MASTER IN BUSINESS ENGINEERING PROFESSIONAL FOCUS IN DATA SCIENCE

Requirements Elicitation for a cloud-based software with Artificial Intelligence and Machine Learning components
a case study of the Esker Sales Order Automation Solution

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Award date:
2021

Awarding institution:
University of Namur

Requirements Elicitation for a cloud-based software with Artificial Intelligence and Machine Learning components: a case study of the Esker Sales Order Automation Solution

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Mémoire présenté
en vue de l'obtention du titre de
Master 120 en ingénieur de gestion, à finalité spécialisée
en data science

ANNEE ACADEMIQUE 2020-2021

Université de Namur, ASBL
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Acknowledgment

To help me write this thesis, I would like to thank all the people that have supported my work from the beginning to the end.

Firstly, I am grateful to my thesis Director, Prof. S. Bouraga for supervising me through the writing and researching of the work that marks the end of my academic journey.

I would also like to extend my sincere thanks to Bosch Thermotechnology, in Belgium for the wonderful internship I was given the opportunity to experience. They gave me the opportunity to gain a practical side to the knowledge I have acquired during my university years and have introduced me to Esker.

I therefore also wish to thank Bosch Building Technology US and in particular my interviewee for their valuable help. I am also extremely grateful to the people working at Esker that have agreed to share their experience. My work would not have the same value without their input.

Special thanks to my family for their encouragement and my friends, especially Marine Guében and Soazic Delefortrie for the mutual support and guidance.

Finally, I would like to thank Christel Berger for reviewing my work and correcting my written English.

Abstract

The purpose of this work is to analyze how Requirements Elicitation is led when dealing with the implementation of a software based on Machine Learning. After reviewing the existing literature about the topic, the author conducted four interviews with people who possess knowledge in Requirements Engineering. The interviews had multiple purposes: compare Requirements Elicitation techniques known in academia with the industry's doings; find out whether dealing with a Machine Learning based software impacted Requirements Elicitation; have an insight at the overall approach to take on Requirements Elicitation i.e., methodology, stakeholders, processes, requirements reuse. The results show that there exists a gap between the focus points of academics and practitioners; respondents indicate that they do not feel like the Machine Learning components impact Requirements Elicitation; the overall process favors an Agile methodology, requirements reuse, and working with an out of the box solution complemented by customizations.

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Chapter I – Introduction

Ian Sommerville, said in his book, *Software Engineering* (Sommerville, Software Engineering, 2011) – "*Different types of software require different approaches"* – and this is exactly what this thesis aims at reflecting. It is true that certain Software Engineering fundamentals apply to all types of software systems but in this work, the emphasis is placed on the particularities of a software utilizing Machine Learning. Furthermore, the Software Engineering activity at focus is Requirements Engineering and more specifically Requirements Elicitation.

Section 1 – Motivation Behind the Empirical Example

The author recently interned for five months at Bosch Thermotechnology in Mechelen, Belgium. During that experience she got introduced to Esker, a company providing process automation solutions. The European Thermotechnology branches of Bosch were considering going into business with Esker to automate their order intake process. Bosch Building Technology (formerly called Security Systems) was already dealing with Esker and had gone live with the order automation in December 2020.

As Esker got presented and demonstrated, the author took a particular interest in the project. Especially since the automation solution implemented (and still undergoing improvements) is the sales order process. A process the author analyzed for the Thermotechnology branch in Belgium during her internship in the Sales and Operations Department. In addition, the general topic of the author's thesis is Requirements Engineering for Machine Learning and the solution provided by Esker uses Machine Learning components to provide an effective automation solution.

The Esker project for Bosch Building Technology (BT) started in February 2020. The implementation was aimed for all Bosch BT branches across the world, but the American branch has been the pilot candidate. Thanks to Esker, an approach shift underwent within Bosch BT: they switched from a data entry driven way of working to a customer focused proactive approach. The implementation resulted in drastic time savings. Before Esker, setting an order into the ERP (SAP for Bosch) took, on average, 6 to 8 minutes. With Esker that time has been downsized to 1 to 2 minutes per order. The project also had a positive impact on the stress levels of the employees. Although it should be noted that they only envisioned the positive effects once they had clearly understood that the automation would not take away their job but allow them to adopt a new approach in which they all fit.

Section 2 – Presentation of Esker

Esker is a French company that initially started out as a software vendor in 1985. As of the 1990s, it started expanding worldwide and acquiring multiple companies to strengthen its international presence and the technologies it mastered (Esker, 2021).

In 2001 it launched its first automation process. Ever since, its AI-driven process automation software possibilities keep increasing. These software offerings allow companies to optimize the way they interact with their customers and suppliers. The automation solutions offered by Esker are divided into four big categories: procurement, accounts payable, order management, and accounts receivable. The service this work will focus on is order management (Esker, 2021).

With the Esker cloud-based platform, users do not need to process the orders manually anymore. The AI, Robotic Process Automation, and Machine Learning technologies used, empower the users to process, track, and archive the orders in one secure and centralized location. It learns by reading the customer's product orders, remembers where the values are, and what to expect. The automation of those processes is also possible thanks to the integration of Esker with some leading ERPs such as SAP, Narvision, Oracle (Esker, 2021).

In addition, the reporting tools provided enable the display of key KPIs to keep an eye on the company's performances. Using Esker enables time savings, prevents data entry mistakes induced by human errors, reduced backlogs, and less stress. A tutorial explaining how order processing works with the Esker automation solution can be found by clicking on the hyperlink (Esker, 2021).

Section 3 – Contribution

The aim of this work is to offer an insight on how requirements can be realistically elicited for the implementation and adoption of a software including Artificial Intelligence and Machine Learning components.

You will be introduced to a cloud-based software automating order processing and will learn how Requirements Elicitation can be conducted for such a solution. In the literature one can find extensive readings written by researchers, sometimes in collaboration with practitioners. Nevertheless, the research

papers that have usable approaches, techniques, and methodologies for the Requirements Elicitation are hard to find. All the knowledge from the literature remains very theoretical and is rarely applicable in the industry.

Through interviews, this work will aim at analyzing how elicitation is led. The interviews will be conducted from two different perspectives. First, Esker employees that have experience in leading Requirements Engineering. The aim of those interviews is to gather the knowledge from the solution experts. Second, the end user who is benefiting from the automation. The latter perspective aims at offsetting the knowledge previously gathered and gaining in objectivity.

It should be noted that the automation at Bosch Building Technology got implemented in the middle of the COVID-19 pandemic. This event has thus, to a certain extent, affected the results of this study (**The Current Pandemic**) and more specifically the experience of the customer in the Requirements Elicitation process.

Chapter II – Literature Review

This chapter will review the existing literature on the topics related to the subject of this study. Each one of the four sections will address a different aspect of the subject, yet all related with one another: Artificial Intelligence, Software Engineering, Requirements Engineering, and Agile Methodology.

Section 1 – Artificial Intelligence (AI)

In a nutshell, Artificial Intelligence consists in developing tools, techniques, and methodologies to automate processes. Its purpose is to increase the capacity and efficiency of humans and allow them to work together with machines (Liu, et al., 2018).

Machine Learning (ML)

Machine Learning is a fast-expanding branch of Artificial Intelligence, focusing on improvements through experience. The breakthroughs in these technologies are induced by a growing need and desire to increase automation. They have proven to have an enormous potential in the future of Software Engineering. Nonetheless, that potential does not come without any challenges (Hrvoje, Marin, & Zelika, 2019); (Zhang & Tsai, 2003); (Vogelsang & Borg, 2019). The case study of (Amershi, et al., 2019) identified several features of the Artificial Intelligence domain, setting it apart from the former software application domain. The domain shift is also the reason given by (Khomh, Adams, Cheng, Fokaefs, & Antoniol, 2018) for the often-experienced failures in AI/ML software. Traditionally, software systems were built by manually coded rules dictating the system's behavior. With AI/ML the rules are coming from training data, making testing and verification more challenging as the origin of the rules is more difficult to understand.

The director of AI at Tesla, Andrej Karpathy, referred to these changes as "Software 2.0" to describe that, behaviors no longer all arise from manually coded rules. Machine Learning approaches produce rules from a set of examples, a.k.a. the training data, and a fitness function (Vogelsang & Borg, 2019).

Besides the domain shift, there exists some fundamental differences in terms of building the applications. With Machine Learning, data is of the essence. The operations needed to discover, source, manage, and version that data are essential and can turn up to be extraordinarily complex. These applications therefore

require not only Software Engineering knowledge, but also a good understanding of Machine Learning (Hrvoje, Marin, & Zelika, 2019); (Lwakatare, Raj, Bosch, Olsson, & Crnkovic, 2019); (Amershi, et al., 2019).

Unfortunately, a gap between the AI and Software Engineering (SE) communities exists. The reason mentioned for this gap is their diverging focus points. Whereas the AI community focuses on algorithms i.e., their performance and characteristics, the SE community focuses on the implementation and the rollout of those algorithms. SEMLA – Software Engineering for Machine Learning Applications – is an attempt to understand and fill the gap (Khomh, Adams, Cheng, Fokaefs, & Antoniol, 2018).

This thesis stresses its research on Requirements Engineering. Nevertheless, it is interesting to have a look at the below visual sketching a Machine Learning workflow. The stage named "*model requirements*" from the workflow is concerned with analyzing which features fit for Machine Learning. Then, for those that fit, one will need to determine which models are best suited to the problem. This phase only partially tackles the Software Requirements Engineering problem (Amershi, et al., 2019).

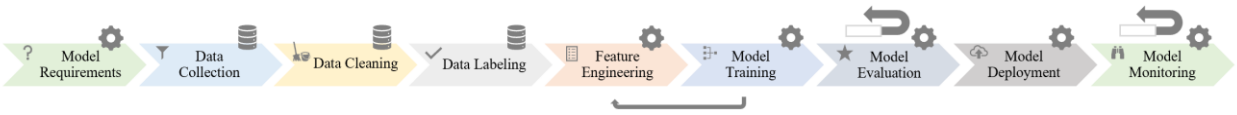

Figure 1 - The nine stages of the Machine Learning workflow (Amershi, et al., 2019)

Email Mining

Text mining is an interdisciplinary approach for information retrieval using Data Mining, Machine Learning, statistics, and computational linguistics. The difference between Data and Text Mining is that whereas the former is designed to work with structured data, the latter can handle unstructured or semi-structured databases such as emails (Bogawar & Bhoyar, 2012); (Gupta & Lehal, 2009).

Emails are composed of two sections:

- A Header contains information about the email's sender such as From, To, CC, Subject, Date.
- The Body is the unstructured text written by the sender and its eventual signature block situated at the end of the email.

Email mining is concerned with the mining of the data enclosed in the header and the body of electronic mails. Email mining can be set apart from Text mining because of the specificities of email data. For instance, email messages are short, making some Text mining techniques inefficient. They also deal with a large number of nonstandard acronyms as well as spelling and grammar mistakes (Tang, Li, Cao, & Tang, 2005).

Section 2 – Software Engineering

Software Engineering

In 1968, at a conference held to exchange about the Software Crisis[1], the notion of Software Engineering got introduced for the first time. After this conference, a handful of Software Engineering techniques, approaches and methods emerged. What is Software Engineering? It is a branch of engineering[2] that sets light on the various aspects related to software production, from the early stages all the way through maintenance of the software once developed. It is different from computer science as it is less theoretical and focuses more on the practical details involved in the development and delivery of software (Sommerville, Software Engineering, 2011).

The secret of a successful software lies into its ability to fulfill the needs of its users and its environment. Software Requirements list those needs while Requirements Engineering is the process used to determine and list the requirements of the stakeholders (Cheng & Joanne, 2007).

Cloud-Based Software

Cloud computing is defined as computing and/or application services provided over the Internet by using a cloud of servers from a third party. The cloud is made possible by a large number of computers and virtualization technology to utilize those computers effectively (Sommerville, Software Engineering, 2011).

[1] Definition: The software crisis referred to the obstacles faces in developing large and complex systems in the 1960s. https://ifs.host.cs.st-andrews.ac.uk/Books/SE9/Web/History/

[2] Definition Engineering discipline: Applying the appropriate theories, methods, and tools to discover solutions and make things work through organizational and financial constraints. (Sommerville, Software Engineering, 2011)

Outsourcing computation to Internet services has gained considerable attraction as it enhances mobility, collaboration, and encourages software reuse to a greater extent. In addition, the software does not need to be installed on personal computers anymore and updated at every new release (Hayes, 2008).

The study led by (Jürgen Cito, 2015) indicated that utilizing the cloud impacts several stages of the software development process. From a customer perspective (Wind & Schrödl, 2011) wrote that switching to a cloud-based software does not change much from traditional Software Engineering: Requirements Engineering remains as important to find out the objectives the cloud solution must reach.

Robotic Process Automation (RPA)

Robotic Process Automation (RPA) is a software-based solution aiming at automating rules-based business processes. Usually, those processes are routine, manual, and repetitive tasks with deterministic outcomes such as tipping, copy-pasting, extracting, merging, and moving data from one system to the other. A task for which RPA is often used is the transmission of data from multiple input sources. In the case of Esker's Order Automation solution, it is used to transfer information from emails to the ERP (Aguirre & Rodriguez, 2017).

Studies have shown the benefits of RPA in terms of error reductions, cost savings, and improved time allocation to value generating tasks. Nevertheless, the implementation of RPA has also brought some constraints with regards to reduced flexibility and worker resistance (Aguirre & Rodriguez, 2017); (Yarlagadda, 2018).

Note that even if the term RPA contains the word "robot", it does not imply the involvement of a physical robot. RPA is a software-based solution implemented to do repetitive and operational tasks formerly done by humans (Lacity & Willcocks, 2016).

As mentioned in (Aalst, Bichler, & Heinzl, 2018), the continuous developments in Data Science, Machine Learning, and Artificial Intelligence push academics and the industry to constantly revise their standpoint on what tasks should be automated. These advances allow RPA to take on more complex and less defined tasks. The goal is that RPA learns behaviors in the same manner humans do: by doing. In the events of a case that the RPA Respondent does not know how to handle, it can hand it over to the human Respondent. By observing how the human Respondent solves problems, non-standard cases are learned which allows automatization for similar future situations.

Section 3 – Requirements Engineering

Requirements Engineering

The research community in Software Engineering claims that the more consistent and more complete the requirements document is, the higher the chances the software will be reliable and delivered on time. Requirements Engineering being the starting point of software development, both the research community and the software industry recognize its importance (Lamsweerde A. V., 2000); (Sommerville, Integrated Requirements Engineering: A tutorial, 2005).

Requirement Engineering is the name given to the process aiming at understanding the environment, its needs, and the features the system to be developed must have. Understanding the context and the environment of the system involves identifying the circumstances under which the environment has a normal behavior as well as possible deviations and threats that must be supported by the system to be. What makes Requirements Engineering challenging is that it imposes the use of natural language to exchange with the end user, which may lead to incomplete and/or ambiguous requirements (Cheng & Joanne, 2007); (Sommerville, Integrated Requirements Engineering: A tutorial, 2005).

The 20th-century view stating that Requirements Engineering must be done before system development and must contain "everything" can no longer be assumed. Many changes in the system development approaches, the short time at hand to deliver, the rising number of requirements due to the increasing complexity, and the obligation to have a better Return on Investment on software assets pushing for software reuse instead of building new systems are some of the reasons for this shift. To address those challenges, some researchers advise integrating the Requirements Engineering activities into the system implementation (Sommerville, Integrated Requirements Engineering: A tutorial, 2005).

Organizations are facing a paradigm shift in their way of conducting software development. The accessibility to data and technologies rising from Artificial Intelligence such as Machine Learning and Deep Learning disrupt the traditional way of handling Requirements Engineering (Hrvoje, Marin, & Zelika, 2019). In (Bosch, Olsson, & Crnkovic, 2018) three approaches are singled out.

- The first approach – Requirements driven – is characterized by early-stage Requirements Engineering and is mainly used in the case of software built to specification. It works well for organizations that do not depend on frequent feature implementation, where requirements are well understood, and the purpose is to deliver a complete product without continuous updates.

- The second approach – Outcome/data-driven development – focuses on quantitative targets that need to be achieved. Development teams will test different ways to improve the given metric and reach the goal that was set.
- The third approach – AI-driven development – is preferred by companies using techniques such as Machine Learning and Deep Learning, on large datasets to develop software components. The research conducted by (Bosch. al) led them to say that AI components have the potential of offering to humans the opportunity to take on more complex tasks. Tasks they could never handle on their own, which increases their skillset and abilities.

Ideally, the traditional requirement driven approach should be enhanced by the two others. Choosing the wrong approach or allocating too much importance to the traditional one can cause problems like inefficiency and wrong deployment of development efforts. Adopting some Agile development practices allow companies to shorten their development cycles, evaluate more quickly the implementation of new functionalities, and see if they reach the expected outcomes (Hrvoje, Marin, & Zelika, 2019); (Lwakatare, Raj, Bosch, Olsson, & Crnkovic, 2019); (Bosch, Olsson, & Crnkovic, 2018).

Requirements Engineering Activities

Requirements Engineering is composed of five fundamental activities, often presented as if they happen in sequence, but in real-life it resembles to a cyclical process where multiple, if not all, steps are exercised simultaneously: (Lamsweerde A. V., 2000); (Sommerville, Integrated Requirements Engineering: A tutorial, 2005)

- Elicitation – determines sources of information about the current system and identifies, extracts, and gathers the requirements through communication with the stakeholders.
- Analysis and negotiation – looks for possible conflicts between the requirements elicited in the previous phase and searches for alternatives to find a middle ground.
- Documentation – consists in the formalization of the requirements, to have them written down with the appropriate specification, meaning that it has to be understood by the stakeholders as well as the engineers handling the system development.
- Validation – checks in with the end user to make sure that the documentation reflects their expectations.
- Management – is concerned with the overseeing and the control of changes in the system's requirements

The focus is set on the Requirements Elicitation process. In the discussion of the systematic mapping study of (Ambreen, Ikram, & Muhammad Usman, 2018), it is stated that Requirements Elicitation is the most empirically researched core area and that the interest in studying it keeps on rising. According to them, the explanation for this success lies in the growing number of problems that need to be addressed in the research and not so much in the inability to solve the existing problems of the elicitation area.

To conduct Requirements Elicitation, various techniques have been presented throughout the years: interviews, workshops, surveys, observations… The ones considered in this work will be reviewed in the Methodology chapter under **Elicitation Techniques**. As indicated by those techniques, Requirements Elicitation highly depends on the communication skills of the requirements engineers.

Requirement Elicitation is a multidimensional and iterative activity that aims at gathering knowledge about the problem faced by the user and their needs (Sharma & Pandey, 2013). The bigger picture is to come to an agreement with the end customer on what the future solution should hold. Several activities enclosed in the Requirements Engineering process will therefore be concerned with understanding the goals and rationale for developing the system. From these goals, requirements will be identified so that the system meets them (Lamsweerde A. V., 2000).

Goals can set light, at different levels of abstraction, on the various objectives the system wants to reach. A branch of Requirements Engineering, namely Goal-Oriented Requirements Engineering (GORE) focuses on the use of goals throughout the process activities. GORE analyzes the system and singles out problems and opportunities. Next, it formulates high-level goals which are then further refined[3] to address the problems and reach the opportunities (Lamsweerde A. v., 2001).

Requirements Reuse

Requirements from domains that are alike and/or for similar tasks have a high chance of being alike. This statement is what initiated the research field of requirements reuse. The field was first studied in (Reubenstein & Waters, 1991) where bits of domain descriptions and task specifications were reemployed with a technique based on inheritance (Lamsweerde A. V., 2000). Requirements reuse can thus be defined as the practice by which Requirements Elicitation is not started from scratch, but makes use of already

[3] Refinement: refers to the process of asking how and why questions about the requirements and goals at hand to reach a higher level of precision or a higher level of abstraction respectively.

existing artifacts. These artifacts can refer to requirements from previous specification documents, catalogues, …

Reusing requirements is valuable in two ways. First, it reduces the time needed for requirements gathering and analysis. Second, identifying similar requirements can lead to reusable code for the software to be developed. Both advantages lead to an overall reduced cost (Irshad, Petersen, & Poulding, 2017); (Cybulski & Reed, 2000).

In (Irshad, Petersen, & Poulding, 2017) several requirements reuse approaches are listed. They are classified in eleven categories and reviewed one by one. The paper also points out that only very few approaches from the once reviewed were validated by industry. In (Cybulski & Reed, 2000), only three requirements reuse approaches were singled out i.e., text processing, knowledge management, and process improvement. They do highlight that for a successful requirements reuse method, the three approaches should be combined to best benefit from their focus points.

In (Franch, Palomares, & Quer, 2020), four factors influencing the level of requirements reuse for a project are identified: Organizational i.e., organizational culture, unavailability of previous specification documents; Project-related as in similarity to previous projects; Human to illustrate the extent of effort put in by the requirements engineer to apply requirements reuse; and Technical i.e., compliance to a new standard to be fulfilled by the platform, impediments for tool support.

Section 4 – Agile Methodology

Concurrent engineering is an approach opposed to the traditional sequential product development process. It promotes concurrent completion of the process activities with continuous feedback and iterations. In Software Engineering, Agile development methods illustrate concurrent engineering. In terms of Requirements Engineering, this implies that the RE activities are carried out concurrently and that they are in turn concurrent to the system development process. The system is developed and provided step by step, in increments, with each step containing a subset of the requirements (Sommerville, Integrated Requirements Engineering: A tutorial, 2005); (Srivastava, Bhardwaj, & Saraswat, 2017).

Usually, Agile methodologies encourage developers to analyze the scenarios at hand, divide them into tasks, and estimate the effort to be provided to implement the scenario. According to the costs of these implementations and the importance of the scenarios, requirements will be assigned a priority for further

software releases. It should be noted that although Agile methodologies offer a high number of advantages, in projects where dependencies between requirements are elevated and a complete and detailed requirement document is the key to a successful end, another method should be considered. The major advantage of Agile and the reason to its success is its ease to include the customer's changing requirements in the system development (Sommerville, Integrated Requirements Engineering: A tutorial, 2005); (Sommerville, Software Engineering, 2011).

By reviewing Eskers' website, the author read that they use an Agile methodology since 2011, more specifically the SCRUM Agile methodology. There exist several frameworks for Agile, SCRUM is one of them. The framework is a mix of an iterative and incremental model as the feature development rollouts are successive and incremental. The aim of SCRUM is to increase the development speed, focus on performance, push for value creation, higher communication throughout the project, and to increase individual quality of life (Srivastava, Bhardwaj, & Saraswat, 2017).

Chapter III – Methodology

This chapter is divided into two sections. The first is the continuation of the literature by listing the various elicitation techniques and the factors influencing their adoption for a project. The second section focuses on the adopted methodology for the data collection of this work and describes how it will be analyzed.

Section 1 – Requirements Elicitation

Decision Factors

Generally, the way elicitation is conducted highly depends on the company and on the personal preferences of the people leading elicitation. It should be noted that most researchers agree to say that there is not one technique that can pretend to capture all the requirements and thus a variety of techniques is preferred. The purpose of this section is to list factors that influence the analysts to choose one technique over another. In a later phase of this study, the purpose is to come up with some guidelines to conduct Requirements Elicitation for the implementation of software with Machine Learning components (Anwar & Razali, 2012); (Yousuf & Asger, 2015); (Goguen & Linden, 1993); (Khan, Dulloo, & Verma, 2014); (Zheying, 2007).

In (Anwar & Razali, 2012) they identified the RE technique as being the dependent factor and the stakeholder's characteristics, the project environment, the techniques' features, and the requirements' sources as the independent factors. The study revealed that there are two types of knowledge that influence the choice of one elicitation technique over another: domain and technical. Domain knowledge refers to understanding the system to be built and its business processes whereas technical knowledge refers to understanding the software development methods and tools.

Sommerville emphasizes that the Requirement Elicitation process depends on the solution to be developed and the company's characteristics i.e., size and culture (Sommerville, Software Engineering, 2011).

(Yousuf & Asger, 2015) argue that the right techniques can only be selected once the requirements engineer acquires a good understanding of what the elicitation techniques are all about. Then and only then, a technique can be implemented efficiently. To be fully efficient, the right number of techniques should be combined: too many are ineffective and too few results in a lack of granularity.

In the study led by (Davis, Dieste, Hickey, Juristo, & Moreno, 2006) four significative results were presented: (1) Structured interviews are the most effective elicitation technique; (2) Several techniques mentioned in the literature i.e., card sorting are not as effective as interviews; (3) Analyst experience does not seem to affect the ability to gather information during Requirement Elicitation; (4) The use of prototypes or visual representations does not appear to have any significant effect on elicitation. Those results should not be considered as certain since they were the outcome of a systematic review of an empirical study that was not replicated.

In (Tiwari, Rathore, Gupta, & Atul, 2012) two main selection criteria are mentioned: company practice and personal experience. A five-step framework guiding the elicitation technique selection is developed. From the steps, the first one is the most relevant to this work as it states: "*Identify the list of situational characteristics of the software under development*" (Tiwari, Rathore, Gupta, & Atul, 2012, p.6). The situational characteristics are listed as being the type of stakeholder, the social environment, the nature of the system being developed, the type of user, the scope of the system, the analyst's skills, and the approach to be followed.

(Zheying, 2007) stresses that Requirements Engineering is a human endeavor. This implies that Requirements Engineering highly depends on the people involved. In addition, as there is a great variety of techniques and the context in which they are used greatly depends on the situation, it is difficult for organizations to come up with a set of appropriate techniques to elicit requirements in a structured and systematic way.

A table summarizing all the above-mentioned factors can be found in **Appendix A.** The aim of the interviews conducted in this work is to come up with some guidelines on how to conduct Requirements Elicitation. Nevertheless, some of the above-cited factors influencing the elicitation technique selection will be reviewed in light of the information gathered. Certain questions from the interview guide aim at uncovering if the factors listed by the literature are verified in our case study.

Elicitation Techniques

	NAME	DESCRIPTION	ADVANTAGE	DISADVANTAGE	COMMENT
Traditional techniques	Interview	Ask questions to domain experts about the domain itself and the tasks it is composed of.	Body language analysis	Time consuming (+ Follow up meetings might be required)	The interviewer should be a good listener, possess domain knowledge, and have social skills
		Structured: predefined set of questions. The purpose is to evaluate the level of understanding of the interviewee about a subject, but not to explore new ideas	Questions are fixed, repeat the interview to check the data reliability	Less flexibility, no new ideas or thoughts	
		Unstructured: like a conversation	- Answers are open for discussion; can deepen certain topics. - Easier to find out about the stakeholder's expectations, they feel more at ease	- Challenging generalizations - Interviewer may cause biases in the way he asks the questions	
		Semi Structured: Mix both above-mentioned techniques	Fixed questions provide the structure and unstructured questions allow exploration	- Risk of focus loss - Challenging generalizations	
	Questionnaire and surveys	Contain clear, open and/or closed questions and is usually conducted in the initial phase of Requirements Engineering to get statistical evidence supporting an assumption or to collect opinions and suggestions	Provide a set of unambiguous, consistent, and relevant requirements.	Set answers into categories (to which the respondents cannot always relate)	Preferred when the requirements engineers want to gather information from a large group of people in the shortest amount of time and with the fewest costs.
	Introspection	The engineer thinks about what kind of system he would want if he were to be doing the tasks of the stakeholders. He imagines the needs and wishes of the stakeholders for the system to be.	No costs	Only effective when the engineers have a good knowledge of the domain and the business processes	The outcome serves as basis for the initial requirements.

	Document Analysis	Consists in collecting information from existing documentation about the current system. Documents include manuals, all kinds of forms, diagrams, process flows, organizational charts, job descriptions, emails, …	- Useful way of gathering information when stakeholders and users are not available - Helps in acquiring a deeper understanding of the organization before meeting the stakeholders (the historical data eases the question framing for interviews) - Can be used for requirements reuse	- Do not overstudy the existing documentation and constrain the new system to what already exists. - Time consuming (huge amounts of documentation) - Information may not be available, outdated, or incomplete	
Contextual techniques	Observations	The requirements engineer observes the stakeholders carrying out their tasks and take notes. Passive observation: the engineer does not interfere in the process >< Active observation: the engineer interrupts the stakeholder to understand their reasoning.	- Gives an insight at the work processes - Better the often-simplified work process explanations. - Points out how the user will interact with the system to be	- Requirements cannot be checked in one single session - Be aware that users can behave differently because they are being observed	
	Ethnography	The engineer observes the stakeholders for an extended period of time to uncover the relationships among actors. The aim is to extract the socio-organizational requirements.	Good way of understanding how people work together and how they interact with one another	- Extends on a very long period of time - Ethnographic records are unstructured - Difficult to execute	

Collaborative/Group techniques	Use cases/ Scenarios	Use cases describe interactions between users and the system. Scenarios are examples of interaction sessions where a single type of interaction between user and system is simulated.	- Useful if a description of the user's viewpoint is needed. - Ease requirement's validation and creation of test cases. - No need to have a technical knowledge to understand them	- Time consuming (depending on the level of details required) - Never cover the entire process	Use cases represent the functional requirements of the system. Scenarios are written in natural language and should include a description of the state of the system before and after completion, what activities might be simultaneous, the normal flow exceptions, … Only after initial requirements are collected.
	Joint Application Development (JAD)	JAD brings together technology experts, business representatives, and key project stakeholders in order to define the requirements from the business perspective and the technology implementation.	- Fastens system design - Promotes collaboration throughout the process: communication, idea generation, feedback…	Lots of planning and a few people very familiar with the technique	The sessions may lead to the creation of a prototype, but the main purpose is to come up with a collection of user requirements.
	Requirements workshops	This technique refers to structured meetings with a group of stakeholders to discuss, refine, and validate the requirements.	- Achieve high quality requirements in a short amount of time - Lower cost than interviews	Handling participants: schedules, right number	For it to be successful, actors need to actively participate and be experts in their domain. Requirements are then assigned a priority level.
	Brain Storming	This technique is used to generate many preliminary ideas. The ideas are then classified according to different criteria such as relevance.	- Promotes the generation of new ideas - Encourages stakeholders to participate in the process, all are equal	- Not very precise - Quantity does not guaranty quality - Not suitable to resolve major issues	One needs to be careful that extroverts do not take the monopole of the session.
	Focus Group/ Group work	With focus groups/group work a small group of people is gathered to define the expectations of the system to be.	- Leads to idea generation, preferences and needs sharing - High quality requirements in little time: cost savings	Handling participants: schedules, tempers, focus, and trust	The moderator plays an important role, ensures that the group remains focused and that every requirement is properly discussed and given the due consideration.

Cognitive technique	Laddering	Laddering is an interviewing technique to obtain the stakeholder's goals, values, and attributes. Once this level is identified, the interviewer digs deeper to elicit more information.	Hierarchical structure eases the understanding of the requirements	- Long process - Not suited if there are many requirements - Need expert opinion and/or data beforehand	
	Card Sorting	Stakeholders are asked to arrange cards of domain entities in categories that make sense to them using index cards or some software packages.	Good qualitative data: understructure, input from users	Not designed for complex and large architectures	Provides in-depth understanding of user's mental model: the way they sort and label assignments and content.
	Protocol analysis	The stakeholder is asked to engage in a task while explaining aloud his/her thought process and opinion.	- Easy to implement - Give an insight at "how the system will work in real life" - Gain knowledge about the product domain	Extremely time consuming, does not work if there is a tight schedule	This technique reflects the problem-solving mechanisms at an individual level and pushes the individuals to apply introspection while executing a well-mastered task.

References: (Tiwari, Rathore, Gupta, & Atul, 2012), (Khan, Dulloo, & Verma, 2014), (Sharma & Pandey, 2013), (Goguen & Linden, 1993), (Yousuf & Asger, 2015), (Anwar & Razali, 2012), (Davis, Dieste, Hickey, Juristo, & Moreno, 2006), (Zheying, 2007)

Specific to:

- Interviews: (Adams, 2015), (Alsaawi, 2014), (Robyn, 2003)
- Joint Application Development: (Liou & Chen, 2015)
- Card Sorting: (Nurmuliani, Zowghi, & Williams, 2005)

Section 2 – Interview Methodology

This thesis chose to collect its data through a qualitative method, more specifically through interviews. Two different kinds of interviews were conducted. The first set of interviews was held with Esker employees to gather data on their expertise in Requirements Engineering. The second kind of interview was held with a Bosch Building Technology employee, closely involved in the Esker project in the United States and who is a user of the software.

Initially it was decided to interview two Esker employees. Nonetheless, after conducting the two planned interviews, the author decided to look for one additional interviewee. A follow-up interview did not seem rational (at that time) as the content of the interview sessions indicated that follow-up questions would only yield a small amount of additional relevant data. The initial number of two interviewees was set following the guidelines in (Malterud, Siersma, & Guassora, 2015), especially the study aim, sample specificity, and establish theory items (**Figure 2**).

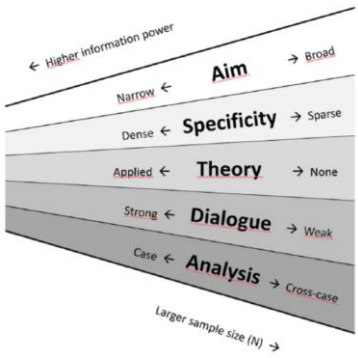

Figure 2. Information power—Items and dimensions (Malterud, Siersma, & Guassora, 2015)

The profiles of the interviewees will remain secret. To respect their anonymity, they will be referred to as Participant, Respondent, Interviewee or with the third person plural pronouns. It should be noted that they come from two different geographical locations but are all acquainted with the Sales Order Process Automation Solution provided by Esker.

The table below introduces the Esker interviewees. Note that Respondent 3 is the participant that was added after the first two interviews.

Name	Respondent 1	Respondent 2	Respondent 3
Job Title	Business Development Manager	Country Manager	Project Manager
Job Description	*"Engage with large enterprises helping them as of their initial interest in automation all the way through process analysis, value engineering, business case definition, technical feasibility, due diligence and so forth"* Note: Involved in the Bosch implementation	*"Coordinating sales-marketing resources to hit targets and technical teams (they implement the software solutions with the project managers and project developers who develop customer specific requirements"*	*"Winning over customers and supporting them throughout the automation implementation by channeling communication, gathering requirements, and coordinate development",*

Table 1 - Presentation of the Profile of the Esker Interviewees

Regarding the Bosch interview, the profile description of person questioned is presented in the table below.

Name	Respondent 4
Current Job Title	Project manager for the customer service logistics operations teams
Job description	Involves dealing with the customers through calls, chats, order intake, inquiries, … And while dealing with the processes, trying to find improvements, automated solutions to make them more efficient and better for the customers Note: 13 years of work experience inside Bosch, always on that operation focus
Job Title at the beginning of the project	Customer service logistics operation supervisor
Job Description	Responsible for the people within the customer service operations team and not so much the processes (as opposed to what she is doing now)

Table 2 - Presentation of the Profile of the Bosch Building Technology Interviewee

The interviews are semi-structured interviews meaning that a list of predefined questions was used in combination with open-ended questions to bounce back on the knowledge gained during the interviews. This way of proceeding was chosen for several reasons. First, as the purpose of the interviews is to extract partially unknown information, the interviewer needs freedom to spot useful needs and pursue them. Second, open-ended questions allow the interviewer to gather independent thoughts from each individual within a group, in this case, within a company (Adams, 2015).

The interview guide was divided into five phases:

1. Introduction – the interviewer introduces herself and describes her work.

2. Respondent information – simple and basic questions to get to know the interviewee.
3. Context questions – short to medium answers are expected. This phase aims at confronting the literature with the more hands-on knowledge of the interviewee and understand their level of theoretical understanding.
4. Longer responds – acquiring new information by letting the interviewees share their thoughts and experiences on various topics.
5. Conclusion – one wrap up question and thanking the interviewee.

The interview guide for Esker employees can be found in **Appendix B**. and the interview guide for the Bosch interview is in **Appendix C**. As stated in (Gionnelloni & Vernette, 2015) it has been decided to start the interviews with the subjects that are the closest to the study topic, the people leading requirements gathering in this case. And then to focus on the end user who was part of the process. The transcriptions of the parts of the interview used in this work can be found in **Appendix D**.

The content of the interviews is analyzed in two different manners. It has been decided to separate the core research topic of this work, Requirements Elicitation techniques, from the more freely discussed topics such as Esker, Agile methodology, Requirements Engineering, Requirements Reuse, customization, and automation. For the former, a table showing the answers of each interviewee and their comments was set up. The table can be found in **Appendix E**. For the latter, a qualitative matrix was created. The analysis grid follows a categorization a priori as described in (Gionnelloni & Vernette, 2015) (p110). This implies that the categories of the grid were chosen mainly based on the interview guide and the knowledge of the interviewer. Only slight changes were made after transcribing the interview as other interesting subjects were discussed. The grid can be found in **Appendix F**.

The grid analysis techniques used are the ones described in (Gionnelloni & Vernette, 2015) (p 113). For the elicitation techniques' grid, the data was mainly analyzed horizontally to compare the experience of each interviewee with the technique at hand. A second analysis consisted in an overall approach to determine the success of the four identified categories and determine how they interact with one another. Requirements Elicitation being a process that uses a variety of techniques, this last view enables one to set light on the bigger picture of the process when conducted for the implementation of a software with Machine Learning components. For the more generally discussed topics grid, a prior step had to be applied: regrouping and restructuring the transcripts into the various selected categories. As a matter of fact, the information collected in the kind of interview conducted does not follow a strict topic discussion, ideas thus have to be sorted and filtered. Once the grid set up, its content is analyzed horizontally.

Chapter IV – Analysis of the Data

From reviewing the analysis grids, the author decided to divide the analysis of the data collected in four sections: Requirements Elicitation, Esker Order Automation Solution, Methodology, Impact of AI and ML. Each section regroups one to several grid categories.

Section 1 – Requirements Elicitation

Defining the Concepts – Requirements Engineering and Elicitation

After asking the introductory questions, the author wanted to start the interview by exploring to what extent the rather academic terms Requirements Engineering and Requirements Elicitation were known and understood in the industry.

When asked if they were familiar with the term Requirements Engineering and if they were, how would they define it, only Respondent 1 and 3 shared their understanding of the term. For Respondent 1, the focus point was: "*Understanding through discussion*". By that the respondent meant that it is only once the work of understanding the processes, the stakeholders, the company, and the context that the requirements can be envisioned. Respondent 3 highlighted a distinction in Requirements: functional and business. Another interesting response to point out is the one of Respondent 2. Once the author gave additional explanations, they directly referred to Agile methodologies (

Section 3 – Methodology).

After having introduced Requirements Engineering, the interviewees were asked how they would define Requirements Elicitation. There again, the name of the process did not sound familiar. Once clarified, Respondent 1 added that in their opinion, Requirements Engineering and Elicitation are very much part of the same process. In addition, they mentioned that it depended on the project's complexity, but that it was always part of an iterative process.

To conclude, one can note that although the respondents either conduct (Respondent 1, 2, and 3) or are part of (Respondent 4) Requirements Engineering and Elicitation, the rather academic terminology is not well known.

Requirements Elicitation Techniques

The author listed 14 different elicitation techniques. To make the analysis of the results as efficient as possible, those techniques will be grouped in four categories: Accepted Techniques, Rejected Techniques, Controversy Techniques, and Additional Techniques. A fifth sub-section has been added: Preferred Techniques.

a) Accepted Techniques

All Respondents agreed to say that observations are used to elicit requirements. From the comments they gave on this technique, one should remember that participants are always asked to explain their tasks and are questioned while they are doing them. The "why" for their actions should be understood. This refers to a mix of what is called *Active Observation* and *Protocol Analysis* in academia. To understand the dynamics of the workplace, respondents also confirm that *Ethnography* is used.

Respondent 2 linked *Introspection* to observations. As a matter of fact, they related that, after observing and understanding how the customers execute their tasks, they think of ways to replicate or improve their processes with the solution.

Use cases and *Scenarios* are also a commonly used technique for elicitation. Respondent 2 stated that they usually come from the customers themselves. It does happen that some scenarios are missing or not detailed enough. By contrast, Respondent 4 said: "*They (Esker) were really good in bringing in best practices from organizations*". Referring to the fact that Esker was using its past experiences with customers that had similar processes to guide them.

The last technique commonly accepted is *Document Analysis*. Respondent 4 added that in the case of Bosch it was challenging due to the number of project participants. Indeed, each country has an overall standard operating process, but they also all have their local variations and the documentation that goes with it.

b) Rejected Techniques

The *Laddering*, *Card Sorting*, and *Brainstorming* techniques were all rejected. Regarding *Brainstorming*, Respondent 4 said: "*It was not to us to come up with new ideas, it was much more to us to explain what we would ideally prefer the tool to do and then they would come up with solutions on how the tool can be customized to do that*". Esker participants admitted not encouraging their customers to come up with new ideas. As their solution is quite mature and they have gained experience over the years, they will much more push toward process rethinking to align the customer's processes with the way the solution works. Also,

customers often do not have the technical expertise to envision the costs generated by the sometimes-unnecessary customizations they ask for.

c) Controversy Techniques

Questionnaires and *Surveys* have not really been recognized by the Esker Respondents, but they have by the Bosch Respondent. They mentioned they were distributed as preparation to most of the workshops.

When asked about techniques that regroup stakeholders in one room, all participants agreed to say that they would agree to use such techniques. But when it comes down to describing how the group session works, opinions vary. Respondent 1 stated: "*the more exposure the better*". Respondents 2 and 4 rather agreed on gathering the same variety of stakeholders. Respondent 3 compared them to interviews but when a bigger number of people is more efficient. Regarding the technique's designations given by academia, one could say that the group sessions used by Esker are a mix between Requirements workshops and Focus Group/Group work.

The last technique that could be qualified as controversy is *Interviews*. The Esker participants answered that it would be a technique they would consider (depending on the situation, according to Respondent 2 and 3). When adopted, they would go for *Semi- to Unstructured Interviews*. Respondent 4 did not recall Interviews being used during their Requirements Elicitation process. One-to-one calls were not employed with the Bosch BT Operations team.

d) Additional Techniques

Respondent 2 mentioned one additional technique, namely *Prototyping*: the customer chooses a set of important use cases, the Esker development teams would then take a few weeks and come back with a prototype that includes them. They specified that they would generally recommend prototyping to customers and reach a commercial agreement to cover the development costs.

e) Preferred Techniques

When asked about a preferred elicitation technique participants had diverse answers: Respondent 1 did not identify one preferred technique; Respondent 2 highlighted that although there are no real preferences, workshops are vital for a successful implementation; Respondent 3 stressed the importance of communication; Respondent 4 explained that in their opinion, work shadowing (Observations and Protocol Analysis) was the most value-added technique.

Section 2 – Esker Order Automation Solution

The point of this section is to cover the perceived advantages of the Esker Order Automation Solution from an Esker perspective as well as from the Bosch side. By asking to the respondents how they perceive Esker and its order processing optimization, the author wanted to analyze whether the technologies, namely AI and Machine Learning would come up.

To summarize the interviewees input (Respondent 1, 2, and 3), Esker is described as helping businesses to optimize their core business cycles by providing automation solutions. It leverages its AI and ML platform to drive automation for the betterment of all the stakeholders involved i.e., employees, suppliers, customers. Esker provides the implementation, the needed customizations, the technical support i.e., helpdesk, and hosts the cloud-based software on a platform called Esker on demand.

As for the order automation solution, all participants agreed to say that it takes over the manual data entry into the ERP. Hence, allowing the order intake teams to focus on better customer care and service.

Respondent 4 explained how the former order intake process would rollout. In the below figure (**Figure 3 - Simplified Order Intake Process for Bosch** BT US) is the corresponding simplified BPMN process flow diagram.

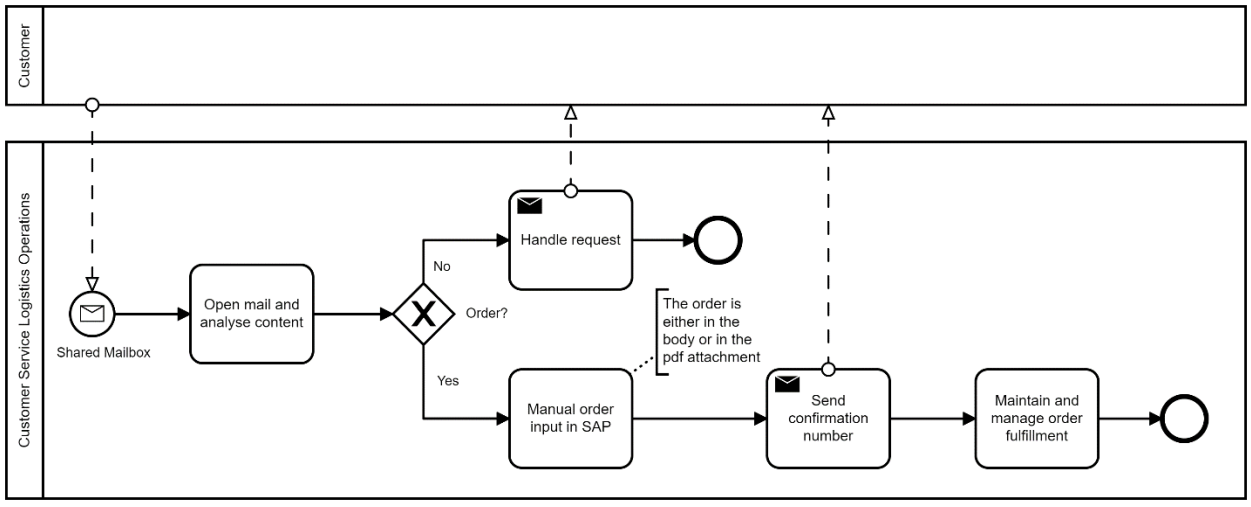

Figure 3 - Simplified Order Intake Process for Bosch BT US

As indicated in the introduction, the order intake process is now much more streamlined and efficient. The average order handling time has been cut down tremendously, from 6-8min to 1-2 min. To have an idea of how the current process looks like, refer to the hyperlink.

Section 3 – Methodology

One of the topics the author was interested in was the chosen approach to lead Requirements Elicitation. To gather that information, the author had originally planned one question at the end of the interview, asking the respondents to take her through a typical requirements process: "*To summarize what we have discussed during the interview, I would like you to walk me through the steps of your first encounters with a customer. Let's say: you get assigned a new project, in a new company and they would like to implement sales order automation*." Before the author got the chance to ask the question, all respondents had already given partial answers to the approach question.

The elements that were the most voiced or paraphrased were: iteration, process, Agile, out of the box solution, and reuse. This section will be structed into several sub-sections to explore the various aspects of the discussion.

Process Review

From the interviews with the Esker Respondents came out that there was not one defined set of steps that had to be followed throughout requirement gathering. There are preferences but sometimes the customer also imposes his modus operandi. Below are eight steps identified by summarizing the data collected from the four Respondents.

1. Negotiations. Esker is not the only company providing this kind of solution. It is up to the Esker sales team to leverage their experience and their other offerings to convince the customers to sign. For the Bosch study case, refer to **Due Diligence**.
2. Preliminary discussions. That phase was highlighted by Respondent 4 as being the step where general requirements were exchanged between the Bosch Project Management team and the Esker team.
3. Workshops and work shadowing. First contact with the operational level: break down the requirements from the management level. Purpose: show how the processes are performed.
4. "RE by doing" (Respondent 2). Show the end users (the operational level) the out of the box solution. It has a double objective: first help explain to the user how the solution works and second, identify the missing features and thus define the needed customizations. By doing this, requirements will be refined and additional once will be identified.
5. Both parties review the requirements internally and then meet again.

6. Define a set of requirements from the previous steps and start a first development.
7. Present the changes and test the new features.
8. Iteration.

All Esker Participants voiced the Agile concept, but they did not specifically mention the SCRUM approach. They characterize Agile as being an approach with successive iterations in the requirements process and implementation. Respondent 2 stated that Agile and Waterfall are two very theoretical concepts and that in everyday life, it is much more a mix of both. They highlighted the, needed, flexibility that an Agile approach offers as opposed to the traditional Waterfall approach. From a Requirements Elicitation technique point of view, Respondent 2 stated that it did not impact the techniques.

When asked about the efficiency of the process. Respondent 4 voiced that the disconnects were mainly coming from miscommunications within Bosch. As it was an international project, countries had to make sure they were aligned and had a same understanding of the requirements.

Customizations & Requirements Reuse

Regarding customizations, all participants agree to say that the first step is to have a look at the out of the box solution. The second step is then to look at changes to be made to that solution. Customizations are necessary as the sales order intake processes are different from one company to the other and thus requirements are too. Respondent 1 expressed: "*It is about finding the delta between the standard product and what the business needs as minimum viable product to consider automation*".

An interesting comment made by Respondent 2 is: "*The art of conducting the workshops and do that kind of requirement analysis is the art of saying no to the customer because they often come up with a lot of ideas*". That quote can also be linked to the comments made by the interviewees when asked whether the brainstorming elicitation technique was used or not.

Many times, during the Esker interviews, participants mentioned that the Esker Order Automation solution was a mature solution, being on the market for more than a decade. From a requirements perspective, that implies that the business analysts have gone through the process many times. Of course, each one of their customers has their specificities, but, with time, they acquire a certain expertise and can identify requirements that do not make sense or that result in tremendous development efforts for only little additional value. Respondent 2 highlighted that they have a counselor role: guiding the customer to make sure that the project does not lose focus from a content, requirements, and budget point of view. Respondent

3 stressed that the customer company size was the main deciding factor regarding customizations. It should be noted that both Respondent 1 and Respondent 2 also underlined the more psychological aspect of Requirements Engineering, as it is a human experience. Respondent 1 quoted Frank Roosevelt: "*Men/Women are best convinced by reasons they themselves discover*". Meaning that during elicitation, even if the analyst knows what the customer needs, he should find a way to guide him to come up with the idea by himself.

As part of the process is to first work with the out of the box solution, the concept of requirements reuse is very present. From their experience, Respondent 2 estimated that there are about 70% standard requirements as opposed to 30% customer-specific requirements. An interesting comment made by the customer experience of Respondent 4 is that in their sentiment the reuse was mainly done for the technical side of it and that the functional side was leading to a greater number of customizations. Respondent 1, being involved in the Bosch BT implementation did point out that the project with Bosch was quite unique because of the numerous ERP customizations. As the ERP, SAP, had been implemented for many years, there had been a fair amount of customizations making it more difficult to fit to the initial out of the box solution.

The last point to be discussed in the sub-section is the requirements development. Respondent 1 explained that whenever a new requirement leading to a new feature was spotted for a specific customer and analysts assumed it was an industry wide requirement, it would be taken to R&D. This avoids custom configuration efforts in the future.

Due Diligence

In the interviews of two respondents (1 & 4) the concept of due diligence came up. The Esker implementation for Bosch BT was intercontinental. Many stakeholders were involved in the process, but even before the development started, a fair amount of due diligence had to be done. Meaning that Bosch reached out to other customers from Esker to discuss how they went through the development process, what their experience was like, what customizations they implemented, how did they change their processes internally… It should be noted that it was the first time that Bosch BT implemented an order automation solution with an external partner, which also explains the duration of the negotiations phase.

In addition, an internal rule at Bosch states that before signing on a new vendor, vendors with whom Bosch already has a contract must be considered. After multiple negotiations, the Project Management team chose Esker, as it appeared to be the best fit. As a matter of fact, Esker was judged to be the best vendor as it also offers other automation solution that might be considered in the future.

Section 4 – Impact of AI and ML

One of the statements that the author wanted to test in her work was whether Requirements Elicitation was different from usual if the solution to be implemented contained AI and ML components.

All respondents were very clear on that inquiry:

- Respondent 1: "*No drastic changes, the differences lay in the terminology used*"
- Respondent 2: "*Not really, ML is a technology that we use*"
- Respondent 3: "*Not really, it is much more a way of developing the software*"
- Respondent 4: "*More or less the same*"

Nonetheless, Respondent 4 gave an interesting addition to their answer. Namely, the training received from the Esker team working with them throughout the project. The purpose of the project is to attain full automation, which is not the case yet, but in order to attain that objective, the model needs to keep on learning. In addition, they mentioned that, at first, the AI and ML components really felt like this black box that was working, no questions asked. But the further the project evolved, and the Esker team understood the work done at Bosch BT and within the operations team, the more they helped them understand the AI components of the solution to push its utilization to a higher level.

To conclude, the interviewees would not consider that the AI and ML components impact the requirements elicitation techniques. It much rather involves acquiring a certain terminology and understanding to improve the collaboration and the services offered.

Chapter V – Discussion

The underlying chapter will first compare the analyzed data from the previous chapter with the reviewed literature, introduce Non-Functional Requirements (NFR), formulate some guidelines for Requirements Elicitation, and conclude with the limitations regarding the scope of this study.

Section 1 – Industry vs. Academia

As brought up by the Respondents and the papers reviewed in **Decision Factors** when it comes down to Requirements Elicitation, there is no ideal technique that works in every context. Techniques complement each other. One can thus conclude, as stated in the literature and the interviews, that a variety of techniques should be used to efficiently elicit requirements.

To further compare the knowledge from both sources, literature and practitioners, the author built an additional analysis grid that can be found in **Appendix G**. This grid is the extended version of the grid presented in **Appendix A** regrouping the factors influencing the choice of Requirements Elicitation techniques, previously listed. They will be compared with the factors identified while interpreting the content of the interviews.

Requirements Elicitation is a *human endeavor*. All participants reflect in their answers that Requirements Elicitation is a human-centered process. On that effect, the factors identified by academia seem to be verified by the interviews. In addition to what has been said in the literature, certain respondents emphasize the psychological side of Requirements Elicitation: "*Men/Women are best convinced by reasons they themselves discover*". This aspect also brings us to the second factor: *analysts* and *company's experience*. If analysts stress the psychological aspect i.e., bringing people to think they came up with the solution, it is to ensure their collaboration throughout the process. The Esker Sales Order Automation solution has been on the market for over a decade. With the years, the company has helped numerous customers and automated lots of processes. Its experience clearly guides them through the Requirements Elicitation process. It gained a certain sense in judging which needs and demands seem reasonable and which ones are set to fail.

Requirements Elicitation is *context* dependent. The author identified two other sub-topics from the interviews, namely the project scope and the number of customizations. The former refers to the number of people involved in the project. In the case of Bosch BT, multiple nationalities and time zones were involved, making web sessions unavoidable, which impacts the way the techniques are performed. The latter refers,

more specifically, to the ERP and the company's processes. The longer the company has implemented its ERP, the more customizations will have to be considered. The challenge is to define whether the customer's specificities can be streamlined to the Esker solution or if customizations will have to be implemented: "*It is about finding the delta between the standard product and what the business needs as minimum viable product to consider automation*" (Respondent 1).

The next topic that needs to be reviewed is the techniques themselves. When it comes to preferred techniques, none of the respondents gave a straightforward answer. However, the further the conversation flowed, the more it became clear that workshops and observations are key elicitation techniques. This finding does not match with the conclusions from the literature, where interviews were named as the technique preferred by requirements engineers. The **Rejected Techniques** presented in the Data Analysis Chapter converge toward the literature's perspective. The author did notice that when it comes to understanding the techniques, the industry does not have the same level of understanding as academics. There is not a real naming for the used techniques or a defined set of features. It does not make sense to limit workshops, for instance, to this or that rather than mixing features and adopting them whenever the context seems to fit.

The table in **Appendix G** displays one last factor: the solution. The research presented by (Vogelsang & Borg, 2019) constitutes a first contribution to a RE methodology for ML systems. They highlighted three particularities imposed by ML systems to requirements engineers: (1) A good understanding of the ML performance measurements to come up with good functional requirements; (2) Be aware of the quality requirements imposed by ML; (3) Integration of ML specificities into the RE process. From those three particularities, two are of interest for this section: (1) could be linked to the comment made by Respondent 4, on the training they received from the Esker analysts to improve the ML model training; (3) represents the initial thought of the author when she started her study. But in the respondents' opinion, the ML component of the software is just a used technology that imposes a certain methodology but it does not affect requirements gathering. The other Requirements Engineering activities should be analyzed to conclude if any changes have been experienced.

Section 2 – Non-Functional Requirements (NFR)

This section aims at analyzing and discussing an important topic in Requirements Engineering that has not been tackled so far: Non-Functional Requirements (NFR). NFR can be defined as any quality or attribute that is non-functional (Horkoff, 2019).

In the above section, three particularities imposed by ML systems to requirements engineers were presented. The second particularity: "*be aware of the quality requirements imposed by ML*", was not further discussed. However, when reviewing NFR, the statement cannot be ignored. The study of (Horkoff, 2019) summarizes a selection of papers examining NFRs for ML. Among them are: Accuracy & Performance, Security & Performance, Testability, and Transparency. Testability and Transparency were already mentioned in the literature review chapter.

The interviewees did not really differentiate functional and non-functional requirements. Respondent 4 highlighted the difference between technical and business requirements. By that they were respectively referring to how the software is built and the specificities of the processes from Bosch. They illustrated by saying that the order form [4]was the same for everyone and thus, the technology allowing the form to exist is the same. But the particularities in the business processes of Bosch, raise new business requirements specificities that require new fields to be added.

The principle of requirements reuse has been addressed multiple times in this work. It can also be linked to NFR. In (Franch, Palomares, & Quer, 2020), quality requirements are identified as being the ones that are the most reused. Applying this knowledge to the case study, one can wonder to what extent the quality requirements for the Sales Order Automation are reused from one project to another. Respondent 1 shared that for the Bosch implementation, they had to deal with many security implications, implications they had not experienced (to that extent) before. One could conclude that the security issues can be customer related. But for instance, if we take transparency and testability, one could assume that over the years, Esker has found ways to take on those challenges. These assumptions do deserve to be verified in further work.

As NFR have not been specifically mentioned by the interviewees, it is difficult to draw conclusions on how they are elicited. The author would conclude that the particularities of NFR for ML lay in the other Requirements Engineering activities such as Analysis & Negotiation or Documentation.

[4] Order form: on the Esker platform, the order form is set next to the customer email. The form contains all the fields that need to be sent to the ERP. The software automatically fills in the fields of the form with the email data. It then highlights the taken data in the email so that user can check their accuracy.

Section 3 – Guidelines

After studying the existing literature and gathering knowledge from the various Respondents. The aim of this section is to come up with guidelines and recommendations on how to conduct Requirements Elicitation.

From the research conducted and the interviews, the author concludes that there is not one perfect technique nor a perfect set of techniques. It is all about understanding. If any generalizations can be made, the following recommendations would be made. Those recommendations will have to be mitigated with the limitations displayed in the next section.

a) Flexibility

This might appear as a very mainstream recommendation, but it does not make it less true. In today's world, systems must be developed fast, and the level of complexity is high. In that context, concepts such as Requirements reuse and Agile Methodology come in handy.

The author would conclude, just like Respondent 2 stated, that Agile methodologies are a necessity to efficiently come up with a solution. Adopting an Agile approach imposes to all the involved parties to be flexible. A debate that can be brought up by Agile is whether to adopt Agile solely for Requirements Engineering or only for software development or for the entire process. Does the chosen Agile approach really matter?

Requirements reuse allows to deliver solutions faster. In the author's opinion, requirements reuse is also narrowly related to the out of the box solution. Which can, to some extent, be compared to prototyping, prototyping being an elicitation technique. The out of the box solution has two purposes: (1) help the customer envision where they are heading to; (2) and structure the Requirement Elicitation conversations.

b) Protocol Analysis, Observations, and Workshops

A big part of this work was to identify which listed elicitation techniques were the best fit in the context of a cloud-based software with AI and ML components. From the analysis came out that in this context, Protocol analysis, observations and workshops are the best fit. It should be noted that during the interviews, Respondents did not really make any difference between Protocol analysis and observations. In a way, this makes sense as the purpose of those techniques is to observe the stakeholders while they are executing their tasks and to make those observations as efficient as possible. They will especially aim at capturing the

customers' thought process behind their actions. It is thus in the authors' opinion that no distinction should be made in the name referring to this technique.

Another technique that all Respondents agreed on are workshops. From the grid of **Elicitation Techniques** "workshops" are not mentioned as such. By workshop, the author refers to a technique that gathers several people in a room, they can exercise the same kind of jobs or do very different tasks, and the meeting in which they are can focus on a specific topic or speak about a variety of subjects. Ideally, workshops should be prepared, on both ends, in advance. The applied methodology during the workshops should not be standardized. It should be customized according to criteria such as the size of the project, the type of stakeholder or the advancement in the project.

To conclude, there is a gap between the denominations given by academia and the way that the industry refers to them. That being said, the goal for the industry is that analysts use techniques that are efficient whatever the name they are given.

c) Prototypes

Although the author had read about the prototype technique, she did not include it in her work for two reasons. First, because of the costs related to their development. Second, because of the development approach. AI and ML being used to develop the software, the model needs to train on a high number of cases to be proficient. Presenting a prototype with only a subset of training expertise did not seem useful at the time. In retrospect, that reasoning does not make much sense especially since the author knew that an Agile methodology was used within Esker and that the proficiency can be tested on a subset of cases.

Considering the interviews, the author considers prototypes to appear in two different shapes in the Esker methodology: as the out of the box solution (as mentioned earlier) and at every development iteration. It could be argued that prototypes are unavoidable when the chosen software development approach is Agile.

d) Requirements on Different Levels

The interviews also made clear that there were different levels to Requirements Engineering: starting off at the Management level and carried on by the Operational level. From her work, the author came to three conclusions.

From a Management level perspective, a way of conducting Requirements Engineering is to go through due diligence. It could also be considered as a way of coming up with requirements and envision the possibilities. The literature review mentioned that these days, there is a lot of pressure to increase the Return on

Investment of software assets, which makes the due diligence step even more important. Being able to talk with former customers and ask for their feedback on the process eases the evaluation of a future, potential partner.

From the interview with Respondent 4, the author got told several times that throughout the process there were disconnects between the Operation and Management sides of the project. The author would thus suggest that even during the due diligence phase, the Management Project team consults with the operational level internally. By doing this, later identified conflict could be avoided.

Furthermore, the previous paragraph highlights a third conclusion: Requirements Elicitation conducted internally. Especially with projects as big as the one conducted within Bosch BT, where many stakeholders were involved, it is important to acquire a common agreement on the needs. And then, as mentioned during the call with Respondent 4, see to what extent the local levels have additional requirements and thus will require further customizations.

Section 4 – Limitations

It is important to single out the limitations of this study. The author identified four limitations to her work: the Interviewees' Profile, the Methodology, the Definitions of the Elicitation Techniques, and the Current Pandemic.

a) The Interviewees' Profile

First, as mentioned during the methodology section, the interviewees work and come from different places around the globe. Even if Respondents 1, 2, and 3 work for the same company, their location can have an influence on their way of working. Requirements Elicitation being a human endeavor, people's behavior impacts the way it is led.

To find interviewees, the author utilized three channels: her contacts within Bosch Thermotechnology, the input from already conducted interviews but the major source was LinkedIn. Unfortunately, few people answered to the sent messages and emails or did not follow up on their initial response which led to certain limitations on the selection of the profiles.

On the customer side, a critic could be that there is only one interviewee. An interesting addition would have been to include the profile of someone from the Project Management Team. As a matter of fact, the interview with Respondent 4, a member of the Operational Project Team, indicated that the first requirements were elicited with the Project Managers. An assumption could be that since they are not system users, requirements could be elicited differently. For instance, the work shadowing technique (cf. Protocol Analysis and Observation) would not be applied. A technique that Respondent 4 did identify as the one with the greatest added value. This assumption also matches with the literature as several papers state that the requirements source influences the elicitation technique. Another interesting profile that was not investigated and that was briefly mentioned by Respondent 2 and 4 is someone with more technical knowledge about the ERP and the company's data structures.

b) The Methodology

It could be argued that the number of interviewees was too small, especially when one looks at the extent of the implementation in the Bosch BT case and the number of stakeholders involved. A more thoroughly lead study would have been conducted on a more extended period of time and would have included more interviewees.

Another approach could have been to reach out to other Esker customers and to compare their experience with the one of Bosch BT. This would have allowed the author to confront whether the environment of the solution impacted the choice of elicitation techniques and the way they are utilized.

The author decided to conduct semi-structured interviews without follow-up calls. After realizing an in-depth analysis of the collected data, the non-follow-up part of the methodology could be questioned. Unfortunately, the time constraint did not allow the author to revise her first chosen methodology.

c) The Definitions of the Elicitation Techniques

As one can see in the interview guides (**Appendix A** and **Appendix B**), the definitions of the elicitation techniques were kept short and simple. In addition, as stated by Respondent 2 when talking about Agile and Waterfall methodologies: "*they are theoretical concepts*". The same can be applied to elicitation techniques; they are theoretical concepts, that might be applied without knowing how they are called in academia. Also, multiple techniques might be combined in one. Nonetheless, by oversimplifying how the listed techniques work, chances are the interviewees did not have the correct understanding of the techniques. The author supposes that this has been the case for techniques such as Ethnography and Joint Application Development sessions.

In addition, it should be noted that academics do not always agree on how they define the techniques. The author has noticed that there was a fundamental difference in the way brainstorming was defined. According to (Yousuf & Asger, 2015) a specific topic is set, whereas (Sharma & Pandey, 2013) define the purpose of brainstormings as being the generation of preliminary ideas without focusing on any one in particular.

Respondents might also have felt pressured to answer that they were using the described technique. This work stated multiple times that the techniques used in industry are a mix of several techniques described by academia. Respondents might thus have answered that they were using the technique, whereas they were using their own customized version of the technique.

d) The Current Pandemic

So far, the COVID-19 pandemic has not been brought up in this work. Nevertheless, two Respondents did mention it, namely Respondent 1 and 4, both being involved in the Bosch implementation. As a reminder, the Esker project at Bosch BT started in February 2020 and went live in December 2020, meaning that the process happened in the middle of the pandemic.

In terms of Requirements Elicitation, the pandemic had an impact on a certain number of techniques. Respondent 1 said that they used to go on site for a workshop of a day or more to immerse into the customer service operations. This had to be replaced by a considerable amount of web sessions. Respondent 4 confirmed this acknowledgement by stating that the physical workshops had to be canceled and to be done virtually with a lot of screensharing. The elicitation techniques for which the COVID-19 Pandemic was brought up were Observation, Protocol Analysis, Workshops, and Ethnography.

An interesting fact to point out is that when asked if elicitation could have been conducted more efficiently, Respondent 4 highlighted the inefficiencies on the Bosch side but did not voice once a thing about the web sessions with Esker imposed by the health crisis.

This limitation does deserve to be mitigated. Throughout this work, has been displayed that the Sales Order Automation for Bosch BT was an intercontinental project and thus agreements on requirements between several countries had to be made. Web sessions were thus unavoidable. The question is to: “what extent would they have been reduced without a Pandemic?”.

Chapter VI – Conclusion

The purpose of this work was to analyze how Requirements Elicitation is led when dealing with the implementation of a software based on Machine Learning. After reviewing the existing literature, the author conducted four interviews with people who possess knowledge or experience in Requirements Engineering. The interviews had multiple purposes: find out whether dealing with a Machine Learning based software impacted Requirements Elicitation; compare Requirements Elicitation techniques known in academia with the industry's doings; and have an insight at the overall approach to take on Requirements Elicitation i.e., methodology, stakeholders, processes, requirements reuse.

This study started out by quoting Ian Sommerville: "*Different types of software require different approaches"*. By means of what has been analyzed in this work, one could argue with his statement. All Respondents clearly voiced that, in their opinion, Requirements Elicitation was not influenced by the AI component of the software. However, the saying of Sommerville refers to Software Engineering and Software Engineering includes more than just Requirements Elicitation. If the comment from Respondent 4 about end-user training is considered, Sommerville's statement cannot be rejected. It is up to further work to analyze the impact of the AI components on the other steps of Software Engineering. To conduct this analysis, a good start could be the nine-step framework identified by (Amershi, et al., 2019), where other steps are already depicted. The software development in itself is different as the rules defining the software's behavior are generated differently.

Regarding the various elicitation techniques, we just stated that the AI and ML components did not influence the choosing of one technique. The author would conclude by stating that techniques should be chosen according to: "how the analyst sees fit". Many factors have been mentioned in the literature such as the context, the stakeholders, the company, the approach, the analyst's knowledge and experience, … The common denominator to all these factors is the analyst himself. Respondents agreed that there is no fixed set of techniques, it all depends. Among techniques, quite surprisingly, interviews were not mentioned as the preferred technique of the respondents. They much more value work shadowing and workshops. There is a gap between the technique's naming as well as the features of each technique. This work emphasizes the more practical side of Requirements Elicitation; therefore, the author concludes that the naming or the technique's features description is not as important as identifying the most efficient way of gathering requirements given a certain setting.

Drawing conclusions about the overall process is not that straightforward. Essential elements in software development appear to be requirements reuse and adopting an iterative approach. The iterative approach

being qualified as an Agile methodology. The concept of requirements reuse is strongly linked to what has been called, the out of the box solution. Esker works with a standard product offering a standard set of features that they suppose essential for every customer. They are thus applying requirements reuse from the start. From there, they work with successive customizations, to offer a solution that fits the specificities of the customers' processes while keeping in mind potential future generalized improvements that could be taken to R&D at the headquarters.

To conclude, future interesting research directions related to the subject under study shall be mentioned. During the interviews, two respondents talked about due diligence. Even if it is not clearly stated as being part of Requirements Engineering, it is in the author's belief that it should be considered as part of it. Due diligence would not fall within Requirements Elicitation at an operational level, but more at a management level. An interesting subject could therefore be to research techniques that are the best suited for this kind of requirement gathering. Furthermore, the COVID-19 pandemic has imposed to the stakeholders involved in the Bosch BT implementation to conduct a fair amount of web sessions, also referred to as teleconferences. The pandemic has changed many ways of working across sectors and disciplines. Requirements Elicitation is no exception. In light of the health crisis, researchers could study to what extent conducting elicitation has changed when it has to be done from a distance. Guidelines could then be articulated on how one can best structure and conduct elicitation under those circumstances. The last identified research direction concerns requirements structuring tools. The focus has been laid on elicitation and the ways of conducting elicitation. However, Requirements Engineering is composed of other steps that are also worth researching. Respondent 4 mentioned the Trello tool to structure the requirements from the workshops and to display the project's progress. But, are there any other tools that would be a greater fit to present requirements in a structured, visual, and straightforward way? Especially when multiple agents from around the globe are involved, that they need to be informed about changes and be able to add up on them. The international aspect of the project could also have been an interesting study perspective: to what extent does Requirements Elicitation need to be adapted when working in a project with that many stakeholders that have diverse working ethics, time zones and local implementations of processes?

Chapter VII – References

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Chapter VIII – Appendix

Appendix A - Elicitation Technique Decision Factors Grid

TOPICS	AUTHORS	DESCRIPTION
Human Endeavor	(Anwar & Razali, 2012)	Stakeholders' characteristics
	(Zheying, 2007)	People involved
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Type of stakeholder and user (situational characteristic)
Analyst	(Davis, Dieste, Hickey, Juristo, & Moreno, 2006)	No effect of their experience
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Company practice and personal experience and skill
Context	(Anwar & Razali, 2012)	Project Environment (size, type, phase)
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Social environment and scope of the system (situational characteristic)
	(Sommerville, Software Engineering, 2011)	Company's characteristics
Technique	(Anwar & Razali, 2012)	Technique feature, Requirements' source
	(Yousuf & Asger, 2015)	Understanding of the technique (by the analyst)
	(Davis, Dieste, Hickey, Juristo, & Moreno, 2006)	- Structured interviews are the most effective - Several techniques are not effective - No significant effect of prototypes/visual representations
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Approach
Solution	(Sommerville, Software Engineering, 2011)	Solution to be developed
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Nature of the system being developed (situational characteristic)

Appendix B - Esker Interview

1. Introduce myself and my work

   Hello, first of all thank you for agreeing to this meeting. I really look forward to hearing what you will say.

   As written in my messages, I reached out to you in order to gather information for my thesis. The global topic of my thesis is RE for ML. During an internship at Bosch Thermotechnology, in Belgium, a few months back I heard about Esker and more specifically about your sales order automation solution. Not only did I find the project really interesting, but it also fitted perfectly to the kind of project I wanted to analyze for my thesis.

   In order to gather the information, I need, I prepared a series of open questions. Before we start, there is one more thing I would like to ask, can I record the call? The recording allows me to analyze more into details the content of the call. I do ensure your anonymity (if this is what you want).

2. Respondents' information

   - Actual position
     - What is your job title?
     - How would you describe your job in five sentences?
   - Work experience (research on LinkedIn)
     - What other positions have you had inside Esker?
     - What were your previous positions? Anything similar to what you are doing now? Always with process automation?

3. Easy, short answer questions

   1) How would you describe the services provided by Esker?
   2) How would you explain with your own words the order automation process?
   3) How would you define Requirements Engineering?
      a. *Note: If needed provide definition*
      b. = Process aiming at understanding the environment, its needs, and the features the system to be development must have.
   4) How would you define Requirements Elicitation?
      a. *Note: If needed provide definition*
   5) My thesis requires me to go through scientific papers and acquire a good understanding of the research topics and knowledge of academics. I thus listed several requirements elicitation techniques. For this next part of the call, I would like to go over those techniques and I would like for you to tell me if this is something you are **using** in your job or not.
      Note: If I feel like it, ask for more details
      Technique by technique:
      a. Do you conduct questionnaires/surveys for the stakeholders? (*Questionnaires/Surveys*)
      b. Do you review existing documentation? Existing documentation being manuals, all kinds of forms, diagrams, process flows, organizational charts, job descriptions (*Document Analysis*)
      c. Make yourself stand in the shoes of the customer and wonder what they would want? (*Introspection*)
      d. Go to the company and observe how the employees execute their tasks? (*Observation*)
         i. Do you ask them questions while they execute the task? (*Active observation*)

ii. Do you ask them to explain what they are doing while they are doing it? (*Protocol Analysis*)

e. Go to the company but instead of observing one individual, observe the entire workplace to uncover the dynamics? (*Ethnography*)

f. Once you acquired the basic requirements, do you build use cases/scenarios that specify sequences of interactions between the system and the user? (*Use cases/scenario*)

g. Workshops
   i. Gather a small group of people in one room to define the expectations of the system to be? (*Focus group*)
   ii. Gather a group of people in one room to focus on one specific issue and encourage them to come up with new ideas? (*Brainstorming*)
   iii. Bring together technology experts, business representatives and key project stakeholders in order to define the requirements from the business perspective and the technology implementation (*Joint Application Development*)
   iv. Organize structured meetings with a group of stakeholders to discuss, refine, and validate the requirements? (*Requirements workshop*)

h. Do you conduct interviews (one-to-one)? If yes, how?
   i. Defined set of questions (*Structured*)
   ii. Conversation (*Unstructured*)
   iii. Defined set of questions, but also room for new topics (*Semi-Structured*)
   iv. Uncover key topics and then topic by topic go further into details (*Laddering*)

i. Use cards on which a part of the domain entity is written, and participants have to group them into categories to which they attribute names, later on they have to explain how they chose the categories and the name they gave them? (*Card sorting*)

j. Are there any other ways of proceeding that you use and that I did not mention?

6) In your opinion, what is the favorite elicitation techniques of the Business Analysts? Why?
   a. From my research, interview is always mentioned as the preferred elicitation technique, do you agree? If it isn't which is according to you? Why?
7) Let's imagine, you get assigned a new project in a new company, to what extent do you adapt the choice of techniques? (On a scale from 1 to 5, 1 being not and 5 entirely)
   a. What would you say are the factors that influence the most the way you will proceed? The company? The requirements source?
8) If you would have to give a top three of your preferred elicitation techniques which once, would they be, why?
   a. What is your flop 3, why?

4. <u>Longer responds</u>

1) Are there some elicitation techniques you quit using?
   a. If yes, why?
2) Are there any techniques you read or heard about but that you have not had to the time to try them out? Why would you like to try this technique out?
3) From your experience, done elicitation, Would you say that your way of working has changed over the years? (if relevant)
   a. If worked for several years
   b. RE techniques specific to Esker?
   c. Esker methodology is different? (know about SCRUM and UX design in case it comes up)
   d. Changed with AI?

4) In your opinion, what changes in eliciting requirements when you do it for a solution built with ML?
5) For the future, do you think better suited techniques to AI and ML should be invented?
6) Are there requirements that are present in every project? A set of requirements that (almost) never change
    a. If yes, which once?
    b. Or on the opposite, are there only very few changes from one company to the other, what are the changes then about?

5. Conclusion

- To summarize what we have discussed during the interview, I would like you to walk me through the steps of your first encounters with a customer. Let's say: you get assigned a new project, in a new company and they would like to implement sales order automation.
  What are the steps you follow? (Framework?)
- Is there anything else you would like to mention, that you feel would be relevant for my work?
- Thank you very much for you input
- Ask if they would like a copy of my thesis.

Appendix C - Bosch Interview

1. Introduce myself and my work

Hello, first of all thank you for agreeing to this meeting. I really look forward to hearing what you will say.

As written in my messages, I reached out to you to gather information for my thesis. The global topic of my thesis is RE for ML. During an internship at Bosch Thermotechnology, in Belgium, a few months back I heard about Esker and more specifically about their sales order automation solution. Not only did I find the project interesting, but it also fitted perfectly to the kind of project I wanted to analyze for my thesis.

To gather the information, I need, I prepared a series of open questions. Before we start, there is one more thing I would like to ask, can I record the call? The recording allows me to analyze more into details the content of the call. I do ensure your anonymity

2. Respondents' information

- Bosh Security Systems? Products? Who are the customers?
- Actual position
    - What is your job title?
    - How would you describe your job in five sentences?
- Role in the project
    - When
    - Position at the time
    - Have you worked with another order automation solution before?

3. Easy, short answer questions

- How would you describe the order intake process without Esker
- How would you describe the services provided by Esker?
- How would you explain with your own words the order automation process?
- How would you define Requirements Engineering?
  Note: If needed provide definition
  Requirement Engineering is the name given to the process aiming at understanding the environment, its needs, and the features the system to be developed must have.
    - How would you define Requirements Elicitation?
      Note: If needed provide definition
- My thesis requires me to go through scientific papers and acquire a good understanding of the research topics and knowledge of academics. I thus listed several requirements elicitation techniques. For this next part of the call, I would like to go over those techniques and I would like for you to tell me if you feel like those techniques have been used to gather the needs of Bosch.
  Note: If I feel like it, ask for more details
  Technique by technique:
    - Did they conduct questionnaires/surveys? (*Questionnaires/Surveys*)
    - Did they review the existing documentation? Existing documentation being manuals, all kinds of forms, diagrams, process flows, organizational charts, job descriptions (*Document Analysis*)
    - Do you think they made themselves stand in your shoes and wonder what it is you would want? (*Introspection*)

- Did they watch you working? (*Observation*)
  - Asking questions? (*Active observation*)
  - Ask to explain what you were doing while doing it? (*Protocol Analysis*)
- Instead of watching one person execute its tasks, observe the entire workplace to uncover its dynamics? (*Ethnography*)
- Do you think they built use cases/scenarios that specify sequences of interactions between the system and the user? (*Use cases/scenario*)
- Workshops
  - Gather a small group of people in one room to define the expectations of the system to be? (*Focus group*)
  - Gather a group of people in one room encourage them to come up with new ideas? (*Brainstorming*)
  - Bring together technology experts, business representatives and key project stakeholders in order to define the requirements from the business perspective and the technology implementation (*Joint Application Development*)
  - Organize structured meetings with a group of stakeholders to discuss, refine, and validate the requirements? (*Requirements workshop*)
- Conduct interviews (one-to-one)? If yes, how?
  - Defined set of questions (*Structured*)
  - Defined set of questions, but also room for new topics (*Semi-Structured*)
  - Conversation (*Unstructured*)
  - Uncover key topics and then topic by topic go further into details (*Laddering*)
- Use cards on which a part of the domain entity is written, and participants have to group them into categories to which they attribute names, later on they have to explain how they chose the categories and the name they gave them? (*Card sorting*)
- Are there any other ways of proceeding that you use and that I did not mention?

- In your opinion, what is their favorite elicitation techniques? Why?
- You as a customer, which technique did you feel was the most efficient?
- Imagine you were the person in charge of gathering the requirements, how would you have done it? Anything you feel could have been done better?

4. Longer responds

- Do you feel like the Esker way of working is different from another company providing similar services?
- In your opinion, what changes in eliciting requirements when you do it for a solution built with AI and ML?
- Do you think there are requirements that are present in every project, whatever the company? If yes, which once can you think of?
- Describe the order intake process with Esker
  - Emphasis on the changes, consequences of these changes
  - Do you feel like there is ML and AI or just consider it as a black box?
- To summarize what we have discussed during the interview, I would like you to walk me through the steps of the process. So you decided to go for Esker and then how did it roll out?
- Is there anything else you would like to mention, that you feel would be relevant for my work?

6. Conclusion

- Thank you very much for you input + Ask if they would like a copy of my thesis.

Appendix D - Interview Transcriptions

Respondent 1

Business Development Manager

Description:

- Engaging with large enterprises many of whom their business is on SAP
- Helping them from as of their initial interest in automation (and thus Esker) all the way through process analysis, value engineering, business case definition, technical feasibility, due diligence and so forth.

Work experience: over 15 years in process automation

Esker:

- Services provided by Esker: helping businesses to optimize their core business cycle both order to cash and purchase to pay, leveraging Esker's AI, ML platform to drive automation within those business cycles for the betterment of all the stakeholders involved (employees, suppliers, customers)
- Sales Order automation process: working typically with large enterprises you see a lot of complexity (supply chains, products, customers with whom they engage, the channels through which they sell…) that often means that when you look at the customer care or service and handling their needs/orders there is a large overhead in terms of labor and cost in order to process those orders. Esker's platform typically removes those manual touch points, streamlines the process makes the experience better for them and for their customers also.

RE? Can be done in a range of ways (had to be changed bc of covid, not possible to go on site). Understanding through discussion, having them explain the kind of customers they deal with, sharing sample orders, understating the customer purchase system, understanding the different channels through which they receive orders (online, email, fax). With web sessions have them share their screens to see how they execute tasks (bc covid, otherwise analysis on site), that person steps us through what they do, they pull the inbox, pull up a customer order, show the SAP screens used to manually process the orders, show the customer that placed the order, where do they want us to ship the order to, how many do they want to buy, what is the material. Once the order is handled, what do we do with it? Do we store it in case of a dispute downstream in finance? Once all that understanding work is done, that helps us envision what would be their requirements (7:40). More so, with Esker being a mature solution (more than a decade) it is about finding the delta between our standard product and what the business needs as their minimum viable product to consider automation.

Requirements elicitation – did not understand the meaning of the term -> I explained difference between RE and elicitation.

- For us, they are really part of the same process
- What I would say, is that it is for every project dependent on the complexity but it is always an iterative process.
- Mentions the level of requirements: iterative process because you will have several sessions through time and those sessions will make you gain in granularity. we would spend a first 90min observing them and have a high level of understanding of what their requirements would look like. At the end the main question is to determine what this is gonna mean in terms of improving their value cycle. Then with time be gain a deeper level of granularity as "the devil lays in the details". Before Covid we would go on site for a day or a multiday workshop where we would be immersed into the customer service operations.
- Find out how their manual process works today and find out how the SAP system works

Example with Bosch:

- SAP had been implemented for many years so many customizations
- We had been on site and done a fair amount of due diligence, the reality is that when we stood the project up we experienced all these security implications

- Could we have done the elicitation differently to prevent it? Maybe but was really specific to Bosch and that company and had never encountered stg similar before.

Agile methodology – we will connect the users to the project very early on in the project regardless of the requirements we gathered before lets be remind that we can switch those requirements in and out as we so choose (we think we needed that, but we actually don't, there is one thing we didn't think about but that will actually provide value…) -> requirements validation

Requirements Elicitation techniques: 23:38

Techniques that are preferred:

- Not really
- Techniques are pretty standard it depends on the complexity (ex: Bosch is multi continent) -> you will get deeper on every level

Way of working changed? Pretty sure there are, but right now cannot think of one. The number of information available on hand changed (ex: LinkedIn) and all of that has changed on how you engage with them.

Esker in order automation, one of the first once on the market with SAP -> having a mature solution now. When we first started delivering these solutions navigating the requirements gathering was much trickier -> we were dealing with early-adopters. Now we can lean on our past experience for the gathering and to convince potential customers to ride along with Esker.

Ai and ML changed your work? No drastic changes, the differences lay in

- The terminology that is used
- When for instance, we know the scenarios when our technologies and the ML aspects of it will yield the biggest benefits for businesses. For example, ML has the ability of learning the structure of the orders and identify the patterns
- Much more generally speaking, we have a project and see that we come up with a new feature that is useful to many customers, we channel it back to our head offices in France (Lyon), so that it might be included in future versions of the product.

Requirement reuse: yes definitely. When you are in a project and you get a new requirement, we always ask ourselves the question whether it is a requirement that is industry wide, is this something that is vertically aligned for this particular company. If we feel like it is gonna come back for the next customer, instead of having consultants that have to figure it out for the next customer, we will take it to R&D to develop it for every customer rather than have it custom configured.

Methodology:

- There are a series of steps, but very customer dependent
- Depends on where you are, pre-project? Is there any competition that has already done more steps? Then you just have to follow and catch up.
  Imagine you are selling to Governments
- Sometimes also follow the rules of the customer

Anything else?

- Requirement gathering already in pre-project
- Agile -> during the project
- Between those two steps another thing that might come into play is due diligence: we want to engage with some of your other customers that have implemented this technology and understand what their experience have been like (things they would have done differently, gaps in requirements…)

Respondent 2

Country manager (Germany) – very sales-oriented job -> coordinating sales-marketing resources to hit targets, coordinating technical teams (teams that implement the software solutions, there we have project managers, project developers they develop customer specific requirements >< developers from the headquarters that are based in R&D that develop in the core of the product, they code as well but with another approach)

More coordinating than involved in projects -> involved when escalations or things don't work out.

Process automation since I joined Esker -> 18 years ago

Description of the services of Esker: we provide software to customers in the cloud model, we provide automation solution mainly in the order to cash and the procurement to pay cycle. A cloud solution, we host the solutions for our customer on our platform called Esker on demand, which is a multitenant platform meaning that all our customers are using the same platform. We are able to individualize the solutions to our customers, they all have their account on our platform, they have their own processes, they share the same database, but the data is separated per customer (from a logical point of view, not a physical point of view). We provide the software, but also the implementation since all out customers have individual requirements.

Sales Order Automation: avoid that people need to type a lot of information in manually, we try to capture the information via OCR, we do database checkups ,… then we pass data to the ERP system but the processes are very customer specific. We need to be able to customize the solutions since the sales order processes are different from one customer to the other and thus requirements are. We also provide support, if stg is not working as planned (centered in Lyon).

Requirements Engineering: (asked for more explanations)

- Process
- Agile methodology – has an impact on the requirements engineer.
  >< Waterfall: first gather all the requirements (6-8 weeks sometimes 3 months), then only after the requirements were approved, we would start development, but during development we would then come to realize that some requirements are not needed, some are old, there has been new ideas -> it was very hard to incorporate those new ideas to the waterfall model.
  Note that it also depends on the customer, if they still want waterfall, waterfall it is.
  In reality, Agile, waterfall are theoretical concepts but in everyday life you usually have a mix of both.

Workshops with customers they are a little bit different, we try to involve the end users quiet early in the process, then we do the technical integration between our solution and the ERP system of the company. Then we do stg like "requirements engineering by doing": we show the end users our solution, say now we are connected to your ERP system, this is the standard set of features we offer out of the box, ask if stg is missing -> put that in requirements, focus on let's say 10, develop those missing requirements, meet again a few weeks later with the new features, is there still any requirement that you are missing? -> iterative process instead of coming up with an extensive list of requirements, because we now that if we have it, it will not work we will have a lot of development that will have been done in vain (30-40%)

Requirements Elicitation: tbh I had to look it up (13:30)

- In real life it is not either one or the other, rather than a mix of several
- Prototyping meaning that if a customer has a set of 5 important use cases, we will do prototyping. Prototyping in the end is close to the end solution but with a limited scope
  Usually we recommend prototyping, then the customer can also be sure that we are able to reflect his use cases
  We don't do this for free -> try to reach a commercial agreement with the customer: 50-50 on the development costs or they pay the cost but if they decide to deal with us than we would reimburse the costs later on in the project

Preferred techniques: not really a preference but we do say that workshops are vital, we need to have all those people at the table and talk with them. One to one interview with a key user, could make sense in one case but might not in another for instance -> techniques depend on the company

Agile methodology changed the Requirements elicitation techniques? Not really, I would say that with Agile we concentrate much more on the end user than what we did before, end users used to be only involved in the testing phase. The requirements elicitation means haven't changed that much.

ML and AI changed? Not really, ML is a technology that we use

Requirements reuse: 70% are always more or less the same and 30% are customer depend

Steps: workshops are always first (usually the project by then is already signed but if it isn't it helps us sign the project)

Anything else? The art of conducting those workshops and to do that kind of requirement analysis is the art of saying no to the customer because the customers also come up with a lot of ideas, we need to have this or that and then you also need to manage the customer expectations bc in some cases some requirements do not make sense because we know right from the beginning that if we go down that path it is going to be 50 of development just for the customer just for one single requirement and it does not make sense, then you have to say no, explain how our customers deal with that requirement, we would recommend to go that way -> come up with alternatives

Sometimes requirements also don't make sense from a technical perspective, they cannot be implemented. This is also stg that needs to be considered: find the right balance requirements make sense or go another route. -> counselor role otherwise the project will lose focus (from a content, requirement, and budget point of view)

Respondent 4

Security systems is now building technologies

Products for commercial buildings, we deal with communication systems, PA speakers, intrusion systems, protections systems, video surveillance systems -> all those kind of different product segments are all within the BT division (Building technologies)

Sell through dealer and distributor network, who then sell to end customer which would be the people who own the buildings (only a few end customers -> large national accounts)

Position: Project manager for the customer service logistics operations teams

- Dealing with kinda direct customer contact
- Customer service communications: phone calls, chats, order processes
- Dealing with all those processes and trying to find automated solutions to make them more efficient and better for our customers
- Do the processes and the optimizations
- Worked 13 inside Bosch always on that operation focus

At the time of the project, the position was slightly different: supervisor of the customer service operations team -> responsible for the people within the customer service operations team and not so much the processes (now not so much responsible on the people but the processes)

Dates:

- Live production: December 2020
- Start collaborating with Esker in Feb 2019

Found the Esker solution at a trade show -> establishing the relationship -> exploring some of their customers -> doing reviews of what their customization of the tool has been -> working through the development phases (which took quiet a bit of time) -> testing

First time experience order automation solution: Yes, with this type of external order solution. We have done other projects like EDI implementation but that was much more +/- inhouse solution that has already been in existence, it is just establishing connections with customers. This was the first for all of BT.

Description Order intake without Esker: customer essentially email to one of the shared email boxes (we have 11 of them), the email either contained a pdf attachment with the order or the order would be written in the body of the email -> email is received to one of the 15 customer service reps all working in the shared mailbox -> manual input in SAP (on avg takes 6-8min) -> send confirmation that the order was received and processed, give the confirmation number -> responsible to maintain and manage that order through fulfillment (ex: in case of a backorder, communicate with the customer when it will be shipping, making sure it is invoicing)

Services provided by Esker:

- They are fantastic
- When it comes to order input -> drastically input time decrease (1-2min)

From a user experience we managed to change the thought process, they were more data entry driven and now we are changing that mindset to a more customer focused proactive approach because now no need to focus as much on making sure that all these order need to get in as they need to be manually typed in, there is more time to consider other things they were too occupied to do before during that entry time

RE? No

Implementation is global:

- EMEA
- Not in APR right now -> on the map for end of this year
- Latin America
- North America was the pilot country and is the country that is utilizing it the most at the moment

Do you feel like requirements could have been gathered more efficiently? Yes, but not so much on Esker side much more on the internal Bosch side -> because there were so many people involved in the process, from the functional/operational side of it, we could articulate what we were asking for but we did not had the technical understanding of what was happening in the backend to be able to relate that information -> disconnect between the operational and technical side (certain details had to be revised multiple times because they were not well understood) -> Solution? Communication and screenshares to show: “this is what I mean”, to make sure that everyone is understood.

Imagine, you were on the Esker side, how would you approach requirements gathering? Their approach was pretty good -> understanding who is who and the overall organization

First contacts with Esker:

- Fair
- Rule at Bosch: when you are signing on a new vendor, you have to look at the current vendors you already have relations with and that can offer similar solutions -> go through a qualification process
- There were 2 other vendors that Bosch already had that were offering a similar solution + another new organization different from Esker -> decided to go for Esker (project management side, the not operational side only came in at the demo phase) as it was better equipped, not only order management but also other solution that we might consider for the future

Elicitation different because of AI and ML? More or less the same -> their training on us for the solution was different because of that element -> teaching us how to get order so that the tool can fully automate, no need for a user to interfere -> training us on how to get the most out of the solution

Requirements reuse: yes especially on the technical side of it -> order form that is standard but then with the more specific to the customer’s requirements they will be able to customize the form to build nuances

Oder intake with Esker: feedback from the sales reps: amazing when it is cut and dry and it works. We try to be very customer focused and easy to do business with -> in the shared mailbox, customer orders and inquiries -> the tool is used for order input and order entry. The challenge we have rn is funneling through the orders versus the inquiries. But when looking at the orders themselves, they are going through this queue, not entering the mailbox (all the mails are condensed into the platform) -> only data validation

Positive impact on the stress levels -> it does once we go over the fear: automation means people are going away -> resistance of the tool not wanting to work -> once you make clear that it is not to take away your job with the automation solution but to change your job everybody was open and willing to explore the topic

AI and ML black box? At first it was, but as the Esker team understood what we do within BT and how operate and function with our customers, they helped us with the understanding of the AI element of the solution as well as breaking into a higher level of tool utilization -> instead of relying on the tool's artificial learning elements, extractions and recognition, we can teach it -> they gave us those tools to push it to the next level, because of the wide variety of Pos types and customers we deal with

Process:

- The exchange of the requirements was first on a project level and an Esker level
- The operational level was not accurately reflected until we had already been months in the discussion of the project
- Once the operational teams made contact with the Esker teams as far as the work shadowing and breaking down what those requirements were -> that is when we were really able to show how the process looks like -> we take the requirements from the users and implement and customize this form to have it do what you want and need
- Technical requirements on paper can sometimes be very different from what the person is doing on an operational perspective
- We used the out of the box solution to help explain what the requirements were from the functional level that we needed.
- First out of the box -> then techniques to refine

From the requirements side, there are requirements for the overall project perspective and then there are soft requirements from the functional perspective and it would have been nice if we (looking back) would have had more of the Esker input when we were talking about requirements and not be required to do business as of today -> what is it you want this to be able to do in the future because apart from esker, you have all these subprocesses inside of Bosch that are also going to impact it, that we from the operational side did not have any knowledge of so now we are kind of in a position where we had to go back and make modifications to what we have implemented in order to accept what we will be doing tomorrow -> better communication from Bosch side what are the future coming projects that you already know of and that will impact what we are doing now with Esker -> Bosch communicate with Esker as well -> a better roadmap of the other projects impacting the order intake

Appendix E - Requirements Elicitation Technique Grid

		Respondent 1		Respondent 2		Respondent 3		Respondent 4	
		Answer	Input	Answer	Input	Answer		Answer	Input
Traditional techniques	Interview	Yes	Unstructured -> always conversation	Yes	A bit of both (questions but also discuss the ideas of the customer) With the key user, but in the end also go to the team so see if there are different versions of the truth -> It all really depends	Yes	Semi-structured -> set of questions but also important for customers to explain what they need -> more effective that emailing, the customer can much more explain his needs	No	I don't believe so, not with the operations' teams anyways
	Questionnaire and surveys	No	Not during requirements gathering Prefers when things flow more naturally	Yes	Sometimes	No		Yes	Long Collaborative approach: associates from our development team ERP side, data side and the operation/functional side also contributing to their specific portion of this document There were technical specifications, use cases and others in that one questionnaire
	Introspection	Yes		Yes	Sometimes	Yes		Yes	With the original development team, we were working with. Now we are working in the enhancement phase -> less, there is a greater disconnect
	Document Analysis	Yes		Yes		Yes	Useful for a first understanding (but not enough to really understand)	Yes	Already made: Yes we had quiet a few which was one of the challenges -> a global project, each country has an overline standard operating process but we all have our variations We all had to go through what our processes were and the variations: documents of local procedures and the overall/global SOP

Contextual techniques	Observations	Yes	Active observation Interrogate them endlessly	Yes	Goes with introspection, we observe and then think of how we could replicate it or improve it in our solution Active observation	Yes	Yes but customers also explain their needs	Yes	But pandemic! Cancel the physical workshop and did it virtually Went through all the different tasks working in a day of what a user would do with the solution, they monitored our current day process, we did screen shares -> did it with the different regions Active observation Even there not one on one: group (not one Esker employee and myself) -> 8-10 on Bosch side
	Ethnography	Yes		Yes		Yes		Yes	Tricky because everyone was working from home We had a core team that has been involved in the project and then when we were doing the user acceptance testing, we expanded out from the core team to other subgroups -> for America we asked for volunteers: 6-7 customers service reps who wanted to be involved in the testing -> increase the focus group and get all those people involved on telcos when it was specific to testing topics
Collaborative/Group techniques	Use cases/ Scenarios	Yes		Yes	But usually, it is the customer that has built them "We had the workshop with you, we built those 10 use cases which are the 10 most common" Either entire use cases are missing or they lack details (they don't show end to end process)	Yes		Yes	They were really good in bringing in best practices from organizations. They had worked with another manufacturer that was set up similar to Bosch -> invited us to a meeting with that organization -> compared their prior ways of working to what we were doing, we were able to take some of their best practices into consideration when we had the tool customized

	Joint Application Development (JAD)	Yes	Not require or mandate but propose that any party that has an interest in the system (customer service, SAP functional expert, supply chain business leader) get a chance of being included -> the more exposure, the better	No		No		/	Yes workshops -> we had different phases of workshops and we had many of them, they were typically a weeklong for each phase of the project: After the questionnaires and the work shadowing that was kind of one phase of the workshops that was one weeklong, then they would collect and exchange information and data on their side and then we would revisit in three weeks and go through the next phase -> that was the development After the development, we would test those developments, then needing new developments and going through that cycle over and over JAD: essentially the same variety of people Requirements workshops: yes, meet again to validate and refine: exchange on what they understood to be the requirements -> then, within Bosch: have separate internal alignments with the project manager and the various regions within Bosch to make sure that everybody was on the same page of what the requirements were
	Requirements workshops	Yes		Yes		Yes			
	Focus Group/ Group work	Yes	30:00 Audi W requirements definition workshop Depending on where it comes in the cycle we would have an Increment Planning Workshop where we take what we think their enhancements would be	Yes	We try to define time slots, bc we don't need all the people at the same time in the same room We will try to have workshops with the IT specialists to see how we can integrate our solution with the ERP system. Workshops with ERP specialists, compliance to see if the kind of integration is compliant with the customer and of course the end user to talk about the business processes and how we can make their life easier. (bc end users they don't care about the technical integration)	Yes	It is important to prepare the workshops Come with already an idea of certain requirements -> requirements reuse or gathered through other techniques (observation + interview) Depends on the stakeholder and the input that needs to be discussed: sometimes group sessions are more efficient and sometimes one on one		

	Brain Storming	No	Engaging with companies in an often-competitive landscape, they have to determine who is the best fit. Emotionally driven decision making: "people buy emotionally and justify logically" "Men/Women are best convinced by reasons they themselves discover" -> meaning that during one of those workshops, you know what the customer needs but you find a way of making them come up with the idea, this will make them feel like they are part of the process -> psychology (makes sense since it is a human experience)	No	We don't really want people to be creative, we want them to see how our solution works and think about how they could change their process and their behavior and align with the way our software work It always comes down to money, that is also why we try that the customer sticks as much as possible with the basic solution, they can be creative in rethinking their way of working though customization is money -> we want the days of customizations to be limited	No		No	It was not to us to come up with new ideas, it was much more to us to explain what we would ideally prefer the tool to do and then they would come up with solutions on how the tool can be customized to do that
Cognitive technique	Laddering	No		No		No		No	
	Card Sorting	No		No		No		No	
	Protocol analysis	Yes	Anecdote about paper copies -> with time some steps are not needed anymore but do not always question themselves whether it is still necessary or not -> You can observe all day long, but without getting the why you don't get the context, it prevents you from changing for the better, understanding what the value is to the business	Yes		Yes		Yes	They were very very involved, and it was great! They were asking questions of why we were doing certain tasks (day to day being so close, sometimes you don't know why you do, what you do) Why do you do that? Idk it is just how we have always done that -> self-exploration process for us

Appendix F - General Topic Grid

	RESPONDENT 1	RESPONDENT 2	RESPONDENT 3	RESPONDENT 4
Requirements Engineering	Understanding through discussion: - Have the client talk about the kind of customers they deal with - Sharing sample orders - The purchase system - Order receiving channels (online, email, fax). Analysis on site to see how tasks are executed: the person explains the steps (shows the inbox, the customer order, SAP screens used to manually process the orders, the customer that placed the order, where the order is shipped, how many are bought, what is the material, what happens with the order once processed) -> Once all that understanding work is done, that helps us envision what would be their requirements	Asked for additional explanations -> Process -> refer to Agile	Take what the customer wants, you divide them into functional and business needs, and you define the functional and technical requirements	Not heard about it (Gave a definition)
Requirements Elicitation	Asked for additional explanations Comments on the authors' input: - Elicitation and RE part of the same process - For every project dependent on the complexity but it is always an iterative process (because there are several sessions through time and those sessions will make you gain in granularity) EX: A first 90min observation gives a high level of understanding of what the requirements would be. At the end the main question is to determine what this is gonna mean in terms of improving their value cycle. Then with time be gain a deeper level of granularity as "the devil lays in the details".	Admitted researching the topic (Author gave a definition)	Not known	Since not heard about RE -> not asked about elicitation

Esker	Helping businesses to optimize their core business cycle (order to cash and purchase to pay) -> leveraging Esker's AI, ML platform to drive automation within those business cycles for the betterment of all the stakeholders involved (employees, suppliers, customers)	Provide software to customers in the cloud model -> host the solutions (platform: Esker on demand = multitenant platform). Provide automation solution Individualize the solutions to the customer + Provide implementation since all out customers have individual requirements.	Helps customers to automate processes but also consulting, meaning helping them to get the features they need and pay for, guiding them through process rethinking	Dates: - Live production: December 2020 - Start collaborating with Esker in Feb 2019 Services provided by Esker: - They are fantastic - Order input -> drastic time decrease (from 6-8 to 1-2min) - Allowed a shift in approaches: from data entry driven to customer focused proactive (be easy to do business with) -> more time to consider other things they were too occupied to do before during that entry time
Sales Order Automation	Working with (large) enterprises: a lot of complexity -> customer care or service and handling their needs/orders experience large overhead in terms of labor and cost to process those orders. Esker's platform removes those manual touch points, streamlines the process making the overall experience better	Avoid that people have to type a lot of information in manually -> capture the information via OCR, do database checkups… pass data to the ERP system We also provide support, if stg is not working as planned	Automate the sales processes for the customers: avoiding manual input into the ERP and mail sorting among employees	First time experience order automation (With this type of external order solution) -> First for all of BT. <u>Order intake without Esker</u>: (essentially) 1. Customer email to one of the shared mailboxes (order in the mail text or pdf attachment) 2. Order handled by a customer service rep all working in the same shared mailbox 3. Manual input in SAP 4. Send confirmation that the order was received and processed: give confirmation number 5. Responsible to maintain and manage the order fulfillment (ex: backorder) <u>Oder intake with Esker</u>: the tool is used for order input and order entry. The challenge rn is to funnel the orders from the inquiries. Orders are going through a queue, not entering the mailbox (all the mails are condensed into the platform) -> only data validation

ML and AI changed RE	No drastic changes, the differences lay in the terminology used -> yield bigger benefits to the customer	Not really, ML is a technology that we use	Not really, it is much more a way of developing the software with algorithms that have good capacities -> it works its magique Many companies do it to provide good automation solutions Explain how it works to the customer? Don't need to understand how it works, but understand the added value	+/- The same BUT training on how to get the most out of the solution -> how to get orders so that the tool can fully automate (now: still supervision) AI and ML black box? At first yes, but as the Esker team understood what we do within BT and how we operate/function with our customers: helped us with the understanding the AI element of the solution -> gave us the understanding to push the utilization to a higher level (wide variety of POs types and customers dealt with)
Customizations	Example of Bosch: SAP implemented for many years -> many customizations Many security implications. Done elicitation differently? Maybe but really specific to Bosch (not experienced before) With Esker being a mature solution (more than a decade), it is about finding the delta between the standard product and what the business needs as min viable product to consider automation.	Need to be able to customize the solutions since the sales order processes are different from one customer to the other and thus requirements are too.	The number of additional features depends on the customer size Small customers are happy with the solution as it is, no need for customizations -> bigger companies = more requirements = more added features	Yes -> see requirements reuse
Requirements Reuse	Yes. New requirement in a project: specific to the customer or industry wide? Instead of having consultants having to figure it out for the next customer -> take it to R&D to develop the requirement and not have it custom configured every time Esker in order automation = one of the first once on the market with SAP (mature solution). At the start, navigating the requirements gathering was tricky -> dealing with early-adopters. Now, lean on past experiences for the gathering and to convince potential customers to ride along with Esker.	Yes. 70% are always more or less the same and 30% are customer dependent	Yes -> but you have individual features (see customizations)	Yes. Especially on the technical side of it -> order form is standard but then with the more specific to the customer's requirements build customizations

Methodology	There are a series of steps, but very customer dependent (sometimes play by their rules) Depends on where you are, pre-project? Is there any competition further along in the process?	1. Workshops with customers: involve the end users early in the process 2. Technical integration between the solution and the ERP system 3. "RE by doing": show the end users the solution -> standard set of features offered out of the box 4. Ask what is missing -> put that in requirements 5. Focus on x missing requirements 6. Meet a few weeks later with the new features 7. Still any requirement missing? => Iterative process workshops are always first (usually the project by then is already signed but if it isn't it helps to sign the project) (Agile approach)	There are a series of steps (follow Agile). First you have to gather the requirements write them down and implement them in the Agile mode. Use the out of the box solution during negotiations: helps to imagine how the future solution looks like	Process: - Negotiations (see due diligence) - Exchange of the requirements on a project level and an Esker level - Contact operational and Esker: work shadowing and breaking down what those requirements were -> when was really shown how the process looks like - Take the requirements from the users and implement and customize this form to have it do what you want and need - Use the out of the box solution to help explain what the requirements were from the functional level -> requirement refinement - Development and testing -> iteration More efficient way for elicitation? Yes, but not so much on the Esker side. Internally at Bosch. Many people involved in the process -> disconnect between technical and functional/operational -> Solution: more communication and screen shares ("this is what I mean") Imagine, you were on the Esker side, how would you approach elicitation? Their approach was pretty good -> understanding who is who and the overall organization More efficient process? Yes, but on Bosch side. Would have been nice to have a roadmap of future projects within Bosch that impact the order intake process and thus the Esker solution
	Agile Methodology: Connect the users to the project early in the project Regardless of the requirements gathered: we can switch them in and out if chosen (we think we needed that, but we actually don't, there is one thing we didn't think about but that will actually provide value…)	Agile Methodology: Impact RE >< Waterfall: first gather all the requirements (6-8 weeks sometimes 3 months), then only after requirements approval start development During development could come to realize that some requirements are not needed /new ideas (30-40% done in vain) -> very hard to incorporate those new ideas to the waterfall model. Agile & waterfall are theoretical concepts: in everyday life: mix of both Impact on elicitation techniques? Not really. With Agile: more focus on the end user (not only at the testing phase) -> Customer dependent	Agile Methodology: Yes Used everywhere, not specific to the way of working at Esker Does Esker use Agile in a different way? No, no specificities	
Additionally mentioned topics	Covid -> impact on the job RE had to be changed as is was not possible to go on site -> web sessions Before Covid we would go on site for a day or a multiday workshop where we would be immersed into the customer service operations.			Covid -> MANY teleconferences and screensharing!

	Due diligence			Yes -> reach out to other customers: reviewing what their customizations they implemented, how they worked through the process Note: Rule at Bosch: when you are signing on a new vendor, you have to look at the current vendors to see if they offer similar solutions -> go through a qualification process -> decided to go for Esker (project management side) as it was better equipped, not only order management but also other solution that we might consider for the future
	frank Roosevelt: "Men/Women are best convinced by reasons they themselves discover" -> meaning that during one of those workshops, you know what the customer needs, but you find a way of making them come up with the idea, this will make them feel like they are part of the process -> psychology (makes sense since it is a human experience) NB: idem comment brainstorming	The art of conducting the workshops and do that kind of requirement analysis = art of saying no to the customer because they often come up with a lot of ideas -> in some cases, certain requirements do not make sense -> Explain how other customers deal with that requirement, come up with alternatives Sometimes requirements also don't make sense from a technical perspective, they cannot be implemented -> counselor role otherwise the project will lose focus (from a content, requirement, and budget point of view)		
				Positive impact on the stress levels -> once over the fear: automation = people going away

Appendix G - Elicitation Technique Decision Factor Grid with Interviews

TOPICS	AUTHORS	DESCRIPTION	DESCRIPTION	RESPONDENT	TOPICS
Human Endeavor	(Anwar & Razali, 2012)	Stakeholders' characteristics	The art of saying no	2	**Customer Psychology**
	(Zheying, 2007)	People involved			
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Type of stakeholder and user (situational characteristic)	People are best convinced by reasons they find themselves	1	
Analyst	(Davis, Dieste, Hickey, Juristo, & Moreno, 2006)	No effect of their experience	Mature solution -> Experience with the years	1, 2, 3	**Analyst and company (Esker) experience**
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Company practice and personal experience and skill	Very good at leveraging past experiences: exchange with former customers + bringing in best practices	4	
Context	(Anwar & Razali, 2012)	Project Environment (size, type, phase)	Scope of the project: intercontinental	1, 4	**Scope**
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Social environment and scope of the system (situational characteristic)			
	(Sommerville, Software Engineering, 2011)	Company's characteristics	Number of customizations (i.e., in the ERP)	1, 2, 3	**Customizations**
Technique	(Anwar & Razali, 2012)	Technique feature, Requirements' source	/	/	**/**
	(Yousuf & Asger, 2015)	Understanding of the technique (by the analyst)			
	(Davis, Dieste, Hickey, Juristo, & Moreno, 2006)	- Structured interviews are the most effective - Several techniques are not effective - No significant effect of prototypes/visual representations	Workshops are vital	2	**Preferred technique**
			Workshops and work shadowing	4	
			Interviews or workshops	3	
			Several techniques are not used	1, 2, 3, 4	**Elicitation technique grid**
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Approach	Multiple iterations	1, 2, 3	**Agile**
Solution	(Sommerville, Software Engineering, 2011)	Solution to be developed	No impact on Requirements Elicitation	1, 2, 3, 4	**Impact of ML and AI**
	(Tiwari, Rathore, Gupta, & Atul, 2012)	Nature of the system being developed (situational characteristic)			