Kramp Benelux

Dealing with Custom Orders in a Highly Standardized Order Environment

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Author:
L. Trienes, BSc

Lead supervisor:
dr. M.E. Iacob

Second supervisor:
Dipl.-Wirt.-Inf. F.M. Aulkemeier

Company supervisors:
N. Nijenhuis
E. Volbeda

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School of Management and Governance
University of Twente

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KRAMP

UNIVERSITY OF TWENTE.

DEALING WITH CUSTOM ORDERS IN A HIGHLY STANDARDIZED ORDER ENVIRONMENT

THE ANALYSIS AND REDESIGN OF THE ORDER PROCESS
OF CUSTOMER SPECIFIC ORDERS

LEON TRIENES, BSC

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AUTHOR:	L. (LEON) TRIENES, BSC
STUDENT NUMBER:	0092770
DATE:	NOVEMBER 2013, VARSSEVELD

GRADUATION COMMITTEE:

LEAD SUPERVISOR:	DR. M.E. (MARIA) IACOB
SECOND SUPERVISOR:	DIPL.-WIRT.-INF. F.M. (FABIAN) AULKEMEIER
COMPANY SUPERVISORS:	N. (NEANDER) NIJENHUIS
	E. (ERWIN) VOLBEDA

UNIVERSITY OF TWENTE
PO BOX 217
7500 AE ENSCHEDE
THE NETHERLANDS

KRAMP NEDERLAND B.V.
PO BOX 9
7050 AA VARSSEVELD
THE NETHERLANDS

UNIVERSITY OF TWENTE.

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Abstract

Background – Recently the company, for which the research described in this paper was carried out, increased its focus on the OEM (Original Equipment Manufacturer) market. Since, the company traditionally focusses on wholesale, the general processes within the company are designed around the delivery of commodities. However, since orders from OEM customers often contain order lines of non-commodity products (e.g. kits, production parts or sourcing parts), current business processes are thought to contain bottlenecks which prevent the company from efficiently processing these orders. The research in this paper seeks to analyse the order process of these customer specific orders and to make recommendations for improving these processes.

Research design – In order to analyse these business processes they were modelled using the comprehensive and widely used standardized modelling language BPMN. After the analysis, recommendations were made regarding process improvement. Subsequently, the proposed redesign was validated and refined by discussing it with key users and experts within the company. Finally, a business case was used to specify the redesign benefits and to give an indication of the costs and risks associated with the implementation of the proposed redesign.

Findings – The scope of the analysis was set to the processing of customer specific order that are received by the company through email, fax or phone (i.e. excluding orders received through EDI – Electronic Data Interchange). During the analysis of the current process it became clear that there exist a number of bottlenecks. The bottlenecks can be related to; the complexity of order input, the current division of labour between Commercial Support and OEM Sales, the availability of order confirmations, and the ERP system currently in use. However, it was determined that only the first three bottlenecks would fall within the scope of the project. Order input complexity and availability of order confirmations were categorized as IT-related bottlenecks, the division of labour was categorized as a bottleneck related to the distribution of resources. For both types of bottlenecks a redesign was proposed that tried to fully eliminate that specific bottleneck. After discussing both redesigns a final redesign was composed that incorporated those elements that were considered to contribute the most to the elimination of these bottlenecks. This redesign was validated and refined by discussing it with a number of key users and IT consultants. Based on the business case, the company is advised to at least implement those features of the redesign that; simplify the order entry of call-off orders and transfer tasks that do not involve customer contact to the Commercial Support department. Since the business case did not sufficiently provide clear evidence to suggest that the benefits obtained from adapting the order confirmation process outweigh the costs, the company is advised to look for additional evidence regarding these benefits before implementing this change.

Research limitations – The validity of the proposed redesign was assessed by consulting key users and experts within the company. Although the sample of consulted users was representative for the population, the sample size might be considered somewhat limited. Another limitation regards the business case that was developed for the proposed redesign. It turned out that in most cases, it was hard to determine the (financial) value of the costs and benefits the company will incur when the redesign is implemented. In order to make a better-informed decision when it comes to choosing between investment options, future research should look into ways to overcome the quantification problems of some of these costs and benefits.

Practical implications – Based on the analysis and redesign of the current process, and the business case that was developed, the company can make an informed decision regarding the selection of process improvements to invest in.

Value – The value of this research lies in the creation of an artefact, in this case the redesigned business process. We argue that, with the implementation of proposed redesign, the order process of customer specific orders will improve, as the redesign causes order entry errors and order entry costs to reduce, and customer satisfaction to increase.

Keywords: Business process management, business process analysis, business process modelling, business process redesign, business case development, design science research methodology

Paper type: Master thesis

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Leon Trienes

Winterswijk, 18 October 2013

Contact information:

✉ l.trienes@alumnus.utwente.nl

linkedin.com/in/leontrienes

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List of Abbreviations

ABBREVIATION	DESCRIPTION
ATO	ASSEMBLE-TO-ORDER
ATS	ASSEMBLE-TO-STOCK
BDN	BENEFITS DEPENDENCY NETWORK
BPA	BUSINESS PROCESS ANALYSIS
BPD	BUSINESS PROCESS DIAGRAM
BPM	BUSINESS PROCESS MANAGEMENT
BPMN	BUSINESS PROCESS MODEL AND NOTATION (PREVIOUSLY KNOWN AS BUSINESS PROCESS MODELLING NOTATION)
BPMS	BUSINESS PROCESS MANAGEMENT SYSTEM
BPR	BUSINESS PROCESS REDESIGN
COMMON	COMMERCIAL SUPPORT – "COMMERCIËLE ONDERSTEUNING"
CRM	CUSTOMER RELATIONSHIP MANAGEMENT
CSF	CRITICAL SUCCESS FACTORS
DIFOT	DELIVERED IN-FULL, ON-TIME
DS	DESIGN SCIENCE
DSRM	DESIGN SCIENCE RESEARCH METHODOLOGY
EDI	ELECTRONIC DATA INTERCHANGE
EPC	EVENT-DRIVEN PROCESS CHAIN
ERP	ENTERPRISE RESOURCES PLANNING
FTE	FULL-TIME EQUIVALENT
IT	INFORMATION TECHNOLOGY
KIT	A COLLECTION OF MULTIPLE PARTS (ALSO CALLED A SET)
KPI	KEY PERFORMANCE INDICATOR
KSC	KRAMP SERVICE CENTRE
MTO	MAKE-TO-ORDER
OC	ORDER CONFIRMATION
OEM	ORIGINAL EQUIPMENT MANUFACTURER
OMS	ORDER MANAGEMENT SYSTEM – THE COMPANY'S ERP SYSTEM
RAS	RELATIONSHIP ACTIVITY SYSTEM – THE COMPANY'S CRM SYSTEM
RFM	REQUEST FOR MODIFICATION – FORMAL REQUEST REGARDING AN IT-RELATED CHANGE
S&P	THE COMPANY'S WAREHOUSE MANAGEMENT SYSTEM
UML AD	UNIFIED MODELLING LANGUAGE ACTIVITY DIAGRAM
WFM	WORKFLOW MANAGEMENT
XML	EXTENSIBLE MARKUP LANGUAGE
XPDL	XML PROCESS DEFINITION LANGUAGE

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1 Introduction

1.1 About Kramp

Kramp, headquartered in Varsseveld (the Netherlands), is one of the largest technical wholesalers in Europe. They define themselves as a one-stop supplier of spare parts, technical services and business solutions, and act as a strategic partner for agricultural, landscaping and forestry companies, as well as for the earth-moving industry sector and original equipment manufacturers (OEMs) (Kramp Groep, 2013b). In the Netherlands the company is considered to be the market leader where they carry over 500,000 different product of which over 150,000 are available in stock. The company plans on increasing these numbers to 1.5 million and 500,000 respectively towards the end of 2016. Currently they process over 5,000 orders per day, totalling over 30,000 order lines. In 2001 Kramp set up a webshop where their customers can order their products, currently over X% of all orders are placed through their webshop (Kramp Groep, 2013a). However, customers also have the option of ordering products using fax or e-mail, these orders are generally processed by Commercial Support (located in Lummen, Belgium). Kramp primarily uses overnight distribution to deliver their products to its customers. Items that are ordered before 6 p.m. will be delivered to the customer the next day before 8 a.m. (provided the items are in stock and ordered through the webshop).

Next to its standard wholesale activities Kramp also offers its customers a number of value-adding business solutions. To simplify the order process at their customers Kramp can provide scanners which the customer can use to scan the barcode of the products they wish to order. The scanner's data file can then be exported to the webshop, after which the products can be ordered (Scan 2 Order). A similar concept which uses a tablet computer is also available. In this case the product page of an item is immediately display on the tablet when the item is scanned, after which the item can be ordered through the webshop immediately (Scan 2 Mobile). The company also supports electronic data interchange (EDI) between their system and the customer's Enterprise Resource Planning (ERP) system. Another important business solution is set/kit deliveries, with this the company offers customers sets of pre-packaged (customer specific) parts which, depending on the customer demand, can for example be delivered in a specific assembly sequence or even (partly) pre-assembled. Next to that the company also offers customers stock management solutions (e.g. based on a 2-bin system).

Beside the business solutions mentioned above, Kramp also offers a number of technical solution such as (cooperative) engineering and prototyping, assembly, machining and cylinder reconditioning. Furthermore, they offer retail services that support customers in their marketing, sales, administration and order process.

1.2 Research Problem

Over the last decade the company's turnover has doubled and it is expected to further increase in future. Currently the company is expanding its business in Eastern Europe, next to that it is heavily investing in the OEM market in the Benelux, Germany, Austria, Switzerland, France, Spain and Italy. The latter relates to the research problem that will be discussed in this paper.

Over the last few years the demand from the OEM sector has been steadily increasing. Although the company considers this to be a positive development, it also causes some problems. Customers, especially those within the OEM sector, increasingly express their interest in value-adding services like set/kit deliveries and pre-assembled parts. Furthermore, orders from OEM customers often contain order lines with production parts (e.g. hydraulic hoses with customer specific couplings), sourcing parts (e.g. parts designed on customer request, produced by a sourcing partner), reserved parts, and parts from the extended assortment (i.e. not kept in stock, but available through a supplier). Since Kramp historically is a wholesaler, the processes within the company are focussed on the delivery of commodities, not on production activities or other customer specific orders. The abovementioned developments cause the workload of the internal departments responsible for these activities to increase, thereby also making it harder to schedule these activities.

1.3 Research Goal

The goal of the research proposed in this paper is to improve the order process of customer specific orders in order to reduce lead time, rework and overall workload, while at the same time increasing customer satisfaction.

1.4 Research Questions

In order to address the research problem at hand, the following research question is proposed:

"How can the order process of customer specific orders be improved in order to reduce lead time, rework and overall workload, while at the same time increasing customer satisfaction?"

To answer this main research question, the following sub-questions are established:

RQ1 Which (scientific) approaches are available to address this particular research problem?

- What is business process management?
- What is business process analysis?
- What is business process modelling?
- What is business process redesign?
- What constitutes a good business case?

RQ2 What are the requirements of Kramp regarding the business process redesign?

RQ3 What type of solution is most desirable for Kramp?

- Who are considered to be the main actors and stakeholders?
- How do the actors define customer specific orders?
- What problems do the actors and stakeholders experience regarding these orders?
- Which type of solutions are feasible within the scope of this project?
- How are these type of solutions designed?
- How are these type of solutions put into practice?

RQ4 Which methods are appropriate for validating the redesign?

- How can the redesign be validated using such a method?

RQ5 What are the costs and benefits for Kramp regarding the redesign implementation?

- What does the business case for the proposed redesign look like?

1.5 Research Scope

In order to prevent the research from becoming too broad, the scope of the research will be delimited in this paragraph. The research in this paper will focus on improving the order process of customer specific orders within the departments responsible for the OEM market, therefore these aspects will be described below.

1.5.1 Customer Specific Orders

Like mentioned above, the company offers their customers value-adding services like set or kit deliveries and pre-assembled items which are tailored to the individual customer's demand. Furthermore, OEMs often place orders containing order lines with production parts, sourcing parts, pre-reserved parts and extended assortment, therewith these types of orders differ greatly from general orders, which mainly contain commodities.

In order to get a workable and unambiguous definition we define a *customer specific order* as: an order that is received through email, fax or phone (i.e. non-EDI orders) containing order lines of non-commodity parts like; set deliveries, production parts, sourcing parts, reserved parts and extended assortment. Where sourcing parts, reserved parts and extended assortment mainly require administrative operations, set deliveries and production parts also require actual physical operations.

1.5.2 Main Actors Involved

The main actors involved in the order process described above are the *customer specialists* and the *Commercial Support department* for the administrative operations. Furthermore, the *Kramp Service Centre (KSC)*, the *workshop*, and the *BK-department* are responsible for the physical operations. The KSC is concerned with orders that are made-to-order (MTO). The workshop generally deals with orders that need to be assembled-to-order (ATO). Whereas the BK-department mainly handles the assembly of kits, either based direct customer demand (ATO) or expected customer demand (ATS).

Next to these actors, there are a number of other actors that are also involved in the order process of these customer specific orders. The *purchasing department* and *sourcing specialist* together with the *logistics department* are responsible for the availability of the different items. Whereas, the *IT department* plays a facilitating role and maintains the ICT infrastructure.

1.6 Research Approach

The theoretical framework of this research is based on a literature review. With this literature review we try to answer the descriptive ('What is…?') research questions posed earlier. The overall purpose of the theoretical framework is to serve as a guide for conducting the research.

After the theoretical basis has been established the current order process will be analysed using a number of qualitative techniques. The current order process will be modelled based on information obtained from discussions held with the different actors and from procedures that are documented within the company. Next, the complexity of the order process and the related problems are analysed through the use (semi-structured) interviews with the main actors.

Based on the bottlenecks found in the analysis phase, a number of alternative processes will be designed. Next, these redesigns will be assessed in terms of validity and feasibility by a number of actors closest to the processes under investigation. The process design that is considered the most suitable will be modelled in greater detail, after which the complexity and potential problems of the new design are assessed by discussing the process models with key users and experts within the company. We will further elaborate on the methodology in the Research Design section of this paper.

1.7 Research Contribution

The main goal of the research described in this paper is to solve the identified organizational problem by creating and evaluating an artefact (i.e. the newly designed business process), thereby the research can be characterized as design science (Hevner, 2004).

Design science research can contribute to research in several ways; either by creating an artefact, by extending or improving the design science knowledge base, or by developing and evaluating design science research methodologies (Hevner, 2004). The contribution of the research described in this paper clearly lies in the creation of a design artefact.

1.8 Thesis Outline

In the next chapters we will; provide the theoretical background of the research using a literature review, further elaborate on the research methodology, describe the outcomes of the research, and provide an answer to the research questions. Finally, we will discuss the limitations of the research and provide directions for future research.

2 Theoretical Framework

When a company is looking to improve their business processes, terms like business process management (BPM), business process analysis (BPA), business process modelling and business process redesign (BPR) immediately come to mind. These fields of study all play an important role in devising new process designs that are superior to the existing ones in one or more ways. Generating these improved process designs is considered one of the most powerful ways boost business performance and raise customer satisfaction (Limam Mansar & Reijers, 2005).

In this chapter we will discuss the current state-of-art of literature, which has been assessed through a literature review using Scopus and, additionally, Google Scholar. By using Google Scholar supplementary to Scopus, missing top journals are covered (e.g. Journal of MIS). The main search terms that were considered are: “design science”, “business process management”, “business process engineering”, “business process analysis”, and “business process modelling” (and derivatives of these search terms). The papers and books considered for review were selected based on an assessment of the title, abstract, the number of citations it received and the year it was published. Moreover, papers had to be peer-reviewed and preferably publish in a high ranking journal, whereas books were preferably published by an academic publisher. Additional peer-reviewed articles were selected using a forward and backward citation analysis. The results of the literature review are described below.

2.1 Business Process Management

Business process management (BPM) can be seen as a comprehensive system for managing and transforming organizational operations (Hammer, 2010). It is a *consolidation of disciplines*, like workflow management, lean management and Six Sigma, which share the belief that a *process-centred approach* leads to substantial improvements in both performance and compliance of a system (Vom Brocke & Rosemann, 2010).

Van der Aalst**,** Ter Hofstede and Weske (2003) define business process management (BPM) as: “supporting business processes using methods, techniques, and software to design, enact, control, and analyse operational processes involving humans, organizations, applications, documents and other sources of information” (p.4). Business process management is used to boost corporate performance by optimizing organization specific business processes with an *emphasis on operational aspects*. To achieve this, BPM tries to manage change by controlling (end-to-end) workflows (Hammer, 2010). Such end-to-end workflows typically consist of a chain of process steps that starts as a result of a customer trigger and ends when a successful outcome for the customer is reached (Davis, 2010).

BPM has two main antecedents; *quality management* and *business process reengineering* (Hammer, 2010). Quality management refers to programs and initiatives that emphasize *incremental improvement* in work processes, whereas reengineering refers to discrete initiatives that are intended to achieve *radical redesign and improvement* of these processes (Davenport & Beers, 1995; Hammer, 1990). Although both these antecedents have proven themselves when it comes to process improvement, they do suffer from some limitations (Hammer, 2010) which will be mentioned below.

The main limitations of quality management lie in its rather broad definition of a process (i.e. *any sequence of work activities*) and its goal of eliminating variation and achieving consistent performance. However, not every process is strategically significant for the company as a hole, and consistency does not necessarily stand for good (Hammer, 2010). Business process reengineering on the other hand provides a better definition of a process (i.e. end-to-end), but lacks the continuous improvement aspects of quality improvement (Hammer, 2010). The intention of BPM is to mitigate the limitations of both approaches and combine their strong aspects.

"Over the last decade, these two [abovementioned] approaches to process performance improvement have gradually merged, yielding modern business process management" (Hammer, 2010, p.4). Today, BPM can be seen as a truly "holistic management discipline" (Rosemann & Vom Brocke, 2010, p.107), which "addresses the interdependence of strategy, people, processes and technology in achieving business objectives" (Hung, 2006, p.23).

Weske (2012) argues that "a company can reach its business goals in an efficient and effective manner only if people and other enterprise resources, such as information systems, play together well" (p.3). The author considers "business processes [to be] an important concept to facilitating this effective collaboration" (p.3). In line with this argument, Hammer (2010) states that the performance of a process may fail to meet performance requirements for one of two reasons; *faulty design* or *faulty execution.* While execution difficulties are generally easy to resolve once the root cause is known (e.g. provide training, repair equipment, or increases available resources), design flaws are generally much harder to deal with. In order to tackle a design problem, the entire process needs to be analysed, an appropriate intervention has to be chosen and implemented and results have to be assessed, after which the entire cycle, again, arrives at the analysis phase (Hammer, 2010).

The cycle describe above is considered to be one of the fundamentals behind the business process management approach and is referred to as the business process lifecycle or process management cycle (Weske, 2012; Hammer 2010). The business process lifecycle (see Figure 1) consists of four phases; design & analysis, configuration, enactment, and evaluation. In the *design and analysis phase* business processes are identified and modelled, after which the initial design is validated using multiple

techniques, including simulation and validation. The *configuration phase* encompasses the integration of the newly designed business process with existing systems while also taking into account the interaction of employees with the system. In the *enactment phase* business processes are executed and monitored. Based on the logs created during process enactment, the business processes and their implementations can be evaluated and improved. This is done during the *evaluation phase* of the business process lifecycle (Weske, 2012). After the evaluation phase the cycle will once again arrive at the design and analysis phase, indicating the continuous improvement characteristics incorporated in business process management.

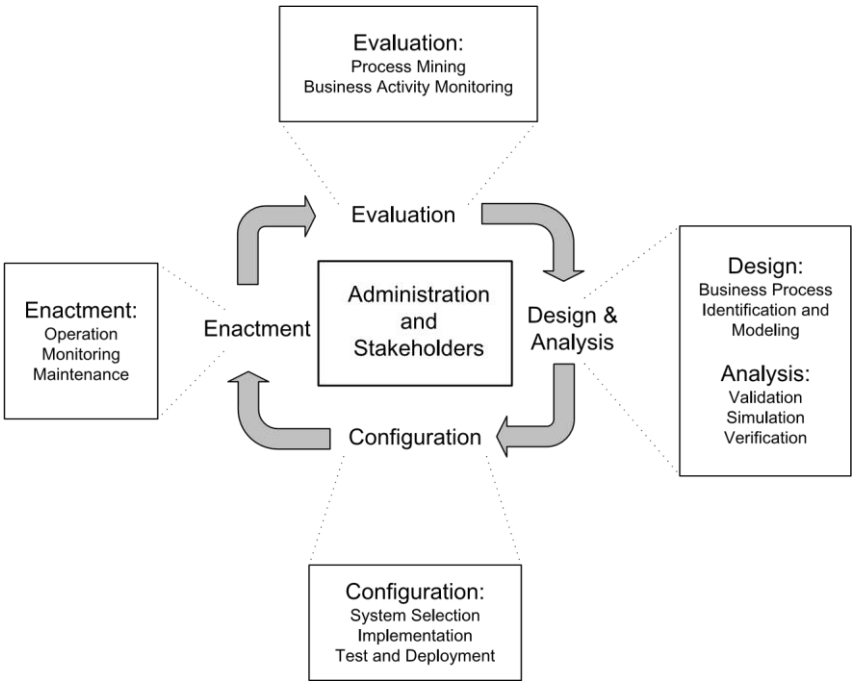

FIGURE 1: BUSINESS PROCESS LIFECYCLE (WESKE, 2012)

2.2 Business Process Analysis

"The business process lifecycle is entered in the Design and Analysis phase, [in this phase] […] business processes are identified, reviewed, validated, […] [after which they can be] represented by business process models" (Weske, 2012, p.11). Therewith, business process analysis is considered an important aspect of BPM.

Business process analysis (BPA) aims at investigating properties of business processes that are neither obvious nor trivial. To this end, the term analysis is used with a rather broad meaning, including, for example, simulation and diagnosis, verification and performance analysis (Van der Aalst et al., 2003). By including this diagnosis component, process analysis, and therewith BPM, differentiates itself from workflow management (WfM) (Ko, Lee, & Lee, 2009).

There are numerous business process management standards and specifications, each addressing at least one of the four phases of the BPM lifecycle (i.e. process design & analysis, system configuration, process enactment, and evaluation). These standards can be characterized as *graphical*, *execution*, *interchange* or *diagnosis standards*. (Ko et al., 2009). The graphical standards "allow users to express the information flow, decision points and the roles of business processes in a diagrammatic way" (Ko et al., 2009, p.754). The execution standards "enable business process designs to be deployed in BPMS [business process management systems] and their instances executed by the BPMS engine" (Ko et al., 2009, p.759). The interchange standards are used to translate these graphical standards into execution standards (Ko et al.). The diagnosis standards "monitor and optimize business processes running in and across companies' BPMS" (Ko et al., 2009, p.772). Figure 2 provides an overview of these different categories of standards, including an indication of their expression level.

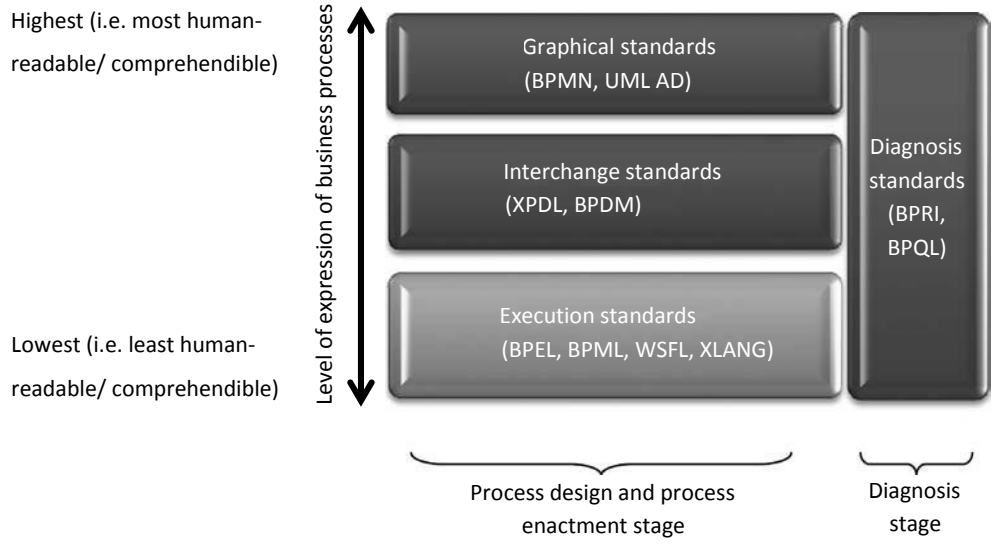

FIGURE 2: CATEGORIES OF CURRENT BPM STANDARDS IN RELATION TO THE BPM LIFECYCLE (ADAPTED FROM KO ET AL., 2009)

Van den Berg, Franken and Jonkers (2008) provide a roadmap for the analysis of business processes, which starts with the formulation of the goals of the analysis and ends with an overview of issues related to the business process. The Research Design section of this paper will delve deeper into the use of this roadmap within business process analysis.

2.3 Business Process Modelling

"Arguably, the most important goal of business process management is a better understanding of the operations a company performs and their relationships. The *explicit representation of business processes* [emphasis added] is the core concept to achieving this better understanding" (Weske 2012, p.21). This statement typifies the attention given to the modelling of business processes within business process management (e.g. Van der Aalst et al., 2003; Van den Berg et al., 2008; Weske, 2012).

This particularly holds for the business process analysis and design phase of BPM cycle, where "business process modelling is the core technical subphase" (Weske, 2012, p.12). In order to model these business processes in a comprehensive and usable way, the appropriate BPM standards should be selected. Preferably those standards that work together well at the different levels of expression (Ko et al, 2009).

Like mentioned above, there exist numerous standards in business process management. However, Ko et al. (2009) identify only a small number of prominent BPM standards that are suited for each of the levels of expression of the business processes.

At the graphical level Ko et al. (2009) discuss the Business Process Modelling Notation (BPMN), the Unified Modelling Language Activity Diagrams (UML AD), and the Event-driven Process Chain (EPC). While the latter is simple and easy to understand for non-technical users, it has some limitations in terms of its semantics and syntax and is not classified as a graphical standard (Ko et al., 2009). Regarding UML AD, Ko et al. state that it is very useful when designing single level business processes. However, they note that sub-processes are not easily modelled within a UML AD. BPMN on the other hand does provide this possibility (White, 2004). Moreover, the basic elements of BPMN are easy to comprehend (Weske, 2012). The main drawback of BPMN that the Ko et al. (2009) put forth is the lack of an XML (Extensible Markup Language) interchange format for BPMN diagrams.

However, in the most recent version (2.0) of BPMN (which has since been renamed Business Process Model and Notation) this issue has been addressed (Weske, 2012). With the release of the current version of BPMN the XPDL (XML Process Definition Language) interchange standard, describe by Ko et al. (2009), can be used to represent business process diagrams (BPDs) (Weske, 2012). Since BPMN now supports these interchange standards, the process models can, through this interchange standard, automatically be transferred to tools focussing on executable processes. These executable processes can be described using an execution standard like BPEL (Business Process Execution Language) which matches the interchange standard used (Weske, 2012). This makes for BPMN to be a suitable standard for modelling the business processes covered in this paper.

In order to graphically model business processes, BPMN uses a number of different elements, which are divided in four basic categories; flow objects, artefacts, connecting objects and swimlanes. A more detailed overview of these components can be found in Appendix A: Elements of BPMN.

2.4 Business Process Redesign

The degree of business process redesign can range from evolutionary improvements to radical redesign (Weske, 2012; Van den Berg et al., 2008). In order to determine the level of change that is needed, the business processes are identified and modelled in the first phase of the business process lifecycle (i.e. design & analysis). The next step involves devising a number alternatives for these processes, after which the most appropriate (re)design is chosen. Next to the roadmap for business process analysis, mention earlier, Van den Berg et al. (2008) also provide a systematic approach that helps in the redesign of these business processes. We will further elaborated on this particular approach in the Research Design section of this paper.

In order for a process redesign to be effective (i.e. deliver high performance over time) Hammer (2007) introduces two kinds of characteristics that a company needs to develop; *process enablers* and *organizational capabilities*. The process enablers are used to evaluate individual processes (i.e. determine how well they are able to function over time), while the enterprise capabilities focus on the entire organization (i.e. evaluate whether the company is ready to support the process-based transformation) (Hammer). An overview of these enablers and capabilities can be found in Table 1.

TABLE 1: PROCESS ENABLERS & ENTERPRISE CAPABILITIES (HAMMER, 2007)

Process enabler	Description
Design	The comprehensiveness of the specification of how the process is to be executed
Performers	The people who execute the process, particularly in terms of their skills and knowledge.
Owner	A senior executive who has responsibility for the process and its results.
Infrastructure	Information and management systems that support the process.
Metrics	The measures the company uses to track the process's performance.

Enterprise capability	Description
Leadership	Senior executives who support the creation of processes.
Culture	The values of customer focus, teamwork, personal accountability, and a willingness to change.
Expertise	Skills in, and methodology for, process redesign.
Governance	Mechanisms for managing complex projects and change initiatives.

It is argued that a company that develops and possesses these two characteristics will be able to better manage the redesign of their business processes, because it "helps executives plan process-based transformations, track their progress, and identify roadblocks" (Hammer, 2007, p.112).

2.5 Business Case Development

A business case is generally considered to play a pivotal role in the allocation of organizational funding and the prioritization of projects (Jeston & Nelis, 2008; Ward, Daniel & Peppard, 2008). Furthermore, a well written and executed business case has the ability to guide a (BPM) project towards a successful completion (Jeston & Nelis). Typically, a business case report should contain at least an orientation, analysis and advisory part (Nathan, 2013).

From a *project manager's perspective* a business case is conducted in order to obtaining project approval and acquiring resources and funding. From a *business' perspective* a business case can be used to; commercially justify the project, assess whether the project is in line with the company's objectives, determine the value the project will add to the company, and to help executives select the project that best makes use of the organization's resources (Jeston & Nelis, 2008). Additionally, a comprehensive and robust business case is necessary to; identify ways to deliver the benefits identified, ensure business managers' commitment and create a basis for reviewing whether or not the expected benefits have been realized (Ward et al., 2008). The latter is found to be a particularly important differentiator in the successfulness of business case development (Ward et al.).

Although "[t]he aim of any business case is to express as many of the benefits as possible in financial terms", it is also important to consider non-financial benefits (Ward et al., 2008, p.2). Furthermore, the authors argue that rigorous evidence is needed to justify the investment in a project, preventing benefits from being overstated and projects oversold (Ward et al.).

Since business process management emphasizes on process aspects, the actual value a project adds to the organization (in terms of costs and benefits) remains somewhat unclear. Therefore constructing a business case can be a useful addition in the implantation and validation of a business process redesign project. The approach to business case development that will be used in this paper is based on the six-stage business case development approach described by Ward et al. (2008). The Research Design section of this paper will go into this approach in more detail.

2.6 Conclusion

With the literature review, described in this chapter, we have tried to elaborate on the (scientific) approaches that are available to address the research problem at hand, and to create a theoretical framework that can be used in conducting the proposed research. We chose to do so by discussing the concept of business process management in relation to business processes analysis, business process modelling and business processes redesign. Finally, the paper briefly discussed literature related to business case development.

To summarize; it was found that BPM can be seen as a consolidation of process-centred approaches like quality management and business process reengineering. BPM tries to combine the strengths of its antecedents, while at the same time mitigating their weaknesses. This results into a truly holistic management approach that also takes the interdependence of strategy, people, processes and technology into account.

One of the fundamentals behind the BPM approach is the business process lifecycle which describes the different steps that need to be taken to reach the goals of business process management. The design and analysis phase of the business process lifecycle addresses an important aspect of BPM, namely the explicit representation of business processes. In order to create a model that represents these business processes a suitable graphical modelling standard is needed. BPMN is considered to be such a standard for it works well with other standards (at different expression levels).

The construction of a comprehensive and robust business case adds to a BPM project for it identifies the project's costs and (non-)financial benefits, therewith justifying the investment in the project. Ultimately a good business case prevents the project's benefits from being overstated and the project oversold.

3 Research Design

This chapter will elaborate on the design of the research described in this paper. First this chapter will provide a brief description of design science on which the Design Science Research Methodology (DSRM) of Peffers et al. (2007) is based. This particular methodology forms the basis of the paper's research design. Next, this chapter will describe the different methods used, and elaborate on the link between design science and business process management (BPM), business process analysis (BPA), business process modelling and business process redesign (BPR). Subsequently, this chapter will go into the methods used for the validation of the proposed process redesign. Finally, the steps that are needed to develop a business case for the proposed redesign will be discussed.

3.1 Design Science

As opposed to natural science and social science, which tries to understand reality (Peffers et al., 2007), "design science [DS] … creates and evaluates IT artefacts intended to solve identified organizational problems" (Hevner et al., 2004, p.77). The research problem stated in this paper can also be addressed by creating such an artefact. "Conceptually, a design research artefact can be any designed object in which a research contribution is embedded in the design" (Peffers et al., 2007, p.55). By following Peffers et al.'s Design Science Research Methodology (DSRM) (Figure 3) it is possible to create a model in which the solution of the problem is embedded. Because this methodology serves as a framework for carrying out DS research it is possible to validate the research without resorting to ad hoc arguments (Peffers et al., 2007). The latter is one of the most important arguments for using such a methodology since it justifies the notion of design as a science.

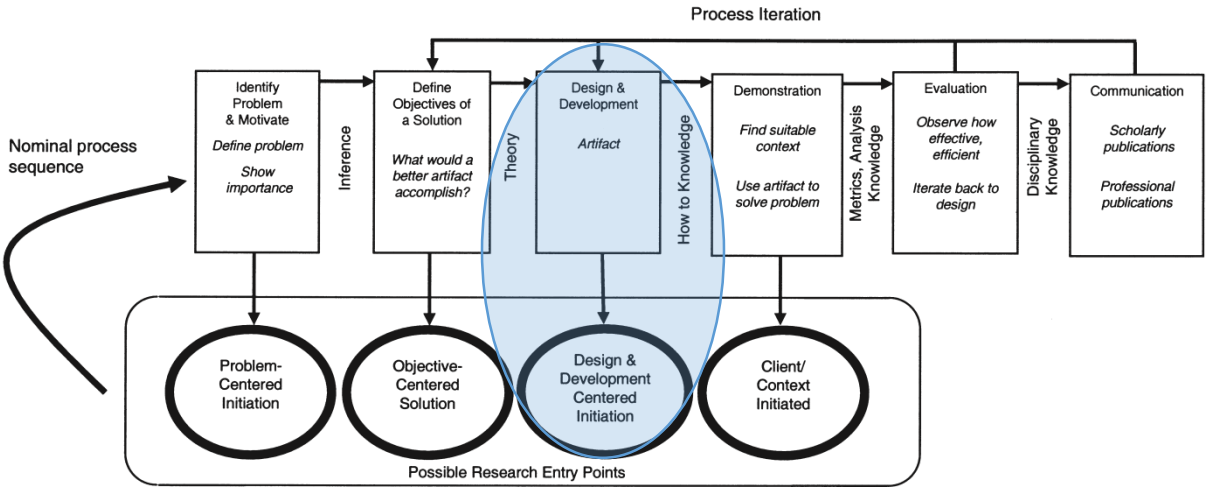

FIGURE 3: DSRM PROCESS MODEL (ADAPTED FROM PEFFERS ET AL., 2007)

3.2 Design Science Research Methodology

The overall research design used in this paper is derived from the design science research methodology (DSRM) by Peffers et al. (2007). Like mentioned above, the use of the design science research methodology results in the creation of an artefact as solution to a problem. In order to come to such a solution the DSRM process consists of six steps: problem identification and motivation, define the objectives for a solution, design and development, demonstration, evaluation, communication (see Figure 3) (cf. March & Storey, 2008). In the following paragraphs we will discuss the business process analysis approach and the business process redesign approach of Van den Berg et al. (2008), and the validation of the redesign. Together these approaches largely cover the different steps described by the DSRM. However, in the research described in this paper the emphasis lies in the *design and development stage* (highlighted in Figure 3).

3.3 Business Process Analysis Approach

The approach to business process analysis proposed by Van den Berg et al. (2008) comprises five steps. The first step consists of defining a goal, research question and boundary condition. Furthermore the actors, processes and information involved in the analysis should be defined. This step has been covered in the introduction.

In the second step of the analysis approach, the analysis techniques (e.g. interviews, surveys, or process models) that will be used are determined. In order to acquire the information that is needed to create the models used in the analysis of the current situation, procedures and work instructions, documented within the company, will be analyse. Additional information that is needed to model the current processes is retrieved from discussions with the actors that are involved in the different processes on a day-to-day basis.

The third step involves the actual modelling of the processes that need to be analysed. To model the processes the BPMN standard, which was described in the previous chapter, will be used. The main reason for choosing this standard is the comprehensibility of this particular graphical notation, enabling the stakeholders to discuss the processes and refine and improve them (Weske, 2012). Furthermore, like mentioned above, the standard works together well with the different business process modelling standards described by Ko et al. (2009). The validity of the process models will be assessed by going through the models and discussing them with the key users. Based on the assessment, the process models will be improved until they are found to be satisfactory.

After this step, the bottlenecks in the business process will be determined together with the causes or symptoms of these bottlenecks. This will be done using a semi-structured interview, which will be carried out among a group of interviewees that consists of a selection of main actors (i.e. the actors

closest to the processes under investigation). The selection of the actors will be made based on the availability of the actors (i.e. be dependent on the actor's work schedule). The reasons for choosing a semi-structured interview approach lie in the fact that, although it has some degree of predetermined order, it ensures flexibility in the way issues can be addressed (Longhurst, 2010). This also makes it that semi-structured interviews are useful for investigating a diversity of experiences and for uncovering issues that interviewees consider particularly important (Longhurst). The list of predetermined questions that were used to guide the interview can be found in Appendix B: Interview Questions).

In the final step of the business process analysis approach the bottlenecks that were discovered will be compared to the goals set in step one, after which the bottlenecks are prioritized. The results from the analysis can then be used in the redesign of the business processes. The redesign approach will be discussed in the next paragraph.

3.4 Business Process Redesign Approach

Van den Berg et al. (2008) also provide a systematic approach for business process redesign. The approach comprises four steps ultimately leading to a concrete redesign.

First the scope of the redesign will be determined and the impact of change will be analysed (based on the COPAFIJTH-aspects[1] described by Van den Berg et al., 2008). For this, different experts among the actors (e.g. sales manager OEM, customer specialist, IT department or production departments) will be consulted. The second step involves determining the essence of the proposed redesign based on the preconditions, scope of the redesign, and analysis of the current situation. In the third step a number of alternatives for the redesigned processes are modelled, again using the BPMN standard. These alternatives will be designed based on the bottlenecks found in the analysis phase. In the fourth step these alternatives are compared, after which a redesign can be selected. This will be done by a group of key users who can validate whether the business process model reflects all business process instances and who can put forward ideas about further improvements of the proposed models (Krueger & Casey, 2000).

[1] An analysis of the COPAFIJTH-aspects goes into the; Commercial, Organizational, Personnel, Administrative, Financial, Information, Juridical, Technological, and Housing aspects related to the changes that are proposed.

3.5 Redesign Validation

The process design that is considered the most suitable will be modelled in greater detail, after which the validity of the new design can be assessed (Van den Berg et al., 2008). To assess the validity of the redesigned process and to further refine it, the complexity, problems and inefficiencies of the new design are assessed through a discussion with a number of key users and IT experts (i.e. the application consultants) within the company.

Once the newly designed process is deemed satisfactory by the main actors (including management), a request for modification (RfM) can be filed to the IT department, after which they can implement, test and deploy the proposed solution (i.e. the configuration phase of the business process lifecycle).

3.6 Business Case Development

Although a lot of the components that need to be present in a business case are covered throughout this paper, the costs and benefits of the proposed redesign remain somewhat underexposed. Therefore the development of a business case, which does focus on these aspects, complements the research described in this paper. Moreover, the business case plays an important role in obtaining approval from management, which is needed for actually implementing the proposed redesign and in acquiring the necessary resources (Ward et al., 2008).

Furthermore, the development of a comprehensive and robust business case increases the chance of a successful implementation of the redesigned process, for it identifies how a company can reach the stated benefits and ensures commitment from business managers. (Jeston & Nelis, 2008; Ward et al., 2008) In addition, the business case can be used to evaluate and review the benefits actually delivered, and assess why some benefits were not achieved (Ward et al.).

Ward et al. (2008) provide a six-stage approach to business case development that covers the aspects that are considered critical in developing a robust business case (see Table 2). The business case in this paper will also follow this approach. The approach starts by defining the business drivers and the investment objectives. After having agreed on the objectives of the investment, the expected benefits are identified and ways to measure these benefits are determined. Furthermore the benefits are assigned to individuals within the organization to build commitment and to demonstrate the importance of the investment. In the third step, benefits are structured to encourage the discussion and evidence-gathering about the expected benefits. In the next step of the framework the business changes that are necessary to deliver each benefit, are determined. Although some of these changes are rather straightforward, others might be less obvious. In order to also identify the less obvious business changes the Benefits Dependency Network (BDN) of Peppard, Ward and Daniel (2007) will be used.

Based on the performance improvement targets and the potential benefits, the combination of IT enablers, enabling changes and business changes that could deliver each of the potential benefits, is identified with this BDN. Subsequently, continuing with the approach of Ward et al., the benefits are classified under the particular type of business change (i.e. do new thing, do things better or stop doing things) necessary for delivering the benefit. Next, the benefits are classified based on the ability to measure the value of specific benefit with the information that is already known or can be determined prior to the investment (i.e. the degree of explicitness). In order to increase the measurability of certain benefits, a number of KPIs (Key Performance Indicators) will be selected to enable the quantitative analysis of these benefits. Finally, in order to make a financial assessment, the costs and risk associated with carrying out the project are identified and compared to the identified benefits.

TABLE 2: SIX-STAGE APPROACH TO BUSINESS CASE DEVELOPMENT (WARD ET AL., 2008)

Step 1: Define business drivers and investment objectives
What are the issues currently faced by the organization?
What does the organization seek to achieve with the proposed investment?
Make sure this is done in such a way that it shows some or all business drivers can be addressed
Step 2: Identify benefits, measures and owners
Identify the expected benefits that will arrive if the investment objectives are met
Determine how a benefit will be measured
Determine the owner of the benefit
Step 3: Structure the benefits
Identify the *type of business change*
Determine the *degree of explicitness*
Step 4: Identify organizational changes enabling benefits
Do new things, or do things in new ways that prior to the investment, were not possible
Improve the performance of activities it must continue to do, that is *do thing better*
Stop doing things that are no longer necessary to operate the business successfully
Step 5: Determine the explicit value of each benefit
Initially allocate each benefit to the “Observable benefits” category
Provide evidence for moving the benefit to a higher degree explicitness (provided by problem owner)
Identify the most appropriate approaches to overcome quantification problems
Determine the total financial value of the relevant benefits
Step 6: Identify costs and risks
Determine the recurring (IT) costs associated with the new system
Determine the costs associated with making business and organizational changes
Determine the difficulty of making each change required to deliver a particular benefit

3.7 Conclusion

The structure of the Research Design described in this chapter is based on the Design Science Research Methodology described by Peffers et al. (2007). Although most aspects of the framework are covered by the approaches described in this chapter, the emphasis of the research lies in the design & analysis phase, which focusses on the creation of artefacts (i.e. the redesigned process models).

The analysis and redesign of the business processes are primarily addressed using the approaches described by Van den Berg et al. (2008), which provide clear steps to come to a concrete redesign of a business process. After which, the redesigned process will be validated though in-depth discussions with key users and experts within the company. Finally the six-stage approach to business case development of Ward et al. (2008) was chosen in order to assess the costs and benefits associated to the redesigned process. An overview of the research design can be found in Figure 4.

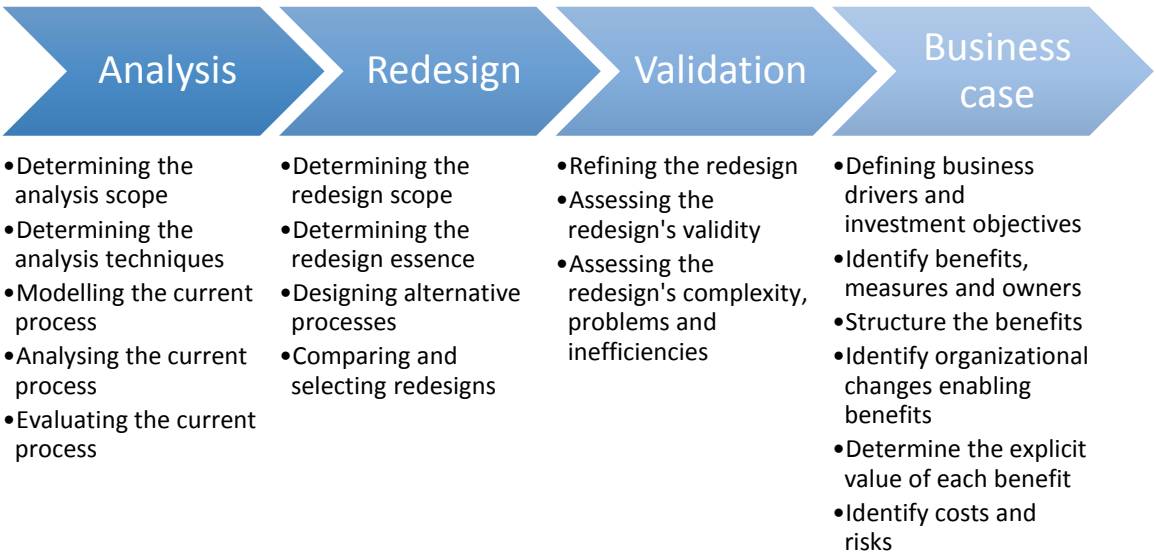

FIGURE 4: OVERVIEW OF THE THESIS' RESEARCH DESIGN

After research question 1 (RQ1) was answered with the literature review described in chapter 2, the subsequent research questions will be covered in the Research Results chapter. Following the steps from Figure 4, research questions 2 and 3 (RQ2 and RQ3) will be answered based on the results from both the *analysis* and *redesign* phase. Next, research question 4 (RQ4) is covered during the *validation* phase. Finally, research question 5 (RQ5) will be answered based on the *business case* developed in the final phase of the research described in this paper. After having answer all the (sub-)research questions in the Discussion & Conclusion section of this paper, eventually, the main research question will be answered.

4 Research Results

In this chapter the results of the research will be described in four separate paragraphs. The first paragraph describes the results of the analysis of the current business process. The second paragraph goes into the redesign selection process. The third paragraph describes the results of the redesign's validation process. Finally, in the last paragraph, a short business case will be developed.

4.1 Business Process Analysis

In this paragraph we first define the scope of the analysis. Second, the analysis techniques and models are determined. Third, the different processes needed for the analysis will be modelled. Fourth, based on these previous steps, the bottlenecks present within the current situation are identified. Finally, bottlenecks will be prioritized and possible solutions will be proposed.

4.1.1 Determining the Analysis Scope

During introductory talks with different stakeholders within the company we tried to get an indication of the problems faced by the company, furthermore we tried to identify possible improvement targets. The most common complaints during these talks were related to the complexity of the *order input* process, the way *order confirmations* are sent to the customer, the *planning of production activities*, and the *on-time availability* of the more complex orders. In order to overcome these problems, most stakeholders suggest some kind of system or process that makes the order entry less complex and error prone, and that better suits the production activities common to OEM customer orders.

Keeping in mind the abovementioned problems and improvement targets, the scope of the analysis was determined during a discussion with the sales manager OEM and the lead customer specialist. Ultimately the scope of the analysis was set to "the processing of customer specific orders within the OEM market, with the general goal of *improving the efficiency of processing these customer specific orders*.

Subsequently, a number of factors were identified that are considered important to the company. The aspects outlined below can be seen as the critical success factors (CSF) of the company and the sales department (i.e. Commercial Support and the OEM sales department) in particular.

- JIT delivery of products to the customers
- Short delivery lead time
- Information about order status available to the customer at any time (e.g. Track & Trace)
- Simple order confirmation for the customer (e.g. one per purchase order, EDI-based)

Next to the critical success factors a number of constraints have been set in conjunction with the sales manager OEM and lead customer specialist regarding the eventual redesign. These constraints are mentioned below.

- The solution should be compatible with the current IT systems (e.g. OMS, S&P, etc.)
- The distinction between the tasks carried out by Commercial Support and customer specialist should remain/improve (i.e. order input versus managing the relationship with the customer)

Based on the scope of the analysis, set earlier in this paragraph, a number of actors were identified. Table 3 provides a summary of the most important actors involved in the process under investigation and the information that is expected to be needed in the analysis phase. A detailed description of the actors' characteristics can be found in Appendix C: Actors & Stakeholders. Next to these actors a number of stakeholders are identified, the most important ones being; the company itself, the customer, the sales director, the manager of OEM Sales and the IT application consultants. These stakeholders are also described in the abovementioned appendix.

TABLE 3: OVERVIEW OF PROCESSES, ACTORS AND INFORMATION

Perspective	Description of the analysis object
Processes	Processing customer specific OEM orders
Actors	**Sales:** • XXXXX • XXXXX • XXXXX • XXXXX • XXXXX **Production:** • XXXXX • XXXXX • XXXXX **Support:** • XXXXX • XXXXX • XXXXX • XXXXX
Information	**Data about:** • XXXXX • XXXXX • XXXXX

As shown in Table 3, the actors involved in the processing of customer specific OEM orders can be divided into three main group. First, Sales which is responsible for assisting customers in the order process, checking customer orders, inputting them and for handling for example aftersales. Second, the production department which is responsible for all activities involving some sort of physical

processing (e.g. machining). Lastly, there is a group of supporting actors which play a facilitating role in processing the OEM orders.

4.1.2 Determining the Analysis Techniques

The most important source of information used to analyse the process and to create the models associated with the process are the (semi-structured) interviews with the main actors. Next to the interviews a number of other techniques are used to analyse the current situation, including the process models themselves. Table 4 provides an overview of these analysis tools in relation to the different sub-aspects. Furthermore, the table includes the motivation for choosing these aspects which stems from the introductory talks mentioned in paragraph 4.1.1.

TABLE 4: OVERVIEW OF GOAL, SUB-ASPECTS, MOTIVATION AND ANALYSIS TOOLS

General Goal	Sub-aspects	Motivation	Analysis tools
Improving the efficiency of processing customer specific orders	Order input	• XXXXX • XXXXX • XXXXX	• Interviews with key users • Modelling the current process
	Order confirmation	• XXXXX • XXXXX	• Modelling the current process • Analyse #OC the customer receives
	Production	• XXXXX • XXXXX • XXXXX	• Interviews with key users • Modelling the current process
	Lead time	• XXXXX	• Analysis of lead time of current orders

By using these different, mainly qualitative, analysis techniques and by focussing on these specific sub-aspects we try to address the Research Goal stated at the beginning of this paper, which was aimed at improving the order process of customer specific orders in order to reduce lead time, rework and overall workload while at the same time increasing customer satisfaction.

4.1.3 Modelling the Current Processes

Like mentioned in the previous paragraph, the main input for modelling the different processes are the interviews with the actors and stakeholders. The notes from these interviews can be found in Appendix D: Interview Annotations. Next to these (semi-structured) interview results, company procedures and work instruction were used as input for the process models found in this paragraph. An example of such a procedure and the related work instructions can be found in Appendix E: Procedure & Work Instruction.

Because the order process' workflow plays a central role in the analysis, *a process oriented approach* is used in modelling the process. This approach starts by roughly modelling the subsequent activities, next the process model is expanded and refined until it represents the actual process in a level of detail sufficient for the intended analysis (Van den Berg et al., 2008).

The processes described below apply to orders placed by OEM customers. These OEM orders may contain order lines of commodity parts, non-commodity parts or a combination of both. The order process starts with receiving an order of an OEM customer, which is then entered into the company's system, picked, processed internally (optional), and prepared for outbound transportation after which it is sent to the customer. The high level view of this (end-to-end) process is modelled in Figure 5. Although, from this high level view, the OEM order process appears similar to the general order process within the company, differences become apparent when looking at the process in more detail. These differences mainly lie in the order input process and the production or assembly activities. The lower level process models in this paragraph will elaborate on these differences.

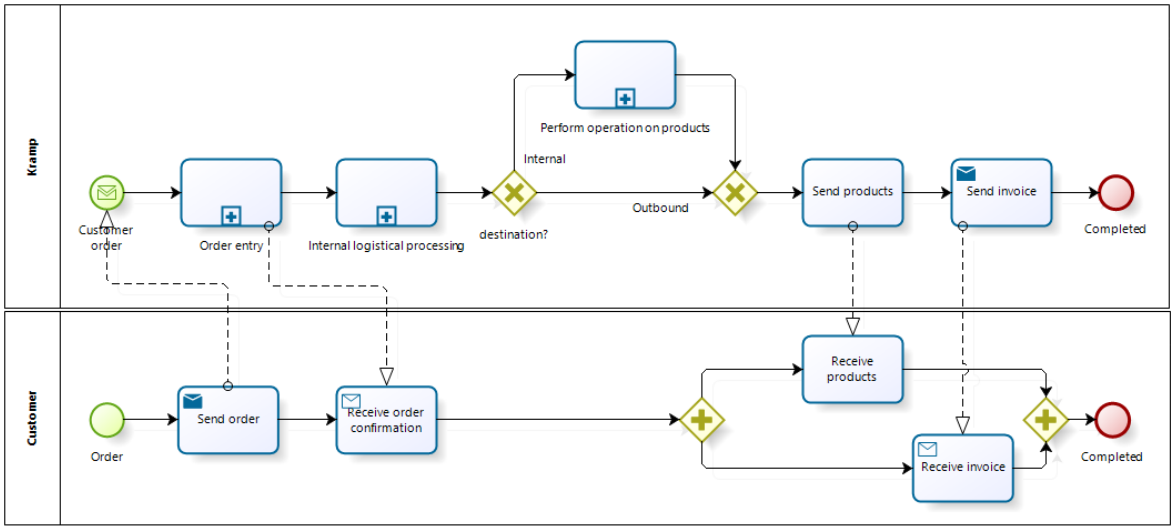

FIGURE 5: CURRENT ORDER PROCESS (HIGH LEVEL VIEW)

A more detailed (lower level) model of the process in Figure 5 can be found in Figure 6 (on page 24). Here the different steps of the process are assigned to the actors performing these activities. The actors mentioned in this process model match the actors described earlier in this paragraph. Furthermore, a number of the exceptions related to the OEM order process become visible within this model.

Like mentioned above, the modelling of the processes is based on the information retrieved from the interviews with the different stakeholders within the company and from the procedures and work instructions available on the company's intranet. Once the processes had been modelled they were validated by a number of key users and refined where needed, ultimately resulting in the process models described below. Additionally, in order to get a clearer picture of the business process models in relation to the systems that are used within the company, the actual steps that are performed during the order process were observed. A selection of screenshots of these process steps is provided in Appendix F: Screenshots Order Entry Process.

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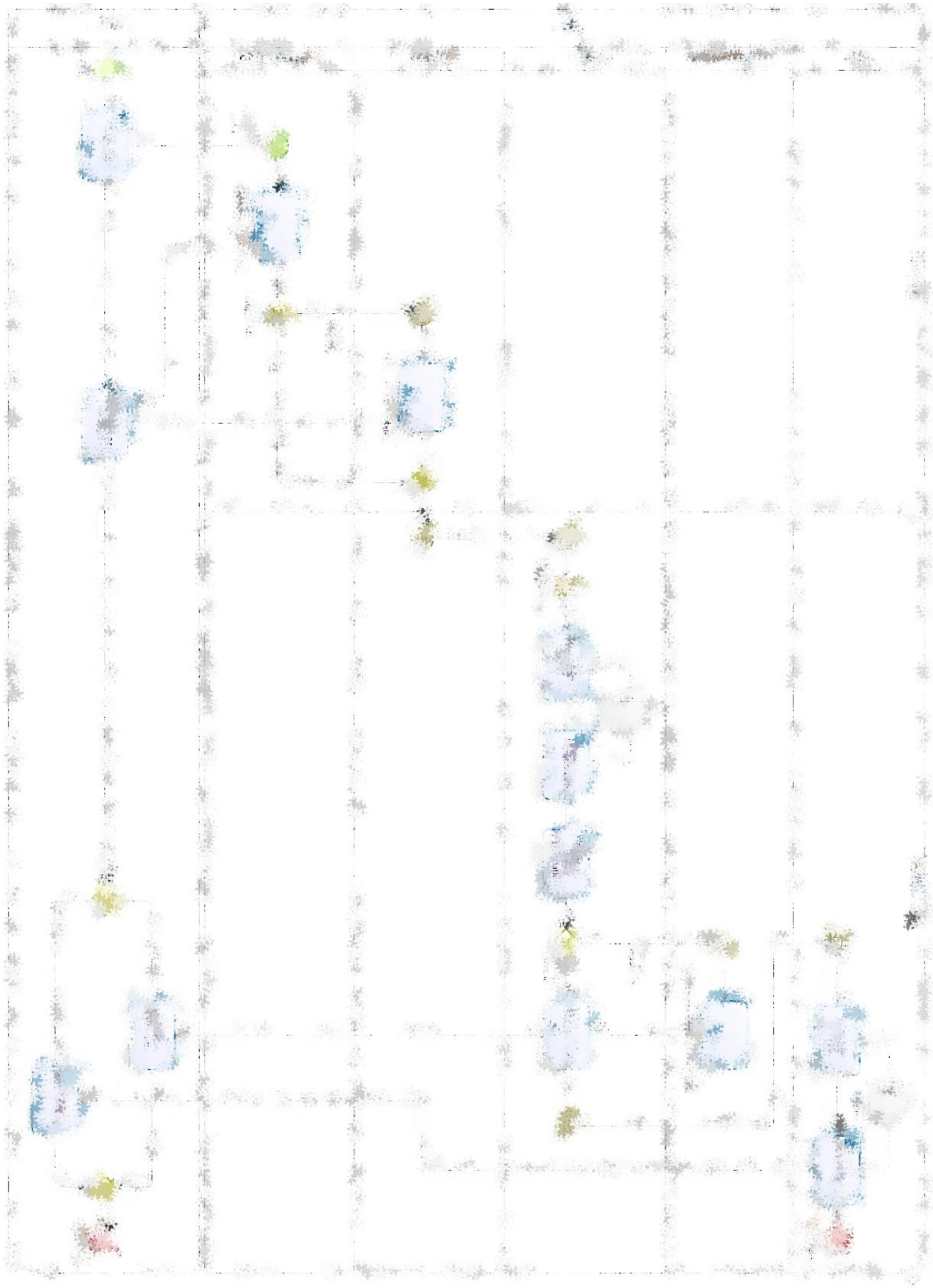

FIGURE 6: CURRENT ORDER PROCESS (LOW LEVEL VIEW)

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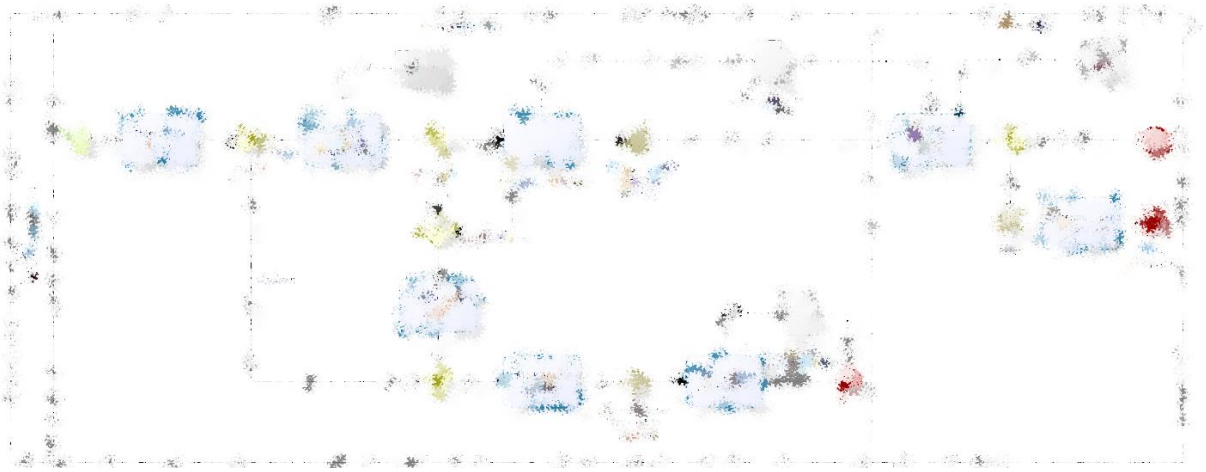

FIGURE 7: ORDER ENTRY PROCESS BY COMMERCIAL SUPPORT

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FIGURE 8: COMPLETION OF ENTERING AN ORDER LINE BY COMMERCIAL SUPPORT

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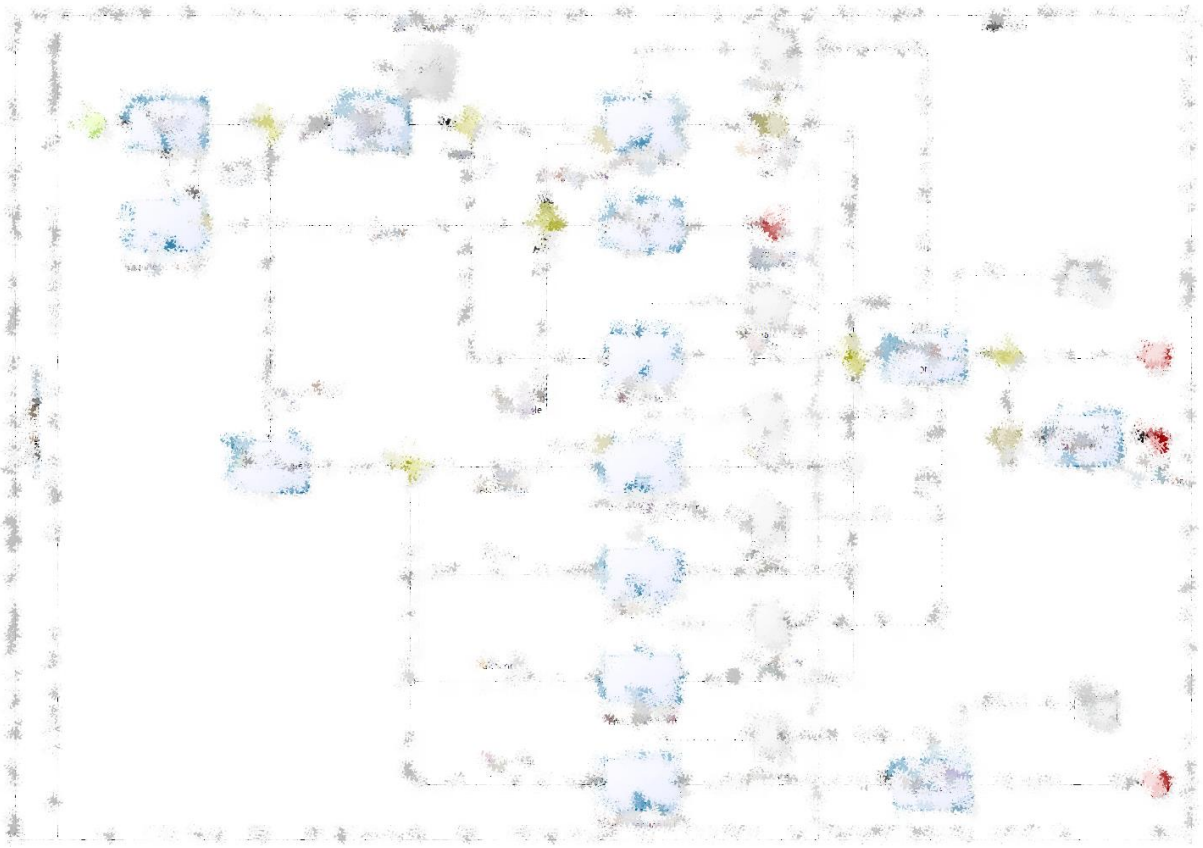

FIGURE 9: ORDER ENTRY PROCESS BY OEM SALES

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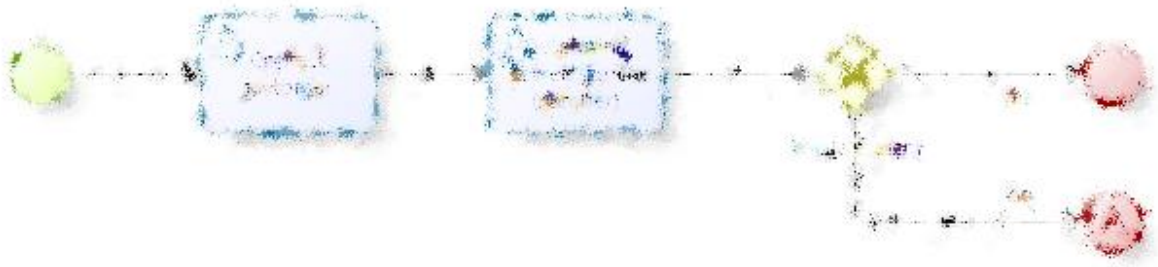

FIGURE 10: PRODUCT INQUIRY AT CUSTOMER BY OEM SALES

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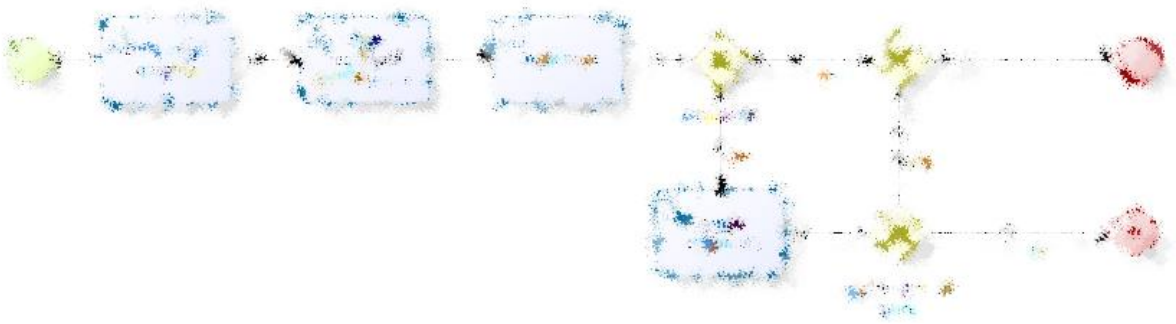

FIGURE 11: COMPLETION OF ENTERING AN ORDER LINE BY OEM SALES

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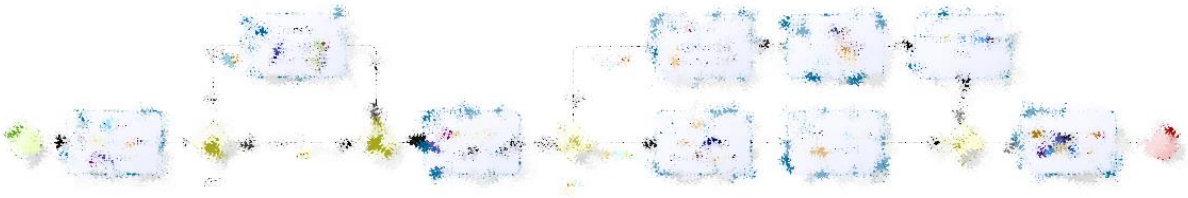

FIGURE 12: CONFIRMATION OF A PROPOSAL BY OEM SALES

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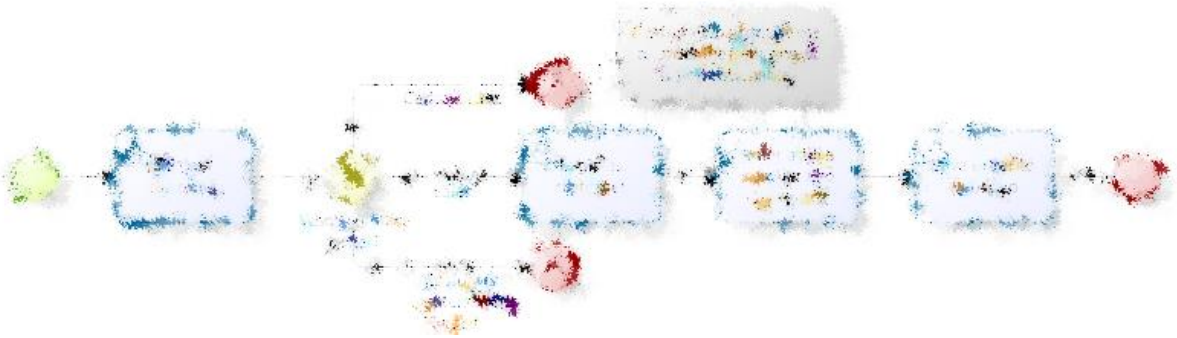

FIGURE 13: COMPLETION OF ENTERING AN ORDER LINE THROUGH THE WEBSHOP BY OEM SALES

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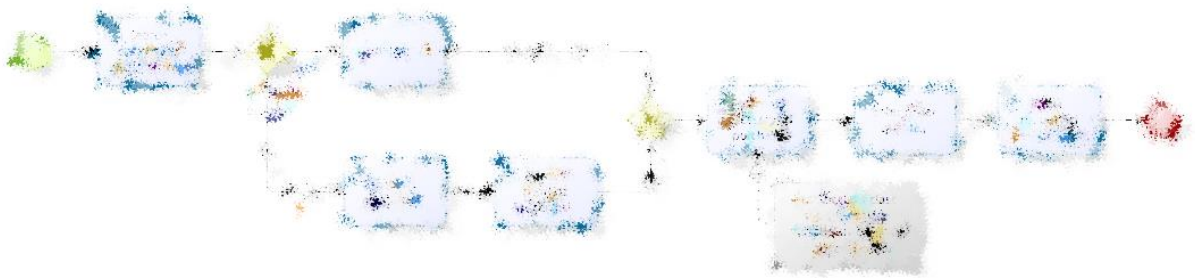

FIGURE 14: COMPLETION OF ENTERING AN ORDER LINE FOR A SPECIAL BY OEM SALES

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FIGURE 15: COMPLETION OF ENTERING AN ORDER LINE FOR A GENERIC KIT BY OEM SALES

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FIGURE 16: COMPLETION OF ENTERING AN ORDER LINE IN RAS BY OEM SALES

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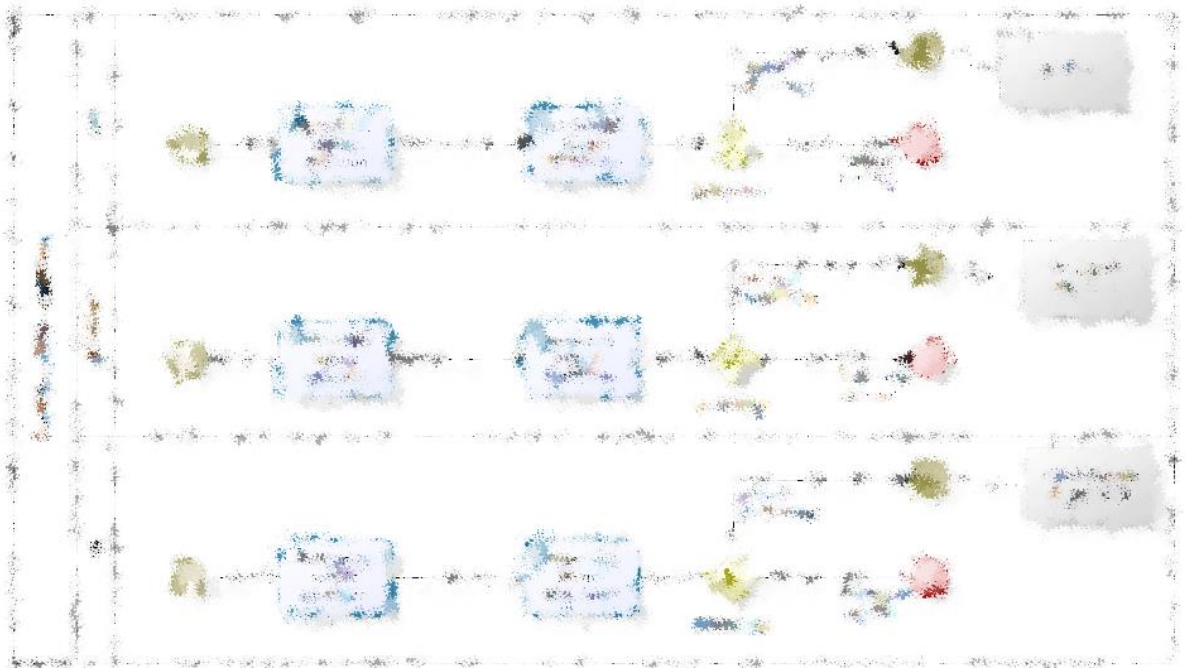

FIGURE 17: PROCESS OF PERFORMING OPERATIONS ON ORDERED PRODUCTS

4.1.4 Analysing the Current Processes

Based on an assessment of the information gathered during the interviews and the models created in the previous paragraph, the existing order process is analysed. Table 5 provides an overview of the most important facts and bottlenecks that emerged from this analysis. We will further elaborate on these facts and bottlenecks after the table, where we will discuss the most important findings from the interviews and relate them to the process models provided above.

TABLE 5: OVERVIEW OF GOAL, SUB-ASPECTS AND MOTIVATION, AND FACTS ABOUT, AND BOTTLENECKS IN THE CURRENT SITUATION

General Goal	Sub-aspects	Motivation	Facts	Bottlenecks
Improving the efficiency of processing customer specific orders	Order input	• XXXXX • XXXXX • XXXXX	• XXXXX • XXXXX	• ERP system used for production activities • Division of labour between CommOn and OEM Sales • Complexity of the order input process of OEM orders • Availability of order confirmations containing the products ordered
	Order confirmation	• XXXXX • XXXXX • XXXXX	• XXXXX • XXXXX	
	Production	• XXXXX • XXXXX • XXXXX	• XXXXX • XXXXX	
	Lead time	• XXXXX	• XXXXX	

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4.1.5 Evaluating the Current Processes

In this paragraph the bottlenecks that were identified in the previous paragraph will be compared to the goals set earlier in this paper. This comparison will be made in conjunction with the lead customer specialist. Based on the comparison, the bottlenecks are prioritized and a direction for a possible solution will be proposed. This will again be done in conjunction with the lead customer specialist. Furthermore, the problem owner (i.e. person responsible for taking away the bottleneck) will be identified. An overview hereof is given in Table 6, which is elaborated on below.

TABLE 6: OVERVIEW OF BOTTLENECKS, PRIORITIES, TERMS, POSSIBLE SOLUTIONS AND PROBLEM OWNERS

Bottleneck	Priority	Term	Possible solution	Problem owner
ERP system in use	4	Long-term	Design entirely new application architecture to incorporate production aspects	Corporate management
Division of labour between CommOn and OEM Sales	2	Short-term	Increase capacity at CommOn so they are able to take on some of the more complex order entry tasks (currently performed by the customer specialists at OEM Sales)	Sales director
Complexity of order input	1	Short-term	Simplify the order input process of certain types of order lines	Sales director/ OEM Sales
Availability of order confirmations	3	Medium-term	Add the possibility to postpose an order confirmation until the entire order is entered	IT / Application consultants

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Based on the results of the evaluation of the current process, described in this paragraph, the final direction of the redesign will be determined together with the sales manager and lead customer specialist. The steps that were taken in redesign process will be discussed in the next paragraph.

4.2 Business Process Redesign

In this paragraph we first define the scope of the redesign. Second, the essence of the redesign will be determined. Third, a number of alternative processes will be designed and modelled. Finally, the different process models will be compared, after which the most appropriate (combination of both) alternative design(s) will be selected.

4.2.1 Determining the Redesign Scope

In the Business Process Analysis phase it was found that, next to the ERP system in use, the workload at CommOn, the complexity of the order input and the confirmation of orders are considered important bottlenecks. The latter three bottlenecks are all closely related to the *order entry* by the OEM sales department. By focussing on improving the (sub-)processes related to the order entry by the sales department (i.e. Commercial Support and OEM Sales), we argue that it is possible to realize significant improvements at relatively low costs and a limited risk. Choosing to redesign the entire ERP system, on the other hand, would involve making changes to a lot of other systems as well, considerably increasing the costs and risk of failure. Therefore, the scope of the redesign is set to *the order entry process of OEM orders* (highlighted in Figure 18), which is strongly related to the goal of "improving the efficiency of processing customer specific orders" stated earlier in this paper.

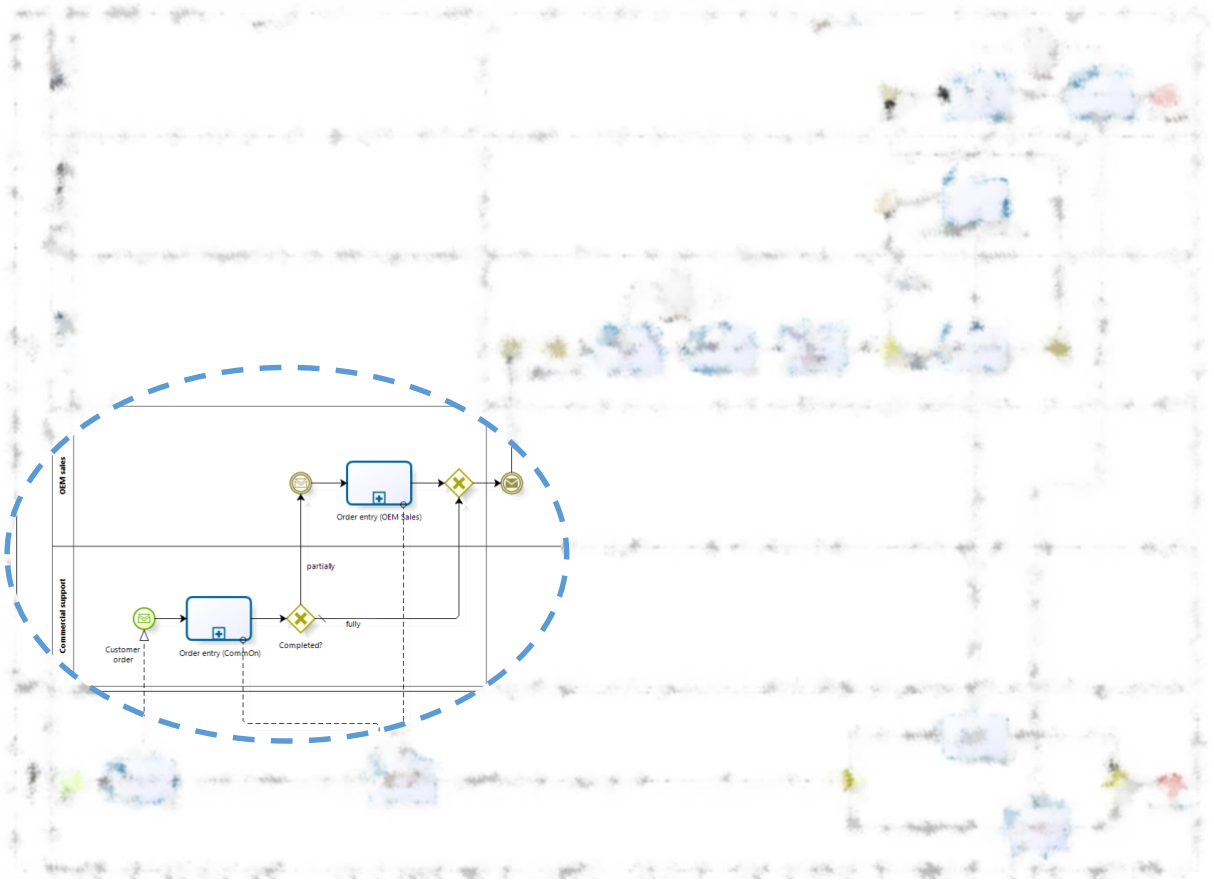

FIGURE 18: SCOPE OF THE PROCESS REDESIGN PROJECT

In order to assess the potential impact that changing the order entry process has, an impact-of-change analysis is carried out describing the most prominent external and internal effects that are expected in case of a redesign. The external effects describe what will change in relation to the environment (e.g. market, customers, competition or products), the internal effects describe what business activities will change internally. The results of this analysis can be found in Table 7 (where external effects are in italics).

TABLE 7: IMPACT-OF-CHANGE ANALYSIS USING THE COPAFIJTH-ASPECTS

Business aspect	Sub-aspect	Specification of the expected internal or *external* effect
Commercial	1. Customer relations 2. Communication	*1. XXXXX* *2. XXXXX*
Organizational	1. Flexibility 2. Structure	1. XXXXX 2. XXXXX
Personnel	1. Job description 2. Employee competence 3. Employee assessment	1. XXXXX 2. XXXXX 3. XXXXX
Administrative	1. Customer service	*1. XXXXX*
Financial	1. Operational costs 2. Cost of quality	1. XXXXX 2. XXXXX
Information	1. Alignment	*1. XXXXX*
Juridical	N/A	N/A
Technological	1. Quality	1. XXXXX
Housing	N/A	N/A

The constraints set in the business process analysis phase state that the solution should be compatible with current IT systems and that the distinction between CommOn and OEM Sales should remain or improve. Based on these constraints and a number of discussions with the sales manager and lead customer specialist the goal is set to improving the order entry process at the sales department (i.e. CommOn and OEM Sales), which corresponds with the redesign scope stated above.

In order to achieve this goal, the involvement of a number of actors is required to monitor and guide the change process. In this case it is suggested to form a group consisting of; the sales director or the sales manager OEM, an IT consultant and a project team with a number of key users, one of which should be appointed project leader.

4.2.2 Determining the Redesign Essence

To determine which activities, actors and items play an essential role in the order process, and thus need to be present in each of the proposed redesigns, the different elements from the process models of the current situation are analysed and assessed regarding there relevance in the redesigned process. Furthermore, the design criteria and the constraints that were set for the redesigns are taken into account. Elements that are not considered essential for all of the redesigns are omitted.

The activities that are considered essential in the redesign are; processing the order lines and saving the order to the company's systems, in order to be able to; generate an order confirmation which can be sent out to the customer and to inform logistics on when to start their activities. CommOn and OEM Sales are considered to be the essential actors in the proposed redesign and are responsible for entering the customer orders (i.e. processing order lines and saving the order). Once all order lines have been processed, customers will receive an order confirmation containing all successfully entered order lines. Therewith the essential items in this process are the customer's purchase order, the resulting sales order (=signal to logistics) and the order confirmation. The model in Figure 19 represents the essence of the redesign in terms of these elements (i.e. the activities, actors and items).

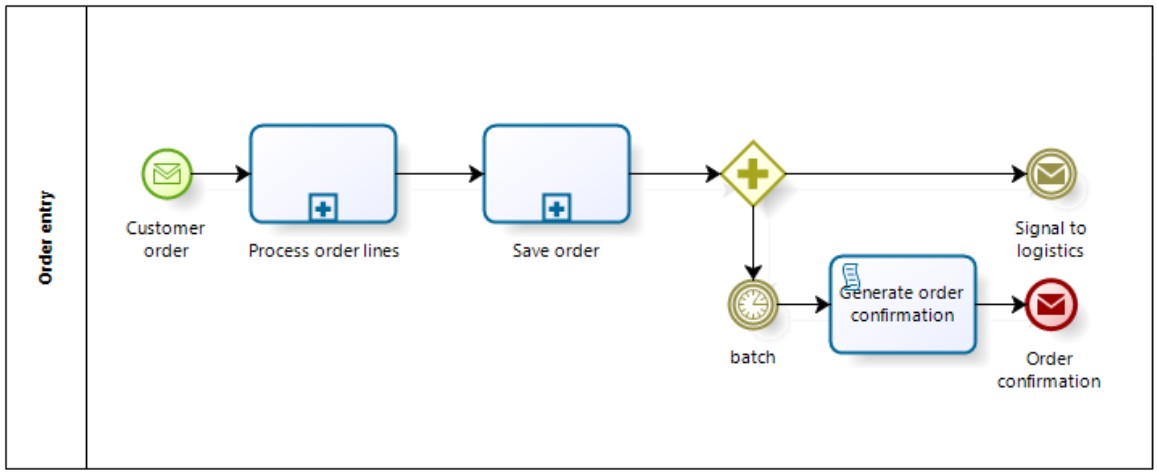

FIGURE 19: ESSENCE OF THE PROPOSED REDESIGNS

A number of criteria have been set for the redesign of the process. These criteria are based on the bottlenecks and their possible solution, discussed in the analysis phase. The newly designed process should; minimize the chance of incorrectly entering an order, minimize the amount of times multiple order confirmations are sent out for a single customer order, and minimize the amount of orders OEM Sales needs to process.

4.2.3 Designing Alternative Processes

Based on the design criteria that are stated in the previous paragraph, two process redesign alternatives are created and described in this paragraph. The first redesign alternative focuses on eliminating the bottlenecks that are related to the IT system that is used for order entry (i.e. the complexity of order input and the availability of order confirmations). The second redesign alternative focusses on eliminating the bottleneck related to the distribution of processes among the different actors (i.e. Division of labour between CommOn and OEM Sales).

First redesign alternative: elimination of IT-related bottlenecks

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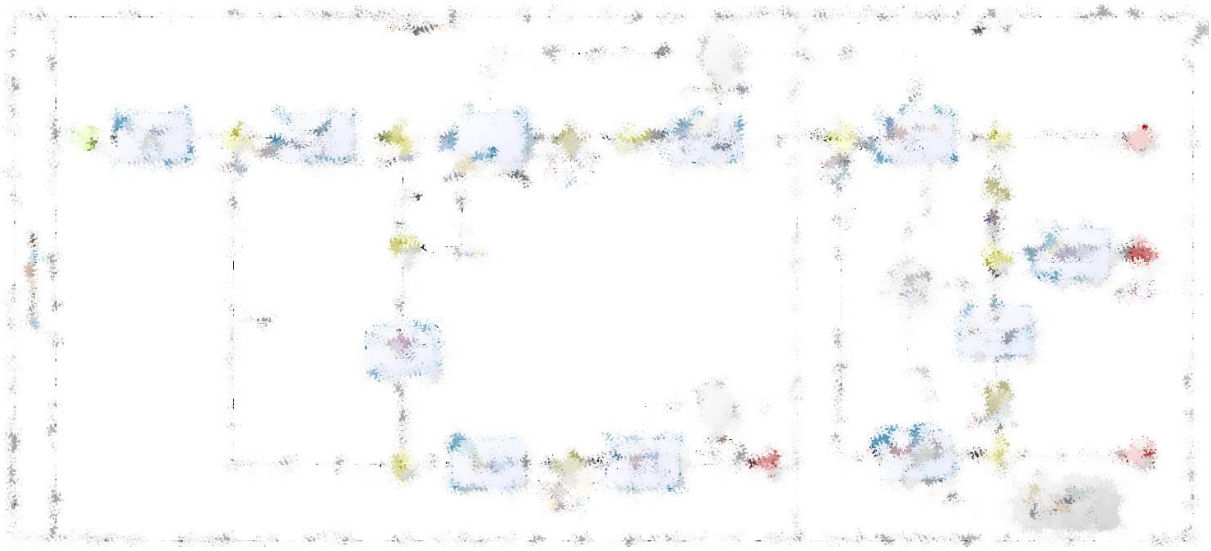

FIGURE 20: ORDER ENTRY PROCESS BY COMMERCIAL SUPPORT (ELIMINATION OF IT-RELATED BOTTLENECKS)

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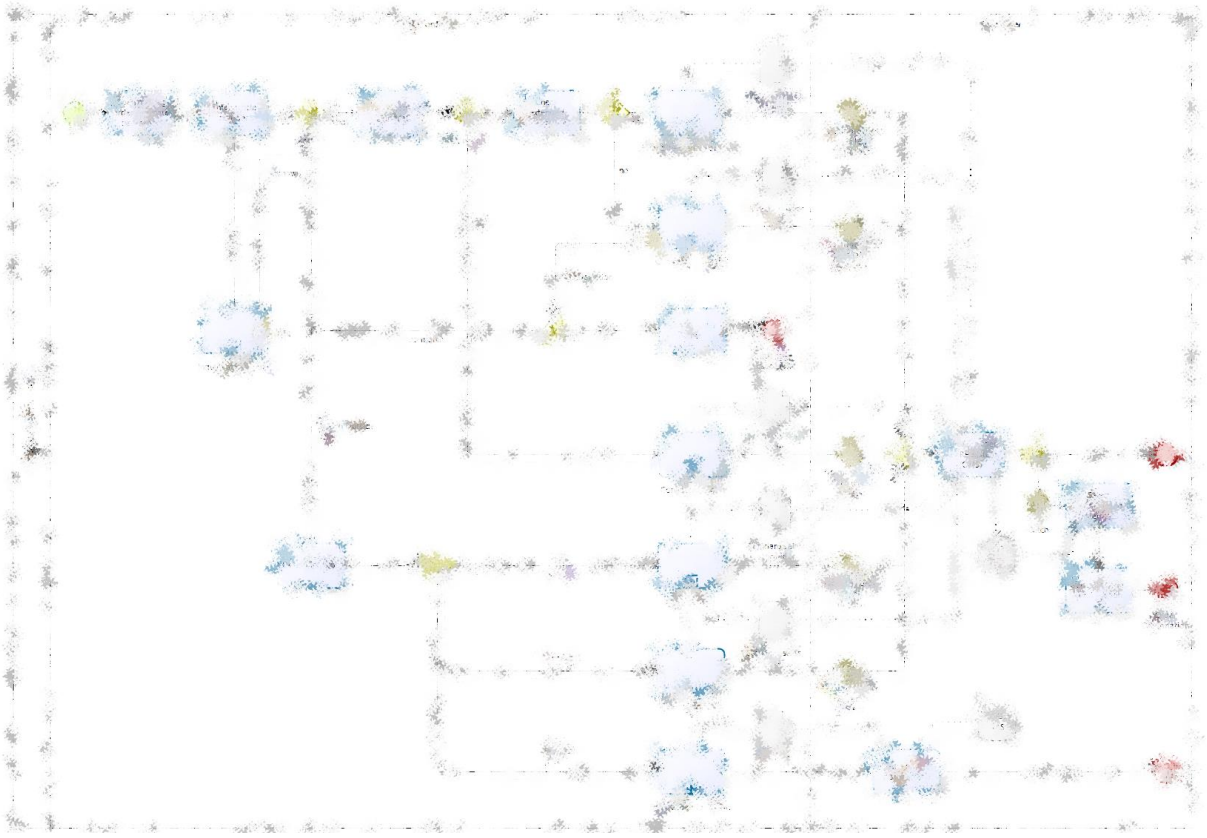

FIGURE 21: ORDER ENTRY PROCESS BY OEM SALES (ELIMINATION OF IT-RELATED BOTTLENECKS)

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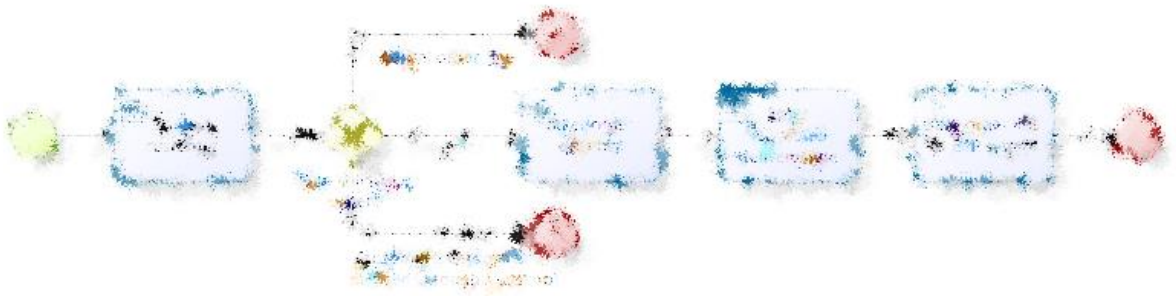

FIGURE 22: COMPLETION OF ENTERING EXTENDED ASSORTMENT BY OEM SALES (ELIMINATION OF IT-RELATED BOTTLENECKS)

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FIGURE 23: CONFIRMATION OF A PROPOSAL BY OEM SALES (ELIMINATION OF IT-RELATED BOTTLENECKS)

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Second redesign alternative: redistribution of resources

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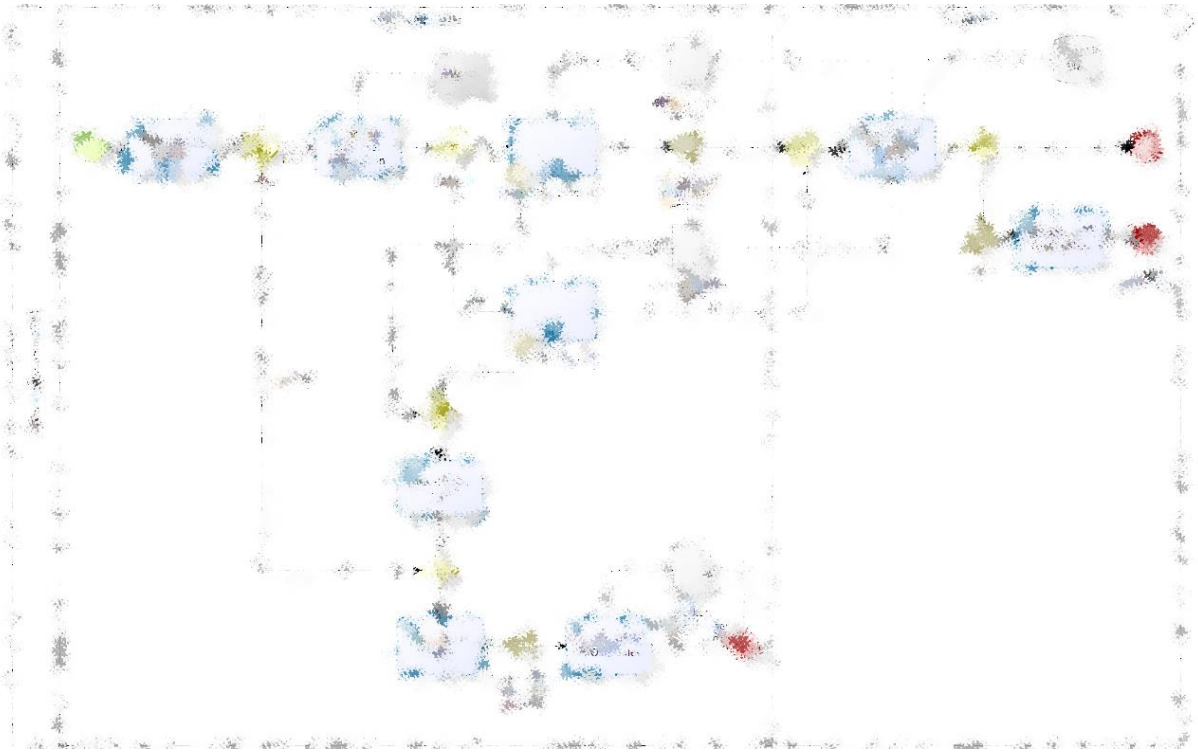

FIGURE 24: REDESIGNED ORDER ENTRY PROCESS AT COMMON (REDISTRIBUTION OF RESOURCES)

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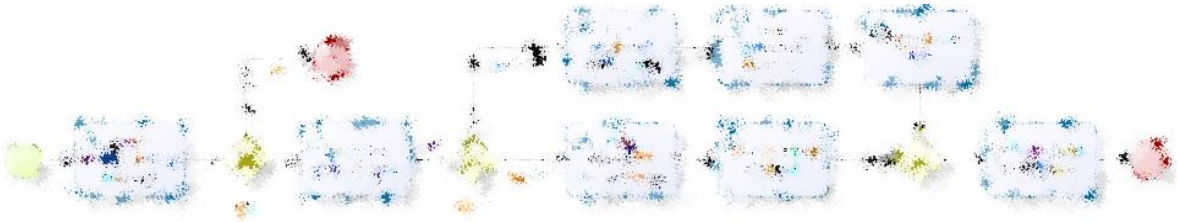

FIGURE 25: CONFIRMATION OF A PROPOSAL BY COMMERCIAL SUPPORT (REDISTRIBUTION OF RESOURCES)

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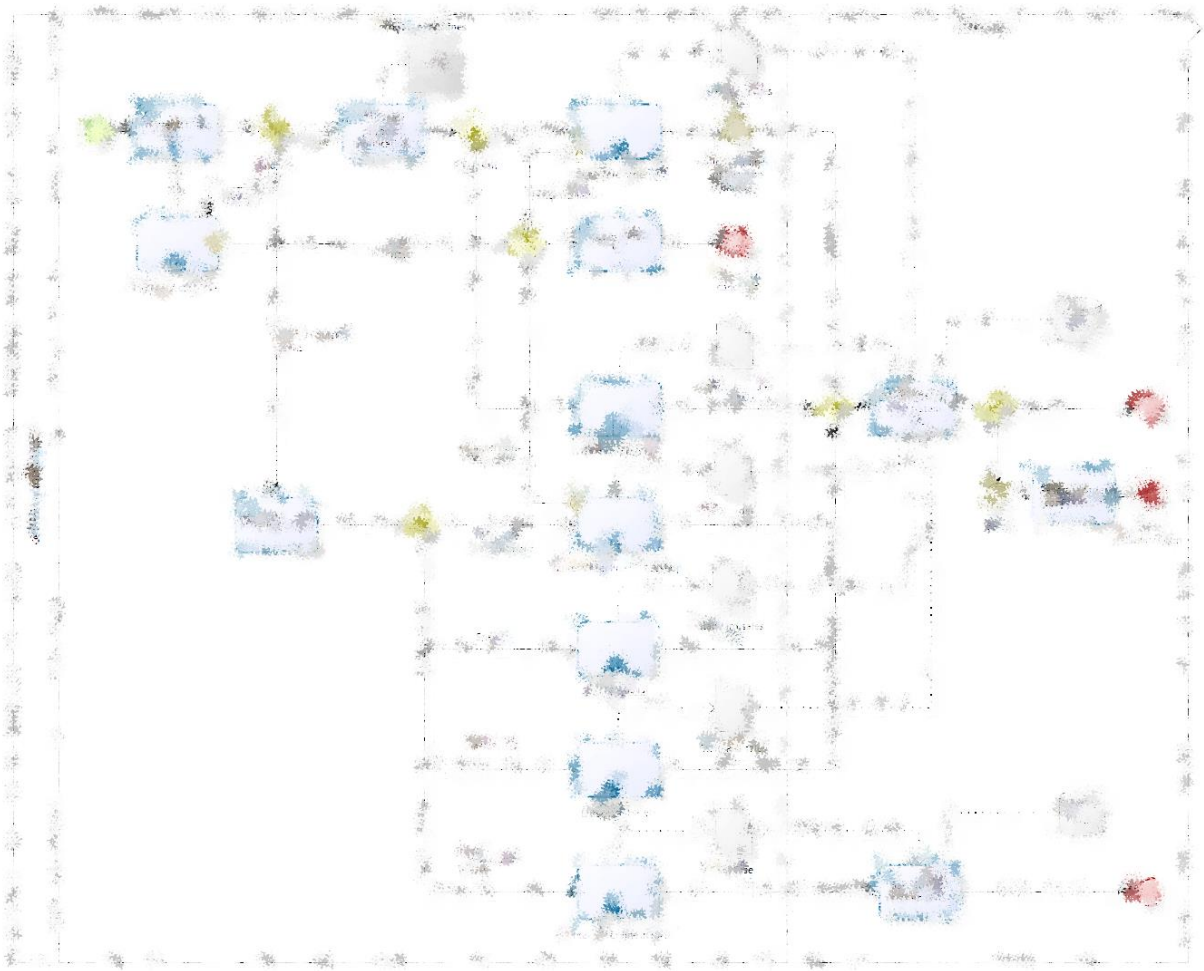

FIGURE 26: ORDER ENTRY PROCESS AT OEM SALES (REDISTRIBUTION OF RESOURCES)

4.2.4 Comparing & Selecting Redesigns

Based on a number of discussions with key users, it was determined that the simplified order entry process of the first redesign was generally desired over merely redistributing the workload. However, since a simplification of the order entry process is thought to make a number of order entry types more efficient and less error prone, it becomes easier to transfer some types of order entry tasks to CommOn. Therefore a combination of both redesigns, where the order entry is simplified and a number of order entry tasks is transferred to Commercial Support, is suggested. In the next paragraph the suggested redesign will be modelled in greater detail, after which it can be validated.

4.3 Redesign Validation

In this paragraph we will provide detailed models of the suggested redesign. Bases on multiple preliminary versions of these models, the validity of the redesign was assessed by discussing the models with several key users and a number of OMS application consultants. Furthermore the complexity of the redesign was assessed and possible problems and inefficiencies of the newly designed process were identified. Based on these assessments the process models were further refined and updated, ultimately leading to the models depicted below.

4.3.1 Refining the Redesign

As stated at the end of the previous paragraph, the suggested redesign will incorporate both the redistribution of resources and the elimination of IT-related bottlenecks. In some cases the order entry (sub-)processes have changed considerably, in other cases the processes only slightly changed or did not change at all. However, for the sake of completeness, all of the (sub-)processes that are present in the redesign will be addressed below.

The degree to which changes were made to the (sub-)processes depends on the design criteria and the constraints set earlier. This means the newly designed process was designed in such a way that it minimizes order input errors, minimize the amount of times multiple order confirmations are sent out for a single customer order, and minimizes the amount of orders OEM Sales needs to process. Furthermore, the newly designed process will be compatible with the current ERP system (OMS).

During the discussions of the preliminary redesigns with the key users and application consultants, it became clear that some of the proposed changes needed to be slightly altered in order to better fit the design criteria and constraints, and to increase the system's overall usability. Moreover, some of changes that were proposed in the redesign alternative in paragraph 4.2.3 were considered to be infeasible due to technical limitations of the company's current IT system. We will discuss these changes and limitation in more detail further on in this paragraph.

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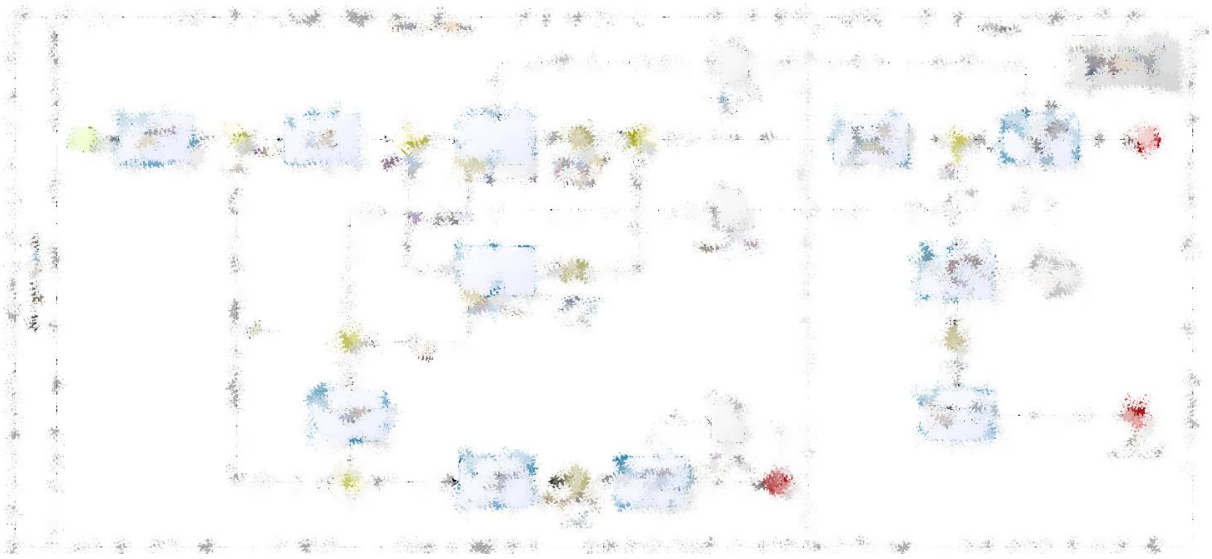

FIGURE 27: ORDER ENTRY PROCESS BY COMMON (REDESIGNED)

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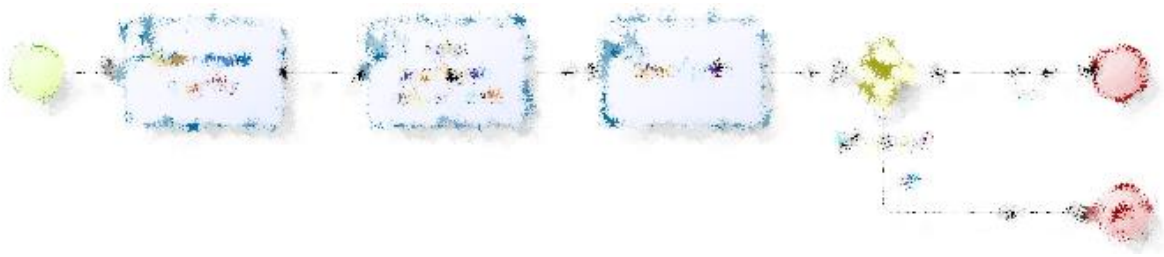

FIGURE 28: COMPLETION OF ENTERING AN ORDER LINE BY COMMERCIAL SUPPORT (REDESIGNED)

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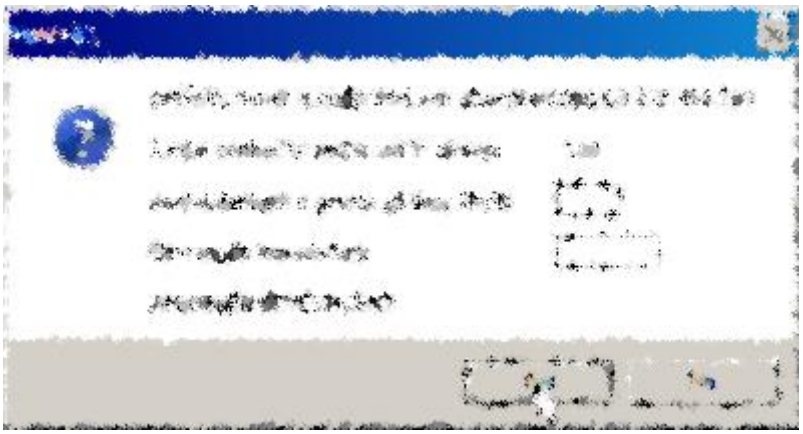

FIGURE 29: SUGGESTED POP-UP FOR THE CONFIRMATION OF AN ORDER LINE THAT IS PART OF A CALL-OFF CONTRACT

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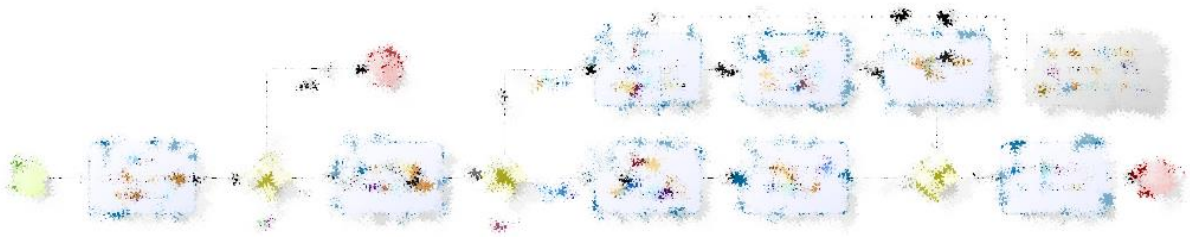

FIGURE 30: CONFIRMATION OF A PROPOSAL BY COMMERCIAL SUPPORT (REDESIGNED)

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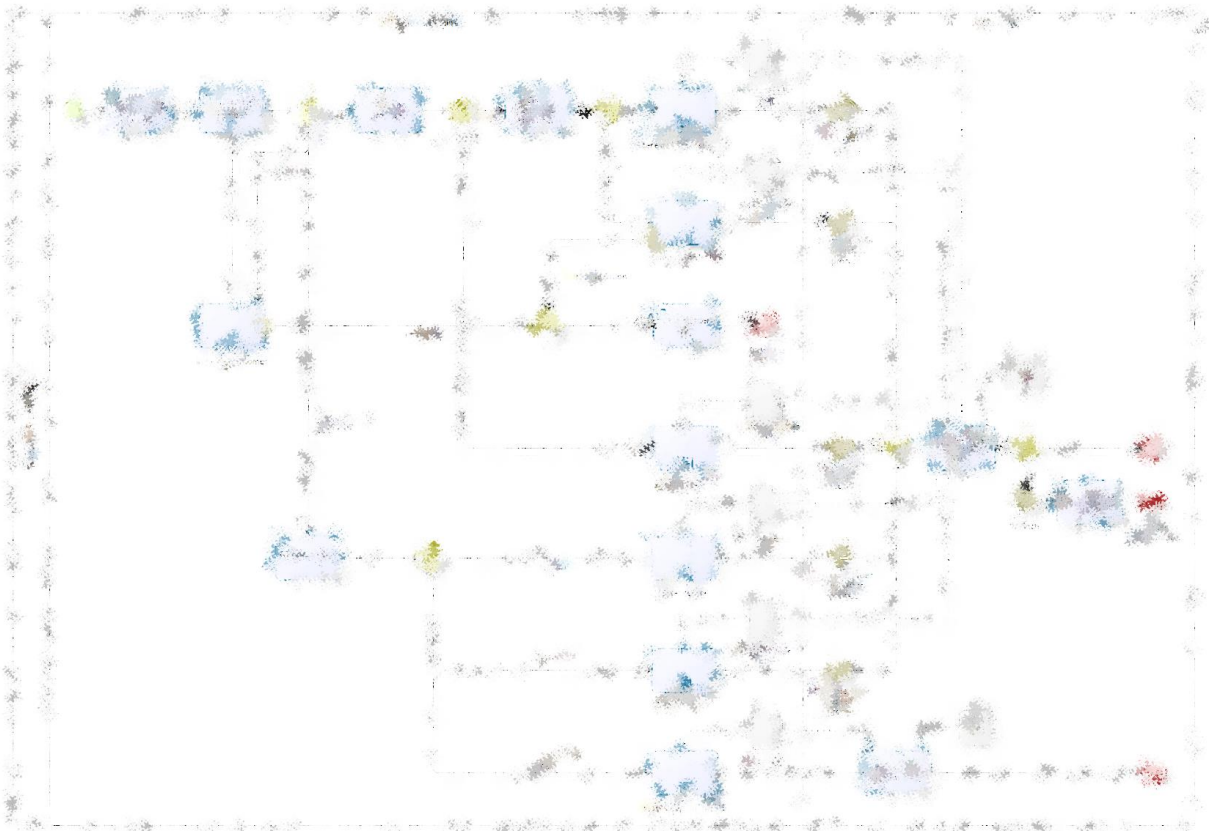

FIGURE 31: ORDER ENTRY PROCESS BY OEM SALES (REDESIGNED)

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FIGURE 32: PRODUCT INQUIRY AT CUSTOMER BY OEM SALES (REDESIGNED)

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FIGURE 33: COMPLETION OF ENTERING AN ORDER LINE BY OEM SALES (REDESIGNED)

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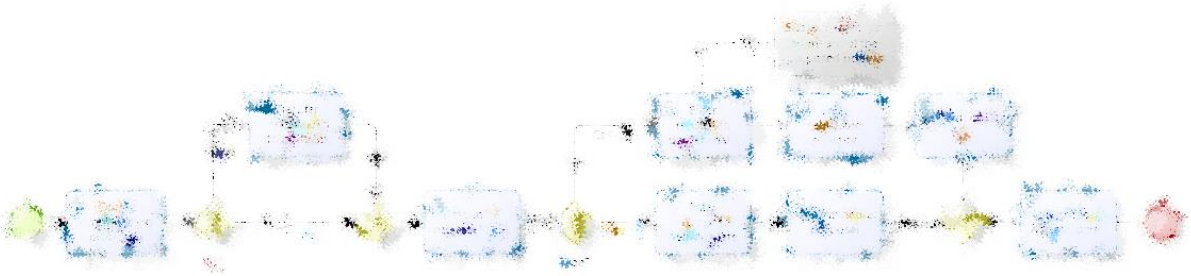

FIGURE 34: CONFIRMATION OF A PROPOSAL BY OEM SALES (REDESIGNED)

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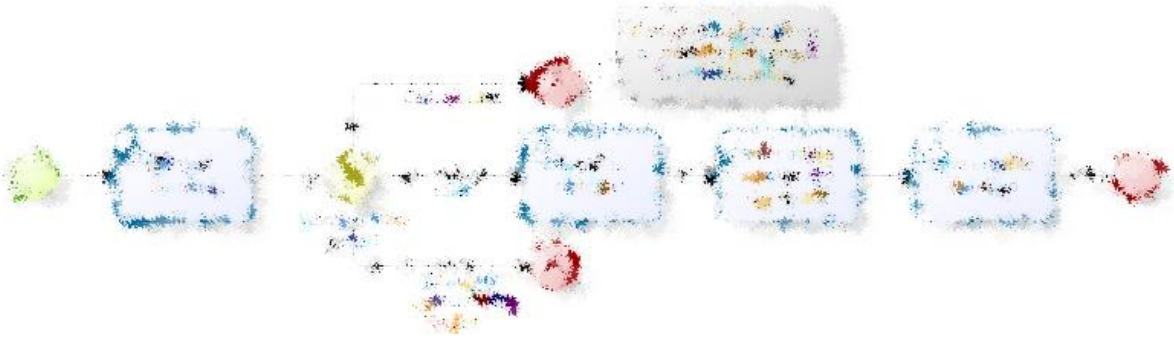

FIGURE 35: COMPLETION OF ENTERING EXTENDED ASSORTMENT BY OEM SALES (REDESIGNED)

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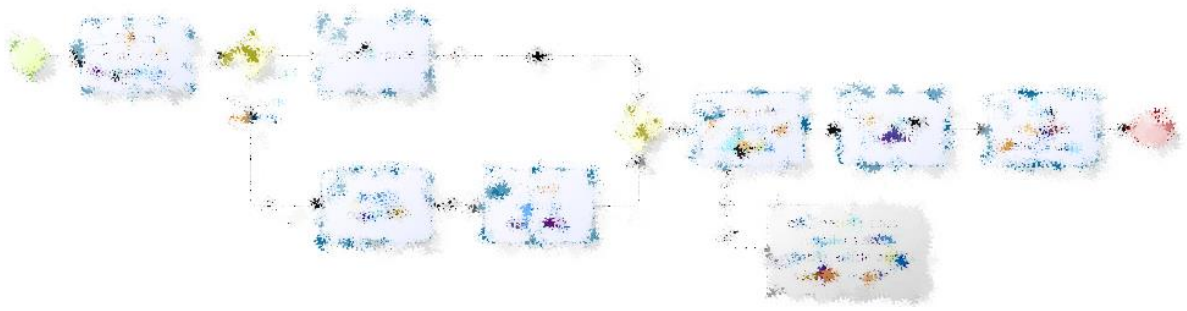

FIGURE 36: COMPLETION OF ENTERING AN ORDER LINE FOR A SPECIAL BY OEM SALES (REDESIGNED)

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FIGURE 37: COMPLETION OF ENTERING AN ORDER LINE FOR A GENERIC KIT BY OEM SALES (REDESIGNED)

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FIGURE 38: COMPLETION OF ENTERING AN ORDER LINE IN RAS BY OEM SALES (REDESIGNED)

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4.3.2 Assessing the Redesign's Validity

Although the proposed changes to the processes may not seem very extensive at first glance, they do require some fundamental changes to the ERP system and in the way work is distributed among CommOn and OEM Sales.

The validity of the redesign was assessed by discussing the process models in the previous paragraph with the key users and IT consultants. By using a number of KPIs (Key Performance Indicators), that are based on the COPAFIJTH-aspects identified earlier (see Table 8), we try to estimate the degree to which the proposed redesign eliminates the bottlenecks which were identified in the Business Process Analysis phase. To come up with a reliable estimate of the expected changes regarding the value of these KPIs, a number of experts within the company were consulted.

TABLE 8: PROPOSED KPIS PER BOTTLENECK

Bottleneck	KPI
Complexity of order input	• Percentage of order lines entered correctly (i.e. correct quantity and delivery date) • Percentage of order lines entered on time (i.e. to realize the requested delivery date) • Percentage delivered in full and on time (DIFOT)
Division of labour between CommOn and OEM Sales	• Number of OEM orders processed per month at CommOn / FTE • Number of hours spent by Common on OEM order input per month • Number of orders processed per month at OEM Sales / FTE • Number of hours spent by OEM Sales on order input per month • Total labour costs of OEM order input
Availability of order confirmations	• Number of incorrect or incomplete order confirmations being sent • Number of order status requests received by OEM Sales

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4.3.3 Assessing the Redesign's Complexity, Problems & Inefficiencies

Although the current bottlenecks are considered to be largely eliminated within the redesigned process, some processes might still be considered complex, and new problems and inefficiencies may arise with the implementation of the redesign. In this paragraph we will go into the potential complexities, problems and inefficiencies of the redesigned processes that came up during the discussions of the process models.

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4.4 Business Case

With the business case described in this paragraph we try to provide a clear overview of the objectives, benefits, costs and risks associated with the proposed redesign of the order input process at the OEM sales department. In order to do so we use the six-stage approach to business case development of Ward et al. (2008) as described in paragraph 3.6.

In the Business Process Analysis section of this paper a number of issues were identified related to the order process of OEM orders. The main causes for these issues should be sought in the irregular and sometimes high workload at Commercial Support, the complexity of the order input process, and the availability of correct order confirmations. By redesigning the order input process the organization tries to mitigate these issues.

4.4.1 Identification of Benefits, Measures & Benefit Owners

By composing a benefits dependency network (BDN) the most prominent benefits, that are associated with solving the issues mentioned above, have been identified. Moreover, the network indicates which combination of IT and business changes are the most cost effective and lowest risk in achieving the desired improvements (Peppard et al., 2007).

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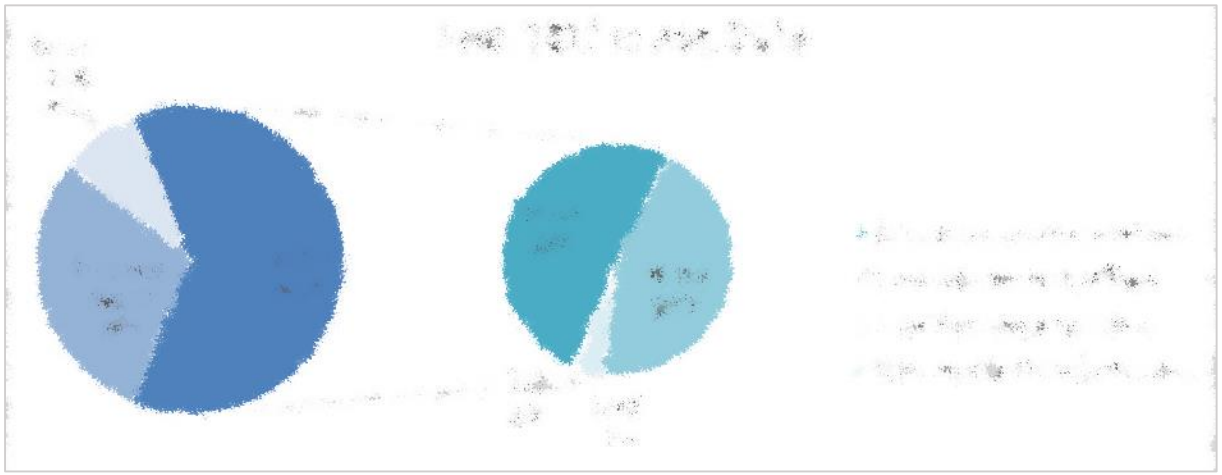

FIGURE 39: PERCENTAGE OF OEM ORDERS INPUTTED PER DEPARTMENT

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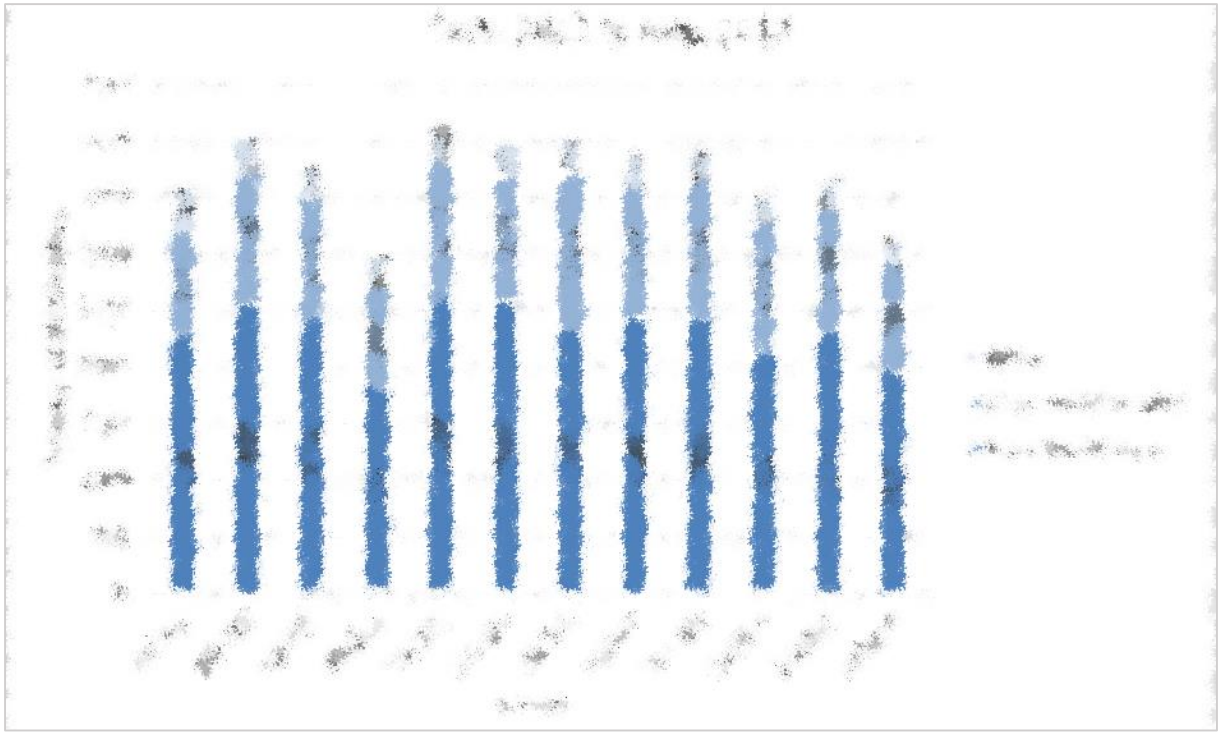

FIGURE 40: NUMBER OF OEM ORDERS INPUTTED BY MONTH

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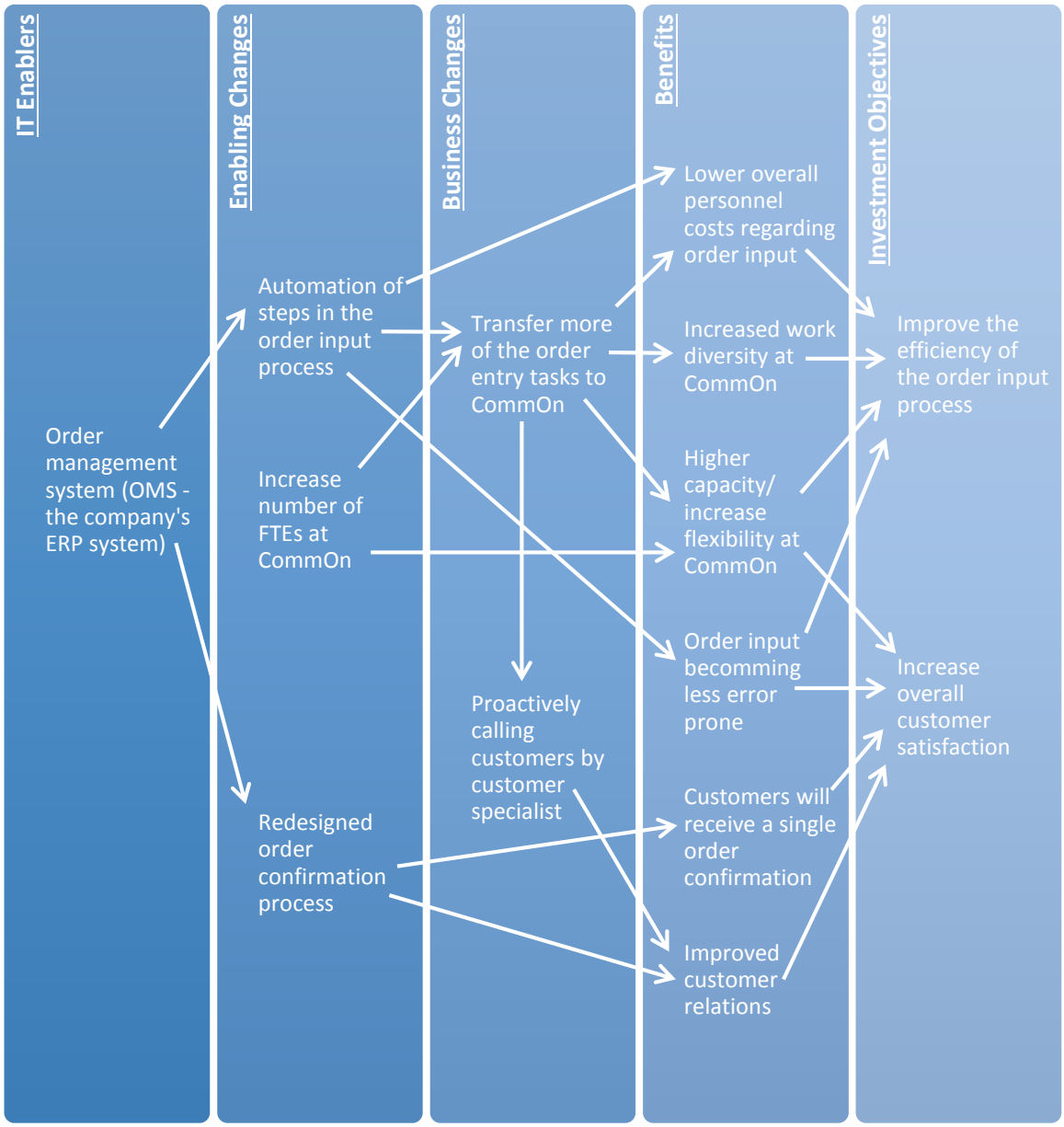

FIGURE 41: BENEFITS DEPENDENCY NETWORK FOR THE REDESIGNED ORDER ENTRY PROCESS

4.4.2 Structuring of Benefits

The expected benefits stated above are structured based on the *type of business change* giving rise to the benefit and the degree to which the value of these benefits can be determined (i.e. the *degree of explicitness*). In order to do so we first need to identify the type of business changes necessary to deliver the benefit. The business changes classified as *doing new things* are; letting the customer specialists pro-actively call customers and adding the order input task of call-off orders to CommOn. The types of changes that can be considered as *doing things better* are; letting CommOn specialize in order input, letting customer specialists focus on customer relationship management and adapting the order confirmation process. Finally, a change that can be characterized as *stop doing things* is the automation of some of the steps in the order input process.

Second, we need to determine the *explicit value of each benefit* (i.e. how much is known or can be determined about the benefit before the investment is made). In some case like diversity of work and improved customer relationships, it is hard to implement an appropriate measure to determine the extent to which the benefit is realized. Other benefits like the focus on customer relations, order input flexibility and a less error prone order entry process are measurable, however it is hard to estimate the changes in performance related to the proposed changes. A benefit for which the performance improvements can be forecasted is the order confirmation process. Finally, the benefit that can be expressed most explicitly (i.e. financially) is personnel costs.

Table 9 on page 51 provides an overview of the benefits that were identified above. The benefits are structured based on *type of business change* giving rise to the benefit and the *degree of explicitness*.

TABLE 9: STRUCTURED BENEFITS OVERVIEW OF THE NEW ORDER ENTRY PROCESS

Degree of explicitness		Type of business change		
		Do new things	**Do things better**	**Stop doing things**
High ↑	**Financial benefits**		**Benefit:** Lower overall personnel costs related to the OEM order input process **Measure:** Hours spent on order input by CommOn and OEM Sales times hourly rate *Savings of €X per annum*[2] **Owner:** Sales director	
	Quantifiable benefits		**Benefit:** Customers will receive a single order confirmation per order **Measure:** Percentage of incomplete order confirmations *Currently X% deviating*[3] **Owner:** Sales manager OEM	
	Measurable benefits	**Benefit:** Customer specialist can focus on customer relations **Measure:** Average number of monthly CRM related calls per OEM customer specialist *Current number*[4] *= X* **Owner:** Sales manager OEM	**Benefit:** Higher capacity/ increased flexibility order input at CommOn **Measure:** Percentage of orders getting processed on time by CommOn *Current value*[5] *= X%* **Owner:** Manager CommOn	**Benefit:** Order input at CommOn will be less error prone due to automation **Measure:** Monthly Number of cases regarding faulty order input by CommOn *Current number*[6] *= X* **Owner:** Manager CommOn
↓ Low	**Observable benefits**	**Benefit:** Increased diversity of work at CommOn **Measure:** Motivation of CommOn employees **Owner:** Manager CommOn		

[2] Based on the assumption that the total amount of time needed to process orders decreases and that the average (gross) hourly rate to process these orders will be lower (see Appendix I: Benefits & Investment Costs)
[3] Based on an estimate provide by the lead OEM customer specialist
[4] Based on the number of external outgoing calls made by the OEM customer specialists (over a 12-month period)
[5] Based on an estimate provide by the lead OEM customer specialist
[6] Based on customer complaints received in August

4.4.3 Identification of Costs & Risks

The final step in the six-stage approach to business case development comprises an identification of the costs and risks associated with the proposed changes to the order entry process.

The most prominent investments relate to implementing changes to the company's order entry system and related system, the training of personnel and the costs of hiring an extra employee at CommOn. Furthermore, there are a number of risks associated with the proposed redesign, ranging from technical risks and financial risks, to organizational risk. An overview of the estimated costs and risks can be found in Table 10. A specification of the calculation of these investment cost can be found in Appendix I: Benefits & Investment Costs, together with a calculation of the financial benefits. The assumptions that were made in calculating the costs and benefits are also specified in the appendix.

TABLE 10: INVESTMENT COSTS AND RISK ANALYSIS OF THE REDESIGNED ORDER ENTRY PROCESS

Investment costs	
IT resources needed to implement the changes regarding order input complexity	€ X
IT resources needed to implement the order confirmation related changes	€ X
Training personnel in using the redesigned part of the system	€ X
Total:	**€ X**
Recurring costs	
Increase in annual personnel costs at Commercial Support	€ X
Total:	**€ X**

Risk analysis	**Description**
Technical risks:	• Technical changes to the order input may have unforeseen effects on other systems
Financial risks:	• Additional systems, related to the order input, need to be adapted • Commercial Support is not able to process orders as efficiently as OEM Sales diminishing the expected cost savings
Organizational risks:	• Workload at Commercial Support becomes too high (orders get delayed/errors arise) • Commercial Support is not able to handle the more complex tasks (to many errors)

As can be seen from Table 10, the main investment costs are related to the adaptations that need to be made to the current system. When looking at financial benefits (i.e. personnel costs) stated in Table 9, it can be stated that the redesign project pays back its initial investment in X TIME. However, other costs and benefits also play a role in the investment decision, and need to be taken into account. Though the additional (recurring) costs of hiring an extra employee at CommOn are relatively easy to calculate, it is hard, if not impossible, to determine the financial value of most of the identified benefits.

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4.4.4 Business Case Summary

Based on the business case and the discussions held with the experts within the company, we argue that the proposed changes to the order entry process of proposals, and particularly call-off orders, should be considered the most cost effective. This especially holds if, concurrently, part of the order entry tasks are transferred to CommOn. Making changes to the order confirmation process, on the other hand, is expected to require more complex and extensive changes to the IT systems. Therefore, this change is considered to be less cost effective and to pose a higher risk. Hence, the company is advised to look for additional evidence regarding the benefits before implementing this change.

Finally, it should be noted that a lot of benefits that contribute into reaching the investment objectives (stated in Table 9) are non-financial benefits. Therefore, we argue that it is pivotal to take them into account when making the final investment decision.

4.5 Conclusion

Based on the analysis of current business processes it was found that the main bottlenecks regarding the OEM order process lie in; the ERP system in use, the division of labour between CommOn and OEM Sales, the complexity of order input and the availability of order confirmations. Together with the sales manager and a customer specialist, the redesign scope was set on solving the latter three bottlenecks.

The redesign phase started out with the creation of two redesign alternatives. The first focused on eliminating the IT-related bottlenecks (i.e. order input complexity and availability of order confirmations), while the second focused on eliminating the bottleneck caused by the current distribution of labour. Eventually both redesigns were combined, creating a basis for the final redesign. Next, the redesign was validated, and further refined, based on a discussion with a number of key users and IT consultants. During the validation phase it turned out that some redesign changes that were suggested would require significant changes to the IT system. In order to reduce the need for such extensive changes, some processes within the suggested redesign were adapted in such a way that it provides a better combination of IT and business changes that are needed.

Based on the business case it became clear which costs and benefits could be related to the redesigned process. The main investment costs of the process redesign are related to; the IT resources needed to implement the proposed changes and the training of personnel in using the system. The recurring costs that should be considered are the potential increase in personnel costs at CommOn. The benefits of implementing the redesign should be sought in; lower overall personnel costs related to order input, customers receiving improved order confirmations, an increase focus on customer relations, a higher capacity and increased flexibility of order input at CommOn, a less error prone order input process, and finally, an increased work diversity at CommOn.

5 Discussion & Conclusion

In this chapter we will discuss the findings that were described in the previous paragraph. Furthermore, the limitations of the study will be addressed and suggestions for future research will be made. Finally, we will conclude this thesis by making a number of recommendations regarding the steps the company should take to improve the order process of customer specific orders.

5.1 Main Findings

The general goal of the research described in this paper is to improve the order process of customer specific orders in order to reduce lead time, rework and overall workload, while, at the same time, increasing customer satisfaction. General consensus within the company is that the current order process of customer specific orders contains certain bottlenecks which compromise the process' efficiency. By identifying these bottlenecks and by proposing and implementing a number of process improvements the company will be able to improve this efficiency.

In the analysis phase a number of bottlenecks were identified based on facts about the current situation. These bottlenecks could be broadly categorized as IT-related bottlenecks and bottlenecks related to the distribution of the company's resources. Based on the redesign alternatives that were drafted for both of these types of bottlenecks, a final redesign alternative was composed that incorporated (parts of) both the initial redesign alternatives. Subsequently the final redesign was validated and refined by a number of key users and the IT department.

5.1.1 Answers to the Sub-Questions

Based on the Research Results described in the previous chapter, we will provide an answer to the Research Questions posed in the beginning of this paper. After having answered all of the sub-questions, the main research question will be answered.

RQ1 Which scientific approaches are available to address the research problem?

To answer this question, the concepts of business process management, business process analysis, business process modelling and business process redesign were discussed (and linked) in the Theoretical Framework section of this paper. These concepts are all related to improving business performance and raising customer satisfaction through a process-centred approach.

It was found that the BPM approach eliminates numerous weaknesses of its predecessors (e.g. quality management and business process redesign) without significantly compromising their strengths. Furthermore, the link between business process analysis, modelling, and redesign and business process management was explained using the business process lifecycle. Finally, it was found that a

business case can be a useful addition in the validation and implementation of a business process redesign project. A good business case takes both financial and non-financial benefits into account, furthermore, it identifies way to deliver these benefits and creates a basis for reviewing whether or not expected benefits have been realized. To prevent benefits from being overstated, and thereby projects oversold, rigorous evidence for each of these benefits needs to be provided in the business case.

From a researcher's – personal – point of view, using these particular theories and approaches proved to be useful in solving the research problem at hand. Not only did they serve as guidelines or roadmaps for carrying out the research, they also provided tools that made it a lot easier to execute the research. BPMN, for example, proved to be very useful in both the analysis, redesign and validation phase of the research because it served as a tool to discuss (and analyse) the business processes, with the people that take part in these processes, in a very comprehensible way. This kind of interaction was perceived as an important factor in effectively carrying out the entire business process redesign project.

RQ2 What are the requirements of Kramp regarding the business process redesign?

The day-to-day operations within the company are highly dependent on the IT system currently in use. Therefore, the proposed redesign should be compatible with the company's current IT systems. Although the research problem stated in this paper mainly applies to the OEM order process, the effects that changing a process has for the entire company should be kept in mind when redesigning the order process. Ultimately this led to a number of constraints. First and foremost, the solution should be compatible with the current IT systems. Second, the distribution of work between CommOn and OEM Sales regarding order input should preferably shift towards CommOn or, at least, remain unchanged.

RQ3 What type of solution is most desirable for Kramp?

Based on the bottlenecks found in the analysis phase, the redesign scope was set to the order entry process of OEM orders. The main actors in this process are the Commercial Support employees and the customer specialists and product specialists of OEM sales department. Based on semi-structured interviews with the different actors and stakeholders, the problems related to the order entry process were identified.

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Of the problems listed above, the first problem is mostly related to the production aspects of customer specific orders. The second through fourth problem, on the other hand, are closely linked to the order entry process. Since the focus of the project was set to the order entry process, solutions were sought in that direction. It was found that the problems could be divided into IT-related bottlenecks and bottlenecks related to the division of labour. By designing two alternative processes, each focussing on solving one type of bottleneck, two distinct processes emerged that each fully eliminated the particular bottleneck type. By subsequently combining both redesign alternatives a redesign was created that largely eliminates both these bottlenecks.

RQ4 Which methods are appropriate for validating the redesign?

In order to validate and refine the final redesign, the process models were discussed with key users and experts (i.e. IT consultants) within the company. Because we chose to use BPMN as the graphical standard to model the processes, most of the actors found it easy to comprehend the models, which made it easy to discuss the proposed redesigns. In order to validate the redesign in terms of feasibility, we chose to develop a business case in which we assessed the redesign in terms of costs and benefits.

RQ5 What are the costs and benefits for Kramp regarding the redesign implementation?

The business case described in paragraph 4.4 provides an overview of the costs and benefits that are associated to the redesigned order entry process. The most important costs to consider are the investments that need to be made in adapting the IT system to enable the proposed process improvements and the costs of training the personnel at Commercial Support in inputting the more complex orders. Furthermore, based on the suggestion to increase the capacity at CommOn, the recurring costs of an additional employee should be taken into account. The only financial benefit that could be identified are the savings related to personnel costs. However, the business case also revealed a lot of non-financial benefits.

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5.1.2 Answer to the Main Research Question

The main research question that was posed at the beginning of this paper was: “How can the order process of customer specific orders be improved in order to reduce lead time, rework and overall workload, while at the same time increasing customer satisfaction?”

It was found that business process management is a useful approach when the goal is to increase business performance and customer satisfaction. Therefore, this approach was incorporated in the research design of this paper (outlined in chapter 3).

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In order for the process redesign to deliver high performance over time, the company needs to evaluate the individual processes and evaluate whether the company is ready to support the redesign. The first can achieved by looking at the process enablers, such as the skills and knowledge of the people who execute the process. The latter can be accomplished by assessing enterprise capabilities, like the leadership skills of the senior executive supporting the process redesign.

5.1.3 Research Contribution

The research described in this paper was set out to analyse the current order process of customer specific orders within the OEM market and to provide the company with a plan to improve this process. In this paper we argues that, with the implementation of the proposed process improvements, the company will be able to reduce lead time, rework and overall workload while, at the same time, increasing customer satisfaction.

5.2 Limitations

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Furthermore, it was sometimes hard to directly measure certain variables. For example, the amount of hours spent on order input by OEM was estimated based on phone logs, and an estimation made by the employees themselves. To overcome these limitations, the company might, for example, consider measuring the actual time it takes the different departments to input the various types of orders. Which could, for example, be done through a field study, or by linking customer order types with sales orders and assessing the processing time.

Another potential limitation of the study relates to the interviewees that were chosen from the population. Although the main actors are represented in the sample of interviewees the sample size might be considered to be somewhat limited. This potentially has a negative effect on the internal validity of the research.

5.3 Directions for Future Research

Like mentioned in the Limitations section, it was hard to determine the financial value of some of the benefits that were identified in the Business Case. The reduction of order input errors, for example, is a benefit that is expected to deliver substantial savings since it impacts a lot of processes within the organization (e.g. faulty order input generally leads to; rush orders, re-picking, deployment of a courier, product returns, additional administration, and potentially reduced customer satisfaction). By determining the financial value of each benefit, the company will be able to make a better-informed decision regarding their investment options.

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5.4 Recommendations

We conclude this chapter with an overview of the recommendations for the company. The recommendations are divided into IT related changes and task related changes (see Table 11). The models in paragraph 4.3 elaborate on the process changes that are proposed in order to achieve these IT and task related changes.

TABLE 11: REQUIREMENTS SPECIFICATION OF THE REDESIGNED BUSINESS PROCESS

IT related changes
The ERP system should incorporate a pop-up with which proposals can be instantly confirmed
The ERP system should automatically add a confirmed proposal to a sales order
The ERP system should contain the possibility to postpone order confirmations until the entire order is entered

Task related changes
All order entry tasks that do not involve customer contact should be handled by Common
All employees at CommOn should be able to handle these specific (sometimes more complex) OEM orders

In addition to the above mentioned requirements, the company might want to consider the option of hiring on-call employees as a way to mitigate the financial and organizational risk related to the proposed redesign.

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Appendices

Appendix A: Elements of BPMN

Appendix B: Interview Questions

Appendix C: Actors & Stakeholders

Appendix D: Interview Annotations

Appendix E: Procedure & Work Instruction

Appendix F: Screenshots Order Entry Process

Appendix G: Basic Application Architecture

Appendix H: Benefits Dependency Network

Appendix I: Benefits & Investment Costs

Appendix A: Elements of BPMN

"The notational elements in business process diagrams [i.e. BPMN] are divided into four basic categories, each of which consists of a set of elements [see Figure 42 through Figure 48] […]. Flow objects are the building blocks of business processes; they include events, activities, and gateways. The occurrence of states in the real world that are relevant for business processes and, more generally, anything relevant that happens, can be represented by events. Activities represent units of work performed during business processes. Gateways are used to represent the split and join behaviour of the flow of control between activities, events, and gateways. […] Artefacts are used to show additional information about a business process that is "not directly relevant for sequence flow or message flow of the process." […] Connecting objects connect flow objects, swimlanes, or artefacts." (Weske, 2012, pp. 208-209).

N.B. All models in this thesis are created using the BPMN based Bizagi Process Modeller (v.2.6), which was chosen for its intuitive and user-friendly interface and the fact that it is freeware[7].

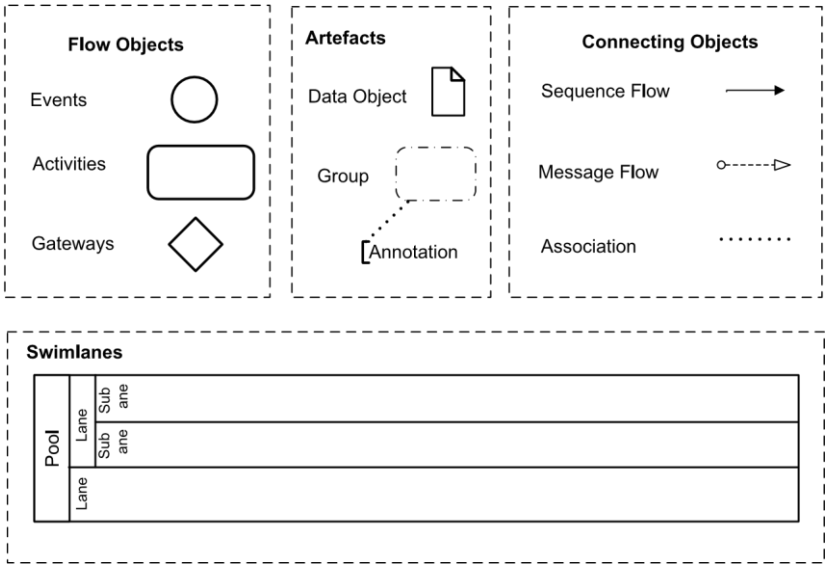

FIGURE 42: BPMN CATEGORIES OF ELEMENTS (WESKE, 2012)

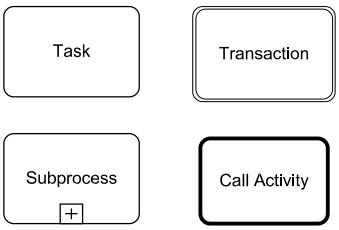

FIGURE 43: BPMN ACTIVITY TYPES (WESKE, 2012)

[7] Bizagi process modeller can be downloaded for free from www.bizagi.com

FIGURE 44: BPMN ACTIVITY MARKERS REFINING ACTIVITY BEHAVIOUR (WESKE, 2012)

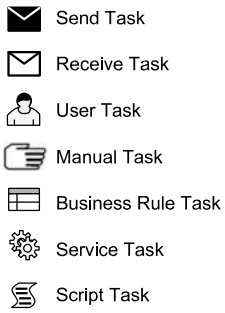

FIGURE 45: BPMN TASK TYPES SPECIFYING THE TASK THAT IS REPRESENTED (WESKE, 2012)

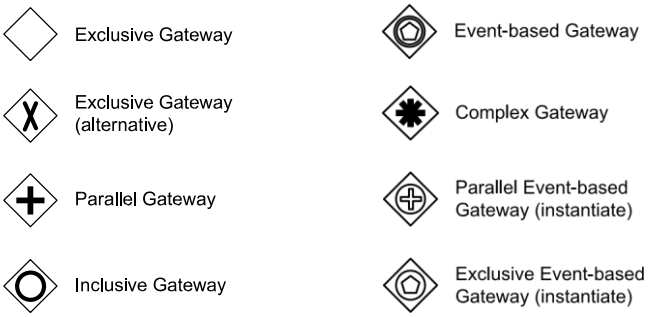

FIGURE 46: BPMN GATEWAY TYPES (WESKE, 2012)

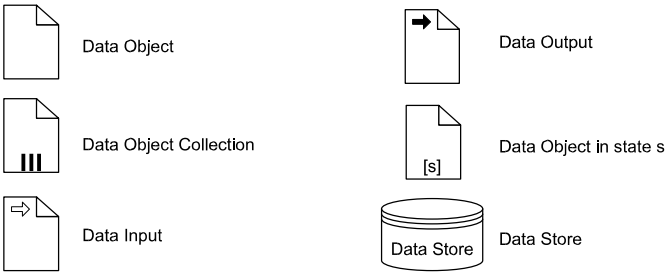

FIGURE 47: BPMN NOTATION ELEMENTS REGARDING DATA (WESKE, 2012)

	Start Events	Intermediate Events				End Events
	Catching	Catching	Boundary Interrupting, Catching	Boundary Non-Interrupting, Catching	Throwing	Throwing
None or blanco: Untyped events, indicate start point, state changes or final states.						
Message: Receiving and sending messages.						
Timer: Cyclic timer events, points in time, time spans or timeouts.						
Escalation: Escalating to an higher level of responsibility.						
Conditional: Reacting to changed business conditions or integrating business rules.						
Link: Off-page connectors. Two corresponding link events equal a sequence flow.						
Error: Catching or throwing named errors.						
Cancel: Reacting to cancelled transactions or triggering cancellation.						
Compensation: Handling or triggering compensation.						
Signal: Signalling across different processes. A signal thrown can be caught multiple times.						
Multiple: Catching one out of a set of events. Throwing all events defined.						
Parallel Multiple: Catching all out of a set of parallel events.						
Terminate: Triggering the immediate termination of a process.						

FIGURE 48: BPMN COMMON EVENT TYPES (WESKE, 2012)

Appendix B: Interview Questions

Below you will find an overview of the questions/topics that were discussed (in Dutch) during the semi-structured interview with the interviewees in the business process analysis phase. An English translation is provided below each of these questions/topics.

a) **Uit welke stappen bestaat het deel van het orderproces waar u verantwoordelijk voor bent/ waar u mee te maken heeft?**
[What are the steps of the order process you are responsible for and which other steps do you have to deal with?]

b) **Hoe ziet dit proces eruit (beschrijf de stappen en bijbehorende connecties)?**
[What does the process look like? Could you describe the different steps involved?]

c) **Tegen welke problemen loopt u aan tijdens het doorlopen van dit proces en wat zijn de beperkingen?**
[What problems do you encounter during the enactment of the process and what do you consider to be the limitations within the process?]

d) **Wat zijn de grootste ergernissen die u ervaart tijdens het gebruik van het systeem?**
[What things annoy you most when using the system?]

e) **Wat zijn volgens u de belangrijkste oorzaken van de eerder genoemde problemen?**
[What do you consider to be the main causes of the previously mentioned problems?]

f) **Wat zijn volgens u de belangrijkste gevolgen van de eerder genoemde problemen?**
[What do you consider to be the main consequences of the previously mentioned problems?]

g) **Welke verbeterpunten kunt u aandragen met betrekking tot het proces en hoe zou u het bestaande proces graag willen veranderen?**
[What improvements do you propose regarding the process and how would you propose to put these improvements into practice?]

h) **Overige op- en aanmerkingen?**
[Any additional remarks?]

Appendix C: Actors & Stakeholders

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TABLE 12: LIST OF ACTORS AND STAKEHOLDERS

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Appendix D: Interview Annotations

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Appendix E: Procedure & Work Instructions

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Appendix F: Screenshots Order Entry Process

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Appendix G: Basic Application Architecture

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FIGURE 49: OVERVIEW OF THE DIFFERENT APPLICATIONS AND THEIR INTERRELATIONSHIPS (KRAMP GROEP, 2012)

TABLE 13: DESCRIPTION OF THE MOST IMPORTANT APPLICATIONS

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Appendix H: Benefits Dependency Network

In this paper the development of a business development network is driven by the elimination of the identified bottlenecks. To develop such a network the problem-based approach from Peppard et al. (2007) is followed (see Figure 50). The typical elements of the BDN, which can be found in Figure 50 and Figure 41, are elaborated on in Table 14.

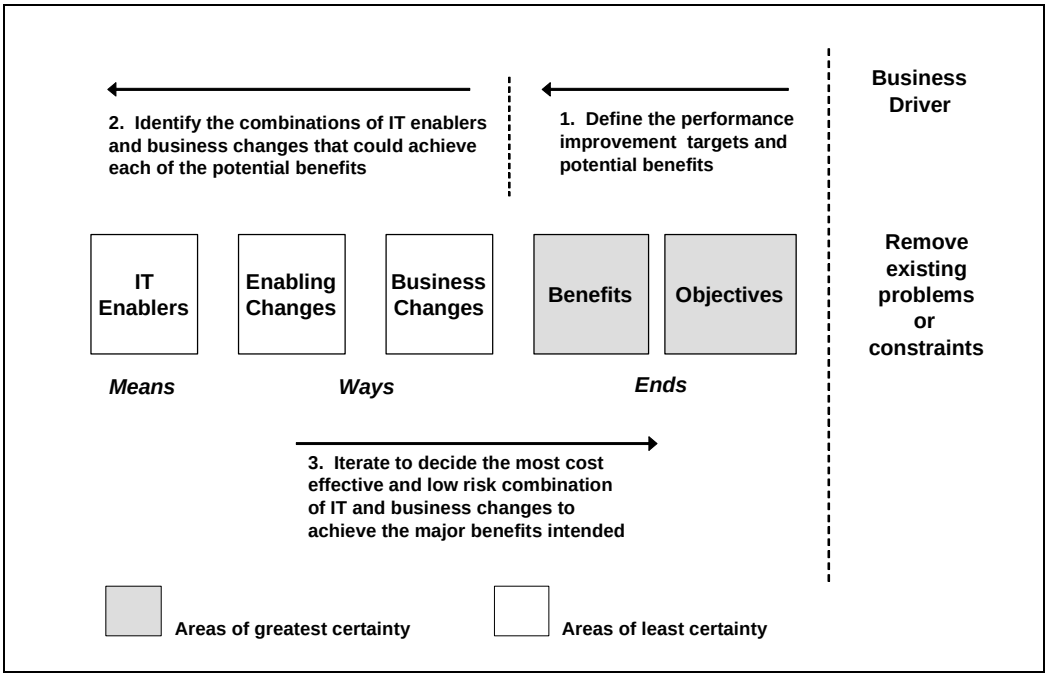

FIGURE 50: DEVELOPING A BDN FOR PROBLEM-BASED INTERVENTIONS (PEPPARD ET AL., 2007)

TABLE 14: ELEMENTS OF THE BENEFITS DEPENDENCY NETWORK (PEPPARD ET AL., 2007; WARD & DANIEL, 2012)

Element	Description
IT Enablers	The technology required to support the realization of identified benefits and to allow the necessary changes to be undertaken.
Enabling Changes	One-off changes that are prerequisites for making business changes or are essential for an effective operation of the newly designed process
Business Changes	Permanent changes to working practices, processes, and/or relationships which will cause the benefits to be delivered
Benefits	All the observable, measurable, quantifiable, or financial benefits that will be obtained
Investment Objectives	A set of statements that describe what the situation should be on completion of the investment

Appendix I: Benefits & Investment Costs

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TABLE 15: SPECIFICATION OF THE FINANCIAL BENEFITS OF THE REDESIGN PROJECT

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TABLE 16: SPECIFICATION OF THE INVESTMENT COSTS OF THE REDESIGN PROJECT

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