Pihla Saarenketo

Developing an Escalation Framework to Improve Quotation Response Time in Spare Part Sales

A Case Study in a Finnish Technology Company

School of Technology and Innovation
Industrial Systems Analytics

Vaasa 2026

UNIVERSITY OF VAASA
School of technology and innovations

Author:	Pihla Saarenketo
Title of the thesis:	Developing an Escalation Framework to Improve Quotation Response Time in Spare Part Sales: A Case Study in a Finnish Technology Company
Degree:	Master of Science in Technology
Degree Programme:	Industrial Systems Analytics
Supervisor:	Binod Timilsina
Year:	2026 **Pages:** 77

ABSTRACT:
The aim of this thesis is to develop an escalation framework to improve quotation response time in spare parts sales. The study was conducted as a case study in a globally operating Finnish technology company, where fast and reliable responses to quotation requests are a critical factor for customer satisfaction and sales performance. The research focuses particularly on the factors causing delays in the quotation process and explores what kind of effective escalation framework can be applied to the process. The ultimate objective is to define clear escalation indicators and to develop a practical framework that enables more systematic management of prolonged quotation cases through the case company's quotation systems.

The study was conducted using a Design Science Research (DSR) approach, combining both qualitative and quantitative data. The qualitative data consisted of interviews, observations, and documentation, while the quantitative data was based on the company's historical quotation data from 2025. The results indicate that the most significant factors negatively affecting quotation response time include poor input data quality, limited transparency and communication between stakeholders, ineffective prioritization practices, and long supplier response times. Based on these findings, the developed escalation framework enables proactive identification and management of delayed cases. The framework defines key escalation criteria, roles, and procedures, and supports improvements in process efficiency and customer experience without requiring a complete redesign of the quotation process.

KEYWORDS: Quotation Response Time, Escalation Framework, Spare Part Sales, Process Improvement, Customer satisfaction

VAASAN YLIOPISTO
Tekniikan ja innovaatiojohtamisen yksikkö

Tekijä:	Pihla Saarenketo
Tutkielman nimi:	Developing an Escalation Framework to Improve Quotation Response Time in Spare Part Sales: A Case Study in a Finnish Technology Company
Tutkinto:	Master of Science in Technology
Oppiaine:	Industrial Systems Analytics
Työn ohjaaja:	Binod Timilsina
Vuosi:	2026 **Sivumäärä** 77

Tiivistelmä

Tämän diplomityön tavoitteena on kehittää eskalaatiomalli varaosamyynnin tarjousten vastesajan parantamiseksi. Tutkimus toteutettiin tapaustutkimuksena globaalisti toimivassa suomalaisessa teknologiayrityksessä, jossa nopea ja luotettava reagointi tarjouspyyntöihin on keskeinen tekijä asiakastyytyväisyyden ja myynnillisen menestyksen kannalta. Tutkimuksessa tarkastellaan erityisesti tarjousprosessin viiveitä aiheuttavia tekijöitä sekä pohditaan minkälainen tehokas eskalisaatiomalli tarjousprosessiin on. Lopullisena tavoitteena on määritellä selkeät eskalaatioindikaattorit sekä kehittää käytännöllinen malli, jonka avulla pitkittyviä tarjouskäsittelyjä voidaan hallita systemaattisemmin.

Tutkimus toteutettiin Design Science -lähestymistapaa hyödyntäen ja yhdistäen laadullista ja määrällistä aineistoa. Laadullinen aineisto koostui haastatteluista, havainnoista ja dokumentaatiosta, kun taas määrällinen aineisto perustui yrityksen historialliseen tarjousdataan vuodelta 2025. Tulokset osoittavat, että keskeisimpiä tarjousvastausaikaa heikentäviä tekijöitä ovat puutteellinen lähtötiedon laatu, heikko läpinäkyvyys ja viestintä eri sidosryhmien välillä, priorisointikäytäntöjen rajallinen vaikuttavuus sekä toimittajien pitkät vastausajat. Näiden havaintojen pohjalta kehitetty eskalaatiomalli perustuu viivästyvien tapausten ennakoivaan tunnistamiseen ja hallintaan. Malli määrittelee keskeiset eskalaatiokriteerit, roolit ja toimintatavat, ja sen avulla voidaan parantaa prosessin tehokkuutta ja asiakaskokemusta ilman koko tarjousprosessin laajamittaista uudelleensuunnittelua.

AVAINSANAT: Quotation Response Time, Escalation Framework, Spare Part Sales, Process Improvement, Customer satisfaction

Contents

1 Introduction 7

1.1 Background 7

1.2 Research problem and scope 8

1.3 Structure of the thesis 9

2 Literature review 11

2.1 Spare part business and management 11

2.1.1 Spare part management (SPM) 12

2.1.2 Spare part sales as an operating environment 14

2.2 Quotation response time 15

2.2.1 Key performance indicators for analyzing QRT 17

2.3 Business process management and escalation frameworks 18

2.3.1 Business process management 19

2.3.2 Exception handling 20

2.3.3 Escalation frameworks 22

2.3.4 The structure of escalation frameworks 23

2.3.5 Escalation strategies 24

3 Methodology 26

3.1 Research approach 26

3.2 Research design 27

3.3 Data collection 28

3.3.1 Interview data 28

3.3.2 Quotation data 29

3.3.3 Observations and documentation 30

3.4 Data analysis 31

3.4.1 Analysis methods for qualitative data: interviews 31

3.4.2 Analysis methods for quantitative data 32

3.5 Reliability, validity, and limitations 33

4 Results 35

4.1 As-is quotation process 35
4.1.1 Process description 35
4.1.2 QRT performance 38
4.2 Qualitative results 39
4.2.1 Challenges and bottlenecks found from the qualitative analysis 40
4.2.2 Current practices on handling prolonged cases 45
4.2.3 Requirements for the escalation framework 47
4.3 Quantitative results 50
4.3.1 General level bottlenecks 50
4.3.2 The impact of different back-office support types on QRT 53
4.3.3 Quantitative perspective on supplier response time 54
4.3.4 Relationship between priority and response time 55
4.4 The proposed escalation framework 56
4.4.1 Scope of the escalation framework 57
4.4.2 Escalation indicators 61
4.4.3 The applied escalation strategies 62
4.4.4 Roles and responsibilities 64
5 Discussion and conclusion 66
5.1 Theoretical and managerial implications 67
5.2 Limitations and future research possibilities 68
5.3 Conclusion 69
References 71
Appendices 76
Appendix 1. Escalation Framework for the Front-end Service Portal 76
Appendix 2. Escalation Framework for the Back-end Case Collaboration Platform 77

Figures

Figure 1. Example of a flowchart (Russell et al., 2006). 20
Figure 2. General Exception Handling Logic. 21
Figure 3. The process of DSR. 27
Figure 4. As-is quotation process. 35
Figure 5. QRT distribution. 39
Figure 6. Case status durations. 51
Figure 7. Impact of back-office case collaboration on QRT. 52
Figure 8. Item action type's effect on average and median QRT. 53
Figure 9. Supplier response time KPIs. 54
Figure 10. QRT group distribution by case priority. 56
Figure 11. Examples on escalation indicators. 62

Tables

Table 1. Research question and objectives. 9
Table 2. Escalation logics. (van der Aalst et al., 2007) 23
Table 3. Escalation strategies. (van der Aalst et al., 2007) 25
Table 4. Research Interviewees. 29
Table 5. The first aimed visual representation of the descriptive analysis. 33
Table 6. The second aimed visual representation of the descriptive analysis. 33
Table 7. Term definitions for the proposed escalation framework. 57
Table 8. Case statuses within the scope of the escalation framework. 59
Table 9. Item action statuses included in the framework 60
Table 10. Used Escalation Strategies. 63

1 Introduction

1.1 Background

For several decades, quotation response time (QRT) has been recognized as one of the most important ways to meet demanding customer expectations and fulfil their overall satisfaction (Nagel and Dove, 1998). By responding quickly to customers' quote requests, companies can communicate that they value their customers' time and needs and ease the overall buying process. From a company perspective, response time is also a remarkable factor for sales success as competitive responsiveness can be linked to customers' purchase intention and decision (Mai and Liao, 2022). In other words, for companies, better response time means more money.

In the context of spare part business, the importance of fast response time is not decreasing, but rather increasing. This is for example because of the spare parts' effect on customers' system availability e.g. whether it is possible to use a production line or not. Without an important spare part an entire production line may be difficult or even impossible to use, which in the worst case can lead to lost business, problems with customers, delays or general interruption costs (Zhang et al., 2023; Diallo et al., 2012). Consequently, spare parts suppliers face growing pressure, as fast and reliable response times are no longer value-adding advantages but essential competitive requirements.

There are many perspectives on how to improve QRT. Sometimes, instead of developing the entire process, a company can for example focus more on exception handling rather than developing their entire quotation process. In practice, exception handling means managing the "situations that differ from the normal behavior of the designed process" (Mourão and Antunes, 2004). In the context of response time, this means managing those cases that prolong and do not flow through the normal process at the required speed. By identifying and proactively managing such exceptions, companies can achieve

significant improvements in quotation response time without redesigning their entire process.

In practice, an exception handling process can be operationalized, for example through escalation frameworks which define how the process should change when an exception is faced. Overall, escalation can take place in many different situations, of which in case of quotation, the most relevant is deadline-based escalation. In this escalation type, escalation framework is triggered when the company's target QRT is getting too close or exceeds (van der Aalst et al., 2007).

Spare parts' quotation escalation framework can be built for example by following the 3D-approach by van der Aalst et al. (2007). In this approach, the escalation framework is planned in three phases: Detect, Decide and Do. From these phases, the first focuses on monitoring cases within the escalation scope and finding those cases that should be escalated. The second on the other hand focuses on deciding what type of escalation measures take place after the escalation whereas in the last phase the escalation actions in practice take place.

1.2 Research problem and scope

However, although academic literature provides useful conceptual models and examples for building escalation frameworks, a limited attention has been given to practical approaches for managing prolonged quotation cases in complex, multi-stakeholder environments such as spare parts sales. In particular, existing research lacks applied frameworks that enable systematic identification and handling of delayed quotation cases without requiring a complete redesign of the quotation process. This gap restricts the practical implementation of escalation frameworks in real-world quotation processes.

Leaning on the research gap described above, the aim in this research is to build an escalation framework for a well-known Finnish technology company. The company operates globally around the world and has operations in nearly 40 different countries and

customers in over 120 countries. The company's products include especially different process relates products such as machines and automation solutions. Additionally, the company's products also include various aftermarket products such as spare parts and services. In this research, the focus is directed to the company's spare parts business unit for which the escalation framework is also being developed and designed.

The construction of the escalation framework in this thesis is approached through four different research questions and their related objectives. In detail, these questions and related objectives are listed below in Table 1.

Table 1. Research question and objectives.

Research Questions	**Research Objectives**
What are the current challenges and delay factors in the case company's spare parts quotation process?	To analyze the current quotation response process at the case company and identify factors contributing to delays
Which indicators can be used to identify quotation cases at risk of delay?	To develop escalation indicators that enable early detection of potentially delayed quotation cases
How can an escalation framework be structured in terms of roles, responsibilities, and escalation levels?	To design a practical escalation framework with defined roles, responsibilities, and processes for handling prolonged quotation cases
What is the expected impact of the escalation framework on response time and customer satisfaction?	To evaluate the potential impact of the proposed escalation framework on quotation response time and customer satisfaction.

1.3 Structure of the thesis

After this section, the thesis is structured as follows. Firstly, Chapter 2 presents the literature review, which builds the theoretical foundation for the study by examining spare part business and management, quotation response time, and business process management with a particular focus on escalation frameworks. This chapter provides the key

concepts and perspectives needed to analyze the quotation process and to support the development of the escalation framework.

Secondly, Chapter 3 describes the research methodology, including the research approach, research design, data collection, and data analysis methods, as well as considerations related to reliability and validity. On the other hand, Chapter 4 presents the results of the study, covering the current quotation process, quotation response time performance, identified challenges, and the requirements for the escalation framework, followed by the proposed escalation framework. Finally, the thesis concludes with a discussion of the findings and a concluding chapter that summarizes the main results, highlights the contributions and limitations of the study, and suggests directions for future research.

2 Literature review

2.1 Spare part business and management

Spare parts are maintenance items that are used in industrial equipment. Compared to so-called standard or process parts, spare parts are used less regularly, for example in case of deterioration or expiration. In practice, use of spare parts can be divided into two parts, corrective and preventive replacement. From these, the first describes use in case of observed failure whereas the second refers to proactive operation in order to avoid failures (Diallo et al., 2012).

Based on the nature of the use of spare parts, it can be concluded that spare parts have practical significance throughout the entire product life cycle. The significance is also well supported by the fact that on average spare parts account for approximately 15 - 18 % of the total lifecycle cost of a manufacturing plant. The relatively high share of total cost is likely due to spare parts management often including some kind of storage activities, which easily leads to significant inventory expenses. The need for storage activities arises from the possibility that a corrective replacement may be required promptly, in case of unexpected failure of a part for example (Hu et al., 2015).

From business perspective, spare parts belong to the category of after-sales services, which refers to activities designed to replace or repair product components and provide accessories that enhance safety, reliability, comfort, and user experience (Durogbo, 2020). This definition highlights that every spare part is tied to a prior purchase or an existing piece of equipment and gains relevance only through this relationship. In other words, spare parts can rarely be seen as products to be used on their own but more as part of something whole.

The after-sales services, to which spare parts belong, is an important market for many of today's businesses. For example, Holmström et al. (2011) state "*Today, after-sales*

services – i.e. the services supporting products – contribute to about 25 percent of all revenue and 40 percent to 50 percent of all profits for manufacturing companies." In other words, companies increasingly rely on after-sales services such as spare parts to sustain their financial performance, as these activities often yield higher margins than the initial product sales.

In this subsection of this thesis, spare parts are reviewed both from the point of view of a customer and a supplier. In terms of the escalation framework, it is important to understand the context of spare parts from both directions, as the customer and supplier perspectives are strongly connected and often difficult to separate. Like in business in general, the customer's actions and needs greatly affect the supplier's operating environment - if not even completely set it. In practice, the customer's viewpoint in this subsection is reviewed through spare part management (SPM) whereas the supplier's and therefore also the perspective of the case company is built through a description of the spare part sales operating environment.

2.1.1 Spare part management (SPM)

Spare part management (SPM) is considered as the management of spare part inventory including aspects such as demand forecasting, stock level control, and maintenance monitoring. For several decades, there has been a growing academic interest in SPM due to the special characteristics of spare parts and the challenges those cause for the management of spare parts. In summary, the special characteristics of spare parts include aspects such as unstable demand, high item variety and importance on system availability (Hu et al., 2018; Zhang et al., 2023).

The unstable demand of spare parts represents one of the most critical challenges identified in spare part management and is a widely recognized in the academic literature. In their article, Diallo et al. (2012) explain that the unstable demand of spare parts is attached to the fact that spare parts are usually intended for a very certain type of a situation that's probability is hard to predict and forecast. The need for spare parts depends

for instance on that how old the company's equipment is (Didriksen et al., 2025) and how well it is maintained (Hu et al., 2018).

In general, companies need to maintain relatively large and diverse spare parts inventory. Referring to Guvenir & Erel (1998), Hu et al. (2018) state that it is common for companies to maintain inventory for up to thousands of different items, which is in a class of its own in terms of challenging SPM. Based on the knowledge gained from the case company, the extensive number of items can for example be explained by the high complexity of the customer company's equipment, which naturally leads to a very large number of spare parts that the company may need. This matter is described well for example by the fact that the in the case company, a general spare parts recommendation for a delivered product includes around four thousand different item codes.

The reason why companies have to stock important spare parts rises from their importance on maintaining system availability. Simply put, system availability means how often a system such as a machine or a production line is up, running and usable when needed. The opposite of system availability is naturally unavailability which, in the worst type of scenario, may have several negative consequences for the system owner, like a manufacturing company for instance. In practice, these negative consequences mean lost business, problems with customers, delays or general interruption costs (Zhang et al., 2023; Diallo et al., 2012). Spare parts have a high importance on system availability because one spare part can be so critical that a whole machine does not work properly or even at all without that part.

For companies, well-performed SPM is important for example so that they can secure the availability of critical parts while keeping also inventory costs under control (Hu et al., 2018; Didriksen et al., 2025). In general, the responsibility of SPM is usually shared responsibility between different departments. Didriksen et al. (2025) list that normally SPM responsibilities are divided between the maintenance, procurement and logistics. In practice, this can be seen to mean for example that maintenance monitors the

condition of assets and identifies upcoming spare part needs. Further, procurement manages sourcing and supplier coordination, and logistics oversees inventory levels, warehousing, and distribution to ensure availability.

2.1.2 Spare part sales as an operating environment

Just like from the point of view of the customer, spare parts are also a unique product category from the viewpoint of a supplier. For the thesis this perspective is especially important because it describes the operating environment of the reviewed case company and sets clear conditions for the developed escalation model. From the supplier's side, the environment is shaped not only by the characteristics of the parts themselves but also by commercial requirements, such as the need to provide timely quotations, maintain competitive pricing, and ensure reliable delivery performance in situations where customer demand may be urgent or unexpected.

Many of the features of spare parts that were described in the previous section also affect the operating environment of the supplier. For example, the big variety of spare parts affects the supplier so that their product catalogue is usually relatively complex and challenging to manage (Hu et al., 2018). In the case company, this can be seen so that there are over 55 000 different items sold to customers every year, including both subcontracted and self-manufactured items. As from this amount around 33 % is generated from new item codes, the product catalogue becomes not only complex but also strongly dynamic in nature. The example of the case company is based on information obtained from internal company documents.

The size and complexity of the spare parts product catalogue also challenge the supplier's item management. In addition to that there is a large number of products to maintain, spare parts also require relatively many data attributes. For example, Didriksen et al. (2025) state that item data for spare parts is needed from up to six different areas: technical specifications, supply and logistics, maintenance and demand, inventory, maintainable asset and cost. Noteworthy also is that these attributes do not necessarily

remain the same over time, meaning that information for the same item may need to be updated many times during the lifecycle of the item.

The unstable demand of spare parts is perhaps one of the biggest things to consider also from the supplier's perspective. When for the customer unstable demand sets challenges on inventory control, for the supplier unstable demand means twists on the sales forecasting. For companies, forecasting sales is important as the whole supply process can depend on forecasts. Additionally, sales forecasts can also be used to prioritize cases with the highest likelihood of sales success. However, when the demand is unstable the accuracy of forecasts easily falls or is extremely hard to conduct (Rohaan et al., 2022).

2.2 Quotation response time

Quotation response time (QRT) can be understood as the time it takes for a supplier to respond to a request for quotation (RFQ). It is part of the overall manufacturing lead time, which is seen as “the total time required to manufacture an item” (Stadnicka and Ratnayake, 2018). Company-specific, QRT can be either counted as a part of the overall lead time KPI or be treated as a separate value. Regardless of the calculation method, QRT is still, however, always an important part of the customer experience, just like the manufacturing or shipment time for example (Stadnicka and Ratnayake, 2018).

In practice, QRT is determined on how efficient or inefficient a company’s quotation process is. The main idea in an average quotation process is very simple: to answer whether the company can supply the part, and if so, to which price and when. However, in practice quotation process can become very complex, mainly due to internal information collection and evaluation. The supplier must for example determine whether supplying the part is economically pleasing and assess the associated costs and other potential impacts. Consequently, these internal evaluations and information flows often extend the quotation process, directly contributing to longer QRT (Veeramani and Joshi, 1997).

The importance of QRT has been recognized for a long time both in academic research and in practical work environment. Already in 1998, Nagel and Dove defined prompt response as one of the strongest ways to meet demanding customer expectations and create overall customer satisfaction. Similarly, in 1997 Veeramani and Joshi noted that especially end-of-supply chain companies experience increasing pressure to respond quickly and efficiently to their customers. In 2012, Elgh stated that companies must adopt new methods and tools to guarantee quick response for their customers.

Although the studies mentioned above have been conducted already some time ago, the view of researchers today is no different. For example, Mai and Liao (2022) mark that "responsiveness is everything for today's customers" and linked strongly to purchase intention and decision. This is straightly aligned with the conception of Rohaan et al. (2022), according to which response time is a remarkable factor for sales success. Taken together, both early and recent studies consistently emphasize the strategic importance of quick quotation response time.

The answer to the question of why customers appreciate better QRT can be studied through the theory of customer value. In their article, Mai and Liao (2022) distribute customer value into two parts: functional value and ease-of-doing-business value. From these two the first describes values connected to the customer's functional demands such as cost reduction and product quality. On the other hand, easy-of-doing-business values consider values that reduce the customer's effort and ease the buying process. It is important to understand that whereas functional values can be measured quite objectively, ease-of-doing-business values can be measured both objectively and subjectively.

Among the two customer value types, QRT can be classified as an ease-of-doing-business value. When customers receive fast responses to their RFQs, the supplier saves the customer's time and supports higher productivity. In addition, this value also operates at an individual level, as purchasing decisions are ultimately made by human beings. When a request is answered promptly, the individual perceives that their time and needs are

acknowledged and respected (Mai and Liao, 2022). These facts together illustrates that ease-of-doing-business values comprise both objective elements, such as time and efficiency gains, and subjective elements related to individual perceptions and experiences.

Having established the importance of QRT as a customer value, the importance of QRT can also be studied through its impact on hit rate. In a nutshell, hit rate means by what percentage a company manages to get a sale from among potential sales e.g. RFQs for example (Rohaan et al., 2022). In their article, Mai and Liao (2022) examine the effect of QRT on hit rate by analyzing supplier responsiveness in a B2B digital platform context. Using data from 220 suppliers on Alibaba.com, the researchers show that faster response time significantly increases response rate, which in turn positively affects the number of sales.

2.2.1 Key performance indicators for analyzing QRT

While QRT itself represents a clear key performance indicator for the efficiency of a company's quotation process, understanding how it develops and how it can be improved requires examining other performance indicators as well. In this thesis, these key performance indicators are important because they can be later on used to answer for example the research question Q1: "What are the current challenges and delay factors in the spare parts quotation process?"

In their article, Stadnicka and Ratnayake (2018) identify and describe several measurements that can be applied to understand how a quotation process performs. The first of these is Process Cycle Efficiency (PCE), which expresses the share of value-adding time relative to the total quotation preparation time. In their example, the authors consider value-adding time to include the activities required to prepare the quotation whereas the waste is considered to be the sum of different waiting times. In general, this value in a transactional process sets around 10 percent although in ideal the value should be more than 50 %.

While we can see that PCE is a useful way to examine the relationship between value-adding work and waste within a quotation process, it is also important to note that it has certain limitations. For example, if the time spent on value-adding activities increases but the waiting time remains the same, the PCE value will improve and give a misleading impression of the process development. In quotation preparation, all elapsed time should essentially be perceived as negative and thus, PCE may only be useful to analyze the percentage that the waiting times contribute to the total QRT. To get a clearer picture of how a quotation process develops, Stadnicka and Ratnayake (2018) suggest measuring the time spent on value-adding activities (VA) and non-value-adding activities (NVA) separately.

Beside PCE, VA, and NVA, other interesting measurements for understanding how a quotation process performs are for example External Parties Influence (EPI) and Client Influence on Lead Time (CILT). From these, EPI measures how much suppliers, subcontractors, or other external partners contribute to overall lead time whereas CILT captures the delays caused by the customer itself. In the case company, studying these values may be reasonable because, based on observations, the quotation process often takes time in external communication and cooperation. Studying these measurements would provide a clear and accurate understanding of the extent to which external actors actually affect the quotation lead time.

2.3 Business process management and escalation frameworks

Having stated the importance of quotation response time we can now move on to review how quotation processes can be developed – especially from the point of view of escalation frameworks. In the academic context, the best approach for the issues is most likely business process management, which refers to the systematic approach for identifying, designing, executing, measuring, and improving an organization's processes (Andree et al., 2022). As an approach, business process management provides a foundation for both overall QRT development as well as exception handling that which escalation frameworks represent.

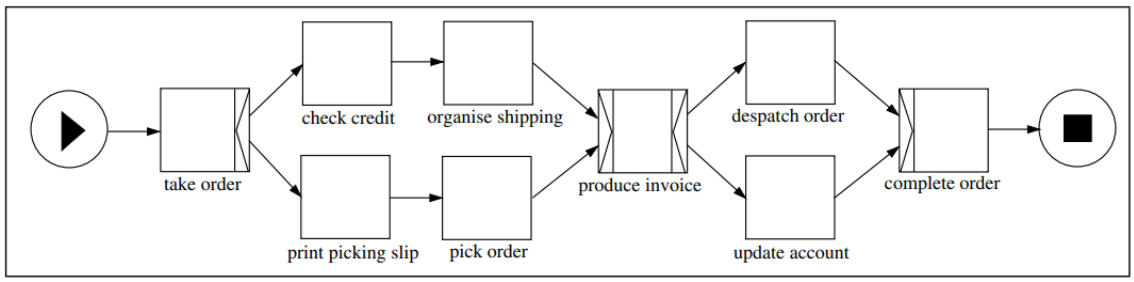
The section is structured as follows. It begins with an overview of business process management and then briefly introduces the concept of exception handling. After that, the chapter moves on to addressing escalation frameworks as an exception handling method and way to handle prolonged quotation cases. Following van der Aalst et al. (2007), escalations can be treated as exceptions that are somewhat expected and triggered by clear and measurable conditions, which makes escalation frameworks as a form of exception handling.

2.3.1 Business process management

Business process management can be seen as the perpetual motion machine of academic literature. It is often the starting point for nearly any business-related project and provides the basic principles on how business processes should be organized, developed, and evaluated. The main goal on business process management is to build such business processes that they serve the businesses' overall goals and set of requirements (Andree et al., 2022). In practical terms, business process management is commonly understood through six core elements: strategic alignment, governance, methods, information technology, people, and culture (Brocke and Rosemann, 2010).

The main output of business process management is usually a business process model, which basically describes the workflow of a chosen process. An enough comprehensive business process model should describe all potential paths in a process from the point that the process is started to that it ends. Commonly, in both the academic literature and practical environments, these kinds of business process models are introduced through different kinds of graphical illustrations such as flowcharts (Andree et al., 2022). An example of this kind of flowchart can be seen from the figure below (Figure 1.).

Figure 1. Example of a flowchart (Russell et al., 2006).



For companies, clear and comprehensive business process models are important for several reasons. Firstly, they provide a foundation for knowledge transfer and facilitate communication between different internal and external stakeholders. Secondly, they help to capture key organizational dimensions by making actors, activities, and workflows explicit. Thirdly, business process models are also required for quality purposes, regulatory compliance, and overall documentation. Furthermore, well-designed process models help avoid errors early in the development lifecycle, which is essential since correcting mistakes becomes increasingly costly the later, they are detected (Moreno-Montes de Oca and Snoeck, 2014).

2.3.2 Exception handling

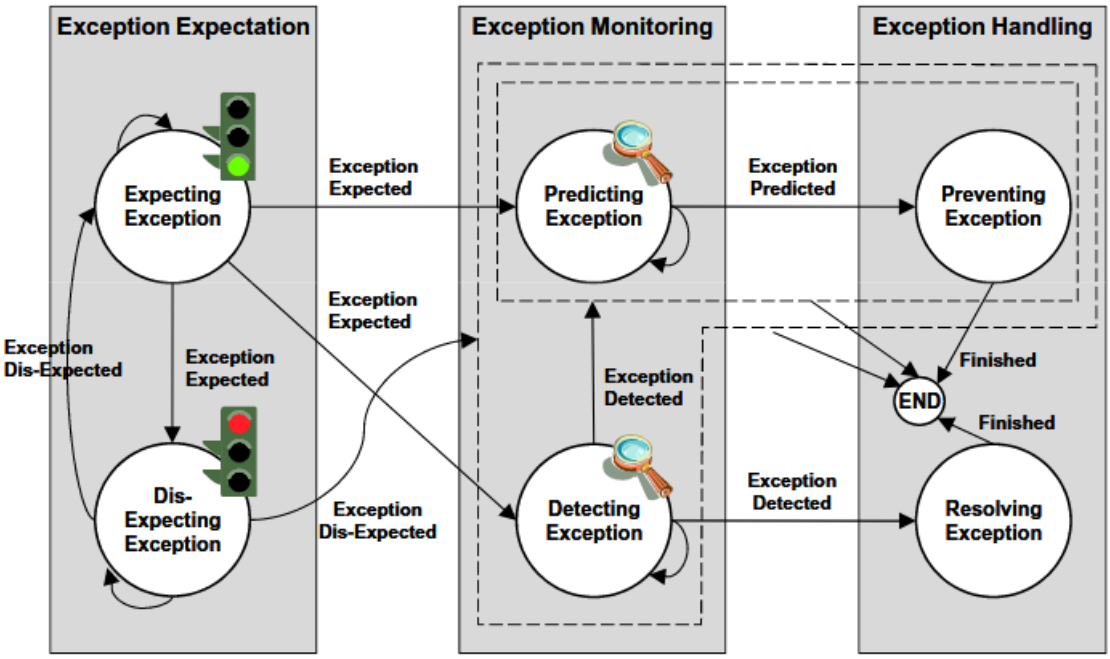
However, although the theoretical idea in BPM is to construct fully specified business process models, in practice achieving such completeness is very challenging. Because real-world processes are highly dynamic, no model can fully address every possible scenario and even the most carefully designed processes will most likely face exceptions. This gap between how processes are designed and how they actually work makes the management of process exceptions an essential part of organizations and thus also business process management (Andree et al., 2022).

By definition, talking about process exceptions means talking about “situations that differ from the normal behavior of the designed process” (Mourão and Antunes, 2004). In business process management, exceptions can be addressed through various expectation-handling methods, frameworks, or approaches. Kim et al. (2011) emphasize that

providing systematic support for expectation handling is essential to ensure that exceptions are managed effectively and properly. Without such structured support, organizations easily fall into a situation where exceptions are handled independently, which leads to fragmented practices and inconsistent outcomes.

A functional exception-handling process begins with anticipating possible exceptions and extends through their prevention, detection, and eventual resolution. Kim et al. (2011) illustrate this overall sequence in a simplified model that outlines how a general exception handling logic is built and used. As shown in Figure 2., the model clarifies the logical structure of exception handling and highlights the key components involved in managing exceptions throughout a process.

Figure 2. General Exception Handling Logic.



Although the general logic of exception handling outlines how processes should respond to deviations, it remains on a conceptual level. In practice, organizations often need more concrete guidance for situations where delays or prolonged cases start to emerge, particularly in time-sensitive processes such as quotation handling. To ensure that these

situations are addressed consistently the principles of exception handling must be translated into clearer operational practices. Escalation frameworks offer one way to do this, as they apply predefined triggers and actions to support timely intervention when cases approach or exceed acceptable limits. The following section introduces escalation frameworks in more detail and explains their relevance to managing prolonged quotation cases.

2.3.3 Escalation frameworks

The concept of escalation frameworks is commonly discussed in the literature, particularly in the context of healthcare processes. In practice, the term “escalation” refers to change of behavior in an action, a process or a procedure for example (van der Aalst et al., 2007). The roots of escalation can be seen leading to typical human behavior as humans usually change their action when they face enough pressure and need for it (Gevers et al., 1983). When this behavior is transmitted to an actual method of operation, can it be referred to as an escalation framework (van der Aalst et al., 2007).

Escalation can take place in many different scenarios and thus the trigger conditions mainly depend on the context. In case of quotations, the most relevant escalation type is perhaps deadline-based escalation, in which escalation is used when a deadline for some process is getting too close or it is obvious that it is not possible to achieve (van der Aalst et al., 2007). Even though there are not usually any clear deadlines in quotation processes, the idea of deadline-based escalation can still be applied but with the target QRT representing the deadline. This way, the escalation framework would be triggered when the target QRT is getting too close or exceeds.

Noteworthy is that, in general terms, escalation is usually done proactively because it is more effective and there is more time for repairing actions (Chan et al., 2009). The proactive action can be enabled, for example with predictions or by setting individual deadlines for specific parts of the process. However, escalation should only be targeted at a

carefully selected group so that its cost do not rise above the benefits (van der Aalst et al., 2007).

2.3.4 The structure of escalation frameworks

The structure of an escalation framework can be built for example by using the so-called 3D approach by van der Aalst et al. (2007). The approach consists of three phases: Detect, Decide and Do, and provides a systematic way to recognize, evaluate, and act within an escalation framework. Therefore, from the point of view of this research the 3D-approach provides one possible way to structure the case company's escalation framework and break down the escalation procedure into clear stages.

The 3D-approach on escalation starts with the Detect phase. The idea of this phase is to monitor the performance of all cases and, within those, find the cases that are needed to escalate. In deadline-based escalation the performance is naturally connected to different time variables such as time spent, predicted time spent, and target time. These time variables can however be assessed at multiple levels of the process, including the case level, task level, and even specific activity instances (van der Aalst et al., 2007).

In deadline-based escalation, the detection phase can for example utilize the four escalation logics presented in Table 2. In the table, the variable C_c refers to the actual time spent on a case, P_c to the predicted time needed for the case, and D_c to the case-level target quotation response time (QRT). Correspondingly, the variables C_c^t, P_c^t, and D_c^t represent these same measures at the task level: C_c^t means the time spent on a task, P_c^t the predicted task duration, and D_c^t the target execution time for the task.

Table 2. Escalation logics. (van der Aalst et al., 2007)

Logic	Logic description
$C_c > D_c$	The time spent in the whole case *c* exceeds target QRT D_c
$C_C^t > D_C^t$	The time spent on single task *t* exceed task target time D_C^t

$P_c > D_c$	The case is predicted to complete too late
$P_C^t > D_C^t$	The task is predicted to complete outside the target time

After the Detect part the 3D-approach moves on to the Decide phase, in which the purpose is to decide what type of escalation measures take place after the escalation. In today's systems, the Decide phase can be performed either manually, automatically or by combining both mechanisms. If the decide phase is based on manual mechanism, decisions about the actions are made by a human e.g. team lead for example. On the other hand, in automatic Decide producers, the appropriate escalation strategy is selected by the system, based on set decision rules.

The last part of the 3D-escalation approach is Do, in which the escalation actions in practice take place (van der Aalst et al., 2007). The Do phase is strongly linked to the Decide phase, as what is done in this phase is, like already described, decided in the Decide phase. There are many viable alternatives to the possible escalation strategies, from which a group is introduced in the next section: 2.3.5 escalation strategies.

2.3.5 Escalation strategies

There are several different escalation strategies on which an escalation framework can be built on. Whereas escalation conditions determine the logic when a process should be escalated, escalation strategies are more about what kind of actions take place after the process is escalated. Choosing a suitable escalation strategy is not always straightforward because each of the options has their own trade-offs and costs. It is also noteworthy that sometimes it may be more efficient to combine different strategies or use different strategies depending on the process task (Chan et al., 2009).

Simplified, escalation strategies can be divided into three different categories. Firstly, there are process-focused strategies, which focus on ordering tasks and how the tasks should be executed in relation to each other. Secondly, there are resource-focused strategies, which consider how task resources are used and divided within a process. Thirdly

and lastly, there are data-focused strategies which focus on the data that is needed to perform each process step (Chan et al., 2009). Examples of all of the strategy categories can be seen from Table 3. below.

Table 3. Escalation strategies. (van der Aalst et al., 2007)

Process-focused strategies	**Description**	**Cost**
Alternative path	An alternative task is selected, or a task is skipped to achieve the deadline.	Deferred work/degraded quality
Escalation subprocess	A dedicated subprocess is spawned off to perform mitigation actions.	Subprocess dependent
Task pre-dispatching	Prepare for the execution of a task prior to completion of a previous task.	Discard and undo work
Overlapping	The execution of two subsequent activities overlaps.	Additional coordination
Prioritization	Critical tasks or cases get a higher priority in order to accelerate their execution.	Lower priority cases neglected
Resource-focused strategies		
Resource redeployment	Increase the capacity of critical resources (e.g., add more resources, overtime).	Additional resources
Batching	Group tasks as batch (e.g., based on location) and assign them to a single resource.	Batching effort
Data-focused strategies		
Deferred data gathering	Postpone gathering of data until the data are actually needed.	Deferred work
Data degradation	Tasks are allowed to be executed with less or different data.	Degraded quality

3 Methodology

This chapter reviews the methodology and the overall research process of this thesis. The first part of the chapter is the research approach, which outlines the philosophical foundations for the study and how the research problem is fundamentally addressed and solved. The second part on the other hand addresses the research design, whereas the third and fourth parts focus on data collection and analysis methods. Additionally, the chapter includes a subchapter about the research's reliability and validity, which highlight the measures taken to ensure the trustworthiness of the research.

3.1 Research approach

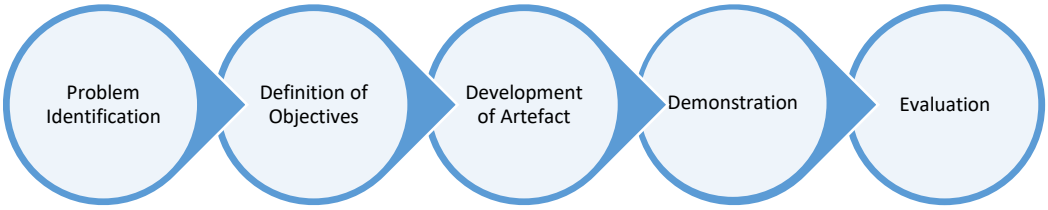
The first component of the methodology is the research approach which, according to Hofler (1983), defines the basic philosophy of how the research problem is addressed and solved. In this study, the selected approach is Design Science Research (DSR), in which the main idea is to solve a problem by building an artefact. Typically, the problem in DSR emerges from a real business context, while the artefact can range from a conceptual model to a process, method, or even a social resource. The origins of DSR are in information systems research (Peffers et al., 2007), but today the approach is widely applied in various fields where practical, organization-focused solutions are needed.

The main reason why DSR was chosen for this study is that it offers a structured and precise way to develop and evaluate the planned escalation framework. Compared to other research methodologies, DSR is particularly suitable for situations where the goal is not only to understand a problem but also to design a practical solution to it. In addition, DSR provides clear guidance on how the developed solution should be demonstrated and evaluated (Peffers et al., 2007), which is an essential aspect of this research.

The process of DSR consists of six different steps that are illustrated in the following figure (Figure 3). The first part of the process is problem identification, in which the importance of the studied problem is explained and argued. After that, the requirements

for the possible solution are defined, followed by the development of the solution e.g. an artefact. Later on, the solution is also demonstrated and evaluated, by using example cases for instance.

Figure 3. The process of DSR.



3.2 Research design

Whereas DSR is the approach for this research, the design of the research follows the principles of exploratory sequential research design. As described by Creswell & Clark (2017), exploratory sequential research is a research design type in which the study starts with a qualitative approach and, on the other hand, ends with a quantitative approach. In other words, exploratory sequential research is a mixed methods research type, because it combines both of the basic data collection types.

For this study, the exploratory sequential research design is suitable especially because it roots the study strongly into the case company's environment instead of being based on general assumptions or purely theoretical expectations. This is important so that the escalation framework can be developed just for this company case and so that it serves especially their purposes. Creswell & Clark (2017) summarizes that exploration is suitable when "there is a need to make an existing quantitative measure or instrument as specific to the participants or culture as possible."

Since exploratory sequential research utilizes both qualitative and quantitative research data, it is also good to clarify the significance of both of these data for the research. In this research, qualitative data plays a key role in building the foundation for the escalation framework and in gaining a deeper understanding of the case company's spare parts quotation process. It helps to identify underlying practices, challenges, and contextual factors within the process. In contrast, quantitative data is used to support and validate these findings by providing measurable evidence, particularly in assessing and confirming the challenges identified during the qualitative phase.

3.3 Data collection

In line with the principles of exploratory sequential research design, this study incorporates both qualitative and quantitative research data. From these two, the qualitative data consists of interviews, observations, and documentary materials, whereas the quantitative data is based on the case company's historical quotation records. In the following section, the chosen data collection methods are described in detail and their suitability for addressing the research objectives is thoughtfully discussed.

3.3.1 Interview data

The interviews for this research were conducted as semi-structured interviews, which allow both focused but also flexible conversations with the chosen interviewees. The flexibility in semi-structured interviews is enabled by using open-ended questions and the possibility to follow emerging topics within the interview. At the same time, the focus is maintained through predefined thematic segments that structure the discussion and ensure that all interviews address the same core topics relevant to the research objectives (Cross and Galletta, 2013).

The interviewees for the interviews were selected from the most important stakeholder groups involved in the case company's quotation process: customer service, technical support, item enrichment and procurement. As critical groups these stakeholder teams

were considered because of the significant share of the items processed relative to other groups. In more detail, all of the eight interviews all described below in Table 4.

Table 4. Research Interviewees.

Interviewee reference	Description
A1	Manager of EMEA Customer Service
A2	Customer Service Employee (EMEA area)
B1	Technology Support Manager
B2	Technology Support Employee
C3	Item Management Manager
C4	Item Management Employee
D1	Procurement Manager
D2	Procurement Employee

As said, semi-structured interviews can be organized for example by dividing the discussion into different segments that all have their own theme or topic (Cross and Galletta, 2013). In this research, this idea was applied by structuring each interview around three main themes: (1) perceived reasons for prolonged quotation cases, (2) handling of prolonged cases, and (3) expectations for an effective escalation mechanism. These themes were selected because they align directly with the research objectives and represent the key areas in which deeper insight was required to support the development of the escalation framework.

3.3.2 Quotation data

To obtain the quantitative approach of the exploratory sequential research, this study includes an analysis of the case company's historical quotation data. The data for the historical quotation analysis is extracted from the case company's customer service platform, which is built on Salesforce. In a nutshell, Salesforce is a widely used customer relationship management technology that can be customized extensively based on company specific needs (Salesforce, 2026).

In the case company, the customer service platform can be seen to be divided into two main parts: the front-end service portal and the back-office case collaboration platform. Based on the company's internal documentation, the front-end portal is used to receive and handle quotation-related requests whereas the back-office platform is a tool used to support the internal work behind the quotations. To be able to achieve a comprehensive understanding of the quotation process, quotation related data must be retrieved from both of these parts of the customer service platform. This means that the retrieved quotation data has at lead partially, had to be pieced together from parts.

The data retrieved includes all quotations cases made by the case company during 2025. To be included in the dataset, the quotation case has to be started and closed during 2025 and have the case record type "spare parts". It is noteworthy that because there is no differentiation between process and spare parts in the company's customer service platform, the quotation dataset includes also process parts. Based on the discussions with the case company, this should not, however, affect the analysis too much.

3.3.3 Observations and documentation

Beside the interviews and quotation data, the research also includes data based on observations and documentation. By definition, observations refer to knowledge obtained through watching, listening, and recording events in their natural context, whereas documentation involves the systematic examination and analysis of various collected documents (Chand, 2025). From the perspective of this study, both observations and documentary materials serve as valuable sources for generating precise and detailed notes related to the phenomenon under investigation.

The observational data used in this research can be seen to gathered over a period of approximately one and a half years during regular work within the case company in tasks strongly related to the case company's quotation process. The documentary material on

the other hand was collected more systematically within a shorter timeframe in the spring of 2026.

3.4 Data analysis

In this research, both qualitative and quantitative data were collected to provide a comprehensive understanding of the studied phenomenon. Because these two data types require different analytical procedures, the analysis process of this research is divided to analysis methods for qualitative data and for quantitative data. In total, there are two different data analysis methods used in this study: thematic analysis and descriptive analysis. Each of these methods was selected to align with the nature of the data and the specific analytical objectives of the study.

3.4.1 Analysis methods for qualitative data: interviews

The interview data in this research was studied by using thematic analysis, which is a widely recognized and used data analysis method in the academic research. In thematic analysis, the aim is to recognize, analyze, and report themes within a qualitative data or datasets – usually with a five-step process (Castleberry and Nolen, 2018). For this research, thematic analysis is suitable especially because it enables identifying patterns and general opinions from the interviews conducted with the case company's employees.

Thematic analysis usually consists of five different steps: compiling, disassembling, reassembling, interpreting and concluding. In the first part, compiling, the research's gathered data is converted from its original form to a form that enables research e.g. from an interview recording to text. In addition to being a basic preparation stage, compiling is also about familiarization with the material and building an overall idea of the gathered data content (Castleberry and Nolen, 2018).

The second step of thematic analysis is disassembling, in which the aim is to identify similarities within the data and based on that group the data into different thematic,

conceptual, or ideological groupings. The connected matters can be anything from a word to a thought, and the final grouping result depends heavily on the researcher's perspective on the material (Castleberry and Nolen, 2018).

After the second step, the thematic analysis moves on to step called as reassembling which focuses on the creation of themes. As simplified by Castleberry and Nolen (2018) themes mean" patterns in the codes" and illustrate the important facts about the studied data in the light of the research questions. In this stage, the researcher begins to see how individual coded segments come together to form broader meanings across the dataset.

The fourth part of the thematic analysis is interpreting e.g. making deductions about the sorted data. In this phase, the researcher moves beyond listing codes and themes and starts explaining what they actually mean. Interpretation should not only happen at the end of the process but already during compiling, disassembling, and reassembling the data. Good interpretation is complete, fair, accurate, valuable in relation to existing literature, and credible to other researchers (Castleberry and Nolen, 2018).

Lastly, thematic analysis involves the phase of conclusion. Like the name suggest, his stage focuses on drawing together the results of the earlier steps into a coherent final understanding. At least some level, the conclusion should answer the posed research questions and introduce the relationship of the created codes, themes and deductions (Castleberry and Nolen, 2018). ´

3.4.2 Analysis methods for quantitative data

In turn, the quantitative data in this research was analyzed with descriptive analysis, in which the idea is to summarize the studied dataset with different statistical measures. The most commonly used measures include for example measures such as median, mean and mode which indicate how the studied dataset is distributed. Additionally, descriptive analysis also usually examines the frequency of different values and the relation

the values have each other. However, the measures can fully be determined according to the case and context (Kaur et al., 2018)

Descriptive analyses typically include at least some kind of visual or tabular representation of the key findings made in the analysis. Building on this principle, this research uses summarizing tables as the primary way to structure and communicate the findings gathered from the quantitative analysis. The structure and design of these tables is inspired strongly by the examples presented by Buzby et al. (2002). In more detail, these references can be seen from the tables below (Table 5. and Table 6.).

Table 5. The first aimed visual representation of the descriptive analysis.

Table II
Current performance of the quoting process (% of total quotes in that month)

Category	June 1999	July 1999	August 1999	October 1999	November 1999	December 1999	January 2000
On time or early responses	66	66	60	53	71	65	52
1-5 days late	19	21	29	27	10	15	27
6+ days late	6	4	8	14	2	8	6
No response	9	9	3	6	17	12	15

Table 6. The second aimed visual representation of the descriptive analysis.

Table V
Total cycle times by quoting task

Employee	Action	Frequency	Total hours	Less unknowns	Average minutes in process	Total wait hours before process	Average waiting (minutes)	Total cycle time
T.F.	Log in	40	21.57	2	2.94	19.71	0.52	3.46
T.F.	Material cost	17	24.95	3	106.93	64.43	276.13	383.06
T.F.	OSP cost	11	95.18	1	571.08	8.71	52.26	623.34
T.F.	Labor cost	9	1.07	3	10.70	9.34	80.0	90.7
R.P.	Labor cost	3	0.89	1	17.80	13.66	409.80	427.60
R.P.	Final approval	3	0.27	0	5.40	18.28	365.60	371.00
C.D.	Type finished quote	12	4.65	0	23.25	25.13	215.40	238.65
J.G.	Proof read	2	.06	0	2.00	0.12	3.6	5.6
C.D.	Send to customer	10	1.17	3	10.03	4.04	26.93	36.96

3.5 Reliability, validity, and limitations

The reliability of this study is supported by the structured application of the Design Science Research approach combined with an exploratory sequential design. The data in this research is also collected from multiple sources, which allows the methodological

triangulation and cross-validation of findings. Consistency between qualitative themes and quantitative patterns strengthens the credibility of the results, particularly in identifying key delay factors such as data quality, communication gaps, and supplier dependencies. However, some limitations to reliability remain, as qualitative data is partly based on individual perceptions and may be influenced by differences in interpretation. In addition, the thematic analysis involves a degree of researcher subjectivity, which may affect the repeatability of the findings despite the use of systematic analysis procedures.

The validity of the research is supported by the clear alignment between the research objectives, data collection methods, and analysis. Internal validity is strengthened by the integration of qualitative insights with quantitative evidence, as well as by linking the findings to established literature on process management and escalation. However, external validity is limited due to the case study design, which focuses on a single company and a specific spare parts context. Consequently, the developed escalation framework is context-specific and its applicability to other environments remains uncertain.

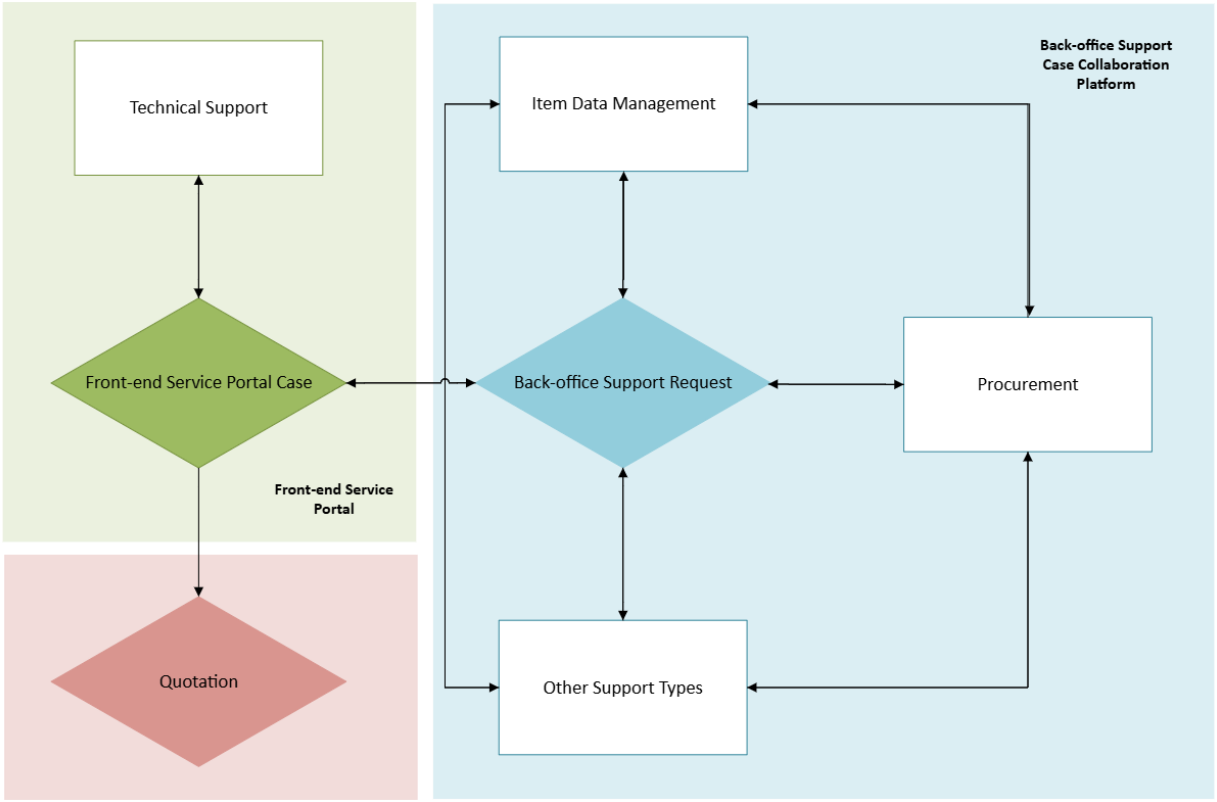
4 Results

4.1 As-is quotation process

4.1.1 Process description

The first part of the results of this research presents a comprehensive description of the case company's quotation process. A thorough understanding of the process is important, as it forms the basis for analyzing the remaining results and for developing the escalation framework. To enhance clarity, Figure 4 presents a visual representation of the as-is quotation process, outlining how quotation cases progress from the initial customer request through different processing stages to the final quotation.

Figure 4. As-is quotation process.



The case company's quotation process starts from the front-end service portal when a customer sends in an RFQ. From the customer's point of view, there are multiple channels for submitting the RFQ, meaning that it can be delivered via phone, email, or through a sales representative for example. Regardless of the channel used, all incoming requests are still routed into the same front-end service portal and assigned to a customer service queue. To which queue a case is assigned depends mainly on the customer's geographical location and the case's technical business area.

Depending on the case, the customer's RFQ may lead to either immediate drafting of the quotation or seeking assistance from the internal collaboration process. The first support type a case may need is usually technical support, which is used when the customer's request is not fully technically recognized and the customer service does not know what the customer need exactly is. In general, technical support is done in the front-end service portal whereas other support types are implemented in the back-office case collaboration platform. In the case company, need for technical support can for example arise when the customer asks for a quotation based on a problem rather than for a specific product or just sends in a picture of the needed part.

After the technical support, customer service can be ready to make the quotation, or the case can move to the back-office case collaboration platform. In total, there are five support teams that work in this platform: item management, procurement, production planning, pricing, and logistics and forwarding support. In addition to these teams, also technical support works on some cases here, although the aim is that the case would arrive to the back-office case collaboration platform always fully technically recognized and so that there is no need for technical support anymore. However, in practice this does not always come true and thus there must be a chance to use technical support also in this point.

From the five support types in the back-office case collaboration platform, most needed are item management and procurement. Of all cases, gone through the back-office case

collaboration platform, approximately 71 % need support on item management and 79 % in procurement. Because these support types are very much attached to each other, in principle it can be said that if a case needs support in either of these it will most likely also go through the other form of support. The percentage of cases gone through both of these support types is 56 %.

In item management, the idea is to enrich the item data so that all needed product related data is complete, accurate, consistent, and usable across different systems. In general, item management focuses on updating the product information in the case company's Enterprise Resource Planning (ERP) system, with occasional use of other systems. The complexity and workload of item management depend heavily on the item type, with some items requiring minimal and others extensive level of item enrichment. In the case company, item data management operates as a category organization, meaning that different product categories have given their own, targeted item data management team.

In practice, item management enriches all other product information than the product's purchase price. In the case company, the team responsible for updating the purchase price is procurement which handles everything from items' sourcing to purchasing. In terms of the item, procurement has an important role in determining whether the product should be manufactured by the company themselves or supplier elsewhere. Similarly, as the item management, also procurement operates as a category organization, with a total of seven spare parts related procurement teams.

Compared to technical support, item management, as well as procurement, the support types of production planning, pricing, and logistics and forwarding are much more unusual. In production planning, the idea is to enrich a manufactured item with data needed in production whereas to logistics and forwarding a case goes if there is questions related for example to shipment or warehouse assistance. Furthermore, in pricing the focus is on value-based pricing, which is occasionally done for some items.

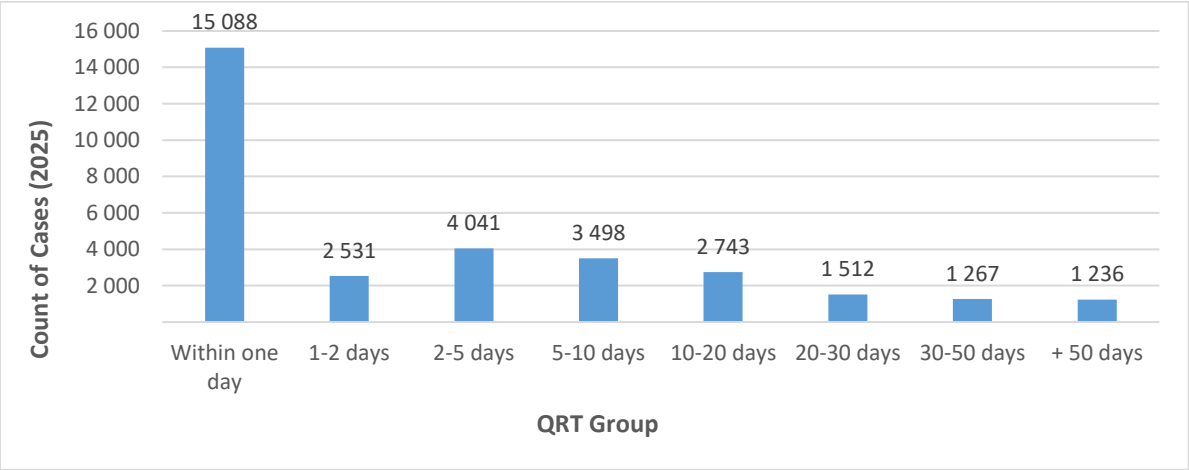
When all the necessary matters have been clarified, the final quotation can be prepared. In the case company, the final quotation for the customer is always prepared in the Enterprise Resource Planning (ERP) system by a customer service employee. Currently, the company utilizes two main ERP systems, Baan and LN, both of which support the creation of quotations through their built-in functionalities. In line with general industrial quotation practices (Veeramani & Joshi, 1997), the final quotation issued by the case company includes the offered price of the part and the estimated delivery lead time. In addition, the quotation specifies the validity period, indicating the timeframe within which the customer must place the order for the terms of the quotation to remain applicable.

4.1.2 QRT performance

After describing the case company's quotation process, we can move on to review the most fundamental response time metrics calculated for the process. Unlike in the quantitative analysis, the purpose of this chapter is not to provide an in-depth examination of the QRT performance, but rather to establish a general overview of the current state of the quotation process. Nevertheless, to ensure consistency and to support the interpretation of the quantitative results presented later, the figures in this chapter are defined so that their scope aligns with that used in the quantitative analysis.

From the figure below (Figure 5) we can see how the case company's QRT performance is distributed across all spare part cases within 2025. The clearest observation from this chart is that for the most part (60%) quotation cases are handled within the target time i.e. in a maximum of three days. According to Kaur et al. (2018) this kind of distribution can be called as positive skew, as the values mostly fall towards the left side of the chart and there are significantly fewer values on the right side. It is noteworthy, that in this thesis we are especially interested on the values on the right side and the escalation framework will be most likely considering a very particular group from the "tail" of the quotation response time performance.

Figure 5. QRT distribution.



When the frequency distribution resembles a positive skew, it is especially worth describing the data with mode and median. Additionally mean can be used, but it "is easily pulled towards the right tail of the distribution", whereas mode and median are more resistant to the influence of the extreme values (Kaur et al., 2018). Based on the quantitative data gathered, the case company's QRT median was discovered to be 1,13 days, mean 8,81 days and mode 0 days. However, it is important to note that from these values, the mode value of 0 days can be considered somewhat misleading due to the case company's QRT calculation method: as certain statuses are excluded from the QRT calculation, the QRT occasionally results in a value of 0 days. Although such zero values occur relatively infrequently, they emerge as the most common individual value because other QRT observations are often distributed across a wider range and recorded with decimal precision. This disperses those observations across multiple distinct values, thereby reducing their individual frequencies and causing 0 days to appear as the mode.

4.2 Qualitative results

As outlined in the data analysis section, the qualitative findings of this study are based on a thematic analysis of the collected interview data. In practice, the findings are divided into three different subparts, from which the first considers the challenges and bottlenecks within the quotation process, the second the current practices on handling

prolonged quotes, and the last the requirements for the escalation framework. Together, these parts build the foundation for developing the escalation framework, which is later validated with the quantitative results.

The core of thematic analysis lies in identifying different themes. Across the different groups, the research identified a total of ten distinct themes. Of these, four relate to the challenges within the quotation process, three describe the current practices for handling prolonged quotation cases, and three define the requirements for an effective escalation framework. Together, these themes provide a comprehensive view of the key factors affecting quotation response time, highlighting both operational inefficiencies and structural limitations in the current process. In addition, they reveal how responsibilities, communication patterns, and decision-making practices are currently distributed across the organization, offering insight into how the process operates in practice.

4.2.1 Challenges and bottlenecks found from the qualitative analysis

The research identified several challenges in the case company's quotation process, from which four are particularly noteworthy. Firstly, deficiencies in the quality of incoming request data often disturbs process flow at an early stage and create unnecessary back-and-fort movement in the process. Secondly, limited transparency and ineffective communication between stakeholders hinder smooth collaboration and create unclarity. Thirdly, long and unpredictable supplier response times create delays that are difficult to manage internally. Finally, the current priority system fails to meaningfully influence case handling, reducing its effectiveness as a management tool. The following subsections examine these challenges in more detail.

4.2.1.1 Quality of process input data

The first challenge found in the case company's spare part quotation process considers the quality of the input data with which spare part cases enter the internal collaboration process. Many of the interviews describe facing frequently situations in which a case

comes to their table with insufficient information or for example so that necessary technical unclarities are not solved yet. In practice, this can mean for example that the required item code does not yet exist, or the sender of the request has not clearly stated which items, and in which amount their request even concerns. Often, there are also problems with unclear or outdated drawings as well as bills of materials.

"We have situations, in which a case comes to the internal collaboration process with insufficient information and the customer service does not know how to tell what they want" (C1)

"Items that are not defined well enough or lack information cause delays in quotation response time" (D2)

"If I think about internal causes of delay, maybe the first to come to mind is the quality of the incoming request" (D1)

If a case enters the internal collaboration process with insufficient information, the flow of the quotation process easily disturbs. The case may, for example, need to be returned to the customer service for clarification, and a considerable amount of time may be spent investigating the missing or unclear information. According to the interviewees, this often results in a repetitive back-and-forth cycle between different stakeholders, during which the case technically remains open but does not actively progress. As a result, quotation lead time increases without corresponding value-adding work being performed.

Reflecting on the case company's described quotation process, the responsibility for submitting spare parts quotation cases with sufficiently input data into the internal collaboration process lies primarily with the customer service. If technical uncertainties arise, customer service may consult technical support to validate the information, but still customer service remains the main responsible for moving the case with sufficient

information. Based on the interviews, shortcomings in customer service performance may stem from factors such as insufficient training or continued reliance on outdated working practices, although more detailed investigation on the matter is left outside of the scope of this thesis.

It is however noteworthy that although responsibility for input data quality formally lies with customer service, the interviews revealed limited systematic feedback mechanisms that would enable learning from incorrectly formulated requests. Both interviewees from customer service stated that feedback on insufficient or unclear quotation requests is not consistently communicated back to them. Interviewee A1 emphasized that poorly formulated requests are rarely reviewed retrospectively, while Interviewee A2 described situations in which quotation cases remain inactive because clarification requests are not proactively forwarded to the original sender. Taken together, these findings suggest that while responsibility is clearly assigned, the absence of a structured feedback loop constrains learning and continuous improvement in the quality of incoming quotation cases.

4.2.1.2 Transparency, collaboration, and communication

The second challenge found in the case company's quotation process is the lack of transparency and communication between the different stakeholders involved in the quotation process. Several interviewees describe situations in which it is difficult to gain a clear overview of in which state a quotation case is and what actions are required to move it forward. This is mainly because, although the case company's guidelines require quotation cases to be updated at regular intervals, this is not always done in practice. Consequently, gathering up-to-date information often requires additional effort, and even then, a clear response may not always be obtained. The interviewees state:

"Communication has weakened significantly and is one of the most serious reasons for the process slowing down" (A1)

"When a case is prolonging, it feels that there is no way to get answers. We have cases like that too often where we have reminded several, up to dozens of times and still no answer comes out. It's incredibly frustrating" (A2)

*"Some people just don't answer" (*B2)

Part of the communication problem is also that there seems to be confusion within the process about who to contact in which situation. Many of the interviewees for example mention that it is challenging to find out who to contact in technical support and what technical support group would be the right in which case. Especially challenging the situation is in North America, where technical support operations differ slightly from other areas.

"It has become a little difficult to know whom to contact, who is taking the role now and who is responsible in this particular team" (C2)

"Speaking of technical resources, there is, I would say, some inconsistency depending on the technology and also the region where the request originates" (D1)

4.2.1.3 Supplier response time

Among the problems in the quotation process, one cannot fail to mention challenges related to the case company's supplier response times. Nearly all of the interviewees mention that delayed or unpredictable responses from suppliers constitute a significant source of quotation delays, and lost time cannot always be controlled despite effort. The interviews indicate that while supplier response time is largely outside the direct control of the case company, slow or inconsistent supplier communication often causes quotation cases to be stuck and prolong overall response times.

"The actual response time from our suppliers might be a cause for delays" (D2)

“Also, supplier response time is not always where we need it to be. Our requests out to the suppliers request to reply within 48 hours, but that's not always observed” (D1)

“We could get all of the quotations out in less than 4 days if we didn't have to use purchasing at all” (A2)

“Case delays are mostly due to the case being stuck in procurement” (A1)

The poor response time of suppliers also involves the question of how the issue is addressed on a case-by-case basis e.g., what employees do if the case gets stuck when waiting on supplier response. For example, the interviewee D1 states that currently there are no clear guidelines or system support on sending supplier reminders and that it is really up to individuals when and how to push the supplier. This view is supported by interviewee D2, who expressed a need for an automated reminder system that would systematically prompt suppliers after a predefined period of inactivity, rather than relying solely on manual and case-specific follow-up actions.

4.2.1.4 Unreliable priority system

An interesting finding found through the qualitative study was also the weak effectiveness of the case priority to the handling time. Many interviewees stated that the priority assigned to a case has no effect on which cases are worked first and that cases receive extra attention only when there is additional internal pressure such as direct inquiries or phone calls from colleagues. In general, the teams were discovered to operate on the First-in-First-out principle and there was no clear joint understanding on what cases should be prioritized more than others.

“*Even if the priority of the case is somehow raised high, it doesn't seem to have any effect”* (A1)

“I think that the prioritizes were misused and they didn't bring the effect they necessarily were intended for” (B2)

“These priorities have become somewhat watered down over time” (D1)

“If someone yells about it, then it's a priority. Otherwise, we're going to try to get the old stuff out first” (D1)

The challenges of prioritization can be at least partially explained by the fact that the case company's prioritization logic includes an automated rule that assigns the priority level “High” to cases originating from so-called Key & Growth customer. Because of the number of these customers is quite high, the number of high-priority cases also increases. Additionally, it appears that because clear guidelines for when and how different priority levels should be applied are lacking, employees tend to select the “High” priority level by default. In the absence of explicit criteria, assigning a high priority may be perceived as the safest choice, even in cases that are not genuinely time-critical, which further contributes to the overuse of high-priority classification

4.2.2 Current practices on handling prolonged cases

The current practices on handling prolonged quotation cases were studied mostly through the eight interviews conducted. In summary, based on these interviews, it can be stated that there are no clear, established, or especially global ways to handle prolonged quotation cases in the case company. In addition, the current process does not consider prolonged cases sufficiently nor does support taking timely actions on them. This contradicts prior research emphasizing how critical quotation response time is for customers and sales performance, particularly in terms of customer satisfaction and hit rate (Mai & Liao, 2022; Rohaan et al., 2022).

The nonexistence of clear, established, and global guidelines on handling prolonged quotation cases can be clearly seen, for example, in how differently and in a circular manner

the interviewees described the current methods of handling prolonged quotation cases. In majority of the interviews, the repeated idea was that handling prolonged cases is mostly a responsibility of the case owner and they can practically decide when and how to act on it. Two of the interviewees mentioned that prolonged quotation cases are sometimes looked into in a weekly meeting, but also in this case there was no clear process or timeline on how a prolonged quotation is then handled.

Additionally, the interviewees did not have a common view on what the definition of a prolonged case in the first place is or how it should be reviewed. Many of the interviews looked at the length of the case only from the perspective of their own contribution, i.e. how long the case spends under their responsibility. For example, whereas interviewee D2 defined a prolonged spare parts quotation case as one that had been under their responsibility for over one week, the interviewee C1 considered a quotation case to be prolonged when it had been on their desk for more than two weeks. In contrast, interviewee B1 described a case as prolonged when it had either remained unmodified for 30 days under their team's responsibility or spent more than seven days waiting in a queue assigned to their team.

While it is somewhat understandable that different teams develop varying perceptions of what constitutes a prolonged handling time specifically within their own scope of responsibility, the responses nonetheless stand in tension with the company's defined target response times. Despite differences in task complexity and team-specific workflows, each interpretation reflects handling durations that conflict with organization-wide service level objectives. Additionally, this finding also highlights the view that the case company's quotation process is very fragmented, meaning that case solution depends on several actors who do not necessarily have a comprehensive, overall picture of the case's situation they are working on.

An important finding from the interviews also was on how poorly the current quotation systems support taking actions on prolonged quotation cases. In other words, the case

company's quotation systems have a very little or near no system built-in features that would enable some kind of exception case management, monitoring, or escalation. This is a critical issue, as prior case management research has shown that in the absence of system-embedded exception monitoring and handling mechanisms, the management of long-running and knowledge-intensive cases is largely shifted to individual users, thereby increasing the risk of delays and inconsistent outcomes (Andree et al., 2022).

Based on observations, the small system-level features supporting the identification of prolonged cases include for example a simple time-tracking indicator, which illustrates the case duration with traffic lights. If the case age is less than 2 days the traffic light icon shows green and on the other hand, if the case age exceeds 5 days the icon shows red. An important limitation, however, is that this visual indicator is not available in the back-end-office platform and is therefore only visible in the customer service system. In fact, in the back-end-office environment, the total duration of a case is not visible at all, limiting users' ability to assess how long a case has been ongoing across the process.

The handling of prolonged cases is not systematically addressed either at the level of work queues or reminders in the case company. Both observations and interviews indicate that prolonged quotation cases are not explicitly highlighted from newer cases within employees' work queues and that there are not any reminders sent if a case prolongs. As a result, identifying and actively managing stalled cases relies largely on individuals rather than on structured process, increasing the risk that prolonged cases may remain unattended for extended periods.

4.2.3 Requirements for the escalation framework

This chapter reviews the main findings on the requirements for a well-functioning escalation framework. The results are based on the interviews and bring out three different requirements for the escalation framework. Overall, the results show that escalation should be clear, consistent, and used only in specific situations. A simple structure, defined rules, and a clear escalation path—starting from case owners and moving to

managers when needed—are important. While some doubts were raised, escalation was generally seen as a useful way to support case handling and prevent issues from being overlooked.

In the semi-structured interviews, all interviewees were asked to reflect on the requirements for a well-functioning escalation process as well as share their thoughts on the possibilities and risks of the potential escalation process. Before going through the interviewee's thoughts, all interviewees were explained what an escalation process means and what it could for example mean in the case company's situation. As an overview, the interviewees had varying views on the escalation process as well as on the requirements for a well-functioning escalation process.

Among the interviewees, interviewee B1 expressed the most critical perspective of the idea of developing the escalation framework. B1 for example questioned, whether improvements in quotation response time can be achieved through implementing an escalation process alone. Instead, the interview emphasized the importance of examining the underlying process and its structures, particularly because the current process has continued to produce similar outcomes over several years. In this context, B1 expressed doubt that a more explicit escalation framework, by itself, would provide a sufficient solution, viewing it rather as a simplified response to a fundamentally more complex process-related problem.

Despite expressing some initial doubts, Interviewee B1 ultimately still recognized the necessity of an escalation model for the company. According to the interviewee, certain cases may be sometimes overlooked or forgotten over time, which creates a need for a systematic mechanism to escalate and accelerate cases when necessary. Importantly, Interviewee B1 emphasized that a well-functioning escalation framework should not only enable faster processing of critical cases but also include analytical capabilities that allow the organization to understand why cases are escalated and what underlying root causes drive these escalations. From this perspective, escalation is seen not merely as an

operational tool, but also as a means to increase process transparency and support continuous improvement.

According to the interviewee B1, an effective escalation framework should also be scoped properly. This perspective aligns with the broader interview data, as multiple interviewees highlighted that unclear or overly broad escalation scopes risk reducing effectiveness and usability. In other words, the escalation framework should be targeted only at clearly defined case types and supported by precise trigger criteria that ensure escalation is applied selectively and consistently. This finding is strongly supported by van der Aalst et al. (2007), who emphasize that selective, criteria-based escalation is essential to prevent excessive workload and to ensure that escalation mechanisms remain economically and operationally worthwhile.

"I think that maybe [one risk] to come to mind would be [that] if [the escalation framework] is not applied consistently" (D1)

"The escalation framework should be based on specific rules" (C1)

"Escalation should be a tool for exceptional situations" (B1)

A clear structure is also expected from the escalation process. For example, interviewee D1 stated that the process should be developed into a more consistent and clearer form and that a global, more unified process would benefit all. On the other hand, interviewee C1 stated that the lack of a clearly defined structure may lead to chaos, where issues are escalated through multiple channels simultaneously, resulting in unclear priorities and conflicting instructions. According to C1, escalation should follow one designated and well-communicated channel to ensure clarity, coordination, and effective decision-making.

The final key requirement the interview data brings out considers the escalation path e.g. to whom cases should be escalated and in which order. In principle, majority of the interviewees, six out of eight, seem to agree that the first escalation step in the case company's escalation process should be the case owner(s) and that after that the cases should be escalated to their managers. This would give the original case workers a chance to act before bringing in additional people, and on the other hand, reduce the workload on managers. The interviewees state:

"Taking into consideration the status of the case is, I think it would be appropriate to contact the case owner's manager" (B2)

"In my opinion the first level of escalation should be the team leads" (C1)

"If my buyer gets escalated once and they're not able to resolve it, then yeah, I probably should know on the second time" (D1)

4.3 Quantitative results

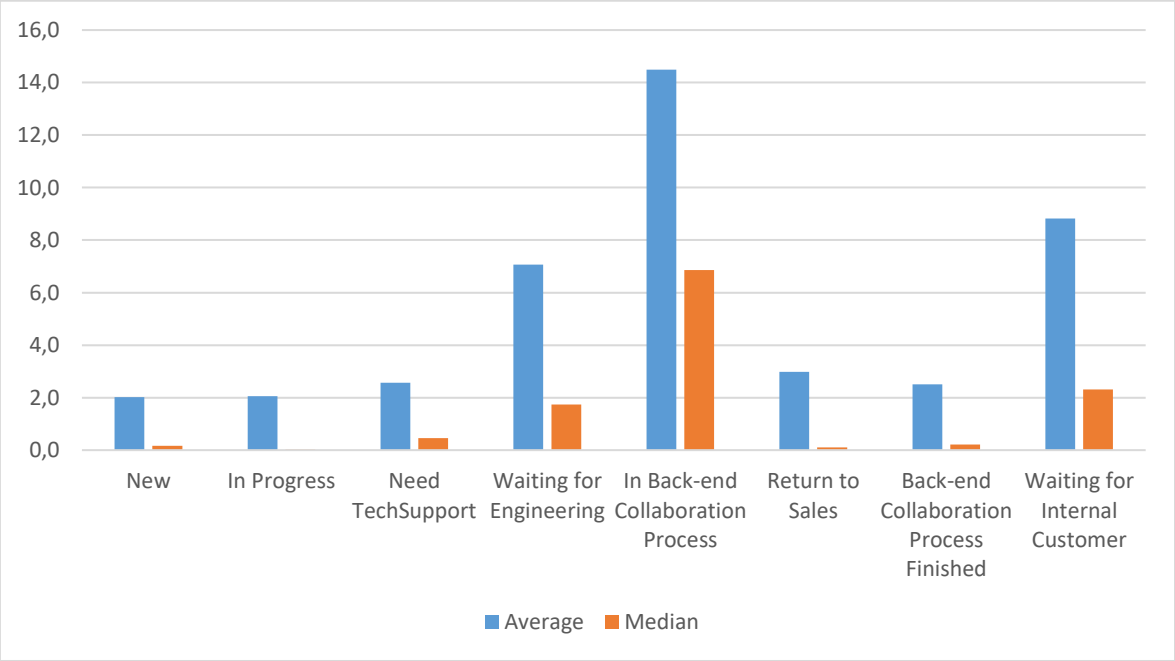
The quantitative results in this research were studied through the quantitative data gathered from the case company's two quotation case handling systems. In this section of the thesis, this data is used to provide an in-depth analysis of the current QRT performance and the challenges within the process. Most importantly, the quantitative analysis, however, aims to examine certain findings identified in the qualitative analysis from a different perspective, enabling a more comprehensive understanding of the observed phenomena.

4.3.1 General level bottlenecks

The quantitative results begin by reviewing the general level bottlenecks in the case company's quotation process. The bottlenecks were identified through an analysis of the company's data on case durations across different statuses, including both an average

and median perspective. By analyzing the average and median processing times, it becomes possible to identify which stages contribute the most to the total processing time and therefore represent key areas for potential improvement. Overall, the identified results are illustrated in Figure 6 below.

Figure 6. Case status durations.

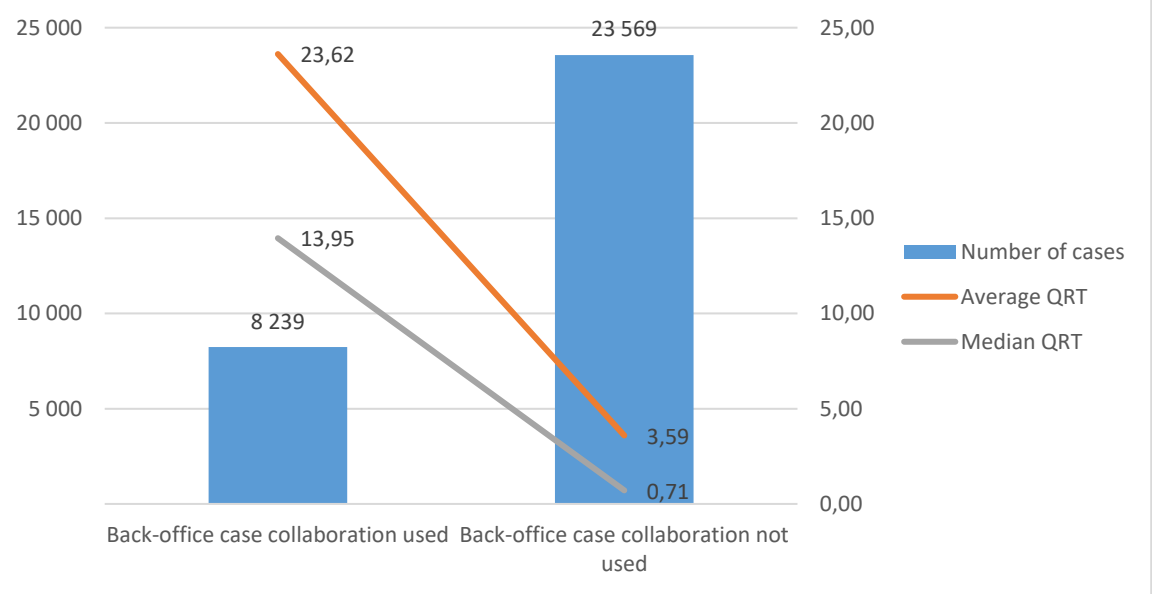


Based on the status distribution shown in Figure 6., the most significant bottleneck in the case company's quotation process is the back-end case collaboration phase. On average, cases spend nearly 15 days in this phase, indicating that it is a clear time-consuming part of the process. However, as the median duration of back-end collaboration is only approximately seven days, the average is likely influenced by a smaller number of significantly longer cases, while most cases are processed faster. Nevertheless, this phase can still be considered a clear bottleneck in the process due to its overall impact on total processing time.

A similar finding on the effect of the back-end case collaboration can be also done by comparing the response times of cases where back-end support has been used and

those where it is not. From Figure 7. below we can see that cases involving back-end support have over twenty days bigger average QRT and on the other hand over 13 days bigger median QRT. This analysis strengthens the view that the involvement of back-end support significantly increases response time and acts as a key bottleneck in the quotation process.

Figure 7. Impact of back-office case collaboration on QRT.



In addition to the back-end case collaboration phase, other notable bottlenecks in the process are also cooperation with internal customers as well as engineering. Based on the data gathered, on average cases spend time on these phases approximately 8,8 and 7,1 days and on median 2,3 days and 1,7 days. It seems that the average values are influenced by a smaller number of cases with significantly longer durations, whereas the majority of cases progress through these phases relatively quickly.

In contrast to the bottlenecks, the quantitative data also points out the most efficient parts of the process. Based on the status distribution, it can be for example seen that usually cases spend only a short time in status “New” and “In Progress”. In practice, these two statuses reflect the initial actions the customer service does for the case before

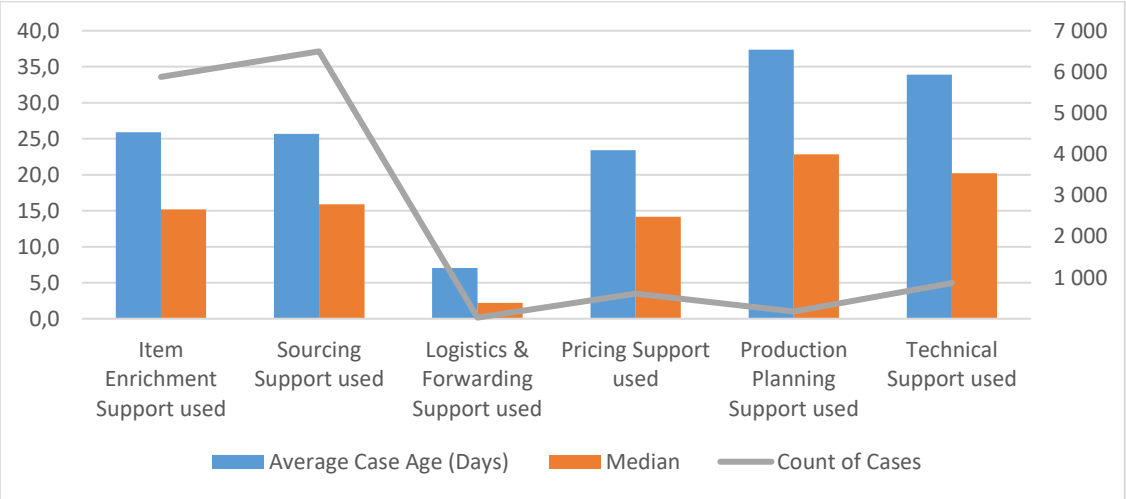
sending it to the back-end case collaboration platform for example. Overall, these initial stages can be considered efficient and unlikely to contribute significantly to delays in the overall process.

4.3.2 The impact of different back-office support types on QRT

Because the impact of back-office case collaboration on QRT was found to be particularly strong, it is important to examine this aspect in greater detail. To complement the overall analysis of its impact, a more in-depth investigation can be conducted by exploring how different types of back-office support influence QRT. This enables a more nuanced understanding of whether certain support types contribute more significantly to delays than others and helps to identify targeted opportunities for process improvement.

Figure 8. below shows the average and median QRT of cases that have undergone a specific form of support. From the figure we can see that there are notable differences in QRT depending on the type of back-office support used. In particular, production planning support results in the highest average QRT at approximately 37,4 days, followed by technical support at 33,9 days and then item enrichment support at 25,9 days. In contrast, logistics & forwarding support shows significantly lower QRT values, with an average of only 7,1 days, although the case amount is however very minimal.

Figure 8. Item action type's effect on average and median QRT.

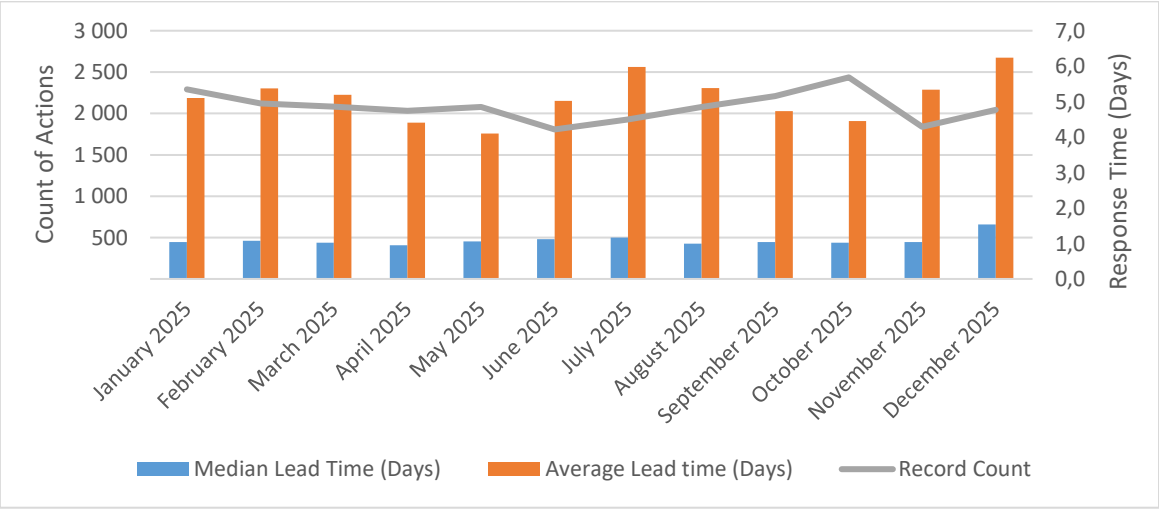


4.3.3 Quantitative perspective on supplier response time

Also the relationship between supplier response time and the case company's QRT was studied through the quantitative analysis. In the qualitative phase of this study, the interviewees stated that slow and unpredictable supplier responses are one of the most significant contributors to prolonged quotation cases. Therefore, this aspect was also examined quantitatively in order to validate the qualitative findings and assess the extent of its impact on QRT.

As the supplier response time was studied through the quantitative analysis, the average response time of suppliers was found to be around 5,1 days whereas the median response time was around one day. This finding indicates that while most supplier responses are handled efficiently, a smaller subset of cases experiences notably longer delays. From the perspective of QRT, this variability is critical, as these delayed supplier responses are likely to contribute at least at some level to prolonged quotation cases and the right tail of the QRT distribution identified earlier. This finding reinforces the qualitative insight that the main issue is not consistently slow supplier performance, but rather the unpredictability and lack of control over delayed responses. The detailed results from the study of the supplier response time can be found from Figure 9. Below.

Figure 9. Supplier response time KPIs.



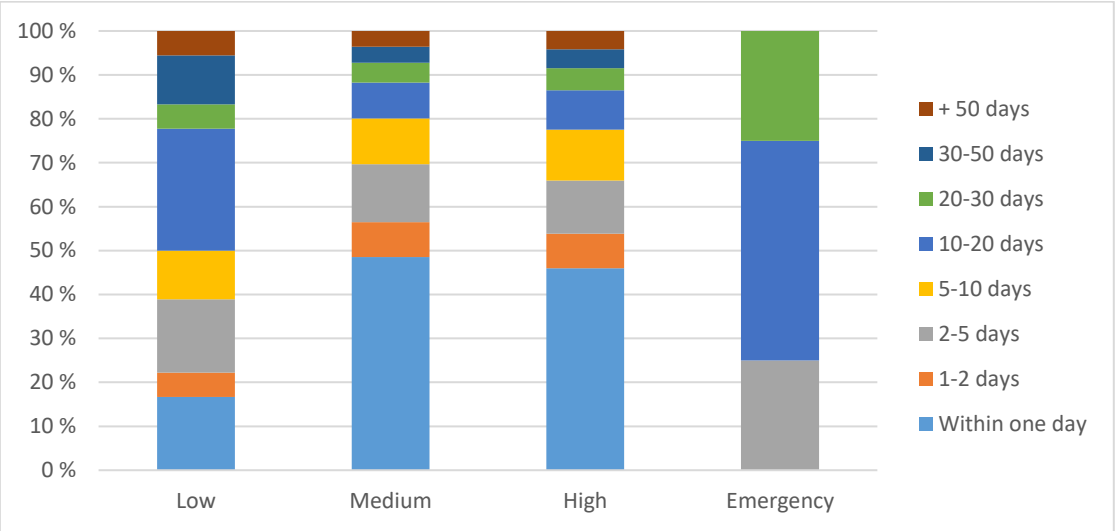
4.3.4 Relationship between priority and response time

In the qualitative study, one interesting finding made about the case company's quotation process was the ineffectiveness of different case priorities. The interviews for example revealed that employees did not perceive case priorities as a meaningful tool, and that in practice, cases were often handled based on a first-in-first-out principle rather than priority-based logic. Additionally, due to the lack of clear guidelines for assigning priority levels, employees were claimed to often by default select “High” priority even for non-critical cases, which diminishes the effectiveness of the prioritization system by blurring the distinction between urgent and routine work.

The findings from the qualitative study are supported by the results of the quantitative analysis conducted in this research. The data for example shows that there are no significant differences in processing times between cases with different priority levels, whereas instead, the QRT distribution across priority categories is highly similar. This indicates that higher-priority cases are not being handled faster in practice, which aligns with the interview insights suggesting that cases are often managed on a first-in-first-out basis rather than according to priority.

Furthermore, the quantitative data confirms that priority levels are applied inconsistently. A notably large proportion of cases—approximately 48%—are classified as “High” priority, with the remaining majority marked as “Medium.” This skewed distribution supports the qualitative finding that employees tend to assign high priority by default, even to non-critical cases. As a result, the prioritization system loses its intended function, making it difficult to distinguish truly urgent cases from routine ones and thereby reducing the overall effectiveness of priority-based case management. In detail, these results are presented in Figure 10. Below.

Figure 10. QRT group distribution by case priority.



As a response to this finding, the priority logic was revised during the course of the thesis project. The updated system introduces more clearly defined priority categories, along with explicit guidelines for when each should be applied. The new priority levels are “Normal,” “Breakdown,” “Shutdown,” and “High Value Case.” Among these, the latter three are designated as the highest priorities, intended to ensure that genuinely critical cases are distinguished from other cases. This change aims to restore the effectiveness of prioritization by reducing ambiguity and promoting more consistent and meaningful use of priority classifications in the quotation process.

4.4 The proposed escalation framework

This section now presents the proposed escalation framework for the case company’s quotation process. Because of system-level constraints the framework is divided into two parts from which the other considers the front-end service portal case level and the other the back-end case collaboration platform item action level. Although these parts are very much similar in several ways, they differ for example from the point of view of the “object” to be escalated and the escalation indicators. This section will mention all these differences in detail, even though the entire framework will still be discussed simultaneously.

The overall illustration of the proposed escalation framework is presented in Appendices 1-2. In a nutshell, the framework can be seen to be formed based on four different parts: the escalation scope, indicators, strategies, and roles and responsibilities. In this chapter, all of these parts are addressed in their own sub-sections – usually by using some "branch" of the framework as an example. If this example does not describe the other branches of the framework completely, it is always mentioned. To fully understand how the escalation framework is built, the following glossary in Table 7. can be used:

Table 7. Term definitions for the proposed escalation framework.

Term	**Term Definition**
Object	The level at which escalation is done. Can be either a front-end service portal case or a back-end case collaboration platform item action
Branch	A part of the escalation framework which differs from others only in its object and priority combination

4.4.1 Scope of the escalation framework

The first fundamental prospect of the proposed escalation framework is its scope. The scope of the escalation framework determines which objects are considered as part of the escalation framework, i.e. which objects the case company should actively monitor for potential escalation. From the perspective of the 3D approach by van der Aalst et al. (2007), the scope of the escalation framework can be seen as part of the Define phase, in which the idea is to monitor the performance of all objects and, within those, find the ones that are needed to escalate.

In the case company's context, it is most reasonable to define the scope by leveraging the data fields available in the company's quotation systems as then the proposed escalation framework becomes more readily implementable within the system environments. The scopes of the escalation framework are very much the same for both objects in the

framework although different data fields must be used in the definition. In practice, the scope for item action escalation is determined by utilizing data fields from the back-end collaboration platform whereas for case objects we use the data fields available in the front-end service portal.

4.4.1.1 Escalation scope for the front-end service portal cases

The first data field determined to limit the scope of the proposed escalation model for the case objects is the case type field, which is a mandatory field in the front-end service portal. The case type field includes approximately ten options for the case type, from which only cases with the case type defined as “Quote” are included in the scope of the proposed escalation framework. However, at a later stage, if deemed relevant by the case company, it may be justified to expand the scope of the escalation model to include additional categories, such as “Order” type cases.

Next, also the data field named as case record type is set to limit the scope of the escalation framework for the case objects. In the case company’s front-end service portal, this field determines the product category of the case, for example, whether the case is related to spare parts or not. Within the proposed escalation model, only cases with the case record type defined as “Spare Parts” are included in scope of the escalation framework, because the escalation model is only intended to be implemented in the spare parts business unit.

Further, also the case status field is utilized to delimit the scope of the escalation framework in this part of the model. The case status field indicates the current stage of a case within its lifecycle, such as whether the case is open, in progress, or closed. In total, there are 12 different options for the case status, from which five can be set manually while others are set automatically by the system. From the case status options, the cases with the following case statuses (Table 8.) are included in the scope of the proposed escalation framework:

Table 8. Case statuses within the scope of the escalation framework.

Status	Definition
New	The case has been created in the front-end-service portal but not worked on yet
In Progress	The case is in progress in the front-end-service portal
In Back-office Process	The case has open back-office processes
Back-office Process Finished	All needed back-office processes related to the case are finished
Waiting for Internal Customer	The case waits information from an internal source/person
Need TechSupport	The case waits for answer from technical support in the front-end-service portal
Waiting for Engineering	The case waits for answer from engineering in the front-end-service portal
Return To Sales	The case has been returned to customer service for example to ask / clarify something

Beside the case type, record type and status, a key limiter for the framework is also the case priority field. As mentioned in section 4.3.4 the case priority options were updated based on the research findings already during the research process, which allowed the escalation model to utilize the updated prioritization logic. Following these adjustments, the escalation framework is specifically targeted at cases that represent clearly defined high-importance scenarios i.e. cases with priority types of “Breakdown”, “Shutdown”, or “High Case Value”. By limiting the scope to these priority categories, the framework focuses on cases with the highest business impact and ensures that escalation efforts are applied selectively and effectively.

4.4.1.2 Escalation scope for the back-end collaboration platform item action objects

Similarly to case objects, the escalation scope for item actions is also firstly defined by the object type. For case objects, this field was called as case type but with item action

objects the field is called as request type. In the proposed escalation framework the value in this field should be “Quote” that an item action is included in the escalation process. However, like also with the case objects also with item actions it can be at some point be justified to expand the scope of the escalation model to include additional categories, such as “Order” type cases.

Next, also the priority field serves as a key limiter for the escalation scope of item action objects. As previously defined for the case objects, the prioritization logic has been updated based on the research findings, enabling the escalation framework to focus on clearly defined high-importance scenarios. This same prioritization logic is applied to item action objects to ensure consistency between the front-end and back-end processes. Consequently, the escalation framework for item actions is limited to requests that represent the highest business impact, namely those categorized under the priority types “Breakdown”, “Shutdown”, or “High Case Value”. By applying the same priority criteria across both object types, the model ensures that escalation efforts are aligned and focused on critical cases throughout the entire service process.

The final limitation of the escalation scope for the item action objects is attached to the item action status field. Like with the case objects the item action status field indicates the current situation of the item action and therefore serves as a good tool to choose which item actions should be included in the framework and which not. In total there are 17 different statuses that an item action may have from which the following nine in Table 9. are included in the framework:

Table 9. Item action statuses included in the framework

Status	**Definition**
New	The item action waits someone to work on it
In Progress	The item action is worked on by someone in the back-end collaboration platform

Return to requestor	The item action is returned to its creator to ask a question, for example
Returned	The item action is returned to the previous owner who is not necessary the creator
Waiting for internal customer	The case waits information from an internal source/person
Waiting for engineering	Engineering works on the item action
Pending quotes	Procurement waits for an external supplier to send a quote related to the item
Supplier responded	External supplier has responded to sourcing with information whether they can supply the part, in which timeline and in which price
Related item action finished	The item action has been waiting for some related item action(s) which has now been finished and thus this item action can be started to work on.

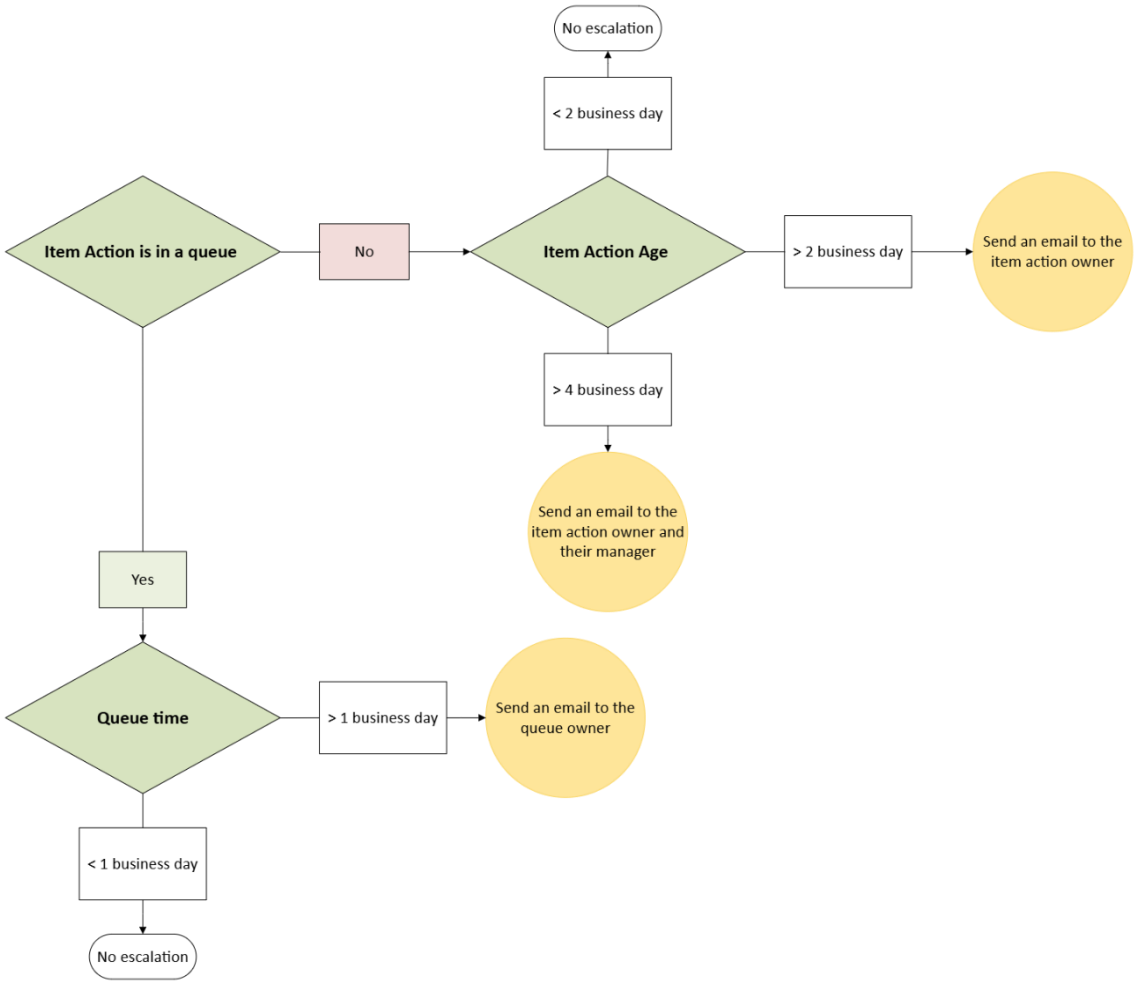
4.4.2 Escalation indicators

In addition to the scope, another important part of defining the escalation framework is deciding the escalation indicators. In practice, the escalation indicators can be fully compared to escalation logics introduced by van der Aalst et al. (2007), as they define the conditions under which a case should be escalated within the escalation framework. In the case company's context, the escalation indicators are defined for each object–priority combination, resulting in six distinct categories. Each category may also include multiple escalation indicators, as there are multiple strategies used for every object–priority combination, from which all require their own escalation indicator.

From Figure 12. below we can see five examples of the escalation indicators, highlighted in white squares. In this figure, the indicators are specifically related to the item action – shutdown branch and illustrate how escalation is triggered based on either item action age or queue time. Similar indicators are defined for each branch of the escalation model

in an almost identical manner, although the exact threshold values vary between the branches. The exact values for each branch can be reviewed from Appendices 1-2.

Figure 11. Examples on escalation indicators.



4.4.3 The applied escalation strategies

Once the escalation scope has been defined and the relevant escalation indicators identified, the framework progresses to the selection of the escalation strategies. The purpose of these strategies is to develop clear and actionable plans for each escalation indicator which may be triggered within the proposed framework. In order to ensure the practical applicability of the framework, the strategies were designed so that the case company's quotation systems could execute them automatically without human labor.

This approach not only improves efficiency but also reduces the potential for human error, while allowing personnel to focus on exceptions and more complex decision-making tasks.

Overall, the proposed escalation framework ended up using four different escalation strategies. Collectively, these strategies are outlined in Table 10. below, alongside the application point and information about whether the strategy is used for both objects or only one. Within the objects, the strategies were used in a recycling style, i.e. the same strategies were used for different priorities but with different indicators. The most useful way to review the used strategies is to look at the escalation flowchart from Appendices 1-2.

Table 10. Used Escalation Strategies.

Escalation strategy	**Application point**	**Used for case objects**	**Used for item action objects**
Notifying an object's queue owner	An object is in a queue and not assigned to anyone.	Yes	Yes
Sending a reminder to the object owner	An object is assigned but not solved within the first time limit	Yes	Yes
Escalation to the object owner manager	An object is assigned but not solved within the second time limit	Yes	Yes
Escalation to the process owner group	An object is assigned but not solved within the third time limit	Yes	No

4.4.4 Roles and responsibilities

The thesis has now gone through the main features of the proposed escalation framework: the escalation scope, indicators and strategies. Although these parts define the escalation framework already at good depth, for practical implementation, it also makes sense to review the roles and responsibilities related to the escalation framework. This way, the framework becomes not only a conceptual tool but also an operational model that is ready to be applied in practice.

The first role and responsibility to review is the role and responsibility of the object owner who is perhaps the most important participant for the framework. Simply put, although the purpose of the escalation framework is to promote the progress of important quotation cases, the object owner is still ultimately responsible, as before, for advancing their own cases and ensuring their efficient progress. In other words, the escalation framework does not replace the responsibilities of the object owner but rather, it functions as a supportive mechanism that facilitates the process and ensures timely intervention when needed. For this reason, the escalation framework also ensures that the object owner is always informed if the escalation progresses beyond their level to other organizational levels, such as to a manager.

The proposed escalation framework also includes a strategy in which the case owner's manager is involved if the case owner is unable to resolve the situation within the defined escalation thresholds. At this stage, from the viewpoint of the roles and responsibilities, the manager is responsible for ensuring that appropriate corrective actions are taken, such as reallocating resources, prioritizing the case, or removing identified bottlenecks. The role of the manager is therefore both operational and supervisory, ensuring that escalation results in concrete actions rather than merely increased visibility.

In the most severe or prolonged cases, escalation may extend beyond the immediate team to the process owner group. The process owner group holds responsibility for the overall performance of the quotation process and is therefore tasked with addressing

systemic issues that individual case owners or teams cannot resolve. In the escalation framework, this role is particularly important in situations where delays are caused by cross-functional dependencies, unclear responsibilities, or structural process challenges. In addition to resolving individual cases, the process owner group also plays a key role in analyzing escalation data and identifying root causes for recurring delays.

In addition to individual roles, the escalation framework also defines responsibilities related to queue ownership and monitoring. Queue owners are responsible for monitoring incoming cases and ensuring that cases do not remain unassigned or inactive. When escalation is triggered at the queue level, the queue owner must ensure that the case is assigned, prioritized, and actively progressed. This responsibility is especially relevant in the early stages of the escalation framework, where delays may occur before a specific owner has taken responsibility for the case.

From a system perspective, part of the responsibilities is also assigned to the information system itself, which supports the execution of the escalation framework. The system is responsible for monitoring escalation indicators, triggering escalation events, and delivering notifications to the relevant actors. By automating these functions, the framework reduces reliance on manual monitoring and ensures consistency in escalation practices across the organization.

Overall, the roles and responsibilities within the escalation framework are designed to support a structured and progressive escalation path. Responsibility begins with the case owner, expands to the managerial level when necessary, and finally extends to process-level ownership in complex situations. This layered responsibility model ensures that escalation leads to timely action, while also supporting transparency, accountability, and continuous improvement of the quotation process.

5 Discussion and conclusion

All results of this research have now been presented in this thesis. The findings of this research show that in the case company the challenges of QRT are primarily driven by a combination of internal process inefficiencies and external dependencies. The identified internal process inefficiencies are represented by issues such as poor input data quality, lack of transparency and communication, and a weak priority system. These factors interrupt the process flow, create unnecessary rework, and reduce the effectiveness of coordination across different functions. At the same time, external dependencies, particularly long and unpredictable supplier response time, further contribute to extended response times and limit the company's ability to manage cases proactively.

In addition to the findings described above, the study also identified a set of requirements for an effective escalation framework. These requirements emphasize the need for clear and measurable escalation indicators that enable early identification of cases at risk of delay. In addition, the findings highlight the importance of well-defined roles and responsibilities to ensure accountability and timely decision-making across different process stages. Furthermore, the framework should support improved transparency and communication by providing better visibility into case status and progress. Finally, the results indicate that the escalation mechanism should be selective and targeted, focusing on a limited group of critical cases where escalation can create the greatest impact.

When reviewing the findings, a clear pattern emerges in which many of the identified challenges are not caused by a single factor, but rather by the interaction of multiple process-related issues. For example, poor input data quality and lack of transparency appear to reinforce each other, as unclear or incomplete requests require additional clarification, which is further slowed down by ineffective communication practices. As a result, cases remain open without active progress, leading to longer response times without corresponding value creation. In addition, the findings suggest that the process currently lacks strong coordination mechanisms, which makes it difficult to manage dependencies between different stakeholders efficiently. A notable observation is that

although some delays originate from external factors, such as supplier response times, the company's limited ability to anticipate and manage these dependencies amplifies their impact on overall QRT. This indicates that the issue is not only external uncertainty itself, but also how the organization responds to it.

The findings of this study are broadly in line with earlier literature on quotation processes and response times. Previous studies highlight challenges related to coordination, information availability, and dependence on external actors, which are also visible in this case. For example, the role of incomplete input data and delays in supplier responses reflects the complexity described in spare parts environments, where demand is uncertain and processes often require input from multiple stakeholders (Hu et al., 2018; Zhang et al., 2023). Similarly, earlier research on quotation processes (Veeramani and Joshi, 1997) points to internal information collection as a common source of delays, which supports the issues identified in this study.

The identified requirements for the escalation framework are also consistent with existing literature on process management and exception handling. Van der Aalst et al. (2007) emphasize that escalation mechanisms should be based on clearly defined triggers and measurable conditions, which supports the need for structured and transparent escalation indicators identified in this study. In addition, the finding that escalation should be selective and focused on critical cases is supported by the literature, which suggests that escalation should target exceptions rather than be applied broadly, in order to avoid unnecessary interventions and maintain efficiency (van der Aalst et al., 2007). This indicates that the requirements identified in this study do not introduce new concepts but rather highlight the importance of their consistent and practical implementation in the case company.

5.1 Theoretical and managerial implications

The implications of this thesis can be divided into the theoretical and managerial implications. From a theoretical perspective, the findings deepen the understanding of

quotation response time and exception handling by showing that delays are not only caused by process failures but also by factors such as poor input data, weak communication, and external dependencies. The study also demonstrates how escalation frameworks can be used as a practical way to apply exception handling theory, especially through proactive monitoring and early detection of risky cases.

From a managerial perspective, the implications are reflected in the proposed escalation framework, which provides a clear and practical tool for improving response time. The framework helps managers identify delayed cases early, define clear responsibilities, and apply consistent escalation actions such as prioritization or managerial support. In this way, it improves transparency, coordination, and accountability in the process, enabling faster and more reliable quotation handling without requiring a full redesign of the process.

5.2 Limitations and future research possibilities

This study has a couple limitations that should be considered when reviewing its results. Firstly, the research is context-bound, as the escalation framework was developed specifically for the case company's spare parts quotation process. While this supports practical relevance, it reduces the extent to which the findings can be directly transferred to other contexts. In addition, the study also relies on a combination of interview-based insights and historical process data, both of which reflect a specific point in time and may not fully capture evolving practices or future changes in the operating environment. The proposed escalation framework is also primarily conceptual in nature, meaning that its effectiveness is assessed based on analytical reasoning and alignment with identified challenges rather than on full-scale implementation and measurable performance improvements.

Building on these limitations, future research could focus on validating and extending the proposed framework in different contexts and through empirical application. Particularly valuable would be studies that examine the actual impact of escalation

mechanisms on quotation response time and related performance indicators after implementation. In addition, further research could explore how escalation frameworks interact with broader process development efforts, such as improving data quality, enhancing cross-functional collaboration, or integrating more advanced system support.

5.3 Conclusion

The objective of this thesis was to develop an escalation framework to improve quotation response time (QRT) in spare part sales. To achieve this, the study addressed four research questions related to delay factors in the quotation process, indicators for identifying at-risk cases, the structure of an escalation framework, and its expected impact on performance and customer satisfaction. The research followed a design science approach, combining qualitative and quantitative data to analyze the current process and build a practical solution for the case company.

The findings showed that the main challenges in the quotation process are related to poor input data quality, lack of transparency and communication, external dependencies such as supplier response times, and ineffective prioritization practices. Based on these findings, suitable escalation indicators were identified, such as time-based thresholds and process-related signals that help detect cases at risk of delay. In response to these insights, an escalation framework was developed by defining its scope, indicators, escalation strategies, and roles and responsibilities. The framework follows a structured logic that enables early detection and consistent handling of prolonged cases.

In terms of answering the research questions, the study demonstrated that delays in the quotation process are caused by both internal and external factors, that escalation indicators can be built around measurable process variables, and that a structured escalation framework can be designed using clear roles, rules, and actions. The expected impact of the framework is improved response time, better process transparency, and increased customer satisfaction. Overall, the key takeaway of this thesis is that a well-designed escalation framework offers an effective and practical way to manage prolonged

quotation cases and improve process performance without requiring a full redesign of the existing process.

References

Andree, K., Ihde, S., Weske, M., & Pufahl, L. (2022). An exception handling framework for case management. *Software and Systems Modeling*, *21*(3), 939–962. https://doi.org/10.1007/s10270-022-00993-3

Brocke, J. vom, & Rosemann, M. (2010). *Handbook on Business Process Management 1: Introduction, Methods, and Information Systems*. https://doi.org/10.1007/978-3-642-00416-2

Buzby, C. M., Gerstenfeld, A., Voss, L. E., & Zeng, A. Z. (2002.). Using lean principles to streamline the quotation process: A case study. *Industrial Management*.

Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning*, *10*(6), 807–815. https://doi.org/10.1016/j.cptl.2018.03.019

Chan, K.-L., Si, Y.-W., & Dumas, M. (2009). Simulation-Based Evaluation of Workflow Escalation Strategies. *2009 IEEE International Conference on E-Business Engineering*, 75–82. https://doi.org/10.1109/ICEBE.2009.20

Chand, S. P. (2025). Methods of Data Collection in Qualitative Research: Interviews, Focus Groups, Observations, and Document Analysis. *Advances in Educational Research and Evaluation*, *6*(1), 303–317. https://doi.org/10.25082/AERE.2025.01.001

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and Conducting Mixed Methods Research*. SAGE Publications.

Cross, W. E., & Galletta, A. (2013). *Mastering the Semi-Structured Interview and Beyond: From Research Design to Analysis and Publication*. New York University Press.

http://ebookcentral.proquest.com/lib/tritonia-ebooks/detail.action?docID=1187368

Diallo, Claver & Ait-Kadi, Daoud & Chelbi, Anis. (2012). A Review of Spare Parts Management Models for Multicomponent Repairable System. Frontiers in Science and Engineering. 2(1).

Didriksen, S. K., Sigsgaard, K. W., Mortensen, N. H., & Jespersen, C. B. (2025). An Empirical Data Model for Spare Parts Management: Linking Maintenance, Logistics, Inventory, and Equipment Data to Bridge Information Silos and Reduce Data-Gathering Efforts. *Applied Sciences*, *16*(1), 94. https://doi.org/10.3390/app16010094

Durogbo, C. M. (2020). After-sales services and aftermarket support: A systematic review, theory and future research directions. *International Journal of Production Research*, *58*(6), 1857–1892. https://doi.org/10.1080/00207543.2019.1693655

Elgh, F. (2012). Decision support in the quotation process of engineered-to-order products. *Advanced Engineering Informatics*, *26*(1), 66–79. https://doi.org/10.1016/j.aei.2011.07.001

J.M.P. Gevers, W. van Eerde, C.G. Rutte. (1983). Time pressure, potency, and progress in project groups, European Journal of Work and Organizational Psychology 10 (2) (2001) 205–221.

Hofler, D. (1983). Approach, Method, Technique: A Clarification. *Reading World* 23 (1): 71–72. https://doi.org/10.1080/19388078309557742.

Holmström, J., Cheikhrouhou, N., Farine, G., & Främling, K. (2011). Product Centric Organization of After-Sales Supply Chain Planning and Control. In *Behavioral*

Operations in Planning and Scheduling (pp. 187–198). https://doi.org/10.1007/978-3-642-13382-4_9

Hu, Q., Bai, Y., Zhao, J., & Cao, W. (2015). Modeling Spare Parts Demands Forecast under Two-Dimensional Preventive Maintenance Policy. *Mathematical Problems in Engineering*, *2015*(1), 728241. https://doi.org/10.1155/2015/728241

Hu, Q., Boylan, J. E., Chen, H., & Labib, A. (2018). OR in spare parts management: A review. *European Journal of Operational Research*, *266*(2), 395–414. https://doi.org/10.1016/j.ejor.2017.07.058

Kaur, P., Stoltzfus, J., & Yellapu, V. (2018). Descriptive statistics. *International Journal of Academic Medicine*, *4*(1), 60. https://doi.org/10.4103/IJAM.IJAM_7_18

Kim, K., Choi, I., & Park, C. (2011). A rule-based approach to proactive exception handling in business processes. *Expert Systems with Applications*, *38*(1), 394–409. https://doi.org/10.1016/j.eswa.2010.06.078

Mai, E., & Liao, Y. (2022). The interplay of word-of-mouth and customer value on B2B sales performance in a digital platform: An expectancy value theory perspective. *Journal of Business & Industrial Marketing*, *37*(7), 1389–1401. https://doi.org/10.1108/JBIM-05-2021-0269

Mourão, H., & Antunes, P. (2004). *Exception Handling Through a Workflow*. *3290*, 37–54. https://doi.org/10.1007/978-3-540-30468-5_5

Moreno-Montes de Oca, I., & Snoeck, M. (2014). *Pragmatic Guidelines for Business Process Modeling* (SSRN Scholarly Paper No. 2592983). Social Science Research Network. https://doi.org/10.2139/ssrn.2592983

Nagel, R. N., & Dove, R. (1998). *21st Century Manufacturing Enterprise Strategy: An Industry-Led View*. DIANE Publishing.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–77. https://doi.org/10.2753/MIS0742-1222240302

Rohaan, D., Topan, E., & Groothuis-Oudshoorn, C. G. M. (2022). Using supervised machine learning for B2B sales forecasting: A case study of spare parts sales forecasting at an after-sales service provider. *Expert Systems with Applications*, *188*, 115925. https://doi.org/10.1016/j.eswa.2021.115925

Russell, N., van der Aalst, W., & ter Hofstede, A. (2006). Workflow Exception Patterns. In E. Dubois & K. Pohl (Eds.), *Advanced Information Systems Engineering* (pp. 288–302). Springer. https://doi.org/10.1007/11767138_20

Salesforce. (n.d.). *Salesforce: We bring companies and customers together.* https://www.salesforce.com/

Stadnicka, D., & Ratnayake, R. M. C. (2018). Development of additional indicators for quotation preparation performance management: VSM-based approach. *Journal of Manufacturing Technology Management*, *29*(5), 866–885. https://doi.org/10.1108/JMTM-01-2017-0016

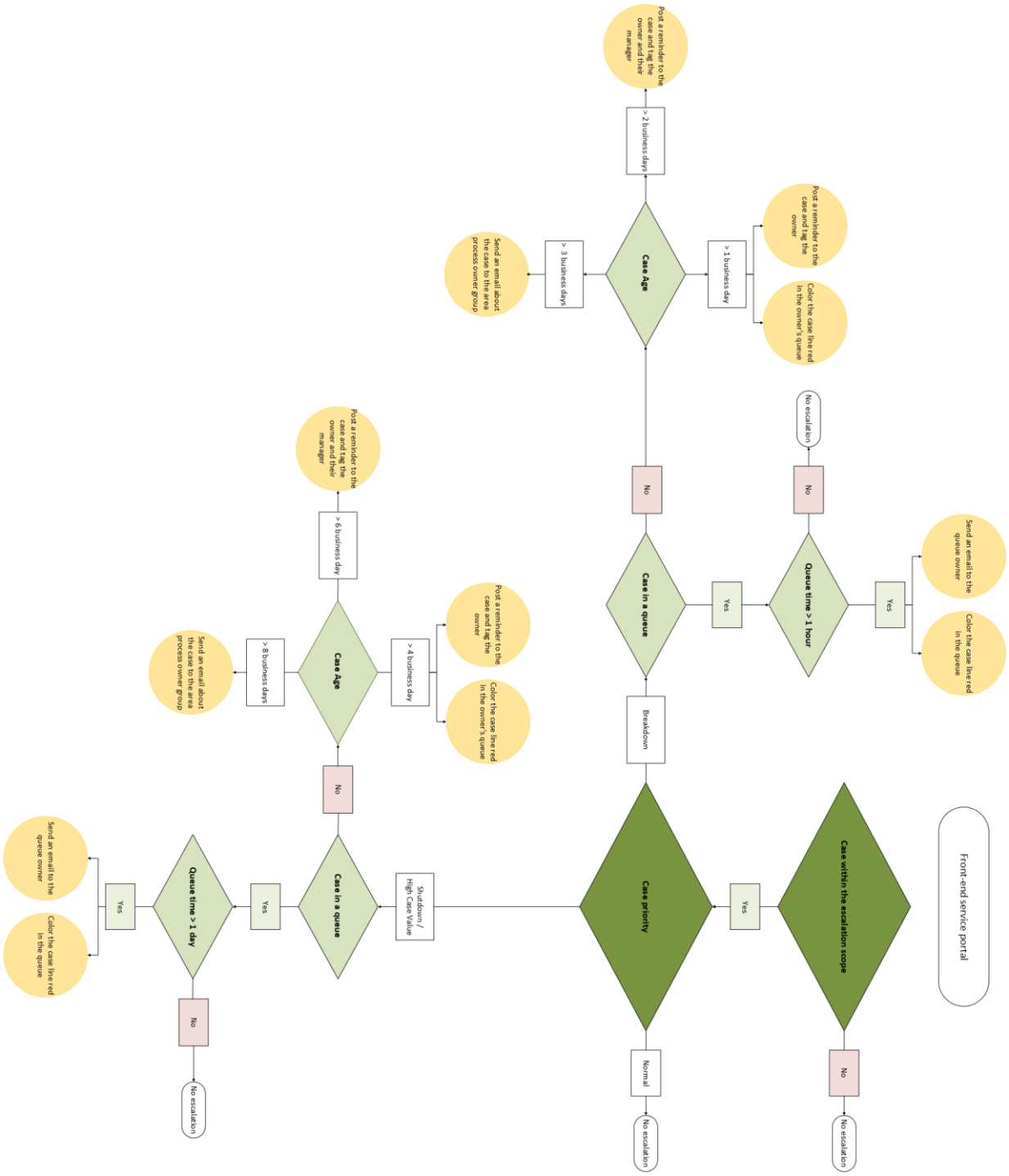
Van Der Aalst, W. M. P., Rosemann, M., & Dumas, M. (2007). Deadline-based escalation in process-aware information systems. *Decision Support Systems*, *43*(2), 492–511. https://doi.org/10.1016/j.dss.2006.11.005

Veeramani, D., & Joshi, P. (1997). Methodologies for rapid and effective response to requests for quotation (RFQs). *IIE Transactions*, *29*(10), 825–838. https://doi.org/10.1080/07408179708966405

Zhang, G., Yang, Y., & Yang, G. (2023). Smart supply chain management in Industry 4.0: The review, research agenda and strategies in North America. *Annals of Operations Research*, *322*(2), 1075–1117. https://doi.org/10.1007/s10479-022-04689-1

Appendices

Appendix 1. Escalation Framework for the Front-end Service Portal



Appendix 2. Escalation Framework for the Back-end Case Collaboration Platform