with – finding which standard system fits best to your needs. And now we need to think things completely different. That's because we have never done the things properly before. It's just about learning it.

10.1.4 Interview case company 4

[Answer 4.1], [Background]

Q: I would like to ask you to present yourself – your position in the company, your experience.

A: My name is [name anonymized], [age anonymized], with an educational background as M.Sc. in construction management from [university name anonymized] and I have been working as a site manager in the company for approximately four and a half years and as a site manager on this project [interview took place on the interviewee's construction site office] for four years, where I have responsibility for own production [field anonymized], because we have our own production [field anonymized] and I am also a BIM coordinator, which is an integrated solution. Broadly, that would be it.

Q: And BIM coordinator only on this sole project?

A: Only on this project, yes.

Q: And you don't have other administrative functions in the company, it is only project related, right?

A: Yes, it is only project related. As we've been talking previously [prior to start of interview recording], there is this ERP solution we are about to implement, where it is required to have someone from quotation department, someone from financial department, someone from production, which can become superusers. That's how I got involved into that. Otherwise I am only working on [construction] projects.

[Answer 4.2], [Background], [Strategy]

Q: What are in your opinion company's core competences and core values?

A: We are an old construction company and regarding buildings, what are really good at, compared to other companies, is unique buildings. Otherwise, we are really good in concrete structures… we have own production department, then we have carpentry. But our core competences is construction, primarily new construction. We also do renovation, but it is not our core competence. It's not something we compete on, that's new construction. Otherwise, some of our competences are within ICT and IT, all these digital ways of relying on, where I would say we are leading in the industry, in Denmark at least.

[Answer 4.3], [Organizational structure]

Q: What about your organization? How is it built?

A: It has a high hierarchical structure. It's a large company. It consists of a CEO, who is director for the company, as well as its daughter companies. We have among others, our daughter company… sister company… [company name anonymized].

Q: Working with… [activity field anonymized], right?

A: Yes, that's their core competence, but they have a turnover of over [number anonymized] mil. DKK a year, a quite big company. Then we also have something that we [own?], like [company name anonymized] within [activity field anonymized]. He is working as a CEO for all the companies in the concern. And then there's a CEO for each of these companies, which each manages their [company] and have different ways of working. But in order to have some synergy across the concern, he manages the whole [main CEO]. And with regards to this new ERP system, it's not only in the main company, but also in [daughter/sister company names anonymized] and so on. So, in order to have cross-synergies, there is one person to manage everything. But otherwise, [the company] is organized by having an east and west department, each with their own director.

And under them are different divisions. For example, there is a concrete division, a renovation division, new construction division, each having their own director. Under them are there further department managers. For example, within concrete there are some that do harbor construction, others that do concrete shell construction. In the department I work, there are for example some that make bridges and so on. So, it's divided in many small parts.

Q: So, it's not so flat? Or is it flat only on project level?

A: On project level it is quite flat. But just as fast as we go further from it, it is probably not as flat.

Q: So, would you say that besides a long way from top to bottom, there is also a long decision-making process?

A: Yes, definitely. When it's something that doesn't run on project level, then there is a long decision-making process. There are many directors in our company.

Q: So, an initiative from the bottom will take long time to come to the top?

A: I don't have a direct subordination line to our top director [CEO]. So, when I have to deliver something, I deliver to my boss, and he has to deliver to his boss and so on. So no, there is long way from people on the project to people on top. And unfortunately, it is like this in a very large company.

[Answer 4.4], [Strategy], [Product (ERP, General)], [Implementation approach]

Q: You have defined an IT strategy…?

A: Yes, we have. And it is something that we work a lot with right now. We are using a lot of time to figure out how to put together our IT strategy. Before we had a program that IBM has delivered to us, which they made for us. I will try to go even further back… much longer before we had around 40 IT employees, which did it [software development] themselves.

Q: So… own software development?

A: Yes. We had our own software development. We had between 40 and 70 employees that did that. And it's quite a lot. It's not our core competences. We are a construction company. And we've decided that we will change this, so we asked IBM to deliver a system to us. And that's something we have used for the last 15-20 years. It has been an OK system, but it is quite expensive to maintain it. Partly because it is not a standard system. It is specially made for us. So, it's very expensive to maintain it and it's very difficult to get them to make it properly. Therefore, it was now decided for the new ERP system to adopt a standard solution, so that we can automatically get the updates they are developing. And it's good, because it is cheaper and we get an update every time, without needing to pay for it every time. But we need to make the compromise that it is not specifically developed for us, it's for many others, so we also need to plan and organize for this system.

Q: Is it a cloud system? It's how it gets updated…? Service as a platform… It's like Office 365, it is cloud based and you only have access to the user interface. The hosting, platform, maintenance and so on, that's what the vendor has responsibility for?

A: It's like that, yes. Everything is browser based. And the only program we have use, runs on [unintelligible speech], on remote computer. They make backups for us, so we don't have anything in-house, we don't have any in-house server. So, it runs online, yes. As a pure cloud solution.

[Answer 4.5], [Strategy], [Business processes (General)], [Product (ERP, General)], [Organizational structure]

Q/A: [Side IT strategy discussion not relevant and not transcribed]. We have different ways of doing things. For example, piecework management, we have a very different way of doing it here in our department, compared to how they are doing in [daughter company name anonymized]. So, it's not that you always have to do it precisely in this way, but there is the possibility for it. There has been [doubts/discussions?] about this new ERP system about how we should handle financial management. It has to function in the new way [new ERP system], because of all the finances which run on concern level. It's clear that when they do annual reports, it all has to be done in the same manner.

Q: You said before that you had a big IT department with many software engineers. What does your IT department actually consist of?

A: We had that before, but after we bought the IBM solution, they were all fired. It was closed [the department]. We don't have much of an IT department anymore. We have some to maintain our IT infrastructure. We have a case drive that functions on the cloud internally. They also help with our network and so on. But we don't have any software engineers employed anymore.

Q: So, it's primarily support function?

A: Yes, primarily support function.

Q: And the rest is just outsourced?

A: We're about to outsource everything, yes. And primarily because we are a construction company. We shouldn't be doing IT.

Q: And how will you be taking IT decisions if you outsource everything? Do you still have some IT specialists that have knowledge on the area, when you should, for example, choose which outsourced solutions you should use… and with regards to IT decision-making.

A: We have an IT director and he also has some people subordinated. It is them that decide how our computers, our safety has to be, for example. There's many that are simply hired to help with the safety. We are constantly under cyber-attacks. So, we have some that do… we have some that decide how our computers should be updated and everything like that. And then we have something that we call infrastructure managers, which decide which software we should have for the company, so that it functions most optimally. And they are also involved in the decision for when we now buy new software [refers to new ERP software to be implemented], together with some concern management and together with some of us, for example, the production, so that everybody has their opinion expressed and come with their ideas and input to it.

[Answer 4.6], [Strategy], [Change management and People (General)]

Q: So, you also talk with the people from the production, when something has to be implemented?

A: Yes, exactly. They usually organize a steering group from different departments. It's also a good way to anchor it, not just the IT boys that… Just as fast someone from the production is involved, we know that our opinion is validated.

Q: Ok, so it's not like… five years after something gets decided, you find out nothing has been implemented?

A: Yeah, that would be bad. But we also try to do it, so that it's also easier to sell [convince to use] it to the people on the site.

[Answer 4.7], [Strategy], [Product (ERP, General)], [Implementation approach]

Q: You said before that you have been using some system from IBM. Is it an ERP system?

A: Yes. We are using something… it's a standard software called Lotus Notes. It's something that I believe that was developed in late 90s, early 00s. Very old system that was customized for us. And that's what we are about to replace now. And now the intention is… the new system we have bought is something from Unit4, which should replace it [the old system], together with Microsoft SharePoint. So, these are the things are switching to and the intention is that this old system has to disappear completely.

Q: But you don't remember what the background was for implementing the old [current] IBM [ERP] system was?

A: No. Back then the decision was that we should not have 70 IT employees sitting in the company, so we bought something external. And back then we thought it was a good idea to buy something and customize it to our needs. We became smarter and realized that it's very expensive to maintain it, so that's why we are switching to a standard solution now. Because the system we are using now, it's not updated, it's very 90ish, very old school and it would be way too expensive to maintain it instead of changing to a new system. So, this decision was made. I think it was three years ago when they began studying the market for a new system. So, that's about it in big lines. But it was ahead of my time, when they decided such things [initial in-house developed system]. I don't actually believe that there are many from that time actually. It's very few.

Q: But the motivation for buying a new system was it exclusively because it was cheaper and easier to maintain, or were there also other considerations?

A: Cheaper, cheaper… it's not certain that it's cheaper in first instance, but ongoing, operational costs should be much lower. And it will be constantly updated. What we found out when we had IBM to make us a system, it was a really good back then, but it's not that good 15 years later, when it's not updated. By buying a new system, it will be updated all the time. They find out that there are some things that are smart, so they add them in right away. That's one part of it. The other part is that it's an old system, IBM system was outdated, so we needed something now. It was completely outdated, so we had to find something new. Then we had to decide if we want to use a huge bag of money, now we develop something new, or we had to buy that standard solution. So, we decided to have a standard solution.

Q: The life span of the old system was about to be over.

A: Yes, it was about to be over. But with the new system we hope it will be longer.

Q: Because…

A: Because it will be updated.

Q: Yes, exactly. But do you also use that system in your daily work?

A: Yes, a lot. We use it a lot.

Q: That means you've implemented it for all functions, not only administration, but also production.

A: Yes. It is just our craftsman which do not use it. But it's all we have… hour registration, payroll registration, driving runs through this system.

Q: And project finances?

A: And project finances… yes… that IBM doesn't actually have project finances. We have that on another system

Q: Which is connected…

A: Yes, partly connected. We had IBM for hour registration and [unintelligible speech] and we had a big spreadsheet to help run project finances and then for concern finances we used a third system called Aspect4. So, we had many different systems. And that's another reason for choosing another system. All these systems will be gathered in one place. We believe this creates value.

[Answer 4.8], [Product (ERP, General)], [Implementation approach], [Change management and People (General)]

Q: But now you have a transition period where you are still using the IBM system and gradually implement the new system, so you are using two systems simultaneously, or how?

A: No. It has been decided that we will use what it is called as big bang. So, 1st of June the old [system] will simply disappear. We have to simply use the new [system]. So, it's a difficult transition… it's on all projects, all the places. So, 1st of June we change from the old to the new. We can't use the old [system] anymore, but we can look in it, but not work with it. Secondly, it was decided that we cannot have a transition period. And I believe it was decided so because people will just use the old, because the new was too complicated and took too long time. It was decided that the only way to ensure that people will use the new is that they only can use the new. And there's of course some challenges with it, but that's just how it is.

Q: Yes, it depends on what you choose, use incremental implementation or big bang…

A: Yes. There's definitely different ways, but that's what it was chosen in this situation. And I believe it's good enough.

[Answer 4.9], [Product (ERP, General)], [Implementation approach], [Change management and People (General)]

Q: With regards to your business processes. You said that you use ERP only for some parts of it [organization] and then there's other systems that you are using. And it comes to cover the whole [the new system]?

A: Yes, exactly.

Q: Have you defined any targets in relation to the implementation? How long time it has to take, how much it has to cost, or was the decision just made that this will be implemented?

A: I am not involved in it. It's too high up, but there are funds allocated to it. There's a budget made for it. One part are the funds for the system, but there are also allocated funds for training. Among others I've

become trained as a superuser. All my wage run on these projects, but there are also super experts in it, which also use time on it, so there are some funds allocated to it, if we have to [overrule?] it, also to help and so on. All the time I use to help others with it, now when I'm superuser, I put in this account… this budget which is allocated to it. So, there are money allocated to it, there's a lot of money allocated to it, because with big bang it may simply not go wrong. It has to succeed. There's no ifs, it simply has to.

Q: Yes, otherwise everything will go wrong…

A: Yes. It wouldn't be good. So yes, decisions have been taken regarding it and money allocated to it, resources… but if there are some targets for it… I don't know, but there are set some targets for when different parts have to be implemented. The ERP system itself is rolled out everywhere. All the new projects after it have to start up using the new system. The old projects which are already started up they will, of course, be allowed to continue further in the same manner [using old system]. But all the new projects have to start up using the new system, but that's split up based on when they have to start up in the new way. There's also a timeline for when the last [projects] have to be completed and out… the old.

[Answer 4.10], [BPR], [Process maturity], [Strategy]

Q: Do you know what business process reengineering is?

A: No.

Q: [Interviewee is introduced to BPR]. Do you have your processes formalized in the company?

A: Yes, partially. We have a vision, it's the one that says that we have to be the most [specific word relating to strategy anonymized] in the industry and one of the subitems is, the central… mission, is the digital way of doing things. It's very atypical that someone says in our industry that they want to be digital. It [the industry] is very conservative. It's not a digital industry in itself. So, it's a part of it [the vision] that we want to be better, a target for digitalizing up to concern level and all the way down, which should enable us to do our work much better, which basically would make us cheaper and make it easier to win projects. So yes, this path is formalized. And it's up to the top management level in the concern.

Q: I also mean on lowest level… process definition level. Decisions come from the top, of course, but with regards to definition, making a procedure, a project description… that's how we do business. That's how we give quotations, some checklists, some steps we need to follow… in that way I mean.

A: Yes, we have a lot of that in the company. We have also a knowledge catalogue… if I had to do concrete floors now, I have a description for how we do good concrete floors in the company. And the same for offers. Before we deliver offers, they have to be approved by the concern management. There's a lot of criteria that have to be met. We have some internal accountant which also looks into it, and they can say if there are any issues and then we aren't allowed to make the offer. There are some steps that are decided that we have to take in order to make us better and avoid bad projects. We have a lot of checklist formats in the company. It's quite typical for the large companies that you have it.

[Answer 4.11], [BPR], [Process maturity], [Strategy]

Q: And there's a good link between it [procedures, process descriptions etc.] and the digital tools you are using? It can be the IBM system, or the other part of the system… it works well together with the way the system works, right? The processes are coordinated with the IT system, you don't have to make extra steps or work around the IT system, because the system is not programmed to match the way you are working?

A: Yes. That also happens once in a while, that we are required to make our own Excel spreadsheet, for example, to manage something. It happens sometimes. But that's something that we hope we can avoid with the new system. But there will also be need for it, I believe, that we have one way or another to keep control things.

[Answer 4.12], [BPR], [Process maturity], [Strategy], [Implementation approach]

Q: And now that you are coming to implement the new system that is standard system, will it mean that you have to reengineer your processes so that they match the new system, because that is standard, and you work in a completely new way? The things need to be connected now…

A: Yes. And I still believe that we will keep using time on doing something. We had a way of doing it before. Now it's disappearing so we need to find new ways of doing it. And with a standard system there will be

things which it can, and we need. And then we will find our own way of doing things, basically. It can be that it's an Excel spreadsheet, which we make it ourselves, for example, to manage it. But it's hard to say, because we haven't implemented it yet. But I would believe that there will be like that to a high degree.

Q: Ok, so you are coming to make your own adjustments to the system, your internal…

A: I don't believe that there are many changes that come to the system. I believe that we will have to get used with the idea that the system is as it is and then we have to find our own ways or methods to get it to work. If it makes sense.

[Answer 4.13], [BPR], [Implementation approach], [Product (ERP, General)], [Change management and People (General)]

Q: When a new system has to be implemented, do you believe that the company's business processes should be adjusted to the new [standard] system, or that a system has to be found so that it matches the way you are doing business?

A: A bit of both. I know that when they found a new system… they had decided that they want a standard system. So, they've talked with many different vendors in order to find the system that fits best to our business. But they were well aware that they cannot get everything that we want. Then we would need a customized system. So, they chose the system that they felt is the best to what we can, and then we should try to adjust ourselves to the system afterwards. If that makes sense.

Q: You haven't made a plan for implementation, right? We are here and the system is here, and this is the path which we need to take to achieve this…?

A: Yes, we did. We have a long plan for how… the whole implementation that starts from three years ago. Precisely when the courses should take place and when we should be finished, a hypercare period, there's time allocated for superusers. We know that in the next period of time, when we go live, we need to allocate some time to help with it and so on. There's a large, very large plan for how they thought that it should be implemented. We also had someone sent to USA for a course in change management, to help people adjust and give some tools for how to make people adjust. Now something new happens and we have to have it implemented.

Q: Yes, because change management is also a large…

A: Yes, it is. It turns up and down a lot of how we have been working until now. It's much different, yes.

[Answer 4.14], [BPR]

Q: With regards to your processes. Were you required to make some radical changes to your processes? For example, you've noticed that some processes that do not function as they should, they are very inefficient or that you need to find another way to do things?

A: It's hard to say, because we haven't reached that long. We haven't implemented it yet.

Q: I mean only with regards to your processes, not in an ERP connection.

A: Yes, we've made a radical change. We should've implemented it 1st of April, but those responsible for it, the implementation responsible person felt that we weren't ready for implementation yet at that point, so they've postponed it to 1st of June.

Q: No, but I mean only with regards to your processes in the company… it can be production, administrative processes. You have ways of doing things, for example, that way the craftsmen work… or…

A: As a starting point, it doesn't get changed, but it will on the long-term. In the old system which was as old as it was. I just take an example.

Q: I mean the way you work in the company… do you make ongoing process changes, or do you make more radical process changes once in a while? How are these things decided and optimized? How do you optimize the things?

A: It's very project… on the project level and the people that are associated those projects, which basically have to figure it out. And it's not so much ongoing, because if we found something that functions, we just continue in that way. It's typically when we start a new project, when we have to figure out how to make things work out. Then we look into the processes. For example, here where we make something that is completely different. Here we chose not to use paper drawings and use iPads instead and it's simply because

the project is so large that we would have to process hundreds of pages of paper and it would be impossible for our craftsmen to figure out which of these drawings they have to use. So, we've decided to use only iPads. But again, when it is implemented, then we don't change so much about it, when it just functions. And I believe that often the process where we develop something new occurs in the start.

Q: Project related…

A: Yes. At least on the level I am. And then I use the knowledge I got, because it works so well with the iPads, I go out and share this on other projects. And then there's others that decide that it's something that they also should be using.

[Answer 4.15], [BPR], [Strategy]

Q: And it also gets included in the IT strategy? When we should use iPads and when paper-based documents?

A: It's not so formalized that it gets written down, but it gets shared to others, yes. It lies implicitly under that vision of being most [word indicating specific vision anonymized] in the industry. So, I tell about it, and others think that it was actually smart, and they will also do it like that. That's how we usually do it. Another we example… [discussion anonymized] and then we start using QR codes set on each window to distinguish each different window type. It's a way of solving our problems and it's something that we took further and gets used on other projects. So, it's down on bottom level that it occurs, and we lift it up once in a while, when it works really well.

10.1.5 Interview third-party company (IT consulting company)

[Answer 5.1], [Background]

Q: Can you please present yourself – position and experience?

A: My name is [name anonymized], administrative director in [company name anonymized] and we have around 12 years' experience in the company, with consulting craftsmen contractors regarding ERP systems. So, we were involved in around 300 implementations in the construction sector.

Q: What is your customers company size? How many of your customers are large contractors?

A: With regards to size of customers... our primary client group is 30-250 employees

Q: So, medium size.

A: Yes, exactly.

Q: Is it also them that want an ERP system the most?

A: The ones from one-man companies to 15-20 they are right now really busy working.

Q: Right. They can't focus on…

A: And you see, it takes time to implement IT systems. Some do, but I mean, it's something besides their formal business. Those with 30 employees and over, they can allocate some time, because they look for some people to do the things, while smaller companies are the ones that most often have to work and if they should also implement something, then it would be difficult to do both things.

Q: Is ERP a part of your company's offer (or supplier catalogue) and have you consulted any of your customers with regards to this type of systems (purchase, implementation etc.)?

[Answer 5.2], [Product (ERP, General)], [Implementation approach]

A: You can say it is. And the ERP system, we look into it from two different points of view. One of them [is the financial part… for example Navision, Visma… we don't have any customers that have SAP. It can be that some from the construction industry has SAP, but we don't have any. The largest use Axapta, maybe the largest.

Q: Developed from Navision…?

A: Yes, Axapta and Navision are two sides under the same roof. That's the financial part. But we also see ERP in the production going towards…

Q: Yeah mean industry or within the construction sector…?

A: Just in the construction sector. We work only in the construction sector.

Q: So, concrete manufacturers and that kind?

A: Also contracting companies. And it's not [just] machinery we are talking about. It's people. You have your resources and workforce and these machineries you have and your tools. They need to be managed in one way or another… one sort of calendar management. And then the usage has to be registered, used as invoicing… invoicing basis, payroll basis and so on. So, there's two sides of the case, and right now if you look into the IT market, there's some that are finances focused and some that are production focused. That means they try to put as much functionality in the same solution as possible.

Q: So… in the whole organization, not just the administrative part?

A: Yes, exactly. Then it also depends on how you define ERP. In this context it is very close to production.

Q: Yes, it is. And you think that you have the base modules, which come with the ERP system. Then there are other modules that are add-ins if you would like to expand the current ERP to cover more of your business.

A: Yes, exactly. And those modules. There are vendors that focus on production managing solutions. So, you can buy those loose. The whole market right now, I would say the direction is more focused on narrow solutions, which integrate with each other. I don't know how much you are working with this, but there are two – best of breed and best of suite.

Q: I know best of breed, but not best of suite.

A: You have width… you get the whole suite in the same package. It's like SAP. There you can buy all the components in the same solution.

Q: Or you can combine different components.

A: Exactly. That's something that we are seeing in the construction sector, that people buy a solution to time tracking, a solution to time management, a solution for change order management, a solution for wage management and so on. And then makes them to communicate with each other.

Q: Yes, that's correct. I had an interview with a company which used DocuBizz. DocuNote and all possible systems, which were independent, but which were then connected to each other.

A: And it's about data. And they don't need to be connected, they just need to exchange data.

Q: Yes, that's right. It's the data exchange.

A: That's ERP, right? And with this development we try to help. So that they [companies] don't have to have the same tools [ERP modules], because it depends what needs you have. So, they need to communicate with each other, some form of data exchange. Does it make sense?

[Answer 5.3], [Implementation approach], [Strategy]

Q: What do you believe the biggest challenges regarding ERP are? Would you say that these challenges are bigger in the construction sector than in other sectors?

A: The biggest challenge in the construction sector is the time. I don't know if it applies to all sectors. I assume it does. But, maybe now what is critical is allocating the time to implement correctly. Also allocating the time to find the correct systems. Because in a large part is all about what one's requirements are, what needs one has for the systems. I mean, completely banal, you should not buy something that's too big or too small. So, it's all about…

Q: …Finding the connection, find a balance between system and company?

A: Yes, exactly.

Q: When do you believe it is the right time for a company to implement an ERP system (f.eg. targets that should be achieved, or a specific company size etc.)?

The challenge is if you can't find the time for it and the right time. I think we should talk about scope. If there's no funds, you can't have the overview in order to invest, because you have no money to invest. If you have funds, then you don't have time. There's a timing, where you need to sit down and make the projects to be as small as possible. It's what we try with an action plan.

[Answer 5.4], [Implementation approach], [Strategy], [Business processes (General)]

Q: I don't know if you also look into the company's IT strategy, if they define such objectives, if it's aligned with the business strategy?

A: Precisely. But how we suggest doing it, is that you make an IT status to find out the company's structure. We have a lot of experience with different tasks [profiles], if you are total contractor, trade-by-trade

contractor, subcontractor, service and so on, how many customers you have in your system, if you're customers are private, company customers, insurance, if other contractors have any importance, if having have 2 or 200 projects in a year has any importance, if having 2 or 200 projects concomitantly has any importance, if you getting 100 or 10000 invoices in your system has any importance, if you sending 100 or 10000 invoices out has any importance. So, all this complexity the company has, has an importance.

Q: Do decide which system is most appropriate…?

A: Yes, exactly. Then you have to look what system you have available, if you have a very complex company, then you need very complex IT tools, or at least full IT tools. And that's something you try working towards. In relation to that we make a status, an action plan, defining some targets for implementation order. That's why we are trying to take small steps, small safe steps at a time, if for example someone needs a time tracking system, so they get that implemented, then they don't need to do anything further, like having a comprehensive finances system, document management system and some quality assurance necessarily. That's where you need to define your strategy, how do we wish to approach our IT investments.

[Answer 5.5], [Implementation approach], [Strategy], [Business processes (General)]

Q: Do you believe that a company should first have their processes formalized/mapped and standardized before they initiate an ERP implementation? What about other IT, if the question cannot be answered for ERP?

A: It's typical to get the processes into place. Standardized is maybe too much said, but you are at least required to find out how do we work with projects and construction projects in relation to bidding and planning and execution, delivery. It's a bad idea…

Q: …Not to have the processes into place, right?

A: The processes have to be into place. You can start an IT project. We recommend that. But there's not so many that have the patience for it. You start IT projects without even looking into IT tools. You start by looking into your business and see how we work together on the projects, how we have our projects structured. We get a project and we look into it as we do it today and you have some sort of tools. And then when you are done looking into how you are doing it today, then you look into how you would think trying to do it [in the future] and find some IT tools that help you support that process. You find some IT tools and define your processes.

Q: But you are saying that most of them don't have the patience to look into how their processes are?

A: Many of those that have to buy IT tools, it's maybe more of the smaller, they go on Google, then they call to the IT vendor and they show what they can. And then it can be that they get convinced and buy it. And they live with the system they get. And it can happen that it's good enough. But it can also happen that it's #$@&%*! bad. The risk is that you have to live with those you've eventually rang to. Or that they download a demo or something. Because they don't clarify precisely what they need to use, so they live with what they get. And that's what happens when you haven't clarified your needs and requirements for the processes.

[Answer 5.6], [Implementation approach], [Strategy], [Process maturity]

Q: From your experience with your clients, how would you describe the IT maturity in your clients' organizations? What about their process maturity?

A: Exactly our customers… it's not sure it generally reflects the market… them we end up helping, have some form of understanding that they are required to do some homework, so they can draw some lines in their organizations.

Q: Otherwise they wouldn't contact you. They would go on Google…

A: Yes. So, you've asked about our customer organizations. There's process understanding.

Q: I'm asking about your customers, because that's what you can relate to… for the most.

A: Exactly.

[Answer 5.7], [BPR], [Strategy], [Implementation approach]

Q: Do you believe that a company's processes should match the new ERP system, or that the ERP system should match the company's processes? What about other IT, if the question cannot be answered for ERP?

A: I don't know if you should match, but you need to find a system to most possible. In the construction sector, there's the standard tools, Axapta and Visma for example and so on, there's some that have adjusted them to the industry, because they have experience to help contractor and craftsmen companies.

Q: So, standard systems that are adapted to the industry, right?

A: We adapt in advance. We attempt to adapt them to industry requirements. It's all about finding them and about finding partners [vendors] that match the concrete way they are working [client companies]. And there's different approaches and we've found that there's different nuances and focus areas and it's about finding that which fits best both on short- and long-term. There's different solutions, not only construction sector, but specialized to EL and HVAC. Even more specific. But it can be that it's heavy to use. Or it can be good enough again. I don't deny that. But it can be that there's a master carpenter that uses a solution that's addressed to EL and HVAC. If you have a carpentry company and use a solution that's addressed to EL and HVAC companies, it can be annoying.

Q: Yes, because it's too specialized.

A: Yes, exactly. There's IT vendors that are good at EL and HVAC but will also help carpenters. But then they only have 20 [software] developers, let's say that. Each time they have to prioritize, each time they have to prioritize, so they prioritize EL and HVAC, because that's where their majority of customers are. And it can be that the master carpenter can receive a solution that fits better to him.

[Answer 5.8], [BPR], [Strategy], [Implementation approach]

Q: So, you don't believe that you should do a lot of changes to standard systems?

A: No. I think you have to find out how you would like to work and of course if you can't find anything that fits, then you can adapt it to that degree you can find something. But you are required to start finding out what you would like to work with projects. And it's an iterative process. You define the requirements and look into the market, define the requirements, look into the market.

Q: Iterative in that way that you look into the market, then you look back into the organization, then make some adjustments.

A: Exactly. You start by making your process homework.

Q: But making adjustments... it can be that it's necessary in a niche company. There you can't really find something.

A: Yes. You will make some. But they can also listen. They can look into IT tools and listen to their good experiences for one way or another for process implementation. But you are required to see if you can figure it out throughout time. I mean also implement it and take the responsibility with regards to training and education of users, that it matches the way you would like to work. If you just accept the way the IT does the things, then the time comes when the employees will not understand it. Why do we do it like that? That's because there's someone that said it's like this, we have to do it, so that we can get that into that box. Instead of saying that we would like to do things in this and this way.

Q: Instead of doing things just because the system says of doing the thing in that way?

A: Yes. Exactly. It's #$@&%*! bad. There's no employee that believe it's a good idea. The best is to work in that way you understand.

Q: So, you get the most out of it. But for example, in one of my interviews I have experienced they had a lot of modifications to the system and they made a lot of ongoing programming and changes. But then I asked what you do when you make too many changes and the system becomes too heavy or not so intuitive. Then they answer that they need to remove them again and again. So, they do that all the time. It wouldn't be completely optimal to make adjustments, if all the time you have to make adjustments.

A: Exactly. At one point, if you don't know what you would like to have, then you begin to turn to left and right without knowing where you will end with it, and if the IT vendor maintains something, or direction and says yes to it, to having the button to the right – just banally, then have the button to left or center, instead of making the things clear. Describe what you wish.

Q: Yes. Without having some strategy for how things should be. Just IT-wise making changes back and forth.

A: Yes, precisely. And there's IT vendors, they are good people, but it's also businesspeople. So, if there's someone coming and asking about something, then it's sales. And they ask if they can't get something, then the IT vendors says that as a starting point we can do that. Then there's different trade-offs for the IT vendors' business. If there's something they can see, a trick, clients, so they have one interest. If it's something very bad you want, but you are the client, so you decide. And they start deceiving you. And you're suddenly alone anyway. And you've paid a lot of money for it. Because the IT vendor doesn't want to say we take half price of that, because I know that I can sell that tomorrow to someone else. So, you end up paying full price for something. You are required to clarifying to that extent that's possible, before you seriously contact an IT vendor.

[Answer 5.9], [BPR], [Strategy], [Implementation approach]

Q: Did you have cases where radical process changes had to be performed with regards to the implementation of new systems (ERP/IT)?

A: I wouldn't say radical process changes. It's more within the frame of normal adjustments. What we try, is finding some IT tools that match the processes, which the companies would like to have. It's more the systems that have to be configured to the processes, then the other way around. It's a least the way we attempt to do it.

Q: There's also many available solutions, so it's a bit easier to find some system that fits the company, instead of investing a lot of money in the company to make changes [in processes].

A: Yes. Exactly.

Q: But then ERP systems don't have a very innovative or creative value proposition for doing business. They're more or less the same, just with some variations… with adjustments to the industry.

A: You are talking with a company that works with IT tools that fit to the construction sector. We don't look for IT tools in the medical industry. So, our customers avoid the largest bad investments, because we have screened the market for IT tools that fit to the construction sector. We have overview over that. And if a customer has a vendor we don't know, because some developments have occurred, so we contact them and find out what they can in relation to the processes we work with. The IT tools we are working with, are intended for the construction companies as a starting point. Otherwise, we don't have anything to do with them. If there's a solution that matches to the construction sector, which one of our customers use, then we also take it in and compare it to what similar vendors from the construction sector can. We ask them the same questions, which the other vendors we work with have received. So that we can organize their functionality in relation to needs and requirements.

Q: Maybe I haven't formulated the last question completely correct, but I mean that the ERP system cannot offer something so creative or innovative or new that it pays off to make many big changes in the company. It's just a question of choosing the right thing.

A: We haven't experienced that any of our customers had to make radical changes in order to get some IT tool to fit. I try to reformulate, it's maybe also because we have been good at finding tools that fit to that process they would like to have or had in advance.

[Answer 5.10], [BPR], [Strategy], [Implementation approach], [Product (ERP, General)]

Q: I am also thinking that throughout time since ERP has been [initially] developed, many new solutions have been developed and released on the market, so there's more to choose among.

A: Definitely. There's many solutions.

Q: So, the implementation process and approach has changed throughout time, I would say.

A: Precisely. You can get something that fits.

Q: Yes. You can now get more standard systems that fit exactly to the industry you are working compared to those times when there was only SAP.

A: Exactly. Throughout the last 10-15 years an enormous amount of new and clever vendors have appeared, which there had been needs which were not covered, then they covered it. There's a large offer of IT tools for the construction sector. And it's something we are also supporting, for example together with [company name anonymized] through [way of supporting anonymized], so that they can see the possibilities that are

available. There's a vast amount of possibilities that are found for implementing a tool that fits to the way you are working.

Q: But you are saying that there's many that are not aware about these changes and improvements throughout time and the possibilities an ERP system has? Because if you look on the statistics you can see that the construction sector is positioned very low compared to the industry sector in relation to ERP implementation, for example.

[Answer 5.11], [BPR], [Strategy], [Implementation approach]

A: That's correct enough. I add a last point of view to this. In relation to ERP and IT in the construction sector, I believe it's difficult to talk about how high the digital height should be, if you look at the supply chain in the construction sector.

Q: Because there's many small companies?

A: If you look at consulting companies, engineers and architects that make drawings and calculations. Their production is on a computer. In the bank system and industry companies. If you work in a factory, your robot works there. That can be considered a bit as ERP, because you make some bill of materials or something like that. In the construction sector, there's still a person that has to do work [on the field]. There's still someone that has to have the hammer, drill or saw and every time they look on a phone or computer, you actually lose efficiency. Because it's the value they have to sell doesn't lie in the computer, but outside the computer. So, why is there a target that everybody has to have a computer in the construction sector. That's something I don't understand. I believe that as few as possible in the construction sector should have a computer. But it doesn't mean there shouldn't be information in the project…

Q: No. For example, the automatic flow… if you think about IoT, sensors, then you can use big data…

A: Yes, yes, yes. It's facility management 100%. I'm nagging a bit. It's also paradoxical. I'm just saying that in relation to execution of construction projects you shouldn't just measure on technology for technology's sake. It has to support your primary production value.

Q: Yes, yes, but it applies to all industries. It's as I said earlier, it's derived from the business strategy, so you shouldn't implement IT for the sake of IT.

A: Exactly. Correctly. Then we're back to discussing about processes and such. Find out what you would like and how you should [deliver value] for your customer, and then you can support this with IT to that extent that it is possible. I believe we should use IT as much as possible, but only to that extent it creates value. And then we also talk about robots and such things. It's how you are trying to compare to manufacturing companies, right? When construction robots are released for use on construction sites, where they do the hard work, in relation with masonry and so on, then it's fine.

Q: Then a digitalization boom will take place.

A: Yes. Definitely.

10.2 Interview guides
10.2.1 Case companies

Spørgsmål nr.	Interviewspørgsmål
	Interviewguide
Spørgsmål nr.	**Interviewspørgsmål**
N/A	• Introduktion om mig og projektet
1	Vil du venligst præsentere dig selv? (stilling, erfaring, erfaring i nuværende virksomhed osv.)
2	Hvad er efter din mening virksomhedens kernekompetencer og kerneværdier?
3	Har virksomheden defineret en IT-strategi? Hvis ja, af hvem og hvordan bliver en sådan strategi defineret i virksomheden? Hvordan hænger denne sammen med virksomhedsstrategien og forretningsstrategien. Hvis nej, hvordan bliver IT-beslutninger taget i virksomheden og hvordan sikrer I jer at disse hænger sammen med virksomhedsstrategien og forretningsstrategien.
4	Hvilken rolle har IT-afdelingen i virksomheden?
5	Har I nogle udfordringer med IT eller synes du at det går godt?
6	Er du kendt med enterprise ressource planning (ERP)?
7	Bruger I et sådant system i virksomheden? Hvis ja, hvorfor har I valgt at bruge ERP i virksomheden (er behovet kommet som resultatet af strategisk planlægning eller kun som et ønske om at bruge noget IT som opfylder nogle funktioner)? Hvornår har I først implementeret et ERP-system i virksomheden? Hvis ja, bruger du ERP også selv på dit job? Hvis nej, hvorfor ikke? Har I overvejet at implementere det? Har det lykkedes eller ej? Bruger I noget andet i stedet for?
8	Hvis virksomheden bruger ERP: Til hvilket formål bruger i ERP i virksomheden (forretningsprocesser – fx økonomi, HR, logistik, projektledelse osv.)? Synes du at ERP også kan bruges til andre formål end de I bruger det til på nuværende tidspunkt? Ja/Nej, hvilke/hvorfor ikke?
9	Har I defineret nogle målsætninger ifm. Implementering af ERP-systemet forud for selve implementeringen (fx tid, mål, økonomi eller andre)? Hvis ja, har I opnået disse målsætninger? Hvis nej, hvorfor ikke (defineret/opnået)?
10	Kan du huske ERP-implementeringsprocessen (var du ansat, da I først var begyndt på at bruge ERP)?
11	Fortæl mig lidt om jeres processer. Har I kortlagt/formaliseret dem (det er sån't vi laver forretning; BPMN, proceskort osv.)?

Spørgsmål nr.	Interviewspørgsmål
12	Har opdateringen af jeres strategi(er) resulteret i et behov for lave radikale ændringer i jeres processer (BPR)? Eller havde I dette behov ifm. med noget andet (fx bemærke dårlige processer)? Er dette noget du ved at I også har gjort i forbindelse med ERP-implementering?
13	Er du kendt med business process reengineering (change, renovation, improvement osv.)? Og synes du at det er noget I har arbejdet med i virksomheden?
14	Hvordan vil du beskrive jeres organisationsstruktur?
15	Synes du at når der skal implementeres en ny software, processerne skal ændres så de passer den måde softwaren fungerer på, eller at der skal vælges en software som matcher den måde virksomheden arbejder på, eller at en mellemvej også kan findes? Synes du at når processerne ændrer sig som et resultat af implementeringen og brugen af en ny software, disse ændringer skal styres på en organiseret måde, fra toppen til bunden af organisationen?
N/A	• Interviewet er slut. • Har du spørgsmål? • Den interviewede må gerne kontakte hvis hun/han har noget/yderligere spørgsmål.

10.2.2 Follow-up questions interviewee case company 3

Enterprise ressource planning (ERP) har været brugt med succes i industribranchen i mange år, men på trods af der ikke særlig mange entreprenørvirksomheder i byggebranchen som bruger det. Hvis den først del af undersøgelsen fokuserede på forholdet mellem virksomhedens organisation, formalisering af processer som indikatorer for ERP-parathed, denne del fokuserer på at forstå motivationen der ligger bag beslutningen for at implementere et sådant system. Disse spørgsmål antager at den interviewede har mindst en ide over hvad ERP omhandler, samt dets funktioner.

Spørgsmål nr.	Spørgsmål
1	Vil du venligst præsentere dig kort (stilling og erfaring)?
2	Er du kendt med enterprise ressource planning systemer (ERP)?
3	Har du/I overvejet at implementere ERP i virksomheden (gruppen/koncernen)? Ja/nej? Hvilken motivation ligger bag sådan en beslutning?
4	Kan du se pointen (fordelene) ved at implementere ERP i virksomheden og synes du dette vil gavne virksomheden? Ja/nej, hvorfor?
5	Hvem beslutter for at implementere et sådant system i virksomheden?
6	Synes du at I skal først have jeres processer formaliseret/kortlagt og standardiseret før I igangsætter en ERP-implementering?
7	Hvis ja, når I kommer til at gøre det, vil du sige at jeres processer skal tilpasses det nye ERP-system, eller at ERP-systemet skal tilpasses jeres processer? Hvorfor?
8	Lige nu bruger I andre systemer (legacy – DAR, DocuBiz, DocuNote (snart)). Er formålet at løbende opnå højere integration mellem disse og løbende forbinde flere systemer, således at i fremtiden I vil opnå en helt kørende og integreret ERP-system?

10.2.3 Third-party company (IT consulting company)

Enterprise ressource planning (ERP) har været brugt med succes i industribranchen i mange år, men på trods af det er der ikke særlig mange entreprenørvirksomheder i byggebranchen som bruger det. Afgangsprojektet undersøger implementering af ERP i byggebranchen. Disse spørgsmål antager at den interviewede har mindst en ide over hvad ERP omhandler, samt dens funktioner.

Spørgsmål nr.	Interviewspørgsmål
1	Vil du venligst præsentere dig (stilling og erfaring)?
2	Hvilken størrelse kunder vejleder i? Hvor mange af jeres kunder er store entreprenører?
3	Er du kendt med enterprise ressource planning systemer (ERP)?
4	Er ERP en del af virksomhedens tilbud (eller leverandørkatalog) og har I vejledt nogle af jeres kunder i forbindelse med den slags systemer (køb, implementering osv.)?
5	Hvis ja til nr. 4, så: Er det mest de store entreprenørvirksomheder som I har vejledt mht. ERP? Hvis nej til nr. 4, så: Hvorfor arbejder I ikke med ERP-løsninger?
6	Hvad synes du at de største udfordringer ved ERP er? Vil du sige at disse udfordringer er større i byggebranchen end i andre brancher?
7	Hvornår synes du at det er den rigtige tid for en virksomhed til at implementere et ERP system (fx visse målsætninger der skal opnås eller vis størrelse osv.)?
8	Synes du at en virksomhed skal først have deres processer formaliseret/kortlagt og standardiseret før de igangsætter en ERP-implementering? Hvad med andet IT, hvis spørgsmålet ikke kan besvares ifm. ERP?
9	Fra din erfaring med dine kunder, hvordan vil du beskrive IT-modenheden i dine kunders organisation? Hvad med deres procesmodenhed?
10	Synes du at en virksomheds processer skal tilpasses det nye ERP-system, eller at ERP-systemet skal tilpasses virksomhedens processer? Hvad med andet IT, hvis spørgsmålet ikke kan besvares ifm. ERP?
11	Har du haft sager hvor radikale procesændringer skulle udføres ifm. implementering af nye systemer (ERP/andet IT)?

10.2.4 Code list

- Background
- Process and Strategy dimension
  - Business processes (General)
  - Process maturity
  - BPR
  - Strategy
  - Implementation approach
- Change management and People dimension
  - Change management and People (General)
  - Organizational structure
- Product dimension
  - Product (ERP, General)