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DEFINITION OF SYSTEM FOR BUSINESS PROCESS MODELING

Faculty of Engineering and
Natural Sciences
Master of Science Thesis
November 2019

ABSTRACT

Julia Komarova: Definition of system for business process modeling
Master of Science Thesis, 100 pages, 8 Appendix pages
Tampere University
Master's Degree Programme in Industrial Engineering and Management
November 2019

The modern business world is getting more and more complicated. In order to satisfy customer needs, companies investigate different options to increase operational efficiency and effectiveness. Business processes management has recently become a focal topic for big and small organizations because accurately designed business processes can ensure competent execution of value-added activities. Apart from that, business process management allows for structured management of process portfolio when based on clearly defined process architecture. This is exactly where this work starts.

The objective of the study is to discuss the development of training material in the form of guideline to contribute to the systematic approach to business process modeling and quality improvement. When modeling business processes, process developers in the case function are going for an ad-hoc approach, and for this reason, training material as a tool to introduce a systematic way of process modeling is needed. The case function can benefit from the defined methods not only by having processes of a higher quality that are easy to follow but also by improved communication with other business areas in the business management system. These benefits may further lead to the improvement of operational efficiency and customer satisfaction.

The desired outcome of the study is the clear definition of process model classification based on the process-architecture-related literature review and current state analysis of the case function as well as the development of the step-by-steep guideline for process modeling. The guideline is built to ensure availability of an easy-to-follow system for process modeling leading to positive impact on process model quality. To reach the goal, the research addresses problems of standardization, methodology and detailed level of models.

Quality of process model is a topic which does not have an extensive literature coverage. As a response to this fact, criteria for evaluation of the quality of training material and process models are set during the research based on the available information from the literature combined with specific needs of the case function. As the result of the research, quality evaluation of initial and improved models proved evidence of the effectiveness of having a defined system for process modelling. Reliability of quality improvement led to the settlement of the defined approach to process classification and methods of modelling to be adopted as a baseline for business management system where process-related documentation is created and stored. Finally, limitations and opportunities for the future research are presented to conclude the thesis work.

Keywords: Business process management, business process architecture, process modeling, training material, quality of process models

PREFACE

This thesis work discusses the importance of standardized approach to business process modeling. Development of a guideline for modeling of business process is proposed by the research to support process developers during the design phase and ensure quality of models. To provide sufficient results, the thesis addresses the topic of business process architecture. It also provides insights into potential process model quality improvement by following systems and methods of process modeling defined in the guideline. The paper presents a real-life case of an industrial company and contributes to the development of business management system.

I would like to express my appreciation towards Jussi, my supervisor in the company, for giving me this thesis opportunity as well as his time, support and meaningful advice. Also, I would like to thank Professor Teemu Laine and Senior Research Fellow Aki Jääskeläinen for supervising my tropic, giving valuable comments and genuine insights. Finally, I am grateful to everyone who has contributed to my one of a kind thesis experience.

Tampere, 14 November 2019

Julia

EXECUTIVE SUMMARY

In today's globalized and ever-changing business world, companies need to continually improve to stay competitive in the marketplace. In this context, monitoring of various key figures is of great importance in order to be able to evaluate the company's overall performance. However, such numbers do not show what the reasons for the current business performance are and what needs to be improved. In this context, business process management is an indispensable tool for optimizing and controlling company processes among others through the introduction of systems and definition of methods.

For a meaningful analysis of business processes, a company might benefit from structuring its process models in a map-type portfolio. In the discussed context, the systematic process structure of process models is called business process architecture. The present work gives an overview of standards for business process architecture based on the review of the relevant literature. For this purpose, research on the wide topic of business process management is undertaken. It is followed by more specific concepts of business process architecture, process hierarchy, importance of defined systems and methods, as well as demand for a guideline serving as training material for business process modeling aiming for quality improvement.

The practical implication is established through the analysis of the current situation focusing on existing business processes of the company’s case function. As an empirical part, the identification of current challenges took place. The core of the empirical research is in the development of a customized approach for classification of business process documentation as well as setting a guideline with systems and methods for process modeling.

Apart from that, reliability of defined systems and methods for process modeling were checked growing a capability for continuous quality improvement. While doing so, the approach for quality evaluation of process models was defined based on the literature and business-case-related insights. After all, the research was able to contribute to the definition of the systematic approach to process documentation in the case company which currently serves as a foundation for the business management system where all process-related documentation is created and stored.

CONTENTS

LIST OF SYMBOLS AND ABBREVIATION

BPM	Business Process Management
BPMI	Business Process Modeling Initiative
BPMN	Business Process Modeling Notations
EPC	Event Driven Chain
GoM	Guideline of Process Modeling
GRIPS	Growth and Results by Improving Processes and Services
ISO	International Organization of Standardization
LCAG	Lufthansa Cargo AG
OMG	Object Management Group
RQ	Research Question
QMS	Quality Management System
SOM	Semantic Object Model
SQI	Service Quality Institute
UML	Unified Modeling Language

LIST OF FIGURES

1. INTRODUCTION

Companies are currently faced with many challenges, such as shorter product life cycles, increasing customer requirements, globalization, legal regulations and standards, increasing cost pressure and rapid developments of information technology (Müller, 2011). Present-day studies show that the interest in business process management (BPM) is already high and will continue to increase significantly in the next few years as this approach is a response to the changing business environment.

In the study by Schmelzer and Sesselmann (2010), companies state that they are not satisfied with the current development of their own business process management. However, the estimated potential for savings and opportunities to improve value-added are agreed to be very high. The trend towards doubling corporate investment in process management also shows that the drive for optimized and systematically managed processes is becoming more important to companies.

Looking closely at business process management in practice, the trend towards modeling of business processes is emerging (Müller, 2011). At this point, the question arises as to whether the hopes placed in the management of processes are also justified and which of different available modeling methods would be the most appropriate.

The aim of the thesis is to first investigate the current status of business process management literature as well as the situation in the case function of the company focusing on process architecture and its hierarchical view overlooking requirements for process related documentation. Based on that, it is important to define a clear standard for the business process architecture approach and provide a guidance for a systematic development and quality assessment of business process models which can further be used in the business management system.

1.1 Background

The case company is a Finnish industrial machinery company providing products and services for mining, aggregates, oil and gas, recycling, and other process industries. It currently employs over 12,000 people in 50 countries and identifies itself as an international and truly global technology and service provider.

This research is focused on a particular Business Area of the company providing innovative solutions for sustainable productivity (Company's website 2019). The main focus is given to the function which is heavily involved in the supply chain management and logistics activities within the organization.

The case function of the company was established in January 2018. The establishment was driven by the desire to enable logistics center's operations to deliver excellent service and adopt the culture of continuous improvement. For this reason, the function combines process leadership, coordination skills, operations analytics and Lean program coordination while communicating the change to all company's logistics centres, offices and other functions.

In December 2018, a new project was initiated to enable the company to operate an efficient and sustainable physical supply chain with business transactions flows following actual business decisions and business risk. The project covered selected business areas and had a great impact on existing logistics processes.

The project aimed at enabling optimization of the supply chain for each product and order, and lead to more direct product streams to customers while building an improved profitability through streamlined supply chain operations as well as increased efficiency with clear processes. By increasing transparency in the supply chain, better responsiveness to customers' needs and better grounds for higher on-time-deliveries are expected to be enabled (Frye and Gulledge, 2007; Balasubramanian and Gupta, 2005).

By the scope of the project, not only existing processes were revised but new ones were introduced alongside with changes in the organizational structure. For the further management of this process portfolio, the concept of business management system was introduced. The study aimed to follow the project implementation and to support it in the area of systematic business process model development, quality management and assessment.

1.2 Problem Definition and Objective

Modeling of business processes is one of the fundamental tasks of business process management in a process-oriented company (Frye and Gulledge, 2008). The following chapter clarifies the motivation for the research and highlights the problem discussed in this work. The research was developed in close cooperation with the company and represents the practice of a real business case.

Companies face a bewildering array of frameworks, models, notations, and tools when launching a systematic business process architecture and managing business process quality. However, there are still challenges associated with the modelling process:

- Systematic approach to business process classification and modelling are abstract topics and correctness of any approach is subjective
- Quality evaluation of business process models is challenging and project specific while no commonly accepted approach exists

Unfortunately, there is no unique solution for standards and methods to be used in business process management, as well as no precise guidance on how to develop business process models based on the defined criteria and standards. For example, approach by Becker et al., (2000) is too general, while framework by Brocke and Rosemann (2010) is too project specific. Up until now, there is no comprehensive approach to be used for development of systematic modelling and quality evaluation.

Challenges discussed above contribute to the motivation for the research as they are reflected in the lack of comprehensive guideline with the developed systematic approach to the process classification and modelling in the case function. The definition of the modelling approach is requested for a project implementation as well as proper launch and maintenance of the business management system where all process related documentation is created and stored.

Therefore, the aim is to conduct a research of existing approaches to process classification and modelling as well as to come up with a guideline as a deliverable which can meet the current business need. Related aim is to build a literature-based customized framework for quality evaluation of developed guideline and designed process models to prove the reliability of the developed approach. Based on the previous statements, the objective is…

… to discuss the development of a comprehensive guideline which can contribute to the systematic approach to business process modeling and continuous quality improvement being a foundation for the business management system.

This thesis aims to discuss the concept that allows process models to be developed consistently for business processes to remain efficient. Hence, even if different models of business process exist on different layers of abstraction fulfilling different requirements, consistency should be the key in any way. To have business process models harmonized, the comprehensive training material in the form of a guideline for process modelling should be project specific while giving a room for abstraction. Based on the objective and operating context of the service-providing case function of the industrial company, it is important to first discuss what kind of business process models fit the purpose and then to develop a framework for quality evaluation. To do so, the thesis addresses the following research questions:

RQ1. What kind of guideline content would support the systematic business process modelling?

RQ2. What quality aspects should be considered in guideline and developed process models for quality reliability and improvement?

The structure of the thesis is based on the objective and research questions. First, terminology in the context of business process management is explained. The next sub-chapter focuses on business process architecture including hierarchy, design principles and mapping of developed processes to obtain a big picture. Later, the concept of

training material is introduced revealing types and features of efficient guidelines that can be further used for definition of modelling methods. As the last part of the theoretical background, several frameworks for quality are discussed. Finally, all parts listed above are summarized in the synthesis providing a theoretical framework for systematic approach to business process architecture through the development of a guidance for process modeling while aiming for continuous quality improvement.

The third chapter investigates into the current situation in the case company and identifies challenges and issues of the current approach to process models. Chapter four provides a benchmark for business process architecture and defines an approach for systematic process classification to be adopted by the case function. Further, chapter five presents the proposed training material in the form of a guideline which includes definition of system for business process classification and modelling methods. Further, quality evaluation of the training material and improved process models takes place to support the discussion about the outcome of the research work. Overview of the identified challenges as well as findings are provided, and the thesis is concluded by the Conclusions chapter including limitations and implications for the further research.

1.3 Research Methods

Research is an essential activity to gain knowledge not only in academic writing but also in business life to support decision making. The whole process of collecting and processing information, research methodology, is dependent on the problem definition and objective of the research (Kasi, 2009). This section introduces research methodology and data gathering strategy and approach to data analysis, while practical implication of these concepts is covered in Chapter 6.

Decision of the research methodology can lead to qualitative or quantitative research. According to Gummesson (2000), qualitative methods are common for theory building and quantitative methods are common for tests. In “Business process architecture” related thesis paper, the emphasis is on retrieving qualitative data. Three approaches to methodology proposed by Moody (2005) are used in this qualitative research to develop a guideline for process modeling and contribute to quality improvement:

- Theory-based approach to gather original data while building a foundation for the discussion based on the literature review
- Analytical approach to critically asses and interpret existing knowledge in the scope of the case research requirements
- Consensus-based approach to connect existing knowledge and practical application

For the comprehensive answer to the research questions as part of the theory-based approach, different data gathering methods are used. In order to develop a basic understanding of "process architecture", a systematic literature review is carried out in

the first part of the thesis. It aims to identify, assess and interpret available data to supplement further research (Kitchenham et al., 2009; Gummesson 2000). The adopted approach to literature review is outlined in Figure 1 and based on the method proposed by Kitchenham et al., 2009.

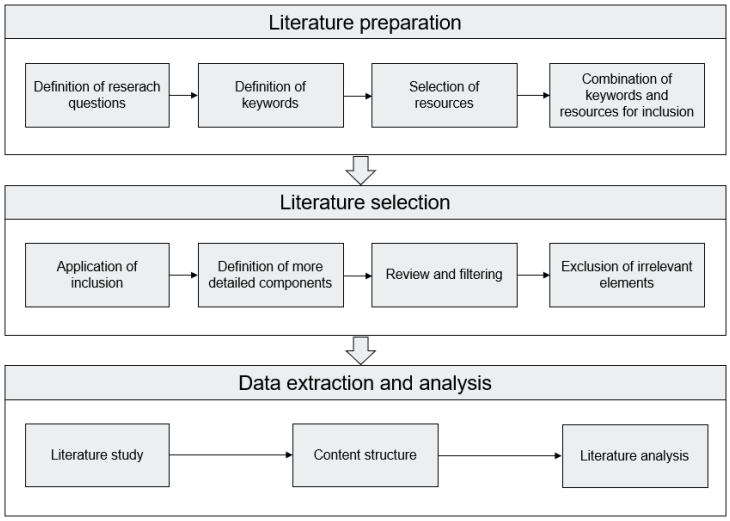

Figure 1. *Literature review as theory-based approach (adopted from Kitchenham et al., 2009)*

For the literature review, various materials were used. Information was mainly retrieved from books, articles, and research reports. Material was searched mainly from Emerald, Springer Link, Google Scholar and TUT Andor databases. In the search for literature, the following were used as search terms: Business process, process quality, process mapping, hierarchical view, process architecture, continuous improvement, training material, quality. Publications from open sources (e.g., Wikipedia) were excluded. For articles with similar content, only the most recent ones were used. The limitations of the sources are precisely the subject of the thesis.

The overall objective of the literature review is to identify and analyze meaningful literature on business process management and architecture as well as its practical implication in process modeling and quality evaluation. The literature review on these topics is conducted to identify its impact on research questions. Later in the process, literature review approach has a significant contribution to the analytical part of the research.

The time horizon of the research process was cross-sectional to provide a possibility for building a correlation between literature review and on-going project while fulfilling the objective of the thesis work. Bridging theory and practice features transformation from the etic level of research and viewpoint development to the emic level (Lyly-Yrjänäinen et al., 2009). This happened by moving from theory-based approach to the "inside" research and more analytical approach. The author of the thesis was able to contribute to the day to day work of the company by combining literature knowledge and business requirements. In other words, the conducted research aimed at giving some new ideas to the existing business situation. The following figure illustrates the relation between data gathering methods used in the research.

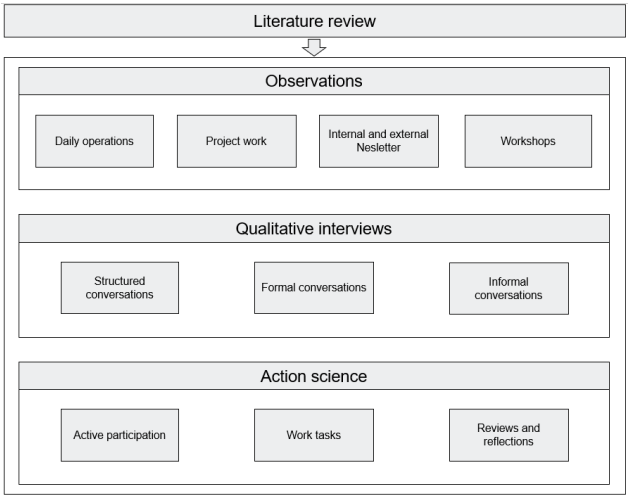

Figure 2. *Data gathering methods (adopted from Gummesson, 2000)*

As illustrated above, business process management and related topics were first studied utilizing existing materials from literature sources as secondary data. Later during the research process observations, qualitative discussions with the team members (Appendix A) and action science took place to collect primary data.

Observations were focused on monitoring the subject of the study, approach to process architecture, and were divided into participant observations and direct observations as according to Gummesson (2000). Direct observations happened without researcher's taking part in the process, while participant observations required personal involvement. Interviews were held as free-form conversations and aimed at obtaining unprocessed original data. In action science, the researcher is able to influence the process and both observations and interviews can be partially included in this method.

For the research being mainly quantitative, the author was able to work with the existing documentation as one source of original data building interpretations based on the study and observing the quality improvement by applying these interpretations. To support the research, the author targeted at methods and system for business process modeling, developing a guideline as the result of data analysis and interpretation.

Different types of data gathering methods were used in this thesis work during the writing process, all of them have both advantages and disadvantages. Table 1 below illustrates methods used during the research with their advantages and disadvantages.

Table 1. Advantages and disadvantages of applied data gathering methods

Method	Advantages	Disadvantages
Literature review	• Source of background information • Easy to access	• Uncertainty in quality of information • Time consuming
Observation	• Data is collected at the actual place of the event	• Bias of observer

	• Action over words	• No precise understanding or reasoning
Qualitative interview	• Emphasis on the most relevant information • Easy to set up	• Trust issues • Unfair analysis
Action science	• Reveal the experience	• Time-consuming • Results change with time

Data gathering is a significant element in both theory-based and analytical approaches to research methodology (Moody, 2005). In this paper, results of the data gathering are used to build requirements for the establishment of the process modeling guideline. When requirements are collected, theory-based and analytical approaches are supported by the consensus-based approach to develop a guideline with a practical application. Final phase of the research is discussions and evaluations where both analytical and consensus-based approaches are used to see how business requirements and theoretical knowledge were combined. The discussion is presented in Chapter 6.

Qualitative data used in this research is characterized by richness and gives an opportunity to explore the researched subject in the most realistic manner combining both literature review and practical observations. Data analysis of the thesis is based on the interpretation and comparison of literature review, benchmarking and real-case requirements retrieved from informal interviews and observations. In this sense, interviews allowed to obtain wider perception of the current state.

Data analysis attempted to solidify a view to the current state of requirements for process modeling and point out key elements to be included in the systematic modeling guideline. Important concepts of business process management were correlated with identified issues of the case company to identify root causes and propose answers to the research questions. In the discussion part of the thesis, data is consolidated, and results are overviewed based on the theory background.

Not only described information gathering and analysis happened while writing the thesis, but also meta-level learning. Meta-learning helps to reflect on the learning process and to develop a “growth mindset”, meaning that one believes he/she “can do it” (Kasi, 2009). In the particular case of being involved in every-day work of the case function, meta-learning happened while interpreting meaningful pieces of literature and providing self-reflection regarding it.

2. THEORETICAL BACKGROUND

2.1 Business Process Management

The pressure on companies caused by global competition is increasing steadily while complex business models bring even more challenges. Modern companies are responsible for providing their customers with a high level of quality in order to differentiate themselves from the competition which places a high pressure on the business processes. There is a challenge of integrating business processes into company's structure in such a way that ongoing changes can be flexibly adapted at any time. The solution to this problem lies in the efficient management of business processes (Brocke and Rosemann, 2010).

In a process-oriented organizational design, it is generally assumed that optimal target achievement in terms of cost, quality and lead time with the goal of customer satisfaction can only be achieved through a holistic view of the complete process chains (Armistead et al., 1999). Business process management (BPM) is a management approach that deals with the fulfilment of organizational and business goals as well as fulfilment of customer requirements providing a desired holistic view.

BPM makes it possible to know existing business processes, meet legal requirements by documenting processes, remove complexity from work procedures and increase company's economic success by improving efficiency and focusing on the customer (Hammer, 2001). To achieve corporate goals, process management deals with the identification, design, documentation, efficient and effective implementation, control and improvement of business processes (Davenport and Short, 1990; Balasubramanian and Gupta, 2005). According to Brocke and Rosemann (2010), the central question of business process management can be stated as: "Who does what, when, how and with what?".

2.1.1 Process and Business Process

To successfully implement practices of business process management, accurate process identification is required. Both business processes and business process management have been an established topic for years. However, looking at the literature, it turns out that little attention has been paid to a good and precise definition of business processes. There is still no generally accepted definition, essential core elements of such a definition are also rather vague.

- Trkman (2010) describes business processes as "…activities that together create value for the customer ".

- Davenport and Short (1990) see a process as “…a temporally and spatially specific set of activities with a beginning and an end as well as clearly defined inputs and outputs”.
- Osterloh and Frost (2000) see business processes clearly characterized by "bundling of cross-functional activities in the structured order with a beginning and an end".
- Hammer and Champy (1995), pioneers in business reengineering alongside Gaitanides (2007) and Scheer (2003), who are known for the popularity of process orientation, describe business processes as "…activities that create value for the customer when implemented in a defined sequence with defined resources".
- Ould (2005) rejects a single definition in his works and describes a process as a concept with the following essential characteristics: activity, groups, collaboration and goal.

The conceptual disagreement and inaccuracy regarding a clear and comprehensive definition of the concept of business process in the known literature is a factor contributing to unclear understanding of the process. However, there are also clear definitions, which include an essential part of a comprehensive end-to-end process understanding:

- Horváth and Mayer (2005) define a process as "a chain of activities aimed at delivering a performance output", identifying such elements as: internal or external customer, defined performance output, certain cost, quality and time requirements, the use of resources and procedures”.
- Hammer (2001) sees a business process in general terms as "a coherent sequence of entrepreneurial activities for the purpose of service delivery. The outcome of the business process is a service requested and accepted by an internal or external customer”.

The above given definitions suggest how large the bandwidth of the process concept is. Business process management literature studies processes, business processes, business activities or performance processes; there is no uniform definition and these terms are often used interchangeably. However, it is very important to see the difference between processes in general and business-related processes. Based on Schmelzer and Sesselmann (2010), definition of processes that allows comparison is illustrated in Figure 3.

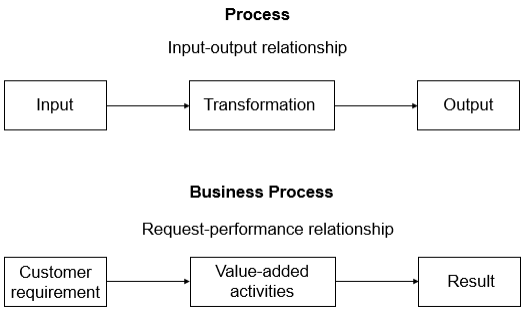

Figure 3. *Definition of process and business process (adopted from Schmelzer and Sesselmann, 2010)*

The figure above illustrates that business processes are a contextual type of general processes. To create a context, discussing the business process, there is a concept of the process-defining object. It is the object to which the process is directed (Horváth, 2009). The introduction of an object into the process concept allows a beginning and an end of the process to be defined. An extended definition of the process with inclusion of the object is: “A process is the content-related, temporal and logical sequence of activities that are necessary for processing a business-relevant object” (Armistead, 1996).

2.1.2 End-to-End View

The first step in meaningful and value-added business process management is the definition of end-to-end business process. Every process consists of activities that can be called process steps (Osterloh and Frost, 2000). To make a set of these steps turn into a process, clearly defined sequence is required (Bergsmann, 2012).

Every process, no matter how it is cut by activities, always has the beginning and the end, making it end-to-end (Ould, 2005). Insofar, the term “end-to-end” is slippery as it automatically means a complete integrated view. To make the definition clear for an end-to-end business process Frye and Gulledge (2008) put the customer need in the beginning of the process and performance that meets this corresponding need to the end, as illustrated in the figure below.

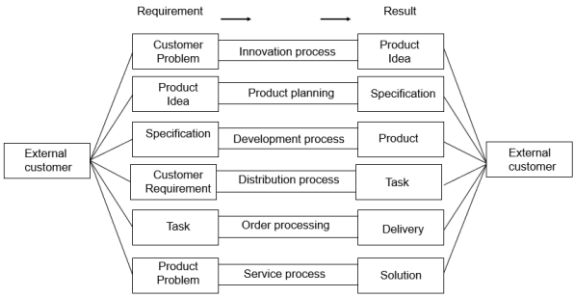

Figure 4. *Business processes in industrial company (adopted from Frye and Gulledge, 2008; Schmelzer and Sesselmann, 2010; Ould, 2005)*

By above, business processes in industrial company are end-to-end business processes but the term only brings value with the understanding of "ends" through customer need and performance to meet this need. The illustration highlights that the process does not only involve activities to create a product or service, but also all what is necessary to deliver the service that meets the initial requirement (Ould, 2005). Thus, business process does not always follow the view of a department or area in the company, it can also follow the view of the business case.

The aim of the end-to-end process view is to extend the area of managerial focus to clearly see the customer with needs as a process trigger and final performance as the result, while achieving full process orientation (Staud, 2001). Frye and Gulledge (2008) and Koch (2011) agree that with the end-to-end understanding of business processes a picture of the entire service provision for the customers and the necessary exchange of services between individual activities is created. The matrix bellow illustrates the concept.

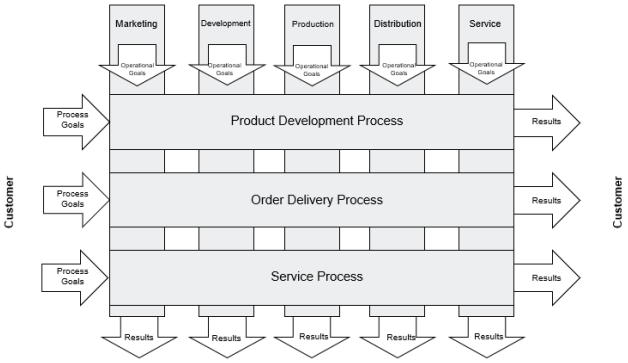

Figure 5. *Function/process matrix (adopted from Koch, 2011)*

Function/process matrix by Koch (2011) illustrates order delivery process. Giving a reference for the supply chain management being a source of end-to-end processes with an aim for integrated and process-oriented planning and control of the flow from the supplier to the customer (Lambert, 2008). When process management, in the end-to-end process understanding, concentrates on the customer-oriented view, it offers a new perspective on supply chain management in the company, bringing added value across functions (Frye and Gulledge, 2008).

2.2 Business Process Architecture

This section clarifies the key terms used in the context of business process management and business process architectures. It aims to provide a deeper understanding of how the topic of hierarchical view on process architecture is embedded in the wide field of business process management.

The term of business process architecture is widely used in scientific research and business practice (Winter, 2003). The understanding of the term differs from author to author, subsequently, various definitions are proposed. Winter (2003) broadly defines

process architecture as "The fundamental organization of a system, embodied in its components, their relationship to each other and the environment, and the principles governing its design and evolution."

Process architecture in the organization aims to simplify the complexity of existing processes by showing the most important components and their interactions with each other (Ungan, 2006). As organizations act through their processes, the process architecture is significantly important. Process architecture develops an understanding of the organization from a process perspective while explaining relationships between processes in the company and when required going down to individual processes (Damij, 2007). In addition to the process details, a process architecture includes goals, principles, and guidelines that serve as the basis for process models (Malinova and Mendling, 2013). The definition of process architecture as a combination of views by different authors is presented below.

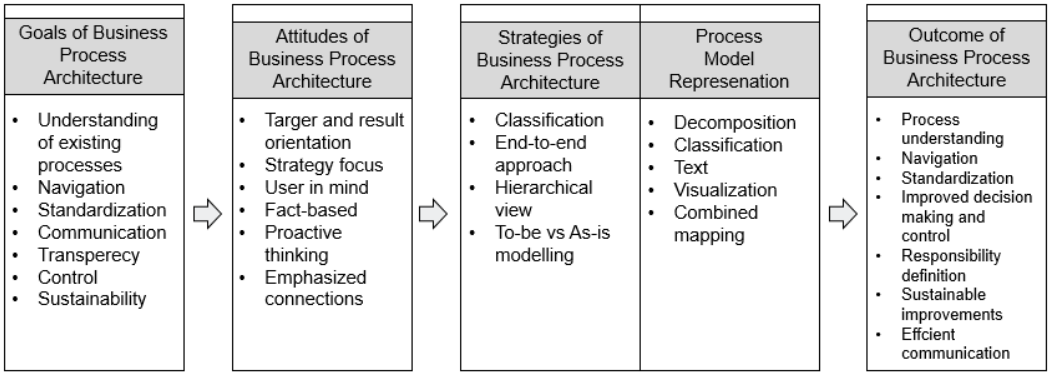

Figure 6. *Defining the term of business process architecture*

An established process architecture saves time and effort in assessing business processes. It is used as a communication tool among process participants in setting goals and responsibilities (Damij, 2007). Process architecture can be used as a basis for discussion in case of changes in business process management. It represents the link between an organization's strategy and the stages of the business process lifecycle in an easy-to-understand way (Ungan, 2006).

A process architecture is a conceptual model that illustrates a company's processes and relationships. At the top level of the architecture lies the process map (Malinova and Meldung, 2013). It maps all processes starting from a very abstract level and describes their relationships to each other. The second level shows the processes in a finer degree of detail than the process map, but still in abstract form. At the third stage, the processes are finally visualized in the form of process models, so that control and data flows can be identified (Dumas, 2013). The details of these processes are presented in the lower levels of the process architecture. This splitting can be continued until the desired level of detail is reached.

The process model extends from the analysis of strategic business areas to process improvement (Schulte-Zurhausen, 2010). The figure below illustrates the most common steps of the business process design.

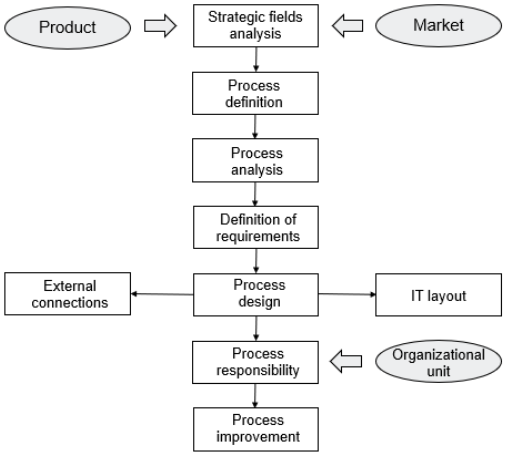

Figure 7. *Steps to design business process model (adopted from Schulte-Zurhausen, 2010)*

Balasubramanian and Gupta (2005) states that business processes should always be defined based on the analysis of strategic business areas. Crandall and Crandall (2008) agree and add that this should be followed by the analysis of actual processes and the definition of requirements for target processes. Based on this, the design of the target processes can be carried out and the process responsibilities can be properly assigned.

2.2.1 Process Decomposition

Management of business process elements originates from value stream thinking described by Porter (1980). Porter (1980) describes value stream as the largest possible process in any organization while Wolf (2003) uses the same definition for a value chain. Thus, value stream is similar to a value chain and it is a set of activities that a company operates with in its' industry to deliver a value to the customer.

One common way of differentiating processes is their division into core, support and management processes. Core processes focus on the external customer and directly create value for the customer. In his model, Porter (1980) identifies the inbound logistics, production, marketing & sales, outbound logistics and after sales services as primary activities, respectively as core processes of a company. Support processes focus on the internal customer and can indirectly create value for the external customer by creating a core process value for the company by, for example, providing a suitable work environment. As a supporting process, Porter (1980) lists purchasing, technology, human resources and infrastructure of a company. The management processes are to manage and practice both core and support processes.

Depending on the context and company, the same process can be a core or support process. As an alternative to the definition by Porter (1980), a core process is therefore a process whose activities add value and are directly related to the manufactured product or provided service. Thus, the processes whose activities have no direct connection to the product or service being non-value-adding are to be understood as support processes (Becker et al., 2013). The figure below illustrates how main processes can be subdivided into sub-processes and activities.

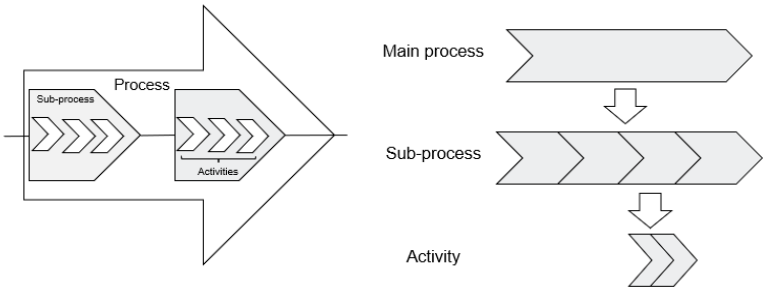

Figure 8. *Process decomposition (adopted from Ljungberg and Larsson, 2001; Winter, 2003)*

Winter (2003) describes the process decomposition distinguishing between core, support, and management processes as Porter (1980) but he gives a different definition. Core processes or business processes in the narrower sense provide services for process customers, who can also be internal customers. Support processes provide input for core processes and managerial processes coordinate the service delivery. The process map in this case is intended to describe the interaction of business processes in the company or business area by mapping the most important business processes according to hierarchy and relation to each other.

2.2.2 Process Hierarchy

A distinction should be made between the terms "process model collection", "process architecture" and "process map". All three definitions are described by Malinova and Mendling (2013), where process collections include all modeled business processes. In order to present processes, along with their details and relationships, concepts such as the process architecture and process map were introduced. A process architecture consists of several levels with different levels of detail. The top level is the process map, which illustrates the most important business processes and their connections.

The process map can be used to navigate various process levels (McCormack and Rauseo, 2005). Map describes the processes of an organization for all employees and stakeholders (Malinova and Mendling, 2013). The involvement of company management in the creation of a process map enables the definition of critical business processes. Thus, the process map aims to further guarantee that everyone involved in the process speaks a common language and has a common understanding.

Focusing on a single process can lead to incompatibilities and contradictions among processes (Malinova and Mendling, 2013). From a process perspective, it may make sense to unify main processes across departmental boundaries by forming process groups and categories. It may help to develop a unified understanding and avoid overlapping of managerial activities. Furthermore, as noticed by Balasubramanian and Gupta (2005), merging a large number of processes into groups and categories precisely indicating handover activities gives management level an ability to see handovers more clearly enabling process improvement. Therefore, the process map by this mean can provide the company with a high-level view that connects with lower level processes, giving a big picture of the situation (Becker et al., 2013). As illustrated below, the process map provides classified description of business processes.

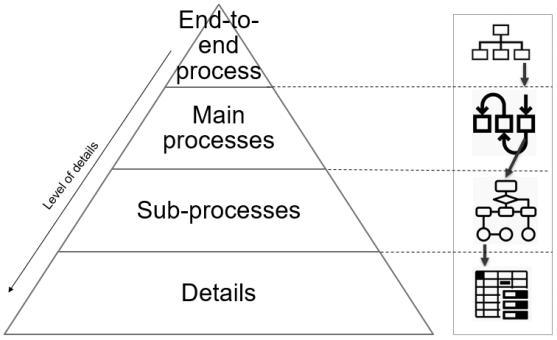

Figure 9. *Simplified end-to-end process architecture framework (adopted from Lind and Seigerroth, 2010)*

It is important to have clear differentiation between core, support and managerial processes. However, when mapped, business processes are structured differently, and detailed differentiation can be found in the literature. Some common examples of process divisions by hierarchical levels are listed below.

Table 2. Process hierarchy

British Telecom (BT), (2006)	**H. Fromm (IBM), (2006)**	**Lind and Seigerroth (2010), REFA Verband**	**Feldmayer and Seidenschwarz (2012)**
1.Business Activities 2.Process Group 3.Core Processes 4.Business Process Flows 5.Operational Process Flows 6.Detailed process Flow	1. Process 2.Sub-process 3. Activity 4. Task	1.Business Process 2.Main Process 3.Sub-process 4.Work System Process	1.Process groups 2.Basic processes 3.Process categories 4.Process chains 5. Workflows 6. Work steps

For the case study of the end-to-end process view by Lind and Seigerroth (2010), rather detailed, six-level structure was used. The clarification of levels is illustrated and explained in Figure 10:

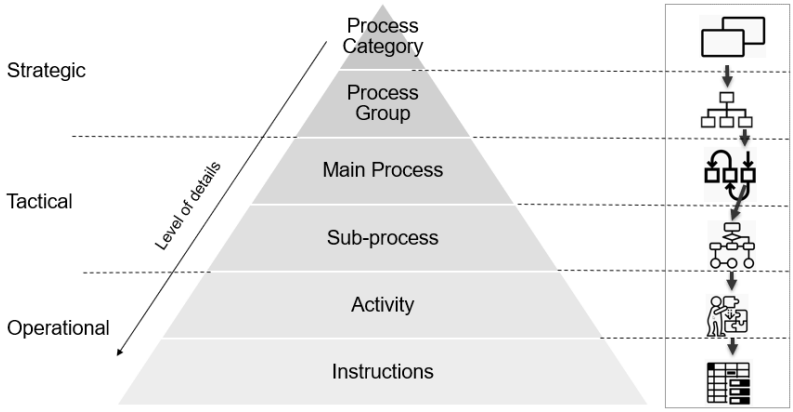

Figure 10. *End-to-end process architecture framework (adopted from Lind and Seigerroth, 2010)*

Level 1: outlines the operational level of a company or process category
Level 2: shows end-to-end processes across the above operational area and combines into process groups, high-level processes
Level 3: breaks a process group down by main processes giving a more detailed outline but not revealing details
Level 4: shows sub-processes required to complete a specific process within an operational area. It contains information for process understanding but may miss details and doesn't function fully well for training or as operational documentation
Level 5: is an activity describing who does what and when
Level 6: is the documentation level, includes instructions and procedures required to complete processes. The procedures and system instructions can be represented as text, presentation or table

2.2.3 Process Models

The question of how to concretely identify processes of a company has not been systematically and widely covered in the literature. There are no uniform procedures and criteria that could be applied in practice. However, identification of processes is critical for further planning and design. As stated by Allweyer (2009) in "Introduction to the Standard for process Modeling", only when identified correctly, processes can be described in detail and visualized remaining reliable. During the process work, existing processes can be identified and documented, or new processes can be introduced. The goal for business process is a holistic view and an operational compliance to the strategy (Koch, 2011).

As agreed by Frye and Gulledge (2007) and Bergsmann (2012), precise process identification, a clear process name has to be defined. Definition of the first and last process step delimits the process. In addition, the input and output of the processes are to be determined. According to Wagner (2008), in the process identification and delineation, the following points are critical:

Table 3. Aspects of process identification (adopted from Wagner, 2008)

Aspect	Description
Process purpose	Explanation of the main task of the process and why it is important for the company
Customers of the process and their expectations	Identification of the main customer of the process and its expectations "What does the customer's voice say?"
Input	Triggering events such as documents, information, intermediate products, initial processes
Output	Result of the process, such as documents, products, services, materials
First process step	Which process step of the considered process is considered to be first performed? How is this process differentiated from the previous one?
Last process step	Which process step of the considered process is performed last? How is this process differentiated from the next one?
Interfaces	Identification of information, intermediate results or data exchanged with other processes or organizational units
Process sketch	Rough list of the essential process steps
Required resources	What aids, resources, machines, qualifications, etc. are required for a smooth process flow?
Success Factors	What are the most important prerequisites for the process to be fully satisfied and to permanently meet customer expectations

In order to make the process information listed above be collected as efficiently as possible, it is recommended to communicate with main stakeholders of the process. These stakeholders should be very well acquainted with the areas and can provide information about possible weak points already during the starting phase (Bergsmann, 2012). As information is collected, modeling can be initiated.

Business processes can be documented and modelled in different ways, e.g.: in the form of a textual description, a tabular representation, a graphical representation without or with a specific notation (Koch, 2011). Process description as text is documented by means of a descriptive document. The process description as text is the easiest way of documentation, it is easy to understand and flexible, since one can represent every issue with natural language. On the other hand, various authors may express the same thing differently and the representation of large processes will become confusing. This is exactly the difference between Frye and Gulledge (2007) and Schmelzer and Sesselmann (2010). Subsequently, it is difficult to see if all the information is available.

Just as with the process description as text, tabular representations are easy to understand and easy to create using a spreadsheet program. According to Damij (2007), the advantage over the description as a text lies in the compactness and clarity. Tabular representations are subsequently easier to compare and to check for completeness. The

table structure is disadvantageous when it comes to describing complex control flows and relationships between the various processes as well as the risk of confusion in large process representations (Damij, 2007).

Another form of presentation extensively covered by Dijkman and Dumas (2007) is representing business processes in the form of flowcharts with the aid of boxes and arrows as well as other graphical elements and explanatory texts but using no established notation. The creation is simple, the control flow can be clearly displayed, and graphical elements can increase the expressiveness. However, the missing notation can lead to inconsistent representations and a process can be represented completely differently. Due to various creative possibilities of graphics programs the danger of confusion with this type of visualization is high (Dijkman and Dumas, 2007).

There is also a possibility of business modeling is the graphical representation according to the defined system of notation. It promotes standardization and control flow can be clearly displayed (Damij, 2007). The use of notation leads to a similar presentation and the associated unified understanding of the models. Extensive processes can be arranged clearly with the help of defined constructs for the division into several coherent models and the graphic modeling elements can be provided with attributes (Allweyer, 2009). The disadvantage explained by Dijkman and Dumas (2007) and supported by Dumas (2013) is the effort for learning the notation and possibly higher modeling effort. There are several standards for notations, such as Event-Driven Process Chain (EPC), Unified Modeling Language (UML), Business Process Modeling Notation (BPMN) and Semantic Object Model (SOM). These notations can be combined or modified according to the purpose obtaining more or less complex system-driven process design.

The process modeling in the empirical part of this work was carried out based on Business Process Modeling Notation (BPMN). As explained by Dijkman and Dumas (2007) in the introduction to the article, BPMN was originally developed by Business Process Management Initiative (BPMI), a consortium consisting mainly of representatives of software companies. In the meantime, BPMI has merged into the Object Management Group (OMG), which deals with the development of standards for vendor-independent cross-system object-oriented programming (Allweyer, 2009). The organization has become known by software standards, such as: already mentioned UML. White paper of IBM and published in 2004. In 2006, the BPMN version 1.0 was officially used as the OMG standard. The current version BPMN 2.0 was adapted by the OMG in 2011. The BPMN has become widely used in practice as a new standard for business process modeling within a short time (Dumas, 2013). The focus is on notation, meaning the graphical representation of business processes (Damij, 2007).

2.2.4 The Process of Process Mapping

A more concrete approach of the discussed above end-to-end definition of business processes has to be investigated in more detail (Schmelzer and Sesselmann, 2010). Following the study by Biazzo (2012), it should be noticed, that the root of the process

mapping method definition ambiguity lies in the lack of a precise and commonly accepted process definition. There is a variety of different definitions of business processes, as discussed previously, and none of definitions is absolute which may cause confusion with related terms.

The involvement of the company management in the creation of a process map enables the definition of critical business processes, which has a special significance for the company. While combining modelled processes into a process map, not only relationship between processes but also a big picture with reference to the strategy should be obtained. Eight step mapping methodology by Ljungberg and Larsson (2001) especially promotes reference to the company's strategy while developing a business process map. The steps are presented below:

1. Definition of process purpose, clear statement of starting and ending points, finding input and output. According to Ljungberg and Larsson (2001), good understanding of the process before the mapping begins, allows more efficient and smoother the mapping work

2. Process portfolio brainstorming session. All possible processes are defined as the result of brainstorming and written down. The purpose of the brainstorming session is to start quickly and easily having a big picture of work ahead

3. Arranging involved processes and activities in the right order until the proper flow of the process is found

4. Merger and addition of processes and activities. Processes and activities that are duplicates of one another are merged and missing ones are added

5. Definition of the object in and out for each activity to connect activities and form a process with a clear purpose

6. Getting processes and activities connected by the objects. Mapping missing activities, each activity's object out should be the next activity's object in

7. Making sure all activities have a common level of detail and accurate names

8. Making adjustments until a satisfactorily description of the process is obtained.

Another method for process mapping is presented by Jacka and Keller (2002) in the third step of their approach to process mapping. In contrast to Ljungberg and Larsson (2001) the information gathering is carried out simultaneously with the map generation. Similarly, it is preceded by a preparatory step.

2.3 Training Material

The concept of training has a significant contribution to the corporate performance. Companies always seek for new skills and capabilities while aiming at improving existing ones. To promote growth and financial progress, it is extremely important to make sure that employees are educated, and corporate knowledge is keeping up with the latest standards (Crandall and Crandall, 2008). Employee education and learning happen at different levels of the organization and these levels correspond to ones discussed in the process architecture chapter. The figure below illustrates organizational levels by Lind and Seigerroth (2010) and corresponding learning according to Bersin (2019).

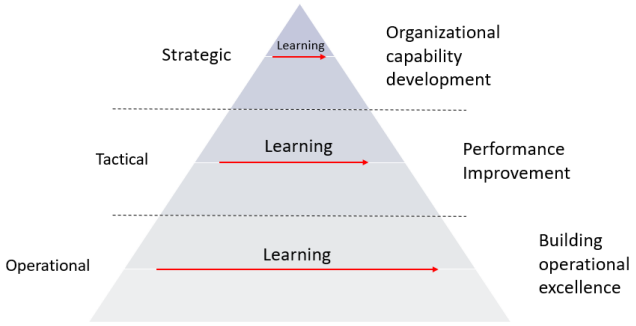

Figure 11. *End-to-end process architecture (adopted from Lind and Seigerroth, 2010) and organizational learning (adopted from Bersin, 2019)*

According to Dessler (2008), learning to achieve a high level of competence and performance is a great challenge for any business at any level. Therefore, trainings are essential to support the organization. As products and services provided by not well-trained employees are associated with a lower quality, companies invest in training material that helps employees to perceive the value of their performance and increase the efficiency of operations (Blanchard and Thacker, 1999).

2.3.1 Definition of Training and Training Material

As defined by Gordon (1992), training is a set of processes aimed at changing the behavior by learning and doing, which encourage participants to gain new knowledge and skills to perform work tasks effectively. According to Wognum and Fond Lam (2000), there are three levels of an organization where training needs may occur. These levels are strategic, tactical and operational. Trad and Kalpic (2014) emphasize the importance of having a suitable training on each level. On strategic level needs are stated by top management in terms of chosen strategy and current problems. Tactical level represents needs determined by middle management considering features of strategic business units. Operational level is one where needs are determined by the lower management in relation to particular operations and performance of individuals. In order to conduct a proper training, precise monitoring within all three given layers is needed.

In recent years, importance of training has been emphasized by growing competition and desire of companies to invest in employee and process development. As stated by Beardwell et al., (2004), success of the company is dependent on skills and knowledge of employees. Continuous training and follow-up are essential for reasonable performance and constant development.

Training aims at giving new or improving existing knowledge related to work tasks. To know where to focus the training process, Dessler (2008) states three types of competencies that are to be observed: technical, personality and managerial. Firstly, technical competencies are skills and knowledge related to a particular job. Secondly, personality competencies are knowledge and skills related to someone's personality and may be required while performing various jobs. Thirdly, managerial competencies are knowledge and skills required for managerial functions, such as decision making, communicating and motivating.

Training is a process aiming to increase knowledge and skills for better performance of job-related tasks. According to the specification, different training material can be applied to support the training. As mentioned by Gerhart et al., (1992), training material can be defined as a set of resources that contains educative information about processes and products to facilitate the formation of knowledge and skills. The decision of training material is very important for the successful implementation of the training process (Crandall and Crandall, 2008). Types of training material are necessary to be described in more detail.

2.3.2 Aims and Types of Trainings and Training Material

Training happens at different levels of the organization and goals of training process at a given level drive the decision of training type and method. Cascio (1992) states that new training methods are constantly appearing. Some of them are widely known and reside in a learning theory, but others are coming from theoretical development and technological innovations.

The training process should be supported by appropriate material as a mean for learners to get information and facilitate the learning process. Materials are selected in consideration to the current situation and desired outcome. Outcomes are related to aims of training material. Most common aims are:

- To introduce the subject of training
- To make a profile of the subject of training
- To perform as a reference
- To be used as an independent guideline
- To facilitate the learning process

The more aims of training material are fulfilled, the better user response to the technology. As noticed by Dessler (2008), depending on the perceived goal, training materials can be presented in two categories: manual and didactic materials. As the first of two categories of training material, training manuals are mentioned. These are materials where the content of training and training method are stated. Training manuals are used to prepare and facilitate training when reference manuals are given as after training material.

The second category is didactic material used to outline the content of learning and also facilitate it. This material is used as a specific tool for reinforcement of a chosen activity. Among the main types of didactic training material, Blanchard and Thacker (1999) mention following types described in Table x.

Table 4. Types of training material (adopted from Blanchard and Thacker, 1999)

Type	Definition
Training manuals	Reference in a form of instruction guiding the learner through the process
Job aids	Packed essential information to support the task
Tools for in-class training	Presentations, slides and audio-visual materials
Production machine	Technology in practice
Blackboards	Interactive field to express ideas and practice outcomes
Game-like tools	Safe to fail training environment for process simulation

Types of training materials mentioned above are utilized according to the resources available to the company, goals, expectations, type of the company and current priority of the training. Depending on the situation, training tools are used independently or reinforce each other for the higher efficiency.

2.3.3 Elements of Efficient Training Material

Goals of training material will only be achieved and lead to the desired results when employees, object of training and environment of the organization are taken into consideration. Cascio (1992) and Dessler (2008) both notice, that for a training process and material to be effective, several learning conditions are to be met. To be effective training should:

- Motivate employees for a better performance
- Clearly illustrate the goal
- Be structured starting from the basic and going further
- Engage trainees for an active participation
- Provide an opportunity for feedback
- Ensuring transfer of knowledge and skills

There is another perspective existing when considering points mentioned above. Blanchard and Thacker (1999) keep connecting training material to the general education process. Their perspective includes motivational and support need of training material together with realistic practice and repletion need.

As a sum of what is mentioned above, training process is not only about properly developed training material. Motivation of employees and reasonable management are also essential. The aim of training material is to reinforce the learning process and make the result of new task, technology solution, and/or process introduction efficient in the shortest possible time (Cascio, 1992; Wright and Geroy, 2001). There are common features that are shared by successfully used training materials, Figure x illustrates these features.

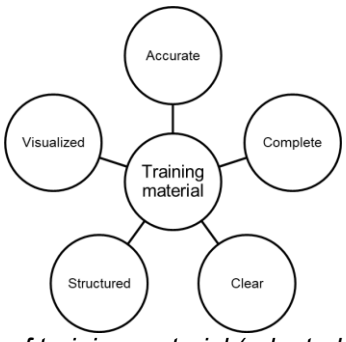

Figure 12. *Characteristics of training material (adopted from Wright and Geroy, 2001)*

The figure above lists main features of effective training material to establish guidelines for organizational, scientific, technical, technological, financial and any other activities of organizations that require training. As was already illustrated, good training material is accurately assembled, understandable, complete, consistent and effective.

Table 5. Description of features in training material

Feature	Description
Accuracy	The more specific the material, the better. Describing should be done intelligibly, avoid words that have multiple meaning or meaningless words. Accuracy is an important aspect for being understood in the desired way.
Complete	Instructions can be clear and understandable, but still unsuccessful if they are incomplete. No important step can be missed in describing the technique because it can lead to the impossibility of completing the assignment.
Clearness	Instructions should be prepared for specific recipients. Instructions can be made more understandable, using short sentences, common words and good bundles.
Structure	The training material is easier to understand and implement if it is consistent and well structured. Distinguishing between

	structural levels within the material and making it obvious to the recipient are important.
Visualization	Good visualization makes information easy to follow and helps to remember it better. It also minimizes the text content of the material while briefly generalizing the content around an illustration.

To develop a training material, studying and detailed description of the production or technological processes should be conducted. The compiler of the instruction has a great responsibility and needs to understand the production process in detail together with needs and goals of the developed material. When proper training material is provided for the final user, an increase of customer value is considered to be one of the desired outcomes.

In the scope of the study, training material is provided for users at tactical and operational levels of the organization. At these levels training material in the form of a guideline is the most efficient type (Blanchard and Thacker, 1999) as it guides the user through the process and be used as a reference at any time. The following figure gives a location of the further discussed training material in organizational and learning levels.

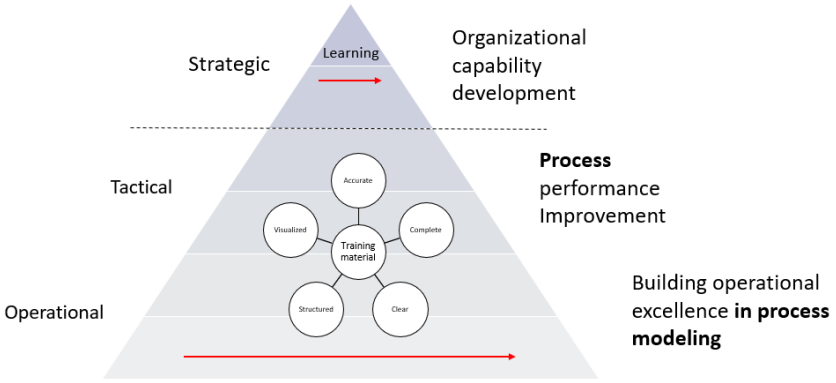

Figure 13. *Levels of organization (adopted from Lind and Seigerroth, 2010), learning (adopted from Bersin, 2019) and efficient training material (adopted from Wright and Geroy, 2001)*

Having efficient training material at tactical and operational levels is expected to ensure high quality of the performed processes and deliverables. As the result, training material is a facilitator for the learning organization in achieving operational excellence and providing high value for the customer.

2.4 Quality in Process Modeling and Models

The concept of quality is known since antiquity and derives from the Latin qualitas, which can be translated as constitution (of an object). Since the beginning of the term

existence, its contents have been discussed. In order to make the complexity of this term clear, different approaches to the description are discussed in this chapter.

The definition of process quality is not yet as well examined as the term of product quality. However, it is commonly agreed that the quality of business processes has a significant influence on the company's success (Schmelzer and Sesselmann, 2010). There are great potentials in the processes for reducing costs, improving quality and shortening lead times. In addition, process quality is significant as it forms the basis and prerequisite for achieving product quality.

After all, every product and service provided by a company is the result of some process or process combination (Allweyer, 2005). If processes do not work reliably, the quality is poor, which in turn affects the product quality. In most cases, product quality is measured extensively in business practice, but the process quality is rarely measured.

As discussed by the Balasubramanian and Gupta (2005) as part of business process design evaluation, several customers and suppliers are usually involved in a business process, which contributes to process quality and, as a result, to product quality due to the certain demands on the process output. The external customers have expectations and demands on the final product. The suppliers and internal customers involved in the process in turn show demands towards the process execution, process inputs and outputs. Quality of business processes can, thus, be considered as fulfilling of process inputs and relevant outputs for meeting customer requirements.

Interdependencies exist between the product quality, process and company quality as well as the quality of society that can be demonstrated within the hierarchy of quality. The picture below illustrates the hierarchy of quality discussed by Schmelzer and Sesselmann (2010) and it is supported by the concept of Lean value principles discussed by Liker (2004) and revealed in Section 2.4.4.

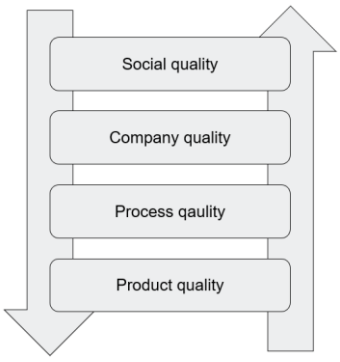

Figure 14. *Hierarchy of quality in the company (adopted from Schmelzer and Sesselmann, 2010)*

Dependencies exist at the higher hierarchical level, but the direction of impact extends to the lower level. At the lowest level, the product quality is located. Customers are particularly interested in features and functions of a product. For this reason, process quality depends on the quality chased by the company. In turn, the quality of the company

is built on the quality of its processes, because a company has numerous activities to be performed in a perfect manner. For development and execution of processes, company relies on employees as resources, meaning the design of process models and developed systematic approach to modeling are relevant.

2.4.1 Quality Control

The consistent orientation to quality assumes that quality management exists and performs planning, monitoring and controlling the achievement of the desired quality level. Quality control is not understood as an independent system, but as a subsystem of controlling in the whole operating environment and various functions. According to Horvath (2003), it extends the quality management by the business-related dimension of the cost-benefit ratio.

Quality control usually comprises analysis, planning, implementation, control and coordination of quality-related activities for quality management. An essential goal of the quality control is to co-ordinate quality-related business processes throughout the company. It is done in a way that facilitates the achievement of high quality and competitive costs while evaluating, measuring and improving process performance (Allweyer, 2005). Other goals of quality control include the following:

- Transforming vision into strategies and ensuring implementation by management
- Guiding employees to continuous improvement
- Outlining motivational factors in quality development and improvement
- Ensuring adequate data.

Accordingly, quality control aims to increase the efficiency and effectiveness of quality management. While the effectiveness of quality management ensures the quality of service delivery according to customer requirements, efficiency ensures tangible benefits of quality-related activities for the company. At the same time, both effectiveness and efficiency of service provision are built on business processes developed and performed by the company. Leading to the fact that performance of processes is heavily dependent on how processes were originally developed and documented for implementation.

2.4.2 Process Model Quality

As discussed before, hierarchy of quality in the company provides different views on the general concept of quality related to business process models. There are different approaches to the concept of quality. According to Garvin (1984), different perspectives on the quality definition can lead to misunderstandings and confusions. He summarizes product, production and user-based approaches, translated from different levels of quality, into fit-to-purpose approach to the quality of process models. The reason behind

this summary is a statement that high quality can only be achieved if the initial goal is properly mapped and clearly defined. Most precisely defined approaches to the concept of quality are:

- SIQ
- Process-oriented quality management aligned with ISO
- Conceptual modeling (combination of requirements)
- Elements of efficient training material for business process modelling
- GoM - recommendations for quality improvement

Specification of syntax, semantics and pragmatics (SIQ)

The assessment of the quality of process models is a debated issue in the literature. A unified response is particularly complex because models are usually created for a specific purpose or in a scope of a project, and therefore are considered "good" if and only if they serve that purpose.

Nevertheless, there are generic frameworks that allow the (formal) assessment of the quality of models. A well-known example of this is the SIQ framework extensively covered by Reijers et al. (2015). Based on the SIQ framework, three types of quality are derived from process models. According to Fellmann (2013), Brocke and Rosemann (2010) and Reijers et al. (2015) these types are as follows:

- Syntactic quality which is defined by the degree of conformity to a previously defined syntax. For this purpose, a modeling language defines rules for elements and relations between these elements, which must be at an early stage adhered to in the modeling approach. Rules for syntactic quality of process models are:
    - Syntactic correctness – process model with only graphemes that are part of the agreed language
    - Syntactic completeness – process models have all the constructs and information to obey the agreed language rules

- Semantic quality describes how much of the underlying object of reality a model represents. There are two sub-goals: completeness and validity. A model is valid if all the statements made by the model are correct and relevant to the underlying problem. A model is complete if it contains not only correct statements about the underlying object, but also statements that could potentially be correct. Rules for semantic quality of process models are:
    - Proper level of process detail
    - One start and one end event
    - Parallel process arrangement
    - Reasonable and reduced number of inputs and outputs
    - Clear decision-making points
    - At least two outcomes from the decision point

- Clear flow from start to the end of the process

- Pragmatic quality describes how well a model can be understood by its users. While a model can be well understood by the users, it can still be of low semantic quality and vice-versa. Rules for pragmatic quality of process models are:
  - No change in the flow direction
  - Naming convention should be followed
  - No unnecessary process elements
  - Splitting of complex processes by sub-process models should be considered

The assessment of the above-listed quality aspects is done according to the concept of "the wall of checking" originally defined by Brocke and Rosemann (2010) and further developed by Reijers et al., (2015). The figure below illustrated the framework:

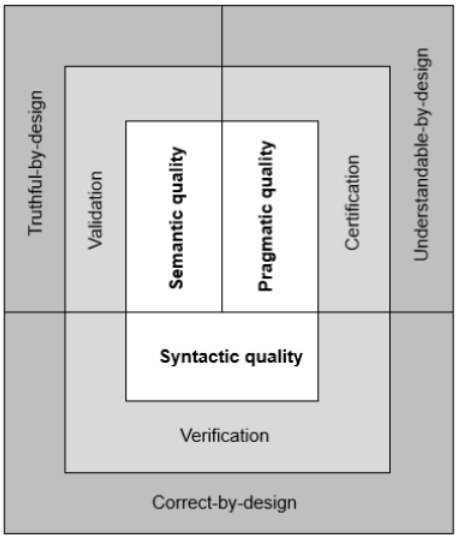

Figure 15. *"The wall of checking" (Reijers et al., 2015)*

The framework provides a clear requirement for business process model to be trustworthy, understandable and correct. Validation and certification belong to the checking phase, when verification is an ensuring. These quality elements should be achieved at the process design stage and can be supported by a clearly defined system of business process modeling adapted by the company.

Process-Oriented Quality Management

The concept of quality aspect is critical for business process modeling. It can be influenced by both internal and external environment. Thus, the knowledge provided for process modeling should be ensured by the actual business situation (Wagner, 2001). Apart from knowledge, systems and notations are an important part of the process model influencing environment. Quality aspects for notations can determine if the developed

design is systematic enough. All in all, quality aspects are commonly case-specific and defined according to the need and environmental influence.

The goal of process management is to achieve an increase in quality through sustainable process optimization. The connection with quality management approaches lies in the similar intention of reducing errors and standardizing and accelerating processes (Koch, 2011). Process orientation plays an important role in the ISO 9000 family of standards. As a process-oriented approach, the standard EN ISO 9001:2008 understands:

"For organizations to be effective, they need to recognize and manage many interlinked and inter-related processes. Often, the result of one process is the direct input for the next one. The systematic recognition and handling of these various processes within an organization, the interactions between such processes, is referred to as a "process-oriented approach".

Benefits of a process-oriented quality management system were specified by Wagner (2001), while it was noted that the specific benefit for each organization is different (Koch, 2011). The potential benefits are:

- Improvement of process and cost transparency
- Clear definition of competences and responsibilities
- Increased productivity through continuous process improvement
- Measurability and monitoring of process performance
- Consistent alignment of processes
- Increased motivation of employees

These benefits are perceived differently and remain company-specific. According to Koch (2011), the quality of products cannot be generated independently of the associated processes. Quality can only be guaranteed if the processes run smoothly and under controlled conditions across all participating organizational units. Quality runs through all levels of an organization and, thus, reflected in all activities and processes.

Quality Management Systems According to ISO 9001

Process models are the result of the modeling process and quality aspects for the final product are usually the most precise. Models should be based on predefined notations and methods while later verified and validated according to the criteria. Process models should clearly and systematically reflect real-life processes in the organization to be suitable for application. There are common criteria that are needed for the model to be considered in line with ISO Guidelines. These areas of focus are:

- Correctness
- Completeness
- Relevance

By these criteria, quality management system (QMS) refers to the entirety of the organizational structure and process organization, to link the quality management system and quality-related activities among each other (Wagner, 2001). The system is in line with SIQ framework discussed before and aims to uniform planning, implementation and control of quality management measures in the company. ISO 9001 understands QMS as a" management system for directing and guiding an organization in terms of quality

The task of the QMS is to ensure that the requirements of customers and other interest groups are met. The structure and scope of the QMS depend on individual requirements. Furthermore, internal and external requirements, different products as well as company size influence the design of the specific QMS (Koch, 2011).

Every company has to decide for itself which processes of the ISO will be implemented with them. Evidence of the effectiveness and functionality of an implemented QMS in accordance with the ISO 9001 can be provided by certification. A neutral certification body carries out a so-called system audit and assigns a certificate when the standard requirements are met.

Guideline of Process Modeling (GoM)

General requirements of modeling were summarized by Rosemann and Schütte (2000) in the so-called "Guideline of modeling (GoM)". The GoM is a framework that has a focus on process model quality. The primary principle of GoM is the process design adequacy while two goals are pursued. On the one hand, it should be ensured that the relevant information objects are included in the model so that the process focus area is displayed correctly. This information is obtained from object types such as e.g. "order", "supplier" and "customer". On the other hand, intra- and inter-model consistency should be achieved.

The intra-model consistency involves the "uniform use of modeling approach", while the inter-model consistency pursues the goal "that real situations are uniformly represented in different models". there are six principles defined by Rosemann and Schütte (2000) which are considered to be a core of GoM. These six principles are:

- Correctness
- Relevance
- Economic efficiency
- Systematic design
- Clarity
- Comparability

The correctness principle considers the adequacy of the language selected for the model. Both correctness of the language and suitability of the language are required. Principle of relevance means that only elements having a direct impact on the process

goal should be used in modeling. This leads to decisions about the elements to be modeled, their relationships and level of abstraction. The principle of economic efficiency takes into account the cost of using models. For this reason, the cost of using the models must not exceed the cost reduction resulting from their use. The principle of systematic design is related to different views in modeling. The objective here is a uniform structure of models developed from different perspectives. The clarity and uniqueness of models are required by the principle of clarity. Hierarchization and layout design are particularly important. Hierarchization is intended to make even large models manageable, while the layout design attempts to support this by optimally arranging the individual information objects. Finally, the principle of comparability must be fulfilled. This is to enable a semantic comparison of two models so that their compatibility can be established. Models are considered comparable if so-called equivalence relations between them emerge.

For the practical application of the GoM Becker et al., (2000) suggest a step-by-step approach. According to it, phases of the modeling should be completed by the implementation of certain activities, which in turn incorporate certain principles of GoM. The suggestion by Becker et al., (2000) is interpreted as a table below:

Table 6. GoM framework

Phase in process modeling	Principle of GoM
Goal definition	• Relevance • Clarity
Definition of elements and development of the framework	• Economic efficiency • Correctness • Clarity
Modeling of the process	• Economic efficiency • Correctness • Clarity
Consolidation and completion	• Systematic design • Clarity • Comparability

Ensured Quality of Processes Modeling and Models with Training Material

The experience of using process models is shaped by several factors, some of those are not even in control of the business process designer. It should be taken into consideration that user experience is “owned” by the user when background, emotions and personal issues are involved. To gain some control over user experience with developed business processes, companies consider development of a systematic approach to process modeling. Systematic and harmonized process model portfolio can be obtained when a defined guidance is used in the modeling process.

The need for a fair user experience emphasizes the importance of guidance for process development. Proper utilization of step by step guideline results in a more effective introduction of a new process with a better understanding of the proper implementation

and faster learning process in comparison to intuitive learning and ad-hoc reaction to tasks without any material support. However, to be efficient and ensure quality user guidance for process development as a document should comply with characteristics of training material defined by Wright and Geroy (2001). The characteristics to be met in order to acetate efficiency are:

- Accuracy
- Completeness
- Clearness
- Structure
- Visualization

Following the above-mentioned standards in the development of the actual guideline can facilitate process development, communication, and implementation. Meaning that the faster understanding of the proper developed process implementation results in the take-off point of the graph being reached earlier and the curve being more pronounced (Lund, 2006). Welin (2017) discusses sales material contribution to the technology diffusion, based on the Lund (2006), the same logic can be applied to the contribution of the training material to the new process introduction. As illustrated in Figure x, guideline as a training material helps to understand the developed process model better and faster systematically revealing all the steps, responsibilities, handoffs and relations to other processes.

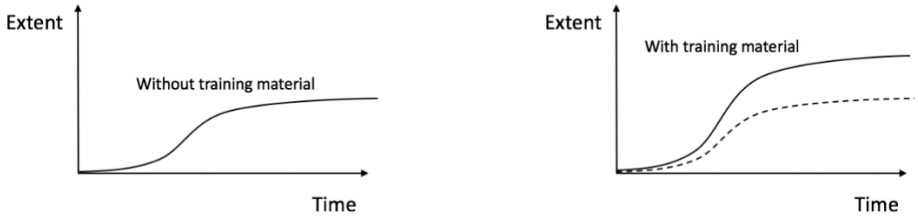

Figure 16. *Introduction of a new process (adopted from Welin, 2017)*

Users expect some additional value from a new approach to the process modeling. The task of the designer is to compare old and new solutions to detect a possibility for addition of perceived value by harmonizing new and existing processes into comparable and easy to follow models. When a process is new to the designer, proper training material as a guidance for the development of the process model can be a tool for the ensuring of value of the final process document. By this, designers aim to make the user understand and rollout the introduced process properly from the very beginning.

2.4.3 Benchmarking

Approaching the topic of quality in the company's processes and their performance, it is often interesting to compare company's process performance with that of other companies. Process benchmarking can be helpful as a mean. The aim of the

benchmarking is to get a view on the business process architecture adapted by another company and evaluate the performance of the overall system based on individual parameters (Ghalayini and Noble, 1996). From conventional comparison of approaches to business process architecture, benchmarking was developed to assess process quality and performance.

Benchmarking is the continuous comparison of products, services and processes and methods with other companies or with other areas in their own to systematically close the performance gap to the best in the class and identifying the potential for improvement (Ghalayini and Noble, 1996). As described by Ljungberg and Larsson (2001), benchmarking is used to position one company relative to the best of its own or another industry, based on critical success indicators. The purpose of conducting a benchmarking process is illustrated in the figure below.

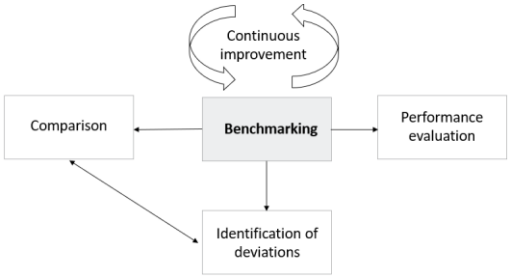

Figure 17. *Purpose of benchmarking*

The result of the benchmarking is an evaluation of the performance of the company or the process in the relevant parameters. Furthermore, the relative position to the considered competitors is shown: better - equivalent - worse (Ljungberg and Larsson, 2001). By benchmarking, strengths and weaknesses of processes in a company under consideration are compared to its competitors. This creates starting points for process improvements (Kohlbacher, 2013).

2.4.4 Continuous Improvement

The concept of continuous improvement goes back to the business philosophy of Kaizen, which was developed in Japan in the 1980s. Kaizen can be translated as "change for the better". As discussed by Liker (2004), the key message of this approach is that no day should pass without any improvement in the company. While the North American-European innovation approach is culturally inscribed on large steps of change at irregular intervals, the East Asian Kaizen approach concentrates on small, but continuous change steps in terms of the corporate culture.

The basic business logic behind the continuous improvement is that most of the abilities of the average employee of a company remain unutiziled during working hours, even though the application of those skills would serve the well-being of the company.

"*There are estimates that about 80 percent of employee skills are not used in companies.*" (Kostka, 2002)

The idea behind this is as follows: quality optimization should not be achieved by hiring new staff, external consultants or by purchasing expensive equipment, but by a "*change in the minds of all employees*" (Kostka, 2002). Based on the quote and supported by Kohlbacher (2013), principles of continuous improvement include the following points:

- Employee and customer orientation
- Target and result orientation
- Process and quality orientation
- Transparency and fact orientation
- Improvement and sustainability orientation

For these principles to be permanently established in a company, a profound process of change is necessary. The change should be associated with the quality improvement at all levels. It should be noticed, that continuous improvement promotes a sustainability-based process of changing the behavior of all employees (Crandall and Crandall, 2008; Kohlbacher, 2013). To illustrates the interrelation between quality, organizational culture and continuous improvement, hierarchy of quality is combined with Lean value principles.

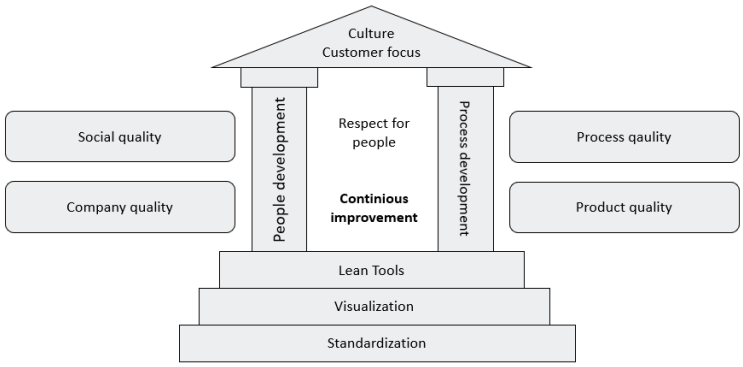

Figure 18. *Continuous improvement and quality (adopted from Liker, 2004; Schmelzer and Sesselmann, 2010)*

The figure above is based on the insights by Kiichiro and Sakichi Toyoda about people, process and product relationship combined in the concept of Toyota Production System and discussed by Liker (2004). Terms of quality are retrieved from Schmelzer and Sesselmann (2010) and used to emphasize the connection between continuous improvement and different quality levels. It should be noticed, that already at this stage of the literature review, common values between continuous improvement thinking, quality management and business process architecture as an approach to business processes can be observed. Links are: quality of results, strategy development focus, aim for transparency and sustainability.

2.5 Synthesis

The modern business environment is characterized by increasing dynamics. The progressive globalization along with digitalization forces companies to become more internationally oriented. Customer groups are becoming ever more diverse and customer requirements are developing faster than ever. These conditions force companies to change operations in order to remain competitive (McCormack and Rauseo, 2005). Company's business processes must, therefore, be sustainable and flexible. This naturally requires proper management to ensure quality.

"Companies need to find ways building advantages rather than just eliminating disadvantages" Porter (1980).

Business process management, in this perspective, focuses on controlling the business process system to achieve desired "growth" goals (Bergsmann, 2012; Crandall and Crandall, 2008) while forming a link between the strategic level of corporate governance and workflow at the operational level (Gadatsch, 2012). The concept is summarized and illustrated below.

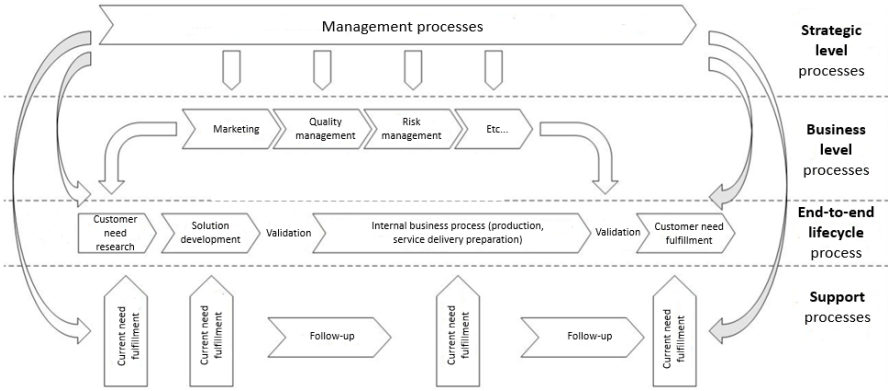

Figure 19. *End-to-end business process concept (adopted from Bergsmann, 2012; Frye and Gulledge, 2007)*

In Gadatch (2012) research, not only links to the workflow were discussed, but also the whole concept of the process management in companies which is usually customized and case-specific due to the varying perception of business processes. At the same time, business process management can only be sustainably successful if the definition of a business process is correctly understood and implemented (Bergsmann, 2012; Frye and Gulledge, 2007). The definition of a business process by Stefan Bergsmann (2012) provides that a business process is the sequence of activities directly related to the business, covering the whole product life cycle. As cited from Davenport and Short (1990): *"… process view is an important contributing factor to the success of process-oriented organization".*

The concept of process-oriented organization belongs to Davenport and Short (1990). The decision of the modeling approach for such organizations should be documented by

the guideline which can be used as training material for process developers. Different types of training material exist to fit the purpose. For defined system of business process hierarchy and modeling methods, training material in a form of a guideline is a reasonable option when definitions by Blanchard and Thacker (1999) are reviewed. Furthermore, the developed guideline should be checked by the principles of accuracy, relevance, cost-effectiveness, clarity, comparability and systematic structure to ensure quality (Wright and Geroy, 2001). Citation by the same authors highlights the importance of training:

"This faith in training, therefore, is one of the fundamental philosophical underpinnings of business".

In the guideline, levels of model detailing can be described depending on the company's need and the hierarchical levels can be named as considered the most convenient (Gadatsch, 2012). The most common hierarchical view at business processes, adopted by British Telecom as extensively explained by Lind and Seigeroth (2010), looks like:

1. End-to-end business process
2. Main processes
3. Sub-processes
4. Activities
5. Instructions

As stated by Frye and Gulledge (2007) and agreed by Bergsmann (2012), with a standardized approach, it is possible to capture the end-to-end processes without gaps, to consider all activities involved in the process and to differentiate between company functions and organizational units. According to Trad and Kalpic (2014), having a defined system in a form of guideline with criteria for process classification makes it possible to examine and optimize interfaces between individual contributors.

Systems and methods for process modeling can have a significant impact on the quality of process models. By enabling activities, process organization is usually able to gain benefits associated with quality of process models (Balasubramanian and Gupta, 2005) highlighted as:

"Systems emphasize a strong commitment of all organizational members in paying attention to process performance and customer satisfaction".

According to process-based strategy development by Ljungberg and Larsson (2001), such benefits usually include optimization of cash flow and other financial benefits, lead time reduction or other time-related benefits, customer satisfaction improvement or other service-level-related benefits and compliance or similar legal benefits.

The most common frameworks for quality of process modeling are SIQ, ISO and GoM. They cover different aspects of process model quality as well as the process of process modeling (Brocke and Rosemann, 2010). Frameworks by Rosemann and Schutte

(2000), Koch (2011) and Wright and Geroy (2001) have very much in common but differences remain in the level of detail and project-orientation. These frameworks can be combined to get a wider view on quality aspects used for this research. The figure below illustrates and combines areas of focus for process model quality.

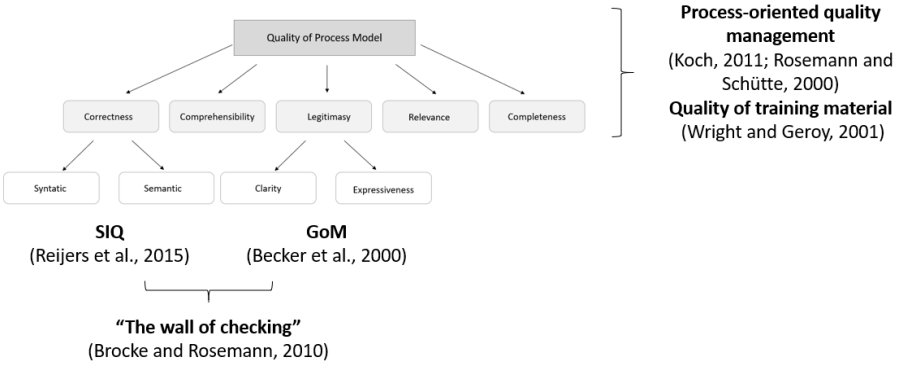

Figure 20. *Combination of quality aspects*

In order to be able to assess various quality aspects, the number of elements, relations and links, like quality criteria, are used. Consideration of criteria as metrics shows that the criteria are not independent of each other which is extensively discussed by Becker et al., (2000). Thus, each process model as a measured variable provides information about several quality criteria at different levels of organization. The quality estimate is a valuable part of the whole process-oriented environment and supports strategy implementation and management of the end-to-end process. The figure below illustrates elements of the research while the summary table of literature-based findings is available in Appendix B.

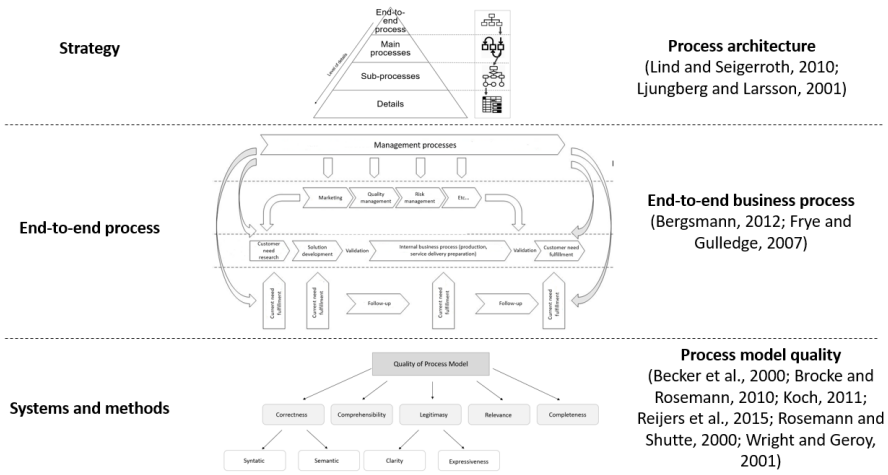

Figure 21. *Framework of the literature review*

In summary, literature review provides that clearly defined end-to-end process architecture, efficient training material ensuring high-quality of process models are essential for organization to achieve its specific goals. However, low quality of process models cannot support process organization enough and may cause deviations from the desired performance through lack of standardization and need for extra cost for process

implementation and/or miscommunication. As a highlight, according to Melding (2008) and fortified by Rosemann (2010), it is critically important to ensure high quality of process models in organizations with extensive process portfolio. For this purpose, proper definition of systems and methods in the form of training material can perform as a facilitator for quality improvement.

3. CURRENT STATE ANALYSIS OF THE CASE COMPANY

After presenting concepts related to business process architecture, training material and quality in the literature review chapter, this section is an empirical part of the work. First, the study of a current situation of the process architecture in the case function of the company is presented to obtain original data, then it is summarized and analysed to identify issues and challenges. Quality of current processes is assessed to identify key focus areas. Subsequently, based on the findings of this chapter, definition of levels for process documentation is established, guideline for business process model development is provided and process models are modified according to recommendations of the guideline. Finally, the quality of modified process models is assessed to see an improvement and prove the reliability of the developed system.

3.1 Approach

The literature research from previous chapters serves as a theoretical frame of reference. In particular, various notations, requirements for process architecture components, design approaches as well as the level of detail for process flowcharts were discussed to be transferred to the practical implication. To cover the scope of the original research questions supported by the objective statement and literature review, following questions arise for the study of the current situation in the case company:

Table 7. Current state analysis questions

Corresponding RQ	Current state analysis question
RQ1	What views and levels occur in the company's existing process architecture to be documented in the guideline? What systems and notations are used to be included in the guideline? What approach is currently used in the business process modeling?
RQ2	What is a process model quality? How can process model quality be measured and improved?

These questions are aimed to be answered in this chapter by such data gathering methods as observations, action science and qualitative interviews. To be able to create a fulfilling understanding of the current situation, closer look at end-to-end process of order delivery in the case function of the company is needed. The figure below illustrates the location of the process and the environment, while figure x provides a closer look at

the end-to-end process disclosing way of decomposition under consideration in the study.

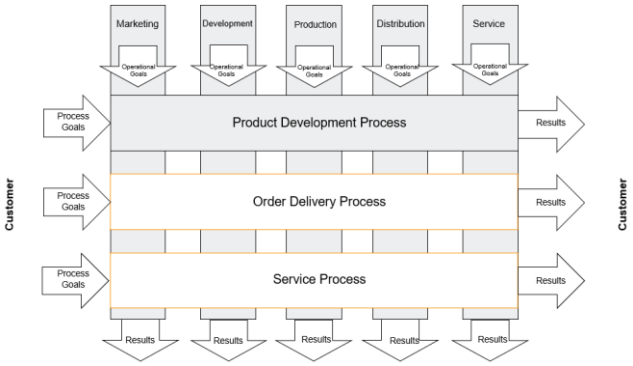

Figure 22. *Locating order delivery process*

On a high-level, order delivery process in the company is illustrated above, the matrix structure of the environment is used to emphasize the connection between parties involved in logistics processes. Depicted end-to-end process of interest is illustrated below giving more details.

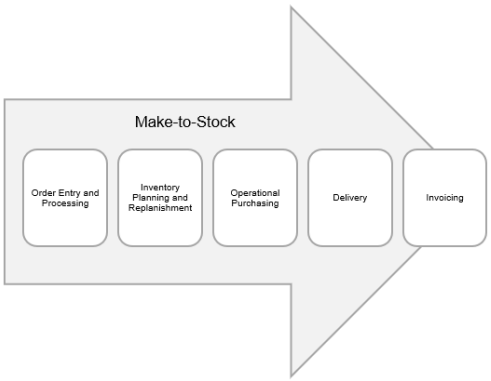

Figure 23. *Decomposition of end-to-end order delivery process*

The process starts from order entry and goes through defined process steps, performed by nominated functions, up to the cash collection phase. The end-to-end process managed by the case function and illustrated above, first extracts information about the process structure break down, process flowcharts as its elements which goes in line with the definition of end-to-end process by Frye and Gulledge (2007). Based on this original information, the following investigation into the current state is conducted to get an understanding of applied views and levels of existing process architecture. With a reference to the disclosed process landscape, conclusions can be drawn on the underlying design approach and notations used for models. At the later stages, the process architecture of the case function is checked to follow conformity to the principles of theory-based findings. Gained data and knowledge will further serve as a starting point for the development of the system and forming a guideline based on the data interpretation and analysis.

3.2 Current Business Process Architecture

Approach to business process architecture is a link between strategy implementation and processes in the case company. As source of the original data, initial situation of business process management of the case function is described in this sub-chapter and compared to the original data from the literature review by referencing. Such data gathering methods as observations and qualitative interviews have facilitated the process.

Each process in the process portfolio of the case function is assigned a process owner, this decision is based on the focus area, the example can be “Operative purchasing” process assigned for availability management. Currently, process owners operate on high-level (main) process and sub-process levels, while work instructions supplement the documentation. Process owners decide the level of developed and managed processes themselves based on the requirements from locations, demand or other captivity. Thus, existing view on the process hierarchy has an emergent structure with similarities to levels by Fromm (2006), excluding the first level of the process map and Lind and Seigerroth (2010) summarizing upper levels and excluding activity level. The current approach is defined as:

- Management processes, as strategy processes, are concerned with the strategic activities, provide direction and guidance for more refined processes performed by the functions
- Main processes have a direct contribution to achieving the business goals and value creation
- Sub-processes only indirectly contribute to the achievement of business goals and value-contribution
- Instruction give minor details to the developed processes

As a real-life example, main process of "replenishment" serves as a core process for inventory related logistics activities in the company. The support or sub-processes, such as making changes in the entry, enable the core process through its services. However, not every currently available sub-process has a developed model or instruction behind it. The modelling decision is based on the demand for a defined process.

Activities for sub-processes, which are included in the hierarchical view by and Lind and Seigerroth (2010), are not defined in the case function, meaning no such separate level currently exists. However, besides core and sub-processes, instructions on a separate level are available to guide the process implementation.

To sum up, case function deals with documentation on three levels (high-level process, sub-process, instruction) having major similarities to the approach by Fromm (2006). There is also a link to studies by Feldmayer and Seidenschwarz (2012) in terms of abstraction levels, while the current architecture approach shows signs of intention to:

- Building the common process architecture design pattern by having a common document template and agreement on used notations
- Stating the processes level by naming (high-level or sub-process in the title)
- Definition of instructions level

In the case company, importance of defined process architecture and quality of process models are acknowledged. However, there are three facts that, when analysed, might have a significant influence on quality. Firstly, the process portfolio of the case function is rather large and processes developers involved differ in process design expertise. Rosemann (2010) discusses large modeling projects mentioning that usually not all participating modelers know the architecture principles and design process with the same level of expertise. Secondly, process modeling as a task is restricted by the time dedicated to it from the whole workload of process developers. Thirdly, the dynamic nature of organization and constant change make modeling errors unavoidable while missing common practices and systems increase the number of them. Finally, process models and related documentation create a closed system where one change causes a sequence of changes in other documents, making any change difficult to track and error-prone.

3.3 Current Process Models

This sub-chapter continues to provide original data about the current situation of the case situation in the case function retrieved mainly by action science method through working with documentation and participation in daily tasks. Observed approach to process modeling is compared to the literature findings in order to build a reliable foundation for further discussion.

Every business process in the case function starts with the request aimed on value creation as a response to the customer request which is in line with the definition by Bergsmann (2012). Initially available processes feature clear start/end points, while all middle steps can be split into factually logical and self-contained parts pursuing the goal of order delivery as an execution of logistics services. The path of each process from start to finish is the overall end-to-end business process. After completion of the whole end-to-end process, it is designed to similarly run again for the different customer case.

Processes are documented as flowchart in MS Visio (Microsoft Corporation, 2018) using standard notations and flow charts are later supplemented by corresponding instructions as MS Word (Microsoft Corporation, 2018) files. It should be noticed, that, for the purpose of the study, current business process models can only provide information about notations used because there is no clearly defined system for any other element of the process modeling to be reviewed. Regarding the notations used, only the process flow charts can be analysed; information on applied notations for the lower-level process documents is not available.

For the process flowchart, the predefined and commonly agreed symbology is used with features mainly adopted from BPMN with simplifications to fit the purpose and be accepted by the target audience. Such approach is commonly used by non-software-related processes as described by Damij (2007). The template with notation is provided for process developers being used for Microsoft Visio and PowerPoint (Microsoft Corporation, 2018) visualisations of process flows as “basics flowchart shapes”.

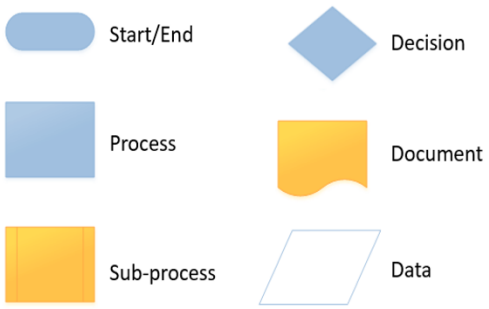

Figure 24. *Current shape guide*

The figure above shows the shape guide used across the company by process developers. Meaning for each shape is specifically documented for users as a separate reference page in each flowchart. In this sense, Process shape represents a typical step in the process being the most frequently used shape in almost every process. Sub-process shape is used to describe a set of steps that are combined to create a sub-process that is defined elsewhere. The Document symbol used for a process step that produces a document. Decision shape indicates a point where the outcome of a decision dictates the next step. There can be multiple outcomes, but often there are just two, yes and no. Start/End shape is us ed for the first and last step of the process, also known as a terminator. Data shape indicates that information is coming into the process from outside or leaving the process. This shape is used to represent materials and sometimes called Input/Output shape.

Shapes and developed flow charts are in line with process design according to BPMN in MS Visio (Microsoft Corporation, 2018). According to Damij (2007), this approach is commonly used in the context of process management to depict, redesign or digitally record business processes. BPMN notations and approach to the creation of process flow charts is rather intuitive for non-technical users (Damij, 2007) which allows a wide spread of the process information across different functions in the case company. However, as part of the data received from interviews, currently used notations have an area for improvement. According to a process owner:

“Maybe a detailed description somewhere could be beneficial while using these notations. For example, the flow chart is not showing that it's actually two documents being processed in some cases. And maybe using notes can also describe which transactions in SAP is doing that.”

Standardized and rather intuitive notations are currently used as a common basis of understanding models and implementing processes properly. In the case function, notations empower understanding of the process flow. However, when there is a case of deviation in design standard coming from the process developer, issues in process quality and implementation, mentioned by Wagner (2008), occur.

In the case function, process owners, developers and selected active contributors master the method and notations in process modeling. Aligning real-life process with the model takes place after the development. It is done by the roll-out team communicating models directly to the location for process implementation. Without additional information in notations, process models developed by in the function turn out to be ambiguous. Thus, changes and improvements are required to the currently used process development approach including notations, while keeping the core design principle as before.

3.4 Findings of the Current State

Both overview of the current approach to business process architecture and state of process models contributed to the assumption that processes in the case function are developed on different hierarchical levels without alignment of methods used. When data from interviews, discussions as well as findings from observations and action science are summarized, the lack of definition and system for process model elements and unclear distinguishing between high level and sub-processes were emphasized to be analysed further. As commented by a process owner during one of formal conversations:

“While approaching processes presented as flowcharts, we combined different available techniques. I think, process description should in the future be broken down to a simpler view (SIPOC) and a more detailed level of flow chart.”

The comment above highlights the importance of utilizing process identification elements by Wagner (2008), the only difference is that similar elements are requested in a form of SIPOC (Supplier, Input, Process, Output, Customer) table. SIPOC is a common tool in process improvement practice used to summarize inputs and outputs of the process in the form of a table. apart from that, syntactic correctness, including naming convention to harmonized naming of processes was often highlighted as a missing component during daily work with documentation and this topic was requested to be addressed by process users. One explanatory comment by a process developer is:

“All approved flowcharts have work-in-progress name since we haven't established a common format to name them.”

The initial approach towards the end-to-end process by process owners can be considered as a functional approach defined by Bergsnamm (2012). For this reason, the structure of existing processes in the case function allows decomposition. For the purpose of the further research, it should be noted that relationships and interfaces only exist between the individual process steps.

Noticed advantages of the existing organization are the development of process-specific competencies, harmonization and the neutral role of governance in case of conflicts of interest between parties involved in the logistics services execution. Observed disadvantages, however, are additional interfaces and increased effort for coordination and escalation. While this coordination can be useful to accelerate process innovation, it can also negatively affect efficiency at such a big organization as the case company. Another disadvantage could be a strict personal focus on the process area, leading to the process owners being exclusive to know details and perform one's own tasks.

Holistic consideration of process approach contributed to the definition of challenges in business process architecture, methods, and systems that the function is currently facing. These issues are coming from three different data sources:

- process developers
- management
- authors of the reviewed literature.

First two groups were able to contribute to obtaining of the current state data while authors of the literature have provided data for proactive identification of problems that are not yet fully realised by the internal company's stakeholders. To support further findings with more detailed comment, challenges related to the business process management in the case function are cited from the executive summary of the project workshop where both process developers and management have participated. *"Challenges on a high level are primarily these:*

- *Mapping and identification of processes (project related process map)*
- *Evaluation of process deployment (project related process landscape)*
- *Development and Roll Out – New, upgrade, update*
- *Measure of process efficiency/performance*
- *Control of process compliance (Process Audit)*
- *Continuous Improvement (Lean)".*

While retrieving information about the current issues, interviews with process owners, process developers, managers and several process users were initiated to identify the most relevant issues, the content of such discussions is available in Appendix A. Information from these interviews was supported by observations of daily work and data gathered during the literature review. Eventually, it was noticed, that different stakeholders have different views on the current situation. The top critical issues and challenges identified are listed as follows:

Table 8. Identified problems of the process architecture in the company

Problem	Description	Main data source
Standardization	Problems regarding standardization of notations, language and tools	Process developers

Process data management	Issues related to the process culture. Management of processes, such as publication, versions, variants, or release updates	Process developers
Detail level of models	Problems with the definition and identification of suitable process hierarchy levels including process map	Management
Methodology	Problems with the implementation of process modeling impacting on the quality of models	Authors of the reviewed literature
Control	Problems related to the process culture. Control of process modeling activities	Process developers
Acceptance	Issues regarding commitment to the process design featuring training material	Process developers
Business IT	IT related problems, such as process information storage, IT management system	Management
Process orientation	Problems concerning the development or teaching featuring training material of a process architecture awareness among the stakeholders	Process developers

Before systematic analysis of the problems listed above, a comment by process owner suggested that:

"…the reason behind current issues can be a lack of precise connection to the pursued company's strategy (harmonization goal) as well as problems in procedure standardization".

This comment has similarities to issues analysed by Movahedi et al., (2016). In general terms, identified problems listed above mostly differ for the three groups. The first category is the most frequently mentioned by process developers and associated with culture-related challenges, including process model approval, adaptation, reuse. during the data gathering, neither authors of the literature nor mangers have emphasized culture as a critical topic.

At the same time, all three data sources have mentioned methodological aspects of modeling as problematic. Furthermore, managers and process developers classify people involved in process development and implementation as a challenge. In this regard, the topic of training is identified as a challenge by academics.

Managers and authors of the literature suspect future problems with process data management and information technology. Interestingly, the literature review identifies

quality of developed process models as a critical challenge, while process developers and managers are mainly focused on building process portfolio as such.

All in all, during the data gathering, process developers rated "standardization" as the biggest difficulty. By contrast, "detailed level of models" for managers and "service orientation" for academics are the most critical. Furthermore, it should be pointed out that standardization was also mentioned by managers aiming for process harmonization and by Rosemann (2010) as a potential pitfall of process modeling. At the same time, both process developers and authors of the literature (Rosemann, 2010; Schmelzer and Sesselmann, 2010) have acknowledged the problems in the area of hierarchical view on process architecture as detailed level of models. While practitioners and manages have covered all issues with their interview answers or during the observed daily work, reviewed academics do not name problems in the area of strategy implementation.

To be mentioned, there is currently a lack of guidelines for the implementation of standardised process modeling and undefined hierarchical view to business process architecture. This suggests that discussed areas are currently the most important challenges in function's and organization's business process management and should be addressed by the further research. These can also be interpreted as influencing factor restricting process understanding and effective implementation.

These results also suggest that managers and practitioners are more concerned with problems related to the goal and adaptation of the process architecture, whereas authors of the related literature are more concerned with the development and evaluation of process models. The table above represented the highest rated problems from three sources of original data. Not all of the identified problems can be discussed by the research work. However, critical similarities across groups providing data for problem identification included three problems: standardization, detail level of models, methodology. **For this reason, while narrowing the scope of the work down, the following challenges are emphasized to be addressed in this thesis paper:**

Table 9. Problems addressed in the thesis work

Problem	Description
Standardization	Problems regarding standardization of notations, language and tools
Detail level of models	Problems with the definition and identification of suitable process hierarchy levels
Methodology	Problems with the implementation of process modeling impacting on the quality of process models

After collecting data from literature and other sources as well as identification of issues to be addressed, the main goal of the thesis is to develop a comprehensive guideline for modeling of logistics processes in the case function of the company ensuring quality of process models. To support the reflection on the original data of the current state and facilitate further development of the systematic approach, questions stated at the very

beginning of the chapter are answered. Summarized answers to the questions of the current state are listed below:

- **What approach is currently used in the business process modeling?**

The initial approach to business process modeling adopted by the case function can be defined as one having an ad-hoc nature. The reason behind it is pursuing customer-centered strategic improvements in the organization's global end-to-end process. Local efficiency in the company is seen as a facilitator to the overall strategy implementation. Being a local, function-specific activity, the sequence in process design was not defined but rather emerged to fill the need of process modeling and cover particular needs of the case function. No consistency was noticed in the modeling process; however, usage of common and pre-defined notations was helping to even out issues critical to process implementation.

"Another thing missing in the flowchart is the actual outputs of documents. So, I think a more detailed version is needed with showing input and outputs on a document level as well."

The comment by a roll out manager, who is the user of the process documentation, cited above highlights that it not enough to state start and end of the process but input and output have to pe specified. Thus, the current approach is rather generic and only provides minimum viable product in terms of the process description in the form of flowchart. Available flow charts represent high-level process information but there is an area for improvement in terms of design and content.

- **What views and levels occur in the company's existing process architecture?**

As of the current situation, processes managed by the case function are distinguished between high-level processes and sub-processes similar to Fromm (2006), however, no clearly documented definition exists. Process owners decide the level of processes themselves and normally base it on the complexity level and value contribution. Thus, the most common approach includes the definition of high-level process as value-added and sub-process as supportive elements to value-adding. Activities for sub-processes are not defined and no such separate level currently exists. However, besides main and sub-processes, instruction level exists to give guidelines for process implementation, which is featured in the framework by Lind and Seigerroth (2010).

- **What systems and notations are used?**

No defined and documented system for process design is observed, however, basic principles are rather intuitive and accepted among process owners and developers. It allows each process flow chart to be comparable to other existing ones. As for notations, several different symbols and two colours to separate core and sub-processes are used

systematically across several business areas of the company. Blue is used to identify main processes steps, while yellow is applied in case of sub-processes. For the process flowchart, commonly used symbology is based on BPMN and visuals are developed with Microsoft Visio and PowerPoint (Microsoft Corporation, 2018).

- **What is a process model quality?**

Several facts were realized regarding the quality of the current process models. Firstly, different levels of process developer's expertise were observed in the case function and described by Rosemann (2006). Secondly, on-going organizational change process is causing distractions to the systematic process modeling approach in the case function similar to what was discussed by Melding (2008). Thirdly, interrelation between process related documentation are causing resistance to change. These facts are considered to be causes for quality deviation and becomes motivators for the development of the systematic quality approach.

Authors reviewed in the literature part evaluate process model quality explicitly by combining various quality aspects with external quality factor to a single criterion. "Fit-to-purpose" definition for quality of process models provided by Garvin (1984) is considered to be the most suitable for models of the case function of the company. The reason for it is that process models were developed in the scope of the project and their quality is associated with the achievement of project goals. Originally, quality of developed process models was not evaluated in any way, but for the purpose of the research, analysis, deeper investigation into flaws of current models and further quality improvement, customized framework for the quality assessment has to be developed further.

- **How can process model quality be measured and improved?**

Findings of qualitative and quantitative aspects of process models is a measurement of quality. However, no defined guideline is available in the literature or practice to do so. Different approaches to quality measurement utilize different quality dimensions while having an abstract nature (Brocke and Rosemann, 2010). Several frameworks by Fellmann (2013), Schmelzer and Sesselmann (2008), Brocke and Rosemann (2010), Wagner (2001), Koch (2011) and Garvin (1984) are selected to be reviewed and combined to get a wider view on quality of process models.

SIQ, ISO, GoM frameworks can be summarized for the purpose of understanding various quality dimensions and as the result, a common view on quality approach has to be created and used to evaluate quality of available models. To support findings by the case-related example, available processes should be checked according to the criteria in order to get information about what quality aspects are currently covered by the process models and come to a conclusion about quality level and areas for improvement.

The upcoming chapter provides a benchmark to compare data and approach to the business process architecture in Finance function of the company as well as in the company operating in the different field. After the benchmarking, next chapter describes steps in the development of comprehensive guideline building a systematic view on process architecture and quality evaluation based on the literature material discussed above.

4. DEFINITION OF LEVELS IN BUSINESS PROCESS ARCHITECTURE

The baseline for the development of systems and methods for process modeling is a clear definition of the hierarchical view on process architecture in the company. Having a defined process classification, the scope of the training material for process models can be sized accurately and design principles can be adjusted according to the particular level of the process complexity. The aim of the chapter is to facilitate the development of the commonly agreed and clearly defined process architecture approach arisen by the first research question (**RQ1**). Having business processes classified, criteria for quality can also be selected to fit the process model at a particular level **(RQ2)**. **Based on the findings of the current state and literature review as the original data, commonly agreed classification for levels of process documentation should be developed matching the requirements of the case function.** To have a better pool of original data on the topic of business process architecture in the hierarchical view, internal and external benchmarking is conducted. Having this type of information will further help to create a function-specific approach to process architecture based on the interpretation of standards available from various sources. **Further, based on the case-specific interpretation of the original data guideline for process modeling is created as the key deliverable of this research.**

4.1 Process Mapping Internal Benchmark

Process mapping of the existing processes according to the classification of process architecture has been a desired tool for various functions in the case company. One of the first functions inside the company to develop a standardized approach for process hierarchy and map its own processes according to the levels was Finance. The definition of levels and arranging processes accordingly to assemble the map was driven by the need to support an on-going change project.

The aim of the process map, as a levelled process portfolio, was to support decision making in the organization providing the best available information. The Finance's process map also aimed at harmonization of processes while being used across the organization. The overview of the process mapping project is illustrated below.

Figure 25. *Finance process mapping scope*

The figure above illustrates the approach of the finance department of the company while building a hierarchical view for business processes. Global processes were defined, classified and described including responsibilities and performance measurements. The map was built on top of the existing template to ensure compatibility and drive the change across the organization.

The map was designed to work with the system, processes and people. The scope of the map development process consisted of three main objectives: people, processes and system. Items and their details are listed below:

People

- Encourage active communication and involvement
- Promote training to new system features and processes in the scope of the change project
- Create process organization and process culture

Processes

- Create financial processes map and make it available across the company
- Choose focal processes from the map and create flowcharts and responsibility matrixes to support the harmonization work
- Depict and harmonize software related processes

System

- Depict and harmonize software related processes
- Design improvements based on the Finance process map work
- Improve data quality, enable work standardization and process automation by harmonization of processes

It should be noticed, that a desired outcome of the finance process hierarchy definition and process mapping included harmonization. This aspect is a priority especially because the map was planned to be used across different functions and even business areas. The structure of the map was built based on the extensive benchmarking following the global framework provided by American Productivity and Quality Center (APQC). The adopted business process architecture in a hierarchical view started with the depiction of processes by different levels. The hierarchical view of the finance process architecture was organized in six layers (level one through six), and the design approach was customer-based. It was observed, that adopted process classification is in line with the framework by Lind and Seigerroth (2010) discussed in the literature chapter. The following figure illustrates these levels and gives an explanation for each.

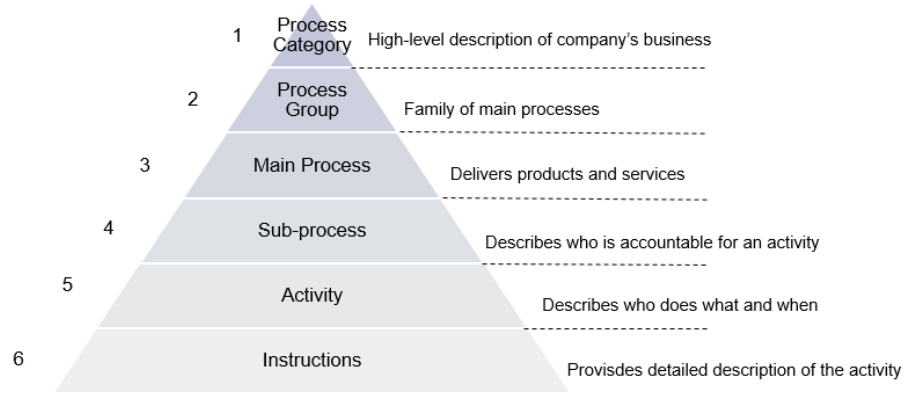

Figure 26. *Business process hierarchy of the internal benchmark*

Finance's business process approach was based on international standards and best practices of OMG's Business Process Modeling Notation (BPMN), APQC's Process Framework and a defined naming convention (verb-noun combination). Apart from the business process hierarchy, there is a definition for process ownership for each level.

Having six levels listed (Lind and Seigerroth, 2010), the publicly available process map for finance processes consists of four levels (level one to level four) as by Fromm (2006). The map is arranged in a way, that on the top, process category of Finance is named, groups are presented by narrowing the scope of the responsibility. Main processes and sub-processes follow.

Each process group has a profile page, which is a basic form of business management system, where main processes are listed being bundled with description, revealing roles, responsibilities, outputs, reports provided, KPIs, required IT tools, critical success factors and requirements. These profiles give the most important information and most questions about the process can be answered from this knowledge.

The development of the process map based on the defined levels of process hierarchy in the finance function of the company was apart from other purposes associated with the process harmonization goal. Having processes classified allowed better communication and served as a decision-making tool. Comment by the stream lead describes benefits of process harmonization powered by a developed process map:

"*In Business Finance we have a vision to leverage the common tools and granular data for strong, proactive business support. Our ambition is to be the trusted business partners and to take the next steps when it comes to automation and digitalization. We will reach this target by developing the processes, providing real-time information and decision-making support, and improving the business finance acumen at the company.*"

It comes down to the pattern of how people work together with the same processes and same tools providing high quality results. Thus, definition of process levels and process portfolio in the form of map according to classification are seen as tools to reinforce business process management approach in the organization.

4.2 Process Mapping External Benchmark

The reviewed external company business process architecture belongs to Lufthansa Cargo AG (LCAG), which is the largest German cargo airline. In 2016, as part of the Growth & Results by Improving Processes & Services (GRIPS) project, processes at Lufthansa Cargo AG were changed and continuous process management was introduced. Goals of the project were to improve customer satisfaction, shorten reaction times, increase process quality and lower unit costs. At the end of the project, a definition of the structured process classification, comprehensive process portfolio as a map and description of all project covered processes were achieved. In addition, new roles have been created that are responsible for implementing and improving business processes. Improved business process architecture of the cargo airline was described by Ringswirth (2017) and interpreted here as an external benchmark.

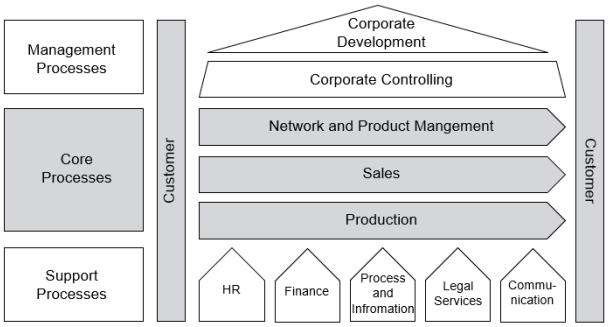

Figure 27. *Process map in LCAG (Lufthansa Cargo AG, 2016)*

The process classification view in a form of a map illustrated above distinguishes between three types of processes: management, core and support processes. This approach is partially similar to Fromm (2006) and REFA Verband (2010). The management processes "Corporate Development" and "Corporate Controlling" are responsible for managing the strategy implementation of the company. The core processes of "Production", "Sales" and "Network and Product Management" relate to the actual core business of Lufthansa Cargo AG. The support processes, such as the human resource management or procurement processes, support the core processes through their services.

Furthermore, the classification of the process architecture can be seen in Figure x provided below. There is a subdivision of the processes into four levels (Fromm, 2006). At the top level, "Level 0", lies the entire value chain of the company, called Process Map or referred to as "LCAG Process House". Each process illustrated in the process map has a connection to its associated “Level 1” business processes. These business processes, in turn, contain core processes, which are located on "Level 2". The lowest level of the process architecture contains the sub-processes of the "Level 3". For each process level, there are roles and responsibilities assigned.

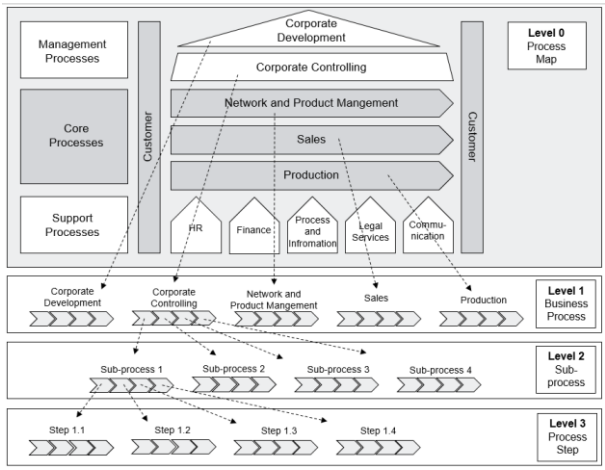

Figure 28. *Business process architecture in LCAG (Lufthansa Cargo AG, 2016)*

The figure above has an intention to explain the existing process map in more details. The described architecture has common features with the study of Schmelzer and Sesselmann (2010), but in addition, each process in company's process architecture is assigned a department together with a process owner. Illustration above provides a comprehensive view on the structure.

To create the process architecture in Lufthansa, the most important business processes were identified and then refined to the level of sub-processes. This approach reflects functional structure of the cargo airline. To adhere to the principles of proper process architecture, the company has introduced continuous business process management as part of the GRIPS project.

Business process management was anchored as a sub-process in process and information management. This ensures that the processes are continuously checked for conformity with the corporate strategy. The process map shows the orientation towards the strategy. The clear emphasis on corporate controlling highlights the importance of planning and monitoring strategic and operational business goals. Thus, it can be stated that the corporate strategy is sufficiently represented in the present process architecture.

Clearly defined process classification on the map visually presents the company's most important processes and allows for navigation through the process architecture. For this reason, it can be stated that systems and methods applied allow transparency in business process management (Frye and Gulledge, 2007; Balasubramanian and Gupta, 2005). Finally, optimization and control of the processes is ensured.

4.3 Proposed Process Architecture

Before the development of training material for business process modeling, it is very important to supplement the current state of the business process architecture in the case company with a clearly defined and commonly agreed view on classification of

process documentation based on the data interpretation from different sources. In this sub-chapter, levels of the process architecture are proposed and explained based on the literature review, internal and external benchmarking and aligned with current needs of the case function obtained from observations, action science and interviews.

The clearly developed hierarchical view on the process architecture is defended to be one of the most important contributions of the guideline for the business process management in the case function. The importance of classification is originally highlighted by Dumas (2013) as:

"A process model can only provide a comprehensive understanding of a process when level of detail is defined correctly".

The target of the research is to build a systematic classification of process documentation. Currently, all architecture elements in the company have different level of detail and abstraction. It was important to define what processes have more influence on performance and how they are connected to each other. For this purpose, hierarchy of business processes allows to distinguish between different levels of process details and map the process model to the right place.

While designing a business process, the definition of the level is important to be able to maintain a reasonable level of detail and build a connection between corresponding elements. Proposed definition of levels for the case function of the company was done according to the benchmarking and comparison of various options based on the literature research. The figure below illustrates adopted business process architecture levels giving a comparison to several options from the original data that were previously described.

Table 10. Adopted process hierarchy

British Telecom (BT), (2006)	**Lind and Seigerroth (2010), REFA Verband**	**Finance function of the case company**	**H. Fromm (IBM), LCAG (2006)**	**Adopted by the case function**
1.Business Activities 1 2.Process Group 3.Core Processes 4.Business Process Flows 5.Operational Process Flows 6.Detailed process Flow	1.Business Process 2. Main Process 3. Sub-Process 4. Work System Process	1.Process Category 2.Process group 3. Main Process 4.Sub-process 5. Activity 6.Work Instruction	1.Process Map 2.Business Process 3.Sub-process 4.Process Step	1. Value Chain 2.Business Process 3.Main Process 4. Sub-process 5. Activity 6. Instructions

The adopted hierarchy approach stated above is based on the combination of common business process architecture practices mainly based on approaches by British Telecom (2006) and external benchmark from the finance function of the company. Approaches were modified to meet the company's specific needs. Definition of levels for business processes was a critical requirement to proceed with the development of the guideline and systematic process design. Thus, the figure below illustrates the approach to hierarchical view on business process architecture summarized for the definitions by Lind and Seigerroth (2010), Wolf (2003) and Harmon (2014) and discussed in the scope of the training material for process modeling.

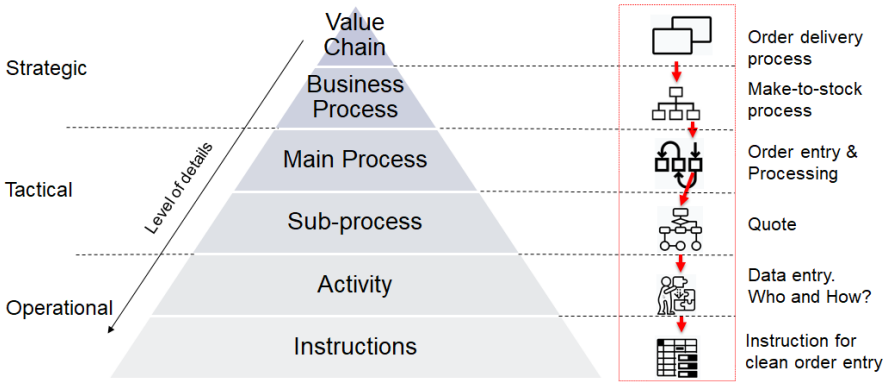

Figure 29. *Proposed end-to-end process architecture framework (adopted from Lind and Seigerroth, 2010; Wolf, 2003; Harmon, 2014)*

Process documentation of the case company belongs to levels from main process to instructions which is similar to the framework by Lind and Seigerroth (2010) on tactical and operational levels. Value chain and business processes are of a strategic level by nature. It is defined and managed depending on the complexity of an organization. For the case company, value chain is represented by Business Area, while business process belongs to the business unit, and further levels are related to functions one of which is a focus of this research. The approach to levels is a top-down in terms of process management in the organization. Discussed levels are explained below, however, criteria for definition of levels is only provided for levels relevant to the case function.

Level 1. Value chain level outlines the operational level of a company or process category. Example: Order delivery process

Level 2. Business process level shows end-to-end processes across the above operational area and combines into process groups. Could be called a high-level process of the process map. Example: Make-to-Stock processes that may not provide details to build a good understanding but enough to narrow down the scope

Level 3. Elements of main processes are retrieved from business processes by refining. Main processes often reveal the "flow-object" of the process and give outline of the flow generalizing minor steps. Example: Operative purchasing process.

- Cross-functional inside the operated level with clearly defined responsibilities
- A product or service delivered can be easily identified

- Direct value-adding activities
- Can be broken into smaller processes (sub-processes) in a way that it makes up a value chain
- Applies direct strategy

Level 4. Sub-process level shows support processes required to complete a specific main process within an operational area. It contains information for process understanding and proper navigation during the implementation but may miss insufficient details and doesn't function fully well for training or as operational documentation. Example: System exception message handling.

- Involves several functions, however, dominant function can be defined
- Represents a set of activities
- Enables value creation on the preceding steps
- Indirect value-adding activities
- Supports main-processes by adding value to the preceding step
- Applies enabling strategy (uses tools)

Level 5. Activity level gives an explanation describing who does what and when as well as other relevant details. In the case of the research, system processes are located on activity level. Example: Robotic process automation activities.

- Explains who does what and when
- Reveals tasks, procedures
- Represents way of working
- Often software related

Level 6. Instruction level consists of the support documentation, work instructions, and procedures required to complete processes. The procedures and system instructions can be represented as text or table. Example: Instruction for "Clean order" entry.

- MS Word, Excel, PowerPoint format
- Explains how to perform an activity
- Provides a full guideline (finite)
- Contains the step-by-step detail

These levels of the hierarchy are retrieved by interpretation from literature frameworks (Fromm, 2006; Lind and Seigerroth, 2010; Harmon, 2014; Balasubramanian and Gupta, 2005 and Wolf, 2003) and proposed as a navigation tool of the process architecture approach used in the case function of the company. Using hierarchical approach while building business process and creating models is a powerful tool for a better system of process management and transparent communication (Koch, 2011; Frye and Gulledge, 2007). For this reason, levels are included in the guideline for process modeling to fulfill the observation by Movahdi et al., (2016) about achieving excellence through documentation of all steps. To make process flow charts fit the corresponding level of

the hierarchy, criteria to differentiate between various levels of existing processes is also provided by the guidance.

4.4 Process Mapping Based on Proposed Process Architecture

Business process hierarchy was developed at an early stage of process implementation and available processes were classified according to the definition with the minor change in models. Changes as part of the action science included breaking down complicated processes of support nature into several sub-processes for better understanding based on the study by British Telecom (2006) and external benchmark from the finance function of the company.

The step of the process map development is a critical phase of the practical implication of defined classification for process documentation. Meaning that after classification, processes were assembled into the map for end-to-end process to be better defined in a holistic view, which goes in line with the study by Schmelzer and Sesselmann (2010). The map was also used to facilitate a project-related workshop. The structure of the map is provided at the end of the chapter.

In terms of the on-going project work as part of consensus-based approach to the research, the map was observed to be beneficial for improvement of communication about process relationship, handoffs, proposal of adjustments and definition of responsibilities. Thus, the business process map was created according to the process classification based on existing literature theories (British Telecom, 2006; Fromm, 2006; Lind and Seigerroth, 2010), external and internal benchmarks, and available tools as a response to the clear business need. In this study, a combination of mapping methodologies by Ljungberg and Larsson (2001) and Bergsmann (2012) were used to create a business process map.

The research proves the statement by Biazzo (2012), that to manage process improvement in the most efficient way, process portfolio of the case function should be visualized in the process map. Based on the defined process classification, the big picture of the approach towards the process map development at the case function of the company can be summarized as three stages similar to the study by Jacka and Keller (2002):

- Definition of end-to-end process of interest. In this case: Order delivery processes consisting of order entry and processing, inventory planning and replenishment, operational purchasing, delivery and logistics care and receipt, cash collection.
- Retrieving existing processes in the scope of the change project from the process library. Processes included approved and to-be approved business processes.
- Creation of as-is map and further communication of the map to process owners and outside functions, gathering comments and feedbacks.

The actual map generation process followed the eight-step mapping plan by Ljungberg and Larsson (2001). The approach was chosen for being consistent, structural, detailed, easy to adapt and follow at any given point. The used mapping methodology, consisting of eight steps, was implemented with some changes and comparison of literature based and actual steps is presented below.

Table 11. Steps of mapping process

Steps by Ljungberg and Larsson (2001)	Actual steps
Definition of the process purpose and its start- and end points	Finding the common view on end-to-end "order to delivery" process in scope of the case function
Brainstorm activities of the process and write them down	Retrieving components of the end-to-end process from the existing process library
Arrange the activities in the right order	Finding out the sequence of existing processes building the logic around areas of responsibilities involved
Add and merge activities	Combining similar processes
Define object out and object in for each of the activities	Defining handover point between functions in each process
Make sure that each activity is connected to the next through the objects	Making sure that each activity has a clear link to the next one by input/output relationship
Make sure that the activities are at the correct level of detail, and that the names are consistent with their purpose	Checking level of detail. Breaking high-level processes into more reasonable components
Adjust until a satisfying description of the process has been composed	No major adjustment to the initial process arrangement were made, however, cross-functional process tasks and naming are to be clarified.

The mapping process of as-is situation was initiated to support a workshop for process owners discussing the progress of the project work as part of original data processing. The goal of the workshop was to create a good understanding of the developed processes in the scope of the change situation while planning next steps regarding process related instructions. Mapping of as-is situation for the case is done as a combination of process modelling frameworks by Jack and Keller (2002) and Ljungberg and Larsson (2001), since preparation step was conducted in the form of the discussion, however, the development of the map was simultaneous to the development of process models.

The mapping has more features of the eight steps by Ljungberg and Larsson (2001), thus, these steps are discussed further in more details. First three steps of the mapping process were performed prior the workshop. The second step of the process mapping was collecting available flow charts and the following comment came:

"The flowcharts that we have developed in the project most likely have few errors, since we didn't define the standard before doing them. There might be misalignment in the ways of working between the streams."

The practical use of the defined process map confirmed statements by Bergsmann (2012) about potential benefits of end-to-end process mapping. Thus, benefits of utilizing process map instead of separate processes during the workshop included creation of transparency of processes in different responsibility areas, promotion of the process understanding and spotting further needs, clear and complete visualization of the existing processes gap identification and ad-hoc adjustments (Frye and Gulledge, 2007; Balasubramanian and Gupta, 2005). Process mapping has therefore served as a basis for ongoing process management tasks. The individual components of the process map are generalized and provided in below.

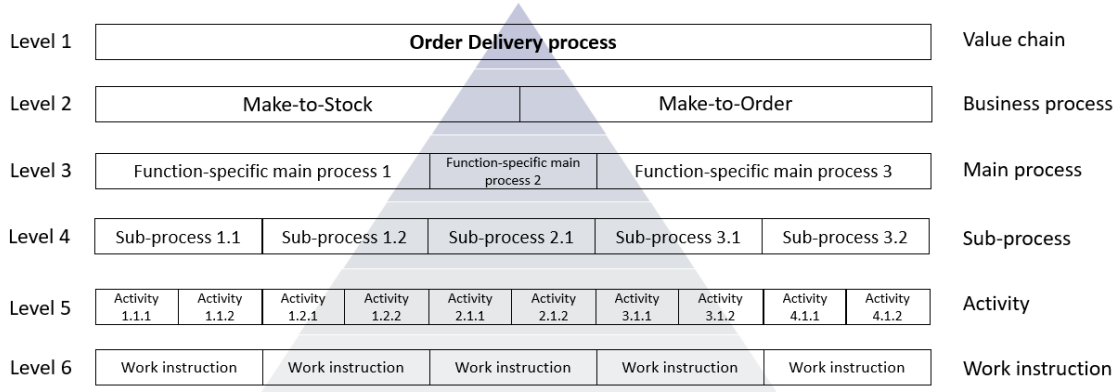

Figure 30.*Classified processes of the case function visualized on a map*

Process map illustrated above helps to identify relationships between processes on different levels while at the same time provides a good visualization of the end-to-end process which is in line with the study by Bergsmann (2012). Having the map as a visual tool, it was noticed that process architecture should always be closely linked to corporate strategy implementation in order to be efficient because end-to-end business process is a strategy building block.

With the clarity of levels for process documentation and by mapping available documents into a map according to the system, users and developers of process models were able to communicate efficiently and spot areas for improvements suggesting new requirements (Biazzo, 2012; Movahedi et al., 2016). However, lack of knowledge about process classification was observed and need for a defined system in the form of training material, guidance or instruction was put into proposals for the future process modeling related work. The request is addressed by the development of training material and discussed in the following chapters.

5. GUIDELINE FOR PROCESS ARCHITECTURE BASED DESIGN

The modeling of business processes is one of the fundamental tasks of process management in a process-oriented company. Business processes are constantly subject to new requirements. To make process management efficient, process models have to be adopted in a consistent manner. Thus, while different models of a business process may exist on different levels of process architecture fulfilling different requirements, consistency should be the key.

There is a bewildering array of frameworks, models, notations, and tools that a company faces when launching a systematic process architecture management. However, there should be a precise guideline on how to approach the modeling of new and existing processes. To have processes models harmonized, clear definition of methods and systems should be developed in the company (Frye and Gulledge, 2007). It is especially important when a company aims for all its processes to be created and stored in one place following the same logic.

Development of a modeling guideline with defined systems and methods allows a proactive approach to process modeling. First, the following chapter aims to answer such research question (**RQ1)** as: ***What kind of guideline content would support the systematic business process modeling?*** It discusses the training material, a modeling guideline, based on data from literature review and combined with observations of the company's needs to allow practical interpretation. Section 5.1 of the chapter reveals the structure of the process modeling guideline which will further be used for integration of quality measures. Section 5.2 summarises the content of the guideline and discusses the newly defined approach to the hierarchical view on business process architecture.

Later, the chapter links to the second research question (**RQ2**): **What quality aspects should be considered in training material and developed process models for quality reliability and improvement?** Section 5.3 is dedicated to the quality aspects and connects developed training material in the form of the guideline to the pattern of quality aspects. Reliability of these quality aspects is evaluated in the Section 5.4. Finally, Sections 5.5 and 5.6 reveal how quality of process models was changed based on the applied guideline requirements.

5.1 Structure of Guideline

The training material for process modeling is built in the form of a guideline and serves as an instruction. The structure of the guideline follows five elements derived from the literature review and defined as the most critical elements for the fulfillment of function's specific needs. The structure was built upon the study on training material by Beardwell et al. (2004), Blanchaerd and Thacker (1999) and quality by Brocke and Rosemann

(2010), Reijers et al., (2015) and Koch (2011) as sources of original data, while the content of the guideline is developed to be able to cover each structural category. The figure below illustrates five structural categories used during the development.

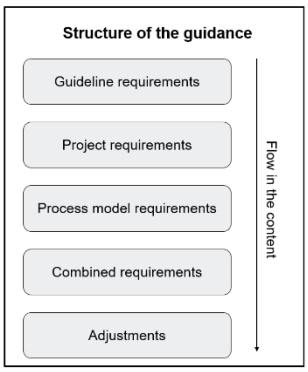

Figure 31. *Structure of the guideline content*

The figure above gives the interpreted and applied content of the modeling guideline while original sources for each structural piece are described further. Firstly, guideline requirements cover specific requirements defined by the content of the training material. Elements of efficient training material by Wright and Geroy (2001) are part of the requirements for the guideline, since they allow the developed training material to be properly perceived by the targeted audience of process designers.

Project requirements, by the definition of Brocke and Rosemann (2010), cover needs of the current project in the company. These requirements are based on the project goals and aim to reinforce the implementation of the project. In the proposed guideline, project requirements cover quality aspects of the business process modeling in the scope of the on-going logistics-related project.

Process model requirements are also explained by Brocke and Rosemann (2010) and cover critical elements of the business process model design in general and in the scope of the developed guideline. For the case, these requirements aim for the definition of systems and methods while clarifying governance of the process models. In the case of the research, these requirements are uniform for every process model under the project scope, otherwise, the desired comprehensibility cannot be achieved.

Combined requirements are coming from the variation of the user needs and their perception of the value of training material. There is an agreement of needs for the guideline as well as its content before the development. Definition of the combined requirements is related to the definition of the target users and plays an important role in the quality of the training material.

The easy-to-follow content of the guideline was supported by user-friendly “look and feel” of the actual document to establish an interest and connection to different types of users. Further adjustments might be needed to support understanding of the guideline by a process developer having no modeling background. Some topic-specific changes to the content might also be required to meet the constantly changing business needs as was

several times highlighted in the study by Koch (2011). The guideline includes elements that support users in their experience with the material such as document version control based on the workflow and change log for the reliability of updates.

5.2 Content of Guideline

The content of the developed guideline is built upon the structure mentioned above and combined original data from studies on training material and quality by Beardwell et al., (2004), Blanchaerd and Thacker (1999), Brocke and Rosemann (2010), Reijers et al., (2015) and Koch (2011). Each requirement category from the previous sub-chapter is covered by several content elements and categories differ in the volume of the content. The table below provides a summary of the content. More detailed and specific elements of the training material content are available in the Appendix D.

Table 12. Content of the guideline based on the structural elements

Category	Content
Guideline requirements	• Scope of the guideline • Objective of the guideline

Project requirements	• Terms
	  ○ Definition of the guideline regarding the case
	  ○ Benefits of the guideline
	• Scoping of the process modeling for the project
	• Classification of process levels
	• Guideline for the process documentation and design
	  ○ Identification of elements
	  ○ Design phase
	• Modeling notations
	• Tools
	• Quality aspects

Process model requirements	• Content quality • Standards for design • Naming convention • Glossary
Combined requirements	• Roles and responsibilities • Deployment
Adjustments	• Periodicity of the review • Continuous improvement • Conclusion with final recommendations for reading process models

The content of the training material in the form of guideline is built for process developers to give a step-by-step recommendation as well as to set requirements and standards based on the commonly accepted practices interpreted to the case of the research. The content of the guideline is built to be logically structured and easy to follow. The content

starts with an introduction and basics of process modeling, then it works out various more detailed steps throughout process modeling topics.

The guideline aims at people with some technical background, however, it can also be convenient for a general user, thus, no preliminary training is needed unless the user is unfamiliar with the topic of business process management. With the content of a guideline listed above, process developers are able to learn how processes can be modeled realistically yet clearly and comprehensibly. All in all, guideline reveals different substantial aspects of process modeling from the general and more detailed, practical points of view. Guideline is accompanied by real-case examples relevant for the function that anchor the content with a current state.

5.3 Quality Aspects of Guideline

The training material in the form of the guideline is built based on the findings of the quality imperfections of the current process models in the company as well as general requirements for development of the structure for process modeling by Wright and Geroy (2010). Quality aspects discussed in the literature part and used for evaluation of the current process models are also used for the overview of the developed guideline to respond to the second research question. The quality of the training material is evaluated separately in this research.

An important observation was made that quality aspects of training material can be also applied to process models due to the nature of documents. Both studies by Schmelzer and Sesselmann (2010) and Brocke and Rosemann (2010) have discussed the quality of the whole systematic approach to process architecture and not the one defined in the detail for the development of training material. However, findings of the holistic approach to quality have a huge impact on quality of case-specific process models.

As follows, with a high quality of training material for modeling, sponsorship and strive for quality, one can expect process models to be of the desired high standard. There is a system of using quality aspects in a way that content of the training material as a guideline is not investigated, but rather a structure of it. The approach puts structure elements under investigation and doubts each one to see the potential impact of the quality flaw on future process models. **For this reason, the discussion of the quality in the proposed training material gives a forecast of the future quality of process models developed based on the instruction from a guideline.**

Not only quality flaws are discussed, but also a reaction to them should be provided as a solution. For this reason, the structure of the quality aspect evaluation of the guideline is provided below and will be opened up according to the quality tools in the following chapter. Training material and later process models will be evaluated according to the criteria of the listed frameworks and presented as a discussion chapter. The approach to the quality evaluation is:

- Title of the quality aspect
- Description of the quality aspect
- Potential problem in case of the quality aspects imperfection
- Solution to the problem caused by quality aspect

The research in the theory section as well as data retrieved from the current state analysis are reflected by the developed training material in the form of a guideline. The individual aspects of quality are based on the insights from both requirements for efficient training material and frameworks for process modeling. Each quality-related framework discussed in this paper is explained below in terms of the defined guideline emphasizing requirements specific for the case function reflected in each framework. Same quality frameworks are later used for process model quality evaluation, however, for the different purpose they are interpreted differently.

Elements of efficient training material. The framework by Wright and Geroy (2001) includes case-important aspects of quality for syntax, meaning, the language of the guidance, completeness and structure, proper visualization and clarity of the structure in terms of the training material in general, regardless the content.

The guidelines of business process modeling (GoM). The framework gives requirements for process model adequacy in terms of semantic, social and pragmatic quality. Desired quality in the case function is also established by the systematic design and comparable final business process models. The framework was selected to be used in the case partially due to the highlight from Becker et al., (2000): *"The clarity in terms of business processes and requirement fulfillment is a driving force in this framework."*

SIQ framework in combination with ISO. The research agrees with the statement by Krogstie et al., (2006): *"Company's external requirements for business process models are very important for proper quality."* Thus, the organizational quality is also an element of the process modeling as a project. Requirements for this framework are based on syntactical, semantic and pragmatic quality through rules for business process design including notations and tools for visualization which are critical for the research.

Conceptual modeling. The quality framework provides a system for composition of concepts defined by the guideline and contributes to the better understanding of context in the scope of the project, its clarity through social and syntactical quality. These quality elements are heavily present in the combination of requirements.

The discussed training material was developed simultaneously with the development of new processes, sub-processes, activities, and instructions to fulfil needs of the project. Quality aspects were considered during the development of the training material. Some of earlier developed processes were designed without the reference to the quality aspects, while later process models were developed with the reference to a training material, having defined criteria for classification and quality aspects in mind.

5.4 Evaluation of Quality Aspects in Guideline

This section of the chapter describes the state of the quality aspects in the developed guideline based on the interpreted data processed during analytical approach to the research. It is considered important to first evaluate the quality of the material providing verification and validation, since it is the driver of the process modeling and then evaluate the quality of the developed or improved models. This paper highlights the point that evaluation of the quality aspect of training material is a reflection of the quality of the modeling process.

The evaluation of quality takes place to give a better understanding of how many of the quality aspects are covered by the developed training material. To conduct such quality evaluation, information from literature review was refined to build a customized framework relevant to the case function. Some critical thinking and potential comparison within the industry were done based on the internal and external benchmarking of hierarchical view to business process architecture building a comprehensive approach to process quality evaluation. The developed guideline is project specific and while criteria and elements of quality evaluation have a wide enough scope to allow for a diversity of views. For the purpose of the research, to systematically evaluate available quality aspects in the guideline, 0-xx scale was chosen. The values have such a meaning:

- **0** - the aspect is not covered
- **x** - The aspect is partially covered, some details are missing
- **xx** - The aspect is fully covered

These values may cause a gap in the interpretation. However, the evaluation is done based on the comparison of the developed modeling guideline against the literature research results retrieved from Wright and Geroy (2001), Rosemann and Shutte (2000) as well as Becker et al., (2000) and discussed in previous chapters. Combination of these knowledge is expected to provide some insight on quality aspects of the training material. The table of the “Requirement evaluation summary in the developed guideline” is available in Appendix E.

The above-mentioned table illustrates the score of how various quality aspects are covered by the developed process modeling guideline giving an evaluation of coverage extent. Interpretation of the score turned into evaluation of the quality and led to **observations** that are discussed further. As part of the result interpretation and analysis, each group of quality aspects is discussed separately.

Guideline requirements

- Scope of the guideline
- Objective of the guideline

The scope of the guideline is defined in detail to make the user aware of the scope covered by the training material. There is a clear reason why the document is provided and what benefits it may bring. The objective is stated clearly to avoid any misunderstanding. The guideline provides a detailed table of content for user information and better overview of the document.

The developed guideline covers the elements of the guideline requirements. The scope and objective are clearly explained, while content gives the precise detailed view. Having guideline requirements fulfilled, gives a good motivation for process developers and helps to avoid practical misuse of the document.

Project requirements

- Terms
  - Definition of the guideline regarding the case
  - Benefits of the guideline
- Scoping of the process modeling for the project
- Classification of process levels
- Guideline for the process documentation and design
  - Identification of elements
  - Design phase
- Modeling notations
- Tools
- Quality aspects

The development of the guideline for process modeling was originally motivated by the on-going project which was related to the massive definition and development of new processes. Respectively to the business case, project leverages the development of sustainable and efficient ways of working. In the scope of the research, project specific requirements drive most of the guideline elements.

The guideline as a document was created in the scope of the on-going project while content is kept generic to be efficiently applied later in day-by-day operations. Creator of the guideline focused on precise communication of the guideline's goal as well as establishment of the connection with users by high quality and reliability of the content. Identification of benefits is done for each user group, for this reason, quality checks might be separated by these groups for more relevant feedbacks and better outcomes. Organizational goals are not covered in detail but rather listed as general bullet points as harmonization, definition of system and methods.

Terms used in the scope of the project are defined to avoid misunderstandings. Proper definitions are stated to ensure common understanding of the discussed topic.

The guideline describes levels of business process classification in minor details giving project-related examples. Classification of levels is supported by the defined criteria.

However, no metadata included in the process model is discussed. Metadata being self-explanatory and already attached to the models might be a reason for it being excluded from the discussion.

Notations are described in the detail covering both previously used and newly added elements. For the use of the project, notations were extended to be more informative and to suit the advanced process model developers. Equivocality is mentioned as a possible issue, however, no clear examples and ways to avoid it are provided.

The process of modeling is supported by IT tools. The guideline names the tool as MS Visio, PowerPoint, Word and Excel (Microsoft Corporation, 2018) depending on the content. However, no facts about tools availability or functionality is discussed. The decision of the tool is given to the process designers.

The concept of data or knowledge needed for the development of the process model is not covered. The aspect of knowledge quality in general and in terms of the specific project were not considered relevant to be included in the guideline.

Intermediate quality checks are mentioned by the guideline and supported by the ever-changing nature of the project organization. Having planned checks allows for better control over the training material as well the outcome of its usage. Having the quality checks mentioned, aspects are not discussed in detail, however, elements of efficient training material might be used for reference in this case.

All in all, the developed guideline does not cover all the aspects of project related requirements. Such aspects as classification of levels, definition of notations and stakeholder goals and benefits are covered in more detail. The missing aspects are explained by peculiarities of the process modeling approach in the organization and well as by the long-time existing approach to modeling in the case function which are considered to be “unspoken rules”.

Process model requirements

- Content quality
- Standards for design
- Naming convention
- Glossary

Syntactic quality is partially covered by the discussion of the goal for process modeling in conformation with roadmaps defined for each modeling step. Text statements in the process models are in accordance to the predefined syntax and follow standards of naming and glossary as a project specific language.

Semantic quality is not mentioned as such, however, it is covered by the elements of efficient training material. Accuracy and completeness criteria for efficient training

material provide that statements in the process modeling guidance and further defined models are reliable and correct.

Pragmatic quality as the goal of any process model perceived by users is not stated as such. The reason for it can be a possibility of misinterpretation of such a quality aspect by someone not familiar with a term and ambiguity of interpretation in relation to detail and semantic quality.

The aspects of design standards and language are covered in a reasonable level of detail. Quality of the content is also discussed but more general approach is taken. Pragmatic quality stayed uncovered to avoid misunderstandings and confusions reported from process developers as users of the training material.

Combined requirements

- Roles and responsibilities
- Deployment

The concept of pragmatic quality is kept untouched by combined requirements as well. Social quality is addressed by the definition of roles and responsibilities. The deployment process is discussed in the guideline due to the new stakeholders being involved.

Adjustments

- Periodicity of the review
- Continuous improvement
- Conclusion with final recommendations for reading process models

The final part of requirements concludes the process of modeling and gives recommendation for the follow up and further improvement. Releasing and publishing of process models are not discussed, since this part is assumed to be clear and familiar for process model developers. Recurrence of quality checks is mentioned to be project specific and can only relate to the particular case of the company's business.

As the summary of the evaluation findings, the guideline gives a clear step-by step interpretation of the modeling process. Approach to business process architecture levels and process classification are major part of the developed guideline which fulfill the requirement by Dumas (2013). Clarification of process levels with examples is provided as well as criteria for classification and mapping of existing processes.

Notations and language are discussed clearly and in minor details to cover requirements by Reijers et al., (2015). The guideline does not provide a list of words to avoid, however, most common abbreviations are discussed, and glossary related to the specific project is provided. The modeling guideline is supported by the visuals that make following the content easier and more efficient which is part of study by Wright and Geroy (2001) as will be discussed further.

It became clear that the developed guideline is very project specific matching the definition by Garvin (1984), for this reason, some elements of quality are covered in little detail while others are only mentioned or even fully missed. It is important to notice that the guideline was not evaluated together with reference material available in the case function as suggested by Becker et al., (2013) but opposed by Reijers et al., (2015). Thus, it is taken as granted that some of the elements missed in the guideline are already covered by separate documents.

Apart from the quality elements discussed previously in this sub-chapter, guideline for process modeling should at least fulfill defined characteristics of training material to be efficient as discussed in the literature review, Section 2.3. The modeling guideline provided as a deliverable of the research work, was able to cover main quality characteristics. The table below explains the form of each characteristic of efficient training material by Wright and Geroy (2001) in the developed guideline for business process models.

Table 13. Description of quality elements in the developed training material

Characteristic	Form
Accuracy	The modeling process described by the guideline follows the current need of the process owners. Any misunderstandings in the content were avoided, no words with multiple meanings were used.
Completeness	Main aspects of the process model development were covered step by step in a logical order.
Structure	Step by step structure was used to make the guideline easy to follow. Table of content is provided for better navigation. When applicable, information was structured from general to more specific.
Visualization	Pictures were used to support understanding of the notations. Roadmaps for creating SIPOC tables and flowcharts were provided as an easy-to-follow visual supplement.
Clearness	The text of the main part of the guideline was kept in short sentences. Bullet points were used to summarize information. Topic were bundled for the convenience of following the logical order.

The above-mentioned criteria aim to ensure the quality of developed process models linked to the information from the guideline based on the extensive study on the topic by Wright and Geroy (2001). However, the way of communicating the value of the training material - guideline, influences how different users in the company accept the standard. Thus, value of the training material is directly related to the value and quality of the developed process flow charts which was not mentioned by Wright and Geroy (2001)

and turned out to be an occurring observation. Evaluation of the training material and the prior research confirm the statement by Becker et al., (2013) that:

"… having a properly developed method for process design, it is easier to provide benefits of a systematically developed process models in various forms to different parties involved in the process implementation".

However, the statement above is restricted by business conditions and stakeholders involved in the process implementation. Process modeling is still rather far from the final implementation, meaning that performance gaps may remain having a root cause different from the quality of process model. Nevertheless, as observed from the day-by-day operation in the company and supported by Frye and Gulledge (2007) as well as Balasubramanian and Gupta (2005), well defined process models, including process elements, tables or flowcharts, show that the business function is opened to share the information and this transparency helps in process performance efficiency.

5.5 Quality of Process Models

Even though several quality-related frameworks were discussed in the literature part of the thesis, as well as applied to the guideline related chapters, including Garvin (1984), Fellmann (2013) and Reijers et al., (2015), the basis for identification of both qualitative and quantitative measurements for the quality of process models is rather limited. It was observed that frameworks lack consensus and better be used in combination with each other to avoid gaps. The figure below illustrates the summary of quality frameworks by Garvin (1984), Fellmann (2013), Reijers et al., (2015), Brocke and Rosemann (2010), Koch (2011) and highlights three aspects of quality to be considered further in this research serving as a framework for the second research question.

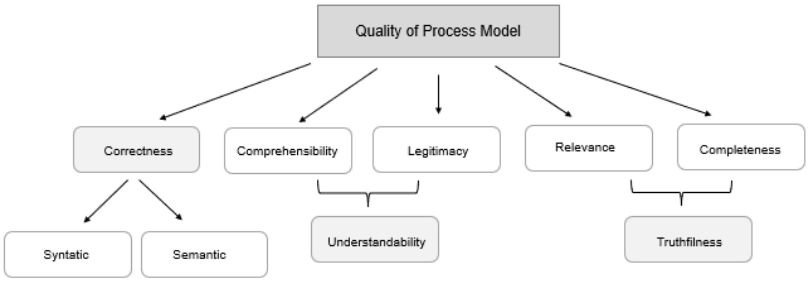

Figure 32. *Quality aspects in the scope of the work*

Quality aspects seem to be very abstract by their nature which makes objective measurement practically impossible. However, for the purpose of the research, three quality aspects covered in the ISO by Koch (2011), such as correctness, understandability and truthfulness, were chosen to be used as a baseline during the data interpretation for criteria definition and process model evaluation. They are represented as grey boxes in the quality framework.

After the data gathering from literature, observations, interviews and action science, the question remains as: *How process model quality can be measured?* To answer this question, the chapter provides interpretation of the reviewed literature and gathered practical data taking requirements of the case function into consideration to build a quality framework for process models.

For this research to meet requirements of the case function, quality aspects of process models were combined into three groups. These groups are based on the SIQ framework with adopted elements from ISO (Koch, 2011) and GoM (Becker et al., 2000) for the wider scope of evaluation. The main reference is the "The wall of checking" defined for SIQ by Brocke and Rosemann (2010). The table below illustrates groups and included elements used for verification and validation of process models taking syntactic and semantic quality into account.

Table 14. Elements of process model quality evaluation

Adapted from SIQ framework, ISO, Conceptual Modeling and GoM		
Validation	Verification	
Correctness	**Understandability**	**Truthfulness**
Language	Clarity	Traceability
Notations	Expressiveness	Change acceptance
Terminology	Perceived difficulty/simplicity	Completeness
Specifications	Process target fulfillment	Relevance
Level of abstraction	Comprehensive efficiency	Reliability
Content flow		

Measurement of correctness combines various aspects of syntactic quality and aims at avoiding confusions while reading process models. These aspects were of the highest priority in the research, as citation from Krogstie et al., (2006) says: *"It is only syntactic quality which can be objectively measured, as both the problem domain and the minds of the stakeholders are unavailable for formal inspection"*. As discussed in the literature part by Reijers et al., (2015), the focus is put on grammatical correctness, since it may cause deadlocks and live-deadlocks in process implementation. For the purpose of the case, the aspects can also be explained as soundness when applied to process models. It combines flow correctness with the language used in the models. The aim for each model is to be correct and provide an undisturbed flow from start to an end with no extra branches left logically disconnected and impossible to execute. When the syntactic correctness is achieved, users are able to execute the process smoothly and performance deviation is avoided.

The measurement of understandability is considered to be similar to comprehensibility and these terms are used interchangeably in this paper as in the paper by Gadatsch (2012). The understandability of a process model cannot be measured fully remaining unbiased, which is one of the flaws in the framework by Brocke and Rosemann (2010). In the contrast to the syntactic correctness which can be measured objectively,

understandability cannot be measured directly, thus, reliability of estimation might be doubted but considered reliable in this research.

Measurement of truthfulness is combined with the term of modifiability for the purpose of wide coverage of the aspect. The term of truthfulness of a process model is adopted from Reijers et al., (2015) and is a reflection of real-life processes performed by the function of a company. In the research, the aspect also discusses ability of a process model to adopt changes while being opened for suggestions and improvements. However, both truthfulness and modifiability cannot be measured directly remaining unbiased. For this reason, this paper proposes approximations and its own particular view on the aspect. This view defines most critical areas, provides a summary of aspects and gives criteria for each quality element as illustrated below.

As the frameworks and quality elements by Fellmann (2013), Schmelzer and Sesselmann (2010), Brocke and Rosemann (2010), Wagner (2001), Reijers et al., (2015), Koch (2011) and Garvin (1984) were summarized, criteria for detailed evaluation of quality of current process models were defined. Based on the literature study highlight, the approach to the evaluation of the process model quality was linked to goals of the organization. Such goals for process models included having a systematic approach to process design and harmonization of process models.

To apply gather data after interpretation based on the case function’s needs, framework for quality evaluation of process models has had to be developed as consensus-based research method. The approach in this thesis was customized to the targets of the case function and it utilizes quality criteria, which can also be considered as attributes of process models. This approach allows to accommodate the diversity of current process models during the quality observation and corresponding criteria are listed in the following table.

Table 15. Criteria for quality aspects

Quality criteria		
Validation	Correctness	Clear input and output
		Unique heading based on the naming convention
		Notations according to the shape guide
		Systematic naming of process steps
		Easy to follow logic
		Comments avoided
Verification	Understandability	Clear objective
		No abandoned elements
		Available full path
		Decision blocks with at least two outputs
		Crossing paths is avoided
		No deadlocks
	Truthfulness	Flexible for modifications
		Reliable
		Comparable
		Up-to-date

The table above is a customized quality framework and provides criteria for the summarized aspects. It is a combination of process model quality frameworks discussed in the literature part and data gathered by participation in daily work to clarify needs of the case function. Bullet points below give more insight on the content of the table above.

- There are a clearly defined input and output of the process
- Process flow chart has a unique heading based on the naming convention
- Notations in MS Visio models are used according to the shape guide
- Process steps are logically arranged in a reasonable level of detail allowing user to follow the flow easily
- Process steps are named shortly, precisely and systematically
- Comments are used for description
- There is a clear objective for the process and its flow chart to be created
- Each block has a defined link to other blocks leading from the start of the process and to the end of the process
- The flow chart provides a full path from start to the end of the process
- Decision blocks have at least two outputs
- Crossing of paths is avoided
- There are no deadlocks and dead ends. In each state of a process, at least one activity is always running and leading to the end of the process
- The model is flexible for modifications and allows addition or take away of elements when necessary
- Each shape of the process model correctly reflects its meaning (sub-process box should have a document with clarification behind it)

- The model is comparable to the ones already in use by look and feel
- The model is up-to-date and reflects the current situation

By the discussed above criteria, 26 available process models of the case function in the scope of the project were checked as action science approach to identify issues of the current state of the business process architecture. However, one process was out of the comparison due to its software related nature. The table below gives 25 analysed process models and shows how many of them fulfil the criteria. Full table revealing the evaluation of each process individually is available in Appendix C.1.

Table 16. Available process model check

Measurement	**Criteria**	**Check of available processes x/25**
Correctness	Clear input and output	17
	Unique heading based on the naming convention	0
	Notations according to the shape guide	19
	Systematic naming of process steps	0
	Easy to follow logic	21
	Comments avoided	16
Understandability	Clear objective	25
	No abandoned elements	17
	Available full path	25
	Decision blocks with at least two outputs	17
	Crossing paths is avoided	12
	No deadlocks	12
Truthfulness	Flexible for modifications	21
	Reliable	8
	Comparable	22
	Up-to-date	25

The table above provides information about the quality of currently available process models. Having the results, quality gaps are noticed to be addressed by the establishment of requirements for process modeling standard documented as a guideline. It can be observed, that all the applied quality aspects, correctness, understandability, and truthfulness, have gaps especially when criteria are observed separately.

Correctness related criteria as GoM framework by Becker et al., (2000), include naming, language, and comments that are not used systematically in the case function due to the lack of defined norm for that. Criteria of unique heading and systematic naming of steps were used but due to the undefined standards, all current process models do not match it. As part of the language related aspect, comments were used in some process models to give better guidance for the user. The criterion of using comments is rather subjective

since it is hard to decide if comments are necessary for the proper perception of the process or not. Process designers are advised to avoid comments in the published versions of the flowcharts as this type of information should be revealed in the work instruction. Comments are not restricted in the working files of the flowcharts aiming to increase the efficiency of development communication. In the table above, only models without notes fulfill the criterion.

The aspect of understandability features such lagging case-related elements as abandoned boxes, decision blocks lacking outputs, crossing paths and deadlocks. Some of the criteria included in the aspect of understandability are shared with correctness and truthfulness. As far as visualization is concerned, observations point out that notations are mostly used according to the shape guide, however, there are still some outlier processes that include extra shapes without any clarifications. Another observed pattern regarding visualization is sub-process shapes that are not linked to any output causing dead ends in the middle of the process. Decision boxes do not always have two outputs, making the flow chart information limited to one scenario. Some process models also feature heavy or occasional crossing of paths which makes reading complicated.

The aspect of truthfulness is widely covered due to process models being rather new and project specific. For the same reason of processes being newly developed, most of the flow charts featuring sub-process boxes do not have any documentation revealing the content of a set of activities bundled into a sub-process. Finally, such flaws as abandoned elements and deadlocks are shared with the aspect of understandability and may cause difficulty in using the process model if not perceived properly, thus, the truthfulness of a process model can be disturbed.

After analysing current process models, the area of focus for the improvement by adopting rules from the guideline was visualized by the score in the table. Firstly, definition of naming convention for both process model header and process steps name are critical for the systematic process modeling as noticed by both Imhoff (2005) and Marjanovic (2007). The goal in company is to get these aspects automated by business management system. Secondly, such flaws as inappropriate shapes, abandoned elements, crossing paths, and various decision outputs are to be improved during the revision and modification of the process models based on the standard defined by the training material.

5.6 Quality of Process Models Based on Guideline Requirements

Most of the existing quality frameworks on process architecture offer quality metrics based on the model structure. This paper proposed criteria that are specific to the purpose of the case function based on various original data. While research follows the defined approach, after the development of guideline for systems and methods to process classification and modeling, the question remains:

What is a good process model?

Models should be clear, comprehensible, understandable, consistent, complete, correct (Wright and Geroy, 2001), while the guideline with standards is required to obtain all these qualities from the first time. What is meant by these quality features was already defined based on the initial requirements by the case function and conditions brought up by the ongoing project.

Guideline proposed by the research gives an instruction on how to develop a process model of a high quality as a desired output of the process development. Most focus in the guideline is put on the design phase because it is exactly the core of the process model development. *Quality of process models is, consequently, closely related to the quality of the process modeling (Becker et al., 2000) which is based on the following instructions from a guideline.* For the purpose of the research, initial process models were revisited and modified according to the guideline defined standard while aiming for quality improvement.

It is critical to evaluate quality of process models to be sure that they satisfy the requirements and objectives of the modeling process as well as to check if original data was interpreted properly to obtain the desired result. To see the improvement in the quality of business processes by application of the guidance, keeping the internal influence of same factors – quality criteria is applied in a similar manner to the evaluation of current models. The list of quality elements is based on the principles by Wright and Geroy (2001), Rosemann and Shutte (2000) as well as Becker et al., (2000). While checking the criteria against improved process models and making a comparison with old ones, changes in quality can be observed. The table below provides information about number of new process models matching earlier defined quality criteria. More detailed check of each available improved process model can be found in Appendix C.2.

Table 17. Quality evaluation of improved processes

Measurement	**Criteria**	**Check initial/improved**	
Correctness	Clear input and output	17	23
	Unique heading based on the naming convention	0	25
	Notations according to the shape guide	19	21
	Systematic naming of process steps	0	23
	Easy to follow logic	21	25
	Comments avoided	16	23
Understandability	Clear objective	25	25
	No abandoned elements	17	23
	Available full path	25	25
	Decision blocks with at least two outputs	17	25
	Crossing paths is avoided	12	18

	No deadlocks	12	21
Truthfulness	Flexible for modifications	21	23
	Reliable	8	23
	Comparable	22	25
	Up-to-date	25	25

The finding of the research comes at place where the assessment of the model quality cannot be decoupled from the chosen methodology defined by the guideline with separately evaluated quality. Level of the process model based on the hierarchical view also have a significant impact on quality evaluation. Since models at different levels serve different purposes, the quality criteria are defined to be suitable for various level of abstraction. To have a different view, rather than size/complexity focused, content-specific criteria were also defined and put to model evaluation.

All in all, development of the modeling guideline with a clear definition of process hierarchy, naming convention and standard for the design has helped to improved quality of process models when compared by the defined criteria. The result goes in line with the literature review and confirms the statement by Gordon (1992) about

"… *training material being beneficial for gaining new competences and performing tasks more efficiently leading to improved quality of deliverables".*

The main improvements are seen in the naming of the process model and process steps. Naming convention provided in the training material ensured consistent use of the selected modeling standards in terms of language in both header of the model and process steps. As far as design is concerned, initially process models were rather harmonized in terms of shapes. MS Visio template was established to specify shapes and colors used in flowcharts. Improved models were aligned in terms of shapes and colors used, as well as fonts and size for the text.

Such issue as crossing paths was approached but due to the cross-functional nature of processes, not every crossing was avoided. However, the number of path crossing was minimized to the lowest possible number. The criterion does not reflect the change in number of path crossings, and only full elimination of such a flaw is documented. It should be noticed, that even though increase in number of path crossing is not significant, actual improvement in readability of the modified models is rather high.

Deadlocks, dead ends and decision boxes missing outputs were addressed with the help of process developers who possess the knowledge of the logical process flow. Improved processes aimed on having consistent flow through each element while considering every possible scenario without confusions caused by looping or dead ends.

Other observations of improvement included high initial and improved comparability level of models. The reason behind it is advanced communication among process owners inside the case function. The outlier models were initially developed outside the function and were improved to fit the harmonized look and feel of the improved model design. All

process models are up-to-date due to the novelty of the project they are built for, however, this criterion is very important for the future, when new models are coming, and older ones are updated.

The major concern in the aspect of truthfulness included low reliability in terms of documentation available to support sub-process boxes. During the improvement of process models with the use of training material, missing documentation was spotted, and gaps were communicated to process owners. Also, incompleteness of the model is a risk when a concept of the process is complex and only selected and/or requested components are represented in the model. Further, it is necessary to be aware if the partial coverage of the process elements is desired or is it due to a lack of standardized approach to the actual process.

The main objective of process model quality improvement evaluation is the efficiency validation of the developed training material for process modeling as well as defined hierarchy levels of process architecture. Evaluation of process models by criteria was performed twice to validate the approach at different stages. Thus, the first evaluation of quality was conducted to verify that initial quality of process models had several constraints influencing the quality. The main objectives behind the first quality evaluation were:

- To ensure that process model can be improved for better quality
- To ensure that there are some commonalities between quality of process models, both positive and negative
- To study the most common flaws of quality, list them and address by the development of the common system for modeling

The results of the above-mentioned evaluation helped to validate the selection of quality criteria and to correct the use of the quality concept. Training material in the form of a guideline was developed and provided as a work instruction in the Business Management System to address most common quality flaws and give a standard for modeling in order to avoid such flaws in the future.

The second evaluation was conducted after initial process models were modified according to the defined system. Thus, the second quality evaluation was done to validate the effectiveness of the comprehensive approach. The main objectives behind the second validation are:

- To ensure that the defined quality parameters can be used for evaluating and comparison of the quality in models
- To ensure that the knowledge provided by the research can bring improvements to the modeling process
- To study improvements and gaps

Evaluation of improved process models helped to validate the strengths and benefits of using the training material as a defined system for process modeling. In both evaluations, similar criteria were used and summarized in the table. Both experiments aimed at finding out how to detect and correct quality defect first in initial models and later in improved ones, since some flaws remained. Action science took place during this stage of the research to apply gathered data and supplement it with the case-related requirements as well as to come up with results to be further analyzed and discussed.

Unfortunately, quality evaluation itself and validation evaluation are still challenging. Both tasks are not covered precisely in any source and only mentioned by Reijers et al., (2015). They are never performed fulfilling every requirement for the reason of being undefined. The research presented in this thesis is a step forward in the semantic and syntactic evaluation and improvement of process model quality based on literature review and needs of the real situation in the company. In order to deliver a solution for systematic process modeling, the knowledge of process architecture, notations, and process design were assembled in the training material. The developed guideline considers current needs of the case function and brings benefits associated with systematic management, storage and access to documentation in business management system which goes in line with the study by Imhoff (2005) and Marjanovic (2007).

6. DISCUSSION

The competitiveness of a company increasingly depends on the agile, cost-effective and overall competent handling of business processes. Shorter product life cycles and increasing customer demands in terms of price and quality require permanent adjustments and improvements in business processes. To be able to efficiently perform these improvements, the initial quality of process development and modeling should be on a high level.

The objective of the paper was to illustrate how properly developed modeling guideline based on the clearly defined elements of business process architecture can ensure quality of process models. For the purpose of building a system for process modeling and quality assurance, literature review was conducted, and concepts of business process management and architecture were explained. Hierarchical view on process architecture as a framework was discussed based on the research by Fromm (2006), Ljunberg and Larsson (2001), Lind and Seigerroth (2010), Balaburamanian and Gupta (2005). Later, types and elements of efficient training material were listed, and its key features were identified and aligned with the study by Wright and Geroy (2001). After that, the importance of quality in process modeling and proper use of developed models were discussed combining studies by Becker et al., (2000), Dumas et al., (2012), Garvin (1984) and others. Data collected during the literature review was later supported by observations working in the company's case function, qualitative interviews and action science. The table below illustrates the research process.

Table 18. Data gathering and analysis

Method	Collected data	Data analysis
Literature review	Books and articles on Business Process Management and related topics	Critical evaluation of existing knowledge. Combining various research papers to illustrate the relationship between business process architecture, process model quality, and modeling systems in a form of the guideline
Observations	Identified points of interest from day-to-day operations, observed patterns and identified areas for improvement	Understanding opinions, experiences and attitudes. Compiling data by asking stakeholders to confirm or deny retrieved observations on the topic of process model design and quality to identify challenges

Qualitative interviews	Semi-structured interviews with stakeholders of the case-company following the agenda provided in Appendix A	Understanding of the current situation by overview of the step-by-step logic. Highlighting critical points in the discussions by giving in-text citations to support or oppose literature findings and challenges identified by observation
Action science	Managing support documentation for every-day activities, meetings and workshops. Improvement of existing process documentation. Development of Business Management System	Comparison of ”as-is” and ”improved” state of process models based on the proposed quality criterion provided in Appendix C
Deliverable: Definition of systems, methods and quality criteria for process modeling in the form of a guideline		

Analysis and interpretation of original data led to key findings of the paper and the deliverable. The key findings aim to show that properly developed and applied training material in a form of a guideline (**RQ1**), based on clearly defined elements of business process architecture, can help to define the step-by-step process of creating business process models and ensure quality of process design (**RQ2)**. Findings of the paper formed to the definition of systems and methods for process documentation is a desired foundation for business management system (Imhoff, 2005; Marjanovic, 2007). At the same time, by creating guideline for the process developers, the company gets involved in the process of value creation, by deeper investigation into processes and involvement in operations.

6.1 Reflection on Literature and Current State Findings

Business processes today are more than a purely operational necessity, more and more companies see business processes as real corporate values and strategic resources Movahedi et al., (2016). As cited from Gaitanides (2007) and observed from the case of this research:

“Attention to business processes is growing rapidly as people search for ways to close the gap between the strategic vision and organizational goals”.

Modern business environment underlines the importance of proper process management not only for facilitating the company’s strategy but also for building new competencies with new technologies. As recognized form the case research and cited from the manager’s comment:

"Ability to competently model business processes is an enabler for digitalization and automation of routine tasks."

This paper highlights the fact that to be understood and implemented properly for any pursued goal, process architecture and process models should be supported by defined systems, standards and methods. These standards and methods can be provided to users in a form of training material, a guideline, based on the knowledge retrieved from literature, benchmarking and daily operations as sources.

Guidelines are commonly used in business context to communicate way of working to employees of the company. As noticed by Blanchard and Thacker (1999) and confirmed by this research, guideline helps to increase efficiency of the performed tasks and effectiveness of work by giving a right direction, increasing motivation and quality of the result. This thesis proposes the use of process modeling guideline for setting a standard in business process model development, which may further lead to more efficient operations of business management system as suggested by Crandall and Crandall (2008). Quality of process models is also affected by the training material if standards are defined and applied accordingly.

Challenges of the case company, discussed in the paper, were listed and explained in the end of Chapter 3, while three issues were later addressed by the research. Process developers rated "standardization" as the biggest difficulty during interviews and it was also noticed while observing daily work. By contrast, "detailed level of models" for management and "methodology" for academics who have provided material in the literature review part are the most critical. **These three issues were closely related to the research questions and the table below provides a summary of responses.** The list includes identified and approached problems giving a short description of responses to issues based on the research questions. Similar table with an extra column stating the main source of original data for reference is available in Appendix F while explanation of sources is brought up later in this chapter.

Table 19. Identified problems of the process architecture in the company and the response

Problem	Description	Response
Standardization	Problems regarding standardization of notations, language and tools. **RQ1**	Developed standard for notations used in process flow charts, naming convention and defined systematic approach to the naming of process steps. Unified approach towards the design
Detail level of models	Problems with the definition and identification of suitable process hierarchy levels. **RQ1**	Definition of process hierarchy levels, setting criteria for classification of available processes,

		providing a guideline for process model design depending on the level. System support
Methodology	Problems with the implementation of process modeling due to the lack of training material for the development of models influencing quality of process models. **RQ2**	Communication with process owners through the guideline developed based on characteristics of efficient training material (accurate, complete, structured, visualized, clear). Step-by-step description of the modeling process mentioning systems and standards to be applied, quality aspects and areas for improvements

Standardization

The most frequently observed of the identified challenges was lack of clearly defined standards and methods for the development of business process models. Having no standard for process attributes to be applied resulted in a deviation of approaches to modeling and quality of models as the result. The deviation made process harmonization in the function and across different business areas rather challenging, which could be predicted based on the study by Frye and Gulledge (2007).

Available quality level of the process models was not promoting efficient process implementation in the desired way. Lack of defined guidance prevented process developers and process users from perceiving the whole set of benefits of the process models. Furthermore, unstructured approach to the design of process flow charts could make communication more complicated while relationship and handoffs in the process responsibilities were difficult to identify.

The issue of standardization was addressed by the definition and documentation of notations and systems to be used during the process modeling. Process developers were served with a defined method for process modeling in a form of a step-by-step guideline and confirmed the importance of the systematic approach as:

"Having naming, modeling notations, hand-offs, roles and responsibilities explicit can lead to significant improvements implying that a commitment to follow the system in process modeling can create value for the whole company".

The documentation was created based on the highlights gained from Bergsmann (2012), Frye and Gulledge (2007), Schmelzer and Sesselmann (2010), Beardwell et al., (2004), Wright and Geroy (2001) who have been working on business process architecture

related topics. Created training material provided all the necessary standards for creating a process model of a higher quality standard including notations, symbols, naming rules, glossary and process element depiction methods.

Detail level of models

Lack of clear process view was a challenge for the management of the case company while conveying strategy and objective to employees. To address the issue, settling a business process architecture included definition of process hierarchy which was adopted with modifications form Fromm (2006), Ljunberg and Larsson (2001), Lind and Seigerroth (2010), Balasubmaramanian and Gupta (2005) combined with benchmarking. Having a clearly stated process hierarchy and processes being classified to an appropriate level can contribute to clear process mapping. The expectation goes in line with striving for visibility (Frye and Gulledge, 2007; Balasubramanian and Gupta, 2005) and stated as:

"Process architecture classified and documented can lend a clarity and transparency to the work being done, leading to improvements and efficiency in management of process portfolio".

The research has accepted the statement by Keller (2002) in which "*the definition of levels is a core of process map as a tool"*. The process map was developed in eight steps similar to ones by Ljunberg and Larsson (2001) but modified to the specific need of the function emphasizing the importance of Metadata for proper structuring. The developed map collects available processes and shows gaps of where new processes are needed. The important finding during the development of the map was that it can only be efficiently used when content is structured properly according to the system of classification.

Methodology

Another challenge faced by the function and addressed by the theory-based research method is lack of methodological approach to business process architecture. The initial introduction of process models in the case function was based on the business need and focused on providing a guideline for operations. At that point, design of models was put aside while processes were lacking integration and alignment:

"When mapping out the processes, gaps are identified that may cause risks in the future".

Now, when the project is at the mature stage and business management system was launched, attention is brought to the communication and improvement of the attitude towards process model development. The whole idea of the business management system and expectations to perceive efficiency-related benefits with it was confirmed in the research by both Imhoff (2005) and Marjanovic (2007).

"When methodology is clearly defined, it is easier to continue with implementations because key elements are identified as well as responsibilities are transparent".

Along these lines, the main objective of the proposed modeling guideline is to define a system for process classification and modeling for the business management system to be efficient (Crandall and Crandall, 2008). As well as to precisely communicate the quality standard for process model development which is mainly based on the framework "The wall of checking" originally defined by Brocke and Rosemann (2010) and further developed by Reijers et al., (2015). The approach is targeting process developers, who are lacking the systematic approach towards the modeling process. Development of efficient guideline according to the characteristics by Wright and Geroy (2001) based on the collected data and requirements is expected to positively influence the spread of the process information possessed by the case function (Frye and Gulledge, 2007; Balasubramanian and Gupta, 2005).

6.2 Lessons Learned

The initial finding of the research happened early in the timeline and was supported by original data from various sources. The finding was: process development is an elementary part of the business process management and methods included there should be properly documented to ensure quality of process modeling. This finding led to the clear definition of the desired deliverable: guideline with systems and methods for process modeling.

The core of the study was based on the analysis of the end-to-end process in the industrial company supported by the insights from Bergsmann (2012). The end-to-end process management approach by Stefan Bergsmann provided a valuable contribution to this research by being different from the bundling of processes to corporate functions and organizational units as discussed by Becker et al., (2013). As a framework, the environment of the research is presented below while findings of the paper follow.

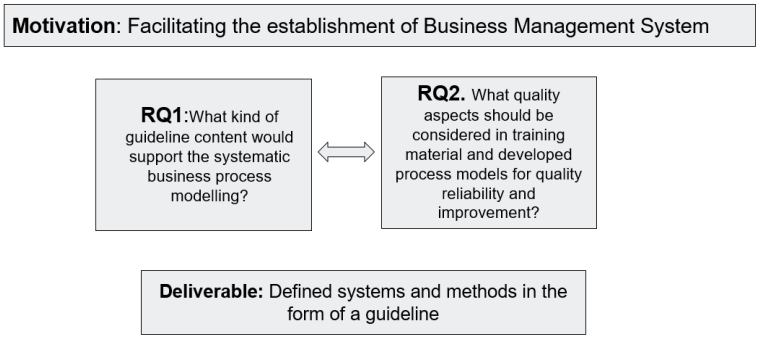

Figure 33. *Relationship between elements in the research*

Conducted literature review highlighted that process-oriented organizations need mature process management. While elaborating on the initial finding and answering **RQ1:** *What kind of a guideline content would support business process management in the case company?,* the definition of standards for business process modeling were reviewed and followed by classification of levels of business process architecture. Later on, the focus was kept on practical relevance and getting an answer for **RQ2**: *What quality aspects should be considered in training material and developed process models for quality improvement?*. For this reason, deliverable as an element of the research can be illustrated as follows:

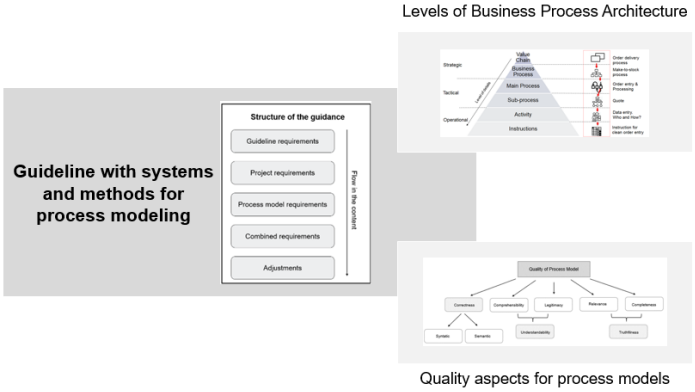

Figure 34.*Research deliverable based on data gathering and analysis*

The figure above illustrates the relationship between research questions and detailed outcome of the research that has had a practical implication in the case company. Process excellence lead has summarized the findings after the implementation of the research deliverable to support the business management system as:

"Development of a modeling guideline with defined systems and methods allows a proactive approach to process modeling and quality control".

While developing a guideline and making a review of individual quality aspects retrieved from the literature, the following fact appeared: guidelines for process modeling that cover requirements specific to the case or project, often cover requirements for developed process models as well. The fact was supported by the observation; however, it was not covered extensively by literature, leading to separate findings related to the methodology. Eventually, the insights gained from the quality-related literature research by Brocke and Rosemann (2010), Koch (2011), Wagner (2001), Wright and Geroy (2001) and some others, covering such concepts as SIQ, ISO, Conceptual modeling and elements of efficient training material were summarized in the framework for quality evaluation to be included in the guideline and applied to case function of the company.

Thus, the research environment led to the development of a process modeling guideline as well as several findings from both literature and case-company study. Findings were combined to target three main issues in the case function while process developers, managers and authors of the revised literature are recognized as the source of these topics as originally discussed in the findings of the current state. The figure below gives

an overview on the research. Literature reference supporting mentioned findings is available as a table in Appendix G.

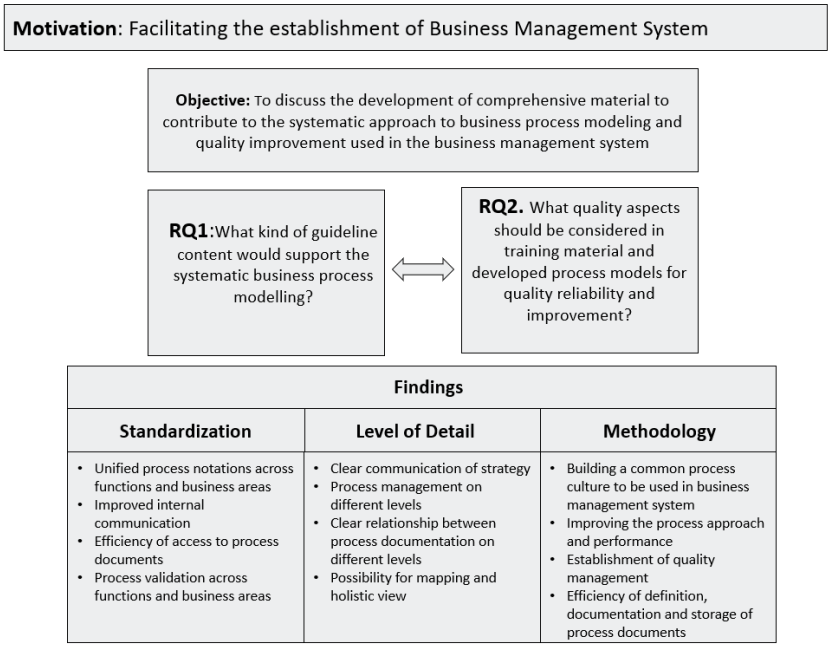

Figure 35. *Findings of the research*

In terms of **standardization**, the problem highlighted by process developers in the case function, findings from the literature review were observed in real life which supported the reliability. Having a system of notations agreed has had a positive contribution to the unification of notations used in different functions which further contributed to easy search for documentation in business management system and efficient communication between users.

During the study, **the definition of levels** was researched as well as the granularity (Fromm, 2006; Balasubramanian and Gupta, 2005; Lind and Seigerroth, 2010). The step was supported by internal and external benchmarking. When levels were applied to existing process documentation, classification made it possible for the management to communicate the company's strategy by the higher-level processes and support the strategy implementation by documentation on lower levels. Approach to review and assessment of documents on different levels was defined. Users and developers were able to see a clear relationship between elements of the end-to-end process obtaining a holistic view. Findings were combined to verify the reliability of a documented system for process modeling in the form of a guideline.

Several findings caused by the establishment of a quality approach for the efficiency of process documentation management were observed in the case function and earlier predicted by the literature review. Definition of **methodology** led to building a common culture towards business process-related documentation which led to high efficiency of the business management system. Improvement of process development performance

took place after building methodology-based guideline, while the improvement of process implementation is expected in a due time.

As a point of lessons learned, it should be noticed that process architecture approach, as well as guideline for process modeling and quality estimation framework, can only be efficiently created depending on a specific need of a company and project. Most companies are not willing to share their experience and approach to business processes. Information security policies make process architecture benchmarking possibilities limited while usually only consultant companies can manage vendor's processes keeping all the sensitive knowledge in-house. For this research, "learning by doing" approach is a substantial part of the guideline development. There is no one common approach for process model quality estimation and for this reason, the modeling guideline of the research is partly based on case-specific features which might be a constraint for objective evaluation of the quality in the project different from the one discussed.

The second point deals with the criteria defined for quality evaluation. Both aspects and more detailed criteria were chosen based on the combination of literature frameworks adopted for the specific needs of the case function. In the future, the criteria might require adjustment if applied in another function of the company or project.

As the third point, the target audience of the guideline is process developers, which makes high quality of process model development to be the main goal. If necessary, quality aspects of the modeling guideline can still be tailored to the specific audience and advanced needs. Most common and expected implications include using the guideline for communicating processes to management, external users, further researchers and even tool vendors for possible process automation.

The thesis work gave an extensive literature review, but it is still possible that a wider view on process architecture, training material, and quality aspects can be found. Additionally, research was based on the requirements of the case company and some requirements as well as external aspects might change by the time if research progresses. If the research in the area continues or need for a new one is confirmed, the input of this thesis work can be used to set a foundation for the new or improved guideline.

7. CONCLUSIONS

The ability of a company to respond flexibly to changing customer and business requirements depends on the ability to manage business processes effectively and efficiently. In the past, however, decentralized organizational structures of globally operating companies meant that developed processes were isolated from each other. Changes in management of process portfolio started from a desire to improve the main customer-focused process. Currently, in the course of business process management, relevant processes are advised to be identified, optimized and modeled in the respect to each other adopting standardized systems and methods while assuring the quality.

The research was motivated by the need for defined components of business process architecture to contribute to the efficient management of process portfolio, establishment of business management system and support of continuous improvement mindset. The present work addressed such topics as business process architecture in a hierarchical view for process modeling as well as quality evaluation and improvement of models. These topics are of increasing interest to the case company due to the undeniable impact that better understanding and management of business processes can have on the effectiveness, consistency, and transparency of activities.

The originality of the approach towards classification for process documentation is the combination of literature studies, benchmarking and current needs of the case function while creating a customized solution used systematically in the business management system. While the originality of the approach towards quality of process models is a proactive combination of different quality types based on theoretical knowledge in the field with the emerging business needs. The quality issue was identified in this research buy the literature review and was addressed before receiving the request from case function’s stakeholders, process developers and users.

The important observation of the research process was that even though both process developers and users in the case company benefit form a process-oriented approach to activities, there is still a resistance to having process modeling aligned to a commonly defined system. The main reason behind it is related to project-specific nature of the approach to process modeling, while the achievement of corporate goals is a higher priority over the harmonization of activities on a function level. To efficiently address the current approach to process modeling, guideline was developed to target process developers and cover various aspects of process modeling including classification, system of notations and quality.

The modeling guideline was developed to be standardized and allow a wider spread of the process knowledge. On the one hand, there was a desire to provide a customized solution for the case function of the company in the scope of the project. On the other hand, case function is not an island and training material as well as process models

developed accordingly aimed at having a wide spread between all types of users. As follows, training material in the form of a guideline was developed to be perceived equally by process developers in different functions, while building a clear approach as a foundation for the business management system, a place to create and store documentation.

Quality in business process models is a challenging topic, and therefore, when targeted to process developers, guideline for process modeling is a powerful tool to improve the quality of existing models according to the defined standard while harmonizing look and feel. This study provides a baseline for training material used in process modeling, while defining process classification, notations, and tools for modeling. In the scope of the research, the quality of training material as a guideline is evaluated based on the customized quality framework. Usually, users perceive the value of process models depending on the content and implementation outcome. For this reason, it was fundamental to provide a high quality of process models to facilitate the proper implementation of the business processes. To ensure the quality of process models, quality of the training material should be on a high level making the guidance efficient during the application.

It is not enough to run business processes day-by-day, systematic approach in the area is fundamental since proper management can lead to an improvement in business operations, ensuring value to the customer while increasing company's profit. Helping process developers to see the systems and methods of process modeling can further lead to the harmonization of the process portfolio in the case function and the whole company. As a consequence, by the result of this research, the strategy deployment of the company can be facilitated by better communication between stakeholders providing possibilities for continuous improvements.

7.1 Limitations and Criticism

Hierarchical view on process architecture is the most controversial topic in this study and brings along some limitations. For the research purpose of the thesis work, different approaches to the business process architecture and modeling were found in the literature, discussed and also compared to the external and internal benchmark as a case study approach. Internal and external benchmarking gave a reason to conclude that there is no common approach to the business process architecture. Companies tend to combine best practices and various methods to customize the approach for their business needs.

This confirms the timeliness and relevance of the approaches to business process architecture presented as part of the research. Most companies use three views of process classification in their process portfolio and map: management, main and support processes. However, there is no standard for any industry and only theoretical research is available for the classification of the processes giving comparable but different views.

From the results of this work, a customized definition for process architecture emerged which is divided into six views: value chain, business process, main process, sub-process, activity and instruction. To build this process hierarchy, a combination of the approaches presented in literature chapter was used supported by the benchmarking to fit the need of the case fucntion.

The design of the process architecture discussed in the thesis evolved from a combination of functional and action-oriented approaches. In conclusion as a response for possible criticism, the research on the subject of "process architecture" is still relatively young and much will have to be clarified in the future. In particular, the development of a process architecture language that is equally recognized in industry and research should be seen as an important task for future research to create a common standard and, thus, better understanding of the business process architecture beyond corporate boundaries.

7.2 Implications for the Future Research

The topic of training material based on the clearly stated elements of process architecture for ensuring quality of business process models has opportunities for the further research. Thus, suggestions for the further research are:

- The current guideline provides only short-term evidence of being beneficial for the quality of process models. To proceed with the research, it is critical to validate the content of the developed process modeling guidance in a longer term. This step should include review of developed process models and check of the delivered quality aspects. The aim is to prove that comprehensive modeling guideline supports the defined process architecture view and provides high-quality of the modeling process.

- As the effectiveness of the guideline is validated it is also important to investigate into ways of communicating the modeling approach to various business areas, functions, units and stakeholders. Communication is essential since changes and updates are required for the improvement. Enforcing the modeling guideline in the organization can provide valuable insights on how to improve business process model quality further in order to fit everchanging needs of the company and customers.

- Another interesting area of the research could be establishment of a modeling guideline that is valid across company boundaries. The guideline may be valuable as a tool for the company to involve the network of partners and suppliers by challenging them and helping them to improve while being involved in business processes. This area of the research arises from the trend

for collaborations across supply chain while working together on various projects. Using common modeling tools and notations can improve communication, however, there is a challenge of handling the change.

- Recently developed process modeling guideline is tailored for the particular function of the company aiming to spread it further across business areas. However, there might be a need to customize the guideline for needs of the specific project while keeping the core content untouched. The research might aim at defining, what information is needed from the project implementation plan and how it can be integrated to the currently used guideline for process modeling.

After all, even if the study results provide some insights to the relationship between efficient training material and quality of developed business process models, it is not possible to fully verify these results due to the lack of previous and current data about the user experience. There might even be a language barrier in developer-owner-user communication which could result in lack of information for the consideration in this paper. To ensure the reliability of the results, experience of several functions or companies should be considered in the future.

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APPENDIX A: CONTENT OF DISCUSSIONS

Process documentation

- Availability of common approach to process modeling in different business areas
- Level of detail during the process modeling
- Quality requirements for process models
- Changes in process design
- reliability of process models, updates
- Clear definition of inputs and outputs
- Modularity of process approach

Governance

- Perception of the process orientation as a way to manage the business rather than a single project
- Leadership of the process organization
- establishment of guidelines and recommendations
- Engagement
- Coordination and integration

Process Ownership

- Assignment of process owner’s role
- Decision-making and influence
- Responsibility for continuous improvement
- Communication with related functions
- Proactive task performance

Performance Measurement

- Specific performance indicators for each process
- Reactive vs proactive performance indicators
- Performance indicators derived from strategic goals and customer requirements
- Improvement actions
- Process benchmarking

Corporate culture alignment with the process orientation

- Understanding of the purpose of the process orientation
- Alignment with the strategy
- Teamwork and communication
- Growth mindset

Continuous Improvement

- Approach derived from the corporate goals to process performance
- Expertise in change management, Lean and business process management
- Methodologies of Six Sigma for process improvement

APPENDIX B: FINDINGS OF LITERATURE REVIEW

Topic	Autor	Finding
Process elements	Bergsmann (2012)	End-to-end process view as key for business process orientation
	Frye and Gulledge (2007)	Relationship between systematically applied process elements, process performance, end-to-end business process scenarios and requirements for system implementation
	Koch (2011)	Process elements for continuous improvement with Six Sigma and TQM
	Schmelzer and Sesselmann (2010)	Process map and steps of process mapping
Process architecture	Balasubramanian and Gupta (2005)	Elements of goal-based process design for process evaluation
	Davenport and Short (1990)	Process map based on defined architecture as a communication tool for change management
	Fromm (2006)	Development of process culture in a process organization with a strong customer orientation
	Frye and Gulledge (2007)	Unified process view across organization for process harmonization and alignment
	Hammer and Champy (1993)	Clear communication of process mapping to the stakeholders
	Lind and Seigerroth (2010)	Definition of core and support processes
	Ljungberg and Larsson (2001)	Eight steps of process mapping as consistent and structured approach
Training material for process design	Wright and Geroy (2001)	Elements of efficient training material
	Trad and Kalpic (2014)	Communicating a process view through suitable training material and support of learning
	Cascio (1992)	Training material's impact of performance and productivity
Quality in process modeling	Brocke and Rosemann (2010)	Process quality is critical for governance, innovations, agility and sustainability
	Harmon (2014)	Relationship between BPM, work simplification, business management and quality control
	Reijers et al., (2015)	Integrative SIQ framework
System support	Imhoff (2005)	Technology gives dissemination of process information and provides basis for proper management and execution
	Marjanovic (2007)	BPM and system integration from a holistic perspective to be suitable for different types of processes
Process integration	Harmon (2014)	Efficiency of using and integrating various business process change supported by the information technology, system
	Crandall and Crandall (2008)	Importance of inter-organizational communication and process compatibility

APPENDIX C: QUALITY CHECKLIST OF PROCESS MODELS

C.1 Quality criteria check of current processes

		1	2	3	4	5	6		25	Score
Correctness	Clear input and output	x	end	x	end	x			x	17/25
	Unique heading based on the naming convention									0/25
	Notations according to the shape guide	x	x	x		x	x		x	19/25
	Systematic naming of process steps									0/25
	Easy to follow logic		x	x	x		x		x	21/25
	Comments avoided				x					16/25
Understandability	Clear objective	x	x	x	x	x	x		x	25/25
	No abandoned elements				x	x	x	n...		17/25
	Available full path	x	x	x	x	x	x		x	25/25
	Decision blocks with at least two outputs	x	x		x	x	x		x	17/25
	Crossing paths is avoided		x	x	x	x	x		x	12/25
	No deadlocks	x	x	x	x	x			x	12/25
Truthfulness	Flexible for modifications		x	x	x	x			x	22/25
	Reliable									8/25
	Comparable	x	x	x		x	x		x	22/25
	Up-to-date	x	x	x	x	x	x		x	25/25

C.2 Quality criteria check of improved processes

		1	2	3	4	5	6		25	Score
Correctness	Clear input and output	x	x	x	x	x			x	23/25
	Unique heading based on the naming convention	x	x	x	x	x	x		x	25/25
	Notations according to the shape guide	x	x	x	x	x	x		x	21/25
	Systematic naming of process steps	x	x	x	x	x			x	23/25
	Easy to follow logic	x	x	x	x	x	x		x	25/25
	Comments avoided	x	x		x	x	x		x	23/25
Understandability	Clear objective	x	x	x	x	x	x		x	25/25
	No abandoned elements	x		x	x	x	x	n...		23/25
	Available full path	x	x	x	x	x	x		x	25/25
	Decision blocks with at least two outputs	x	x	x	x	x	x		x	25/25
	Crossing paths is avoided	x	x	x	x	x	x		x	18/25
	No deadlocks	x	x	x	x	x			x	21/25
Truthfulness	Flexible for modifications	x	x	x	x	x			x	23/25
	Reliable	x	x	x	x	x	x		x	23/25
	Comparable	x	x	x	x	x	x		x	25/25
	Up-to-date	x	x	x	x	x	x		x	25/25

APPENDIX D: KEY CONTENT ELEMENTS OF TRAINING MATERIAL

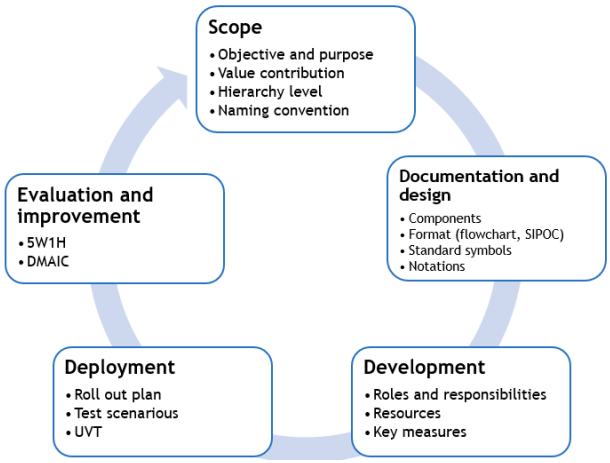

Figure 1. Framework of the step by step guidance for process model development

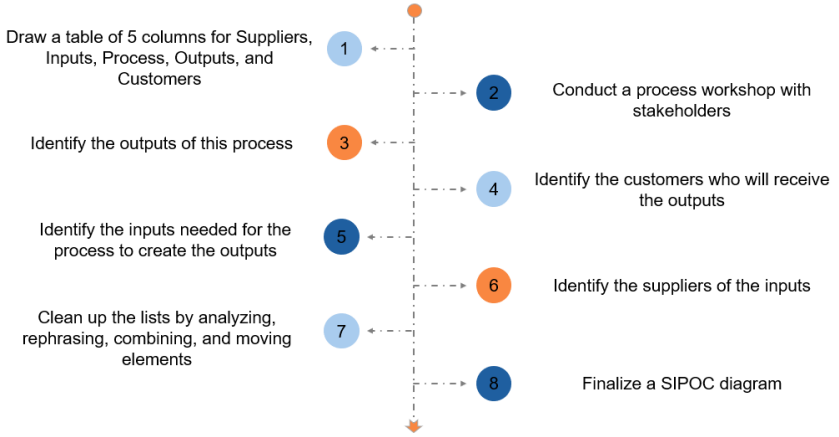

Figure x. SIPOC process development steps

Table 1. SIPOC process description

Title				
Suppliers	Inputs	Process	Outputs	Customers
• Providers of the required resources • Who provides each input?	• Resources required by the process • What inputs enable the process?	• Description of the process and each activity • What are the process boundaries? • What is the process?	• Deliverables of the process • What are the outputs?	• Receiver of the output • Who are customers of outputs?
Critical to Quality: How it affects?				
Scope: What is the scope of the process?				

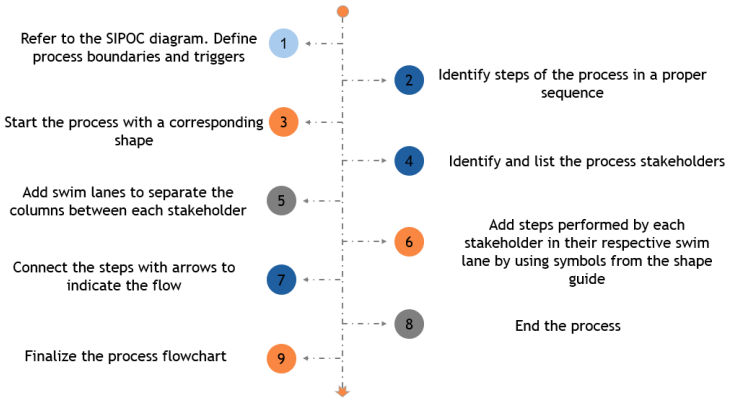

Figure 2. Steps of process flow chart design

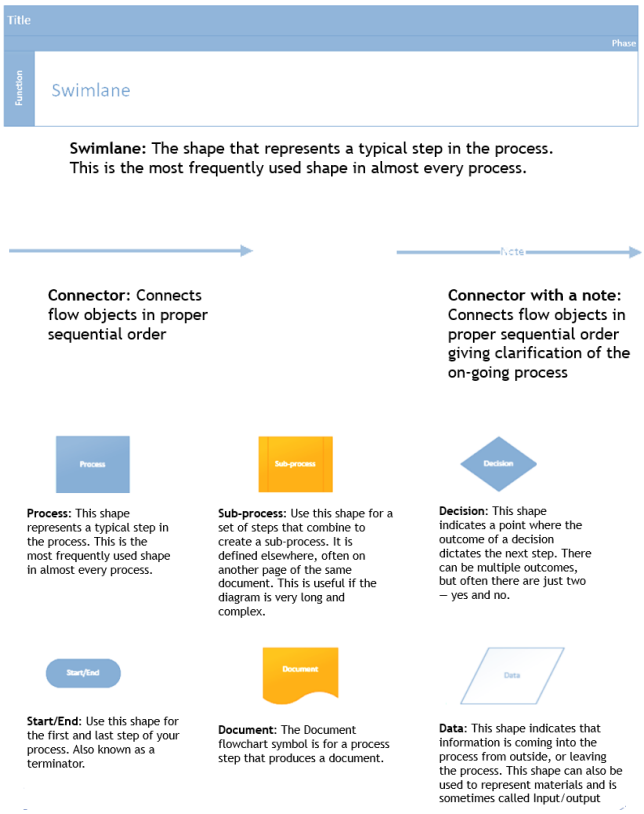

Figure 3. Shape guide

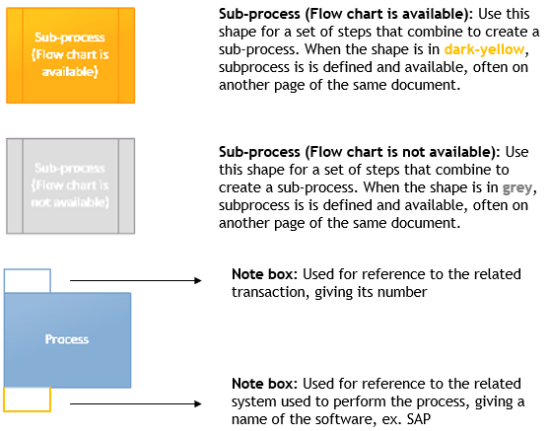

Figure 3.1. proposed additions for the shape guide

APPENDIX E: REQUIREMENT EVALUATION SUMMARY IN THE GUIDELINE

Element	Content	Score
Guideline requirements	• Scope of the guidance	xx
	• Objective of the guidance	xx

Project requirements	• Terms
	  o Definition of the guidance regarding the case
	  o Benefits of the guidance
		x

	• Scoping of the process modeling for the project	x
	• Classification of process levels	

	• Guidance for the process documentation and design
	  o Identification of elements
	  o Design phase
		xx
		xx

	• Modeling notations	
	• Tools	xx
	• Quality aspects	xx
		xx
Process model requirements	• Content quality	xx
	• Standards for design	xx
	• Naming convention	xx
	• Glossary	xx
Combined requirements	• Roles and responsibilities	xx
	• Deployment	x
Adjustments	• Periodicity of the review	x
	• Continuous improvement	x
	• Conclusion with final recommendations for reading process models	x

APPENDIX F: IDENTIFIED PROBLEM, RESPONSE AND REFERENCE

Problem	Description	Response	Key reference
Standardization	Problems regarding standardization of notations, language and tools. **RQ1**	Developed standard for notations used in process flow charts, naming convention and defined systematic approach to the naming of process steps. Unified approach towards the design	Bergsmann (2012) Frye and Gulledge (2007) Schmelzer and Sesselmann (2010)
Detail level of models	Problems with the definition and identification of suitable process hierarchy levels. **RQ1**	Definition of process hierarchy levels, setting criteria for classification of available processes, providing a guideline for process model design depending on the level. System support	Balasubramanian and Gupta (2005) Davenport and Short (1990) Fromm (2006) Frye and Gulledge (2007) Hammer and Champy (1993) Lind and Seigerroth (2010)
Methodology	Problems with communicating a defined process view modeling approach due to the lack of training material for the development of models influencing quality of process models. **RQ2**	Communication with process owners through the guideline developed based on characteristics of efficient training material (accurate, complete, structured, visualized, clear). Step-by-step description of the modeling process mentioning systems and standards to be applied, quality aspects and areas for improvements	Blanchard and Thacker (1999) Brocke and Rosemann (2010) Crandall and Crandall (2008) Wright and Geroy (2001)

APPENDIX G: IDENTIFIED PROBLEM, FINDING AND REFERENCE

Problem/ Research question	Finding	Reference
Standardization / **RQ1**	• Unified process notations across functions and business areas • Improved internal communication • Efficiency of access to process documents • Process validation across functions and business areas	Bergsmann, (2012) Frye and Gulledge (2007) Schmelzer and Sesselmann (2010)
Detail level of models / **RQ1**	• Clear communication of strategy • Process management on different levels • Clear relationship between process documentation on different levels • Possibility for mapping and holistic view	Balasubramanian and Gupta (2005) Davenport and Short (1990) Fromm (2006) Frye and Gulledge (2007) Hammer and Champy (1993) Lind and Seigerroth (2010)
Methodology / **RQ2**	• Building a common process culture to be used in business management system • Documenting standards and methods as an accessible training material (guideline) • Improving the process approach and performance • Establishment of a defined system and quality management • Efficiency of definition, documentation and storage of process documents	Blanchard and Thacker (1999) Brocke and Rosemann (2010) Crandall and Crandall (2008) Imhoff (2005) Wright and Geroy (2001)