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Continuous Improvement From A Software Engineering Perspective: An Interview Study

Master's thesis in Computer science and engineering

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Gothenburg, Sweden 2024

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Master's Thesis 2024
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Typeset in LaTeX
Gothenburg, Sweden 2024

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Abstract

Historically, the philosophy of continuous improvement has been widely recognised in both research and global organisations. The philosophy is commonly defined by a subset of principles and practices where any initiative taken ought to strive towards improving parts of an organisation. Subsequently, the philosophy has garnered attention in the software development field. However, the rate at which software companies have expanded throughout the last decades has made it increasingly harder to understand how continuous improvement should fundamentally be implemented. Furthermore, the current research available encompassing the philosophy appears to lack associations towards the software industry. Fortunately, human behaviour in the context of software development has attracted increased attention in the research field. Consequently, this resulted in a multidisciplinary research field that explores the interplay between human behaviour and software development processes and practices, titled Behavioral Software Engineering. With an increase in research continuously published, similarities between the two research fields are emerging, without necessarily intercorrelating. As a result, this Master's thesis aims to explore how continuous improvement should fundamentally be implemented in software development by exploring the published literature in contrast to each other. A systematic literature review was conducted for each research field and, subsequently, the findings were then incorporated into our qualitative research methodology. The qualitative research method was conducted as part of an interview study at Polestar Performance AB, Gothenburg. In total, 9 interviews were conducted with software engineers working across diverse departments of the company. Furthermore, a thematic data analysis was performed on the data gathered. The findings derived from the qualitative research method were later compared to those derived from the systematic literature review. The findings strongly indicate that CI can be efficiently implemented in the field of SWD by emphasising particular key factors. In total, 10 fundamental key factors, shared across the two research fields, were identified as particularly critical to the successful implementation of CI. Furthermore, while CI is not directly addressed in existing BSE literature, the findings suggest that the two principles are highly compatible and that the identified factors serve as a sufficient initial step for organisations aiming to achieve CI in SWD. Lastly, findings derived from the TDA not only reinforced the considerable key factors but also provided new perspectives, not evident in the existing published literature. Ultimately, the successful implementation of CI in SWD is not only theoretically possible but highly achievable if organisations are committed to recognising these key factors and continually striving towards them.
Keywords: continuous improvement, software engineering, behavioral software engineering, systematic literature review, thematic data analysis.

Acknowledgements

This Master's thesis would not have been achievable without the guidance, support and contribution of the many people involved in the process of writing this Master's thesis. First and foremost, we extend our gratitude to our supervisor, Lucas Gren, whose insights and support have been pivotal in shaping our encompassed research. Likewise, we are thankful to our examiner, Jennifer Horkoff, who provided supportive feedback, ensuring the quality of our work.

Furthermore, we express our most profound appreciation to Polestar and everyone involved in the process of writing our Master's thesis for letting us conduct our research at their organisation. Their support, cooperation and openness have made our research journey incredibly insightful and meaningful. Furthermore, we express our gratitude to Klas Magnusson, Head of Procurement, William Hylton, Head of Electrical and Electronics, and Magda Fogmark, Software and Electronics Business, for taking us under their wings and their collaborative spirit.

Moreover, we would like to express our gratitude to everyone who took part in our study. The insights and perspectives shared and the data gathered were invaluable. We sincerely thank every one of you for participating and taking the time to share your many insightful experiences and knowledge. Your participation played a pivotal role in grounding our research in real-world experiences.

This thesis would not have been achievable without the collective effort of all those mentioned above. It is with gratefulness that we say, thank you.

Johannes Lagergren & Nicolas Nappo Andersson, Gothenburg, September 2024

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1
Introduction

The term continuous improvement (CI) is generally described as any initiative taken, commonly within an organisational environment, that increases work-related success and achievements whilst prospering innovation and minimising failure [8]. Furthermore, the implementation of CI in organisational environments typically involves sustainable processes where eliminating waste in various systems and processes is strived towards. Throughout the last decade, the practice of CI has subdivided itself into numerous methodologies. Nowadays, the philosophy of CI can be acknowledged in methodologies like Lean, Six Sigma (SS) and Total Quality Management (TQM) for instance, each with its own core goal and philosophy [8]. Nonetheless, core fundamentals and values specifically derived from CI remain and are generally seen as essential fundamentals regardless of organisational sort, nature and size.

Apart from this, CI has materialised itself into two prominent approaches commonly associated with the philosophy, Kaizen and Kaikaku. Kaizen (Kai – do, change, Zen – well) defines a way in which management perceives how the organisation should aspire to improve its products, services and processes. It describes gradual and continuous progress and should be recognised as a never-ending journey towards organisational quality and efficiency [135]. On the contrary, Kaikaku (Kai – do, change, Kaku – radical) proposes that when larger, more revolutionary, organisational changes are to be made, they should occur in more radical implementations [135]. Consequently, an organisation must recognise when and where to act cautiously and when more drastic measures should be executed.

Historically, the perception of organisational improvement can be argued only observed quality-related aspects like a company's products and profits, for instance. However, the significance of CI goes far beyond those quality movements. Ultimately, it concerns organisational renewal and efforts to prevent organisational ossification and stagnation [86]. A few compelling benefits associated with the implementation of CI can notably vary from increasing stakeholder satisfaction and employee motivation to improving performance, productivity and efficiency in various aspects of an organisation's operations. Moreover, by identifying and eliminating waste accordingly, companies are better able to effectively allocate resources, consequently allowing for more responsible investments [135, 13]. However, these benefits only scratch the surface of what the philosophy of CI can ultimately offer.

In Software Development (SWD), the integration of CI-based practices has also been attempted. However, there appears to exist a noticeable gap in empirical studies demonstrating the practicality of integrating CI in SWD [5]. Historically, SWD has commonly faced challenges due to disconnects between its various phases, like planning, development and implementation. Consequently, the "continuous improvement" agenda presents several challenges that must be addressed for its successful implementation [55]. Past conducted research surrounding this topic has offered limited clarification to terms and concepts aimed towards eliminating the confusion that exists within the software industry. Fitzgerald et al. [55] highlight the necessity for a closer connection across business strategy, development, and execution phases. Furthermore, Swaminathan et al. [5] emphasise consistent coding standards, efficient hardware and software infrastructures and a mindset towards addressing defects. However, although research that emphasises collaboration and culture, for instance, exists, they appear to be overshadowed by more performance-related aspects [5, 55].

According to Eriksson [51], the five major principles commonly associated with successful organisations stem from their ability to always improve, be purpose-driven, be motivated, produce value-creating processes and have committed leadership. Historically, the methods of addressing these major principles have been attempted by various approaches. One recurring technique commonly found in past research surrounding CI is the Plan-Do-Study-Act (PDSA) cycle. Eriksson [51] suggests that if successfully integrated, it can present a viable approach for continuous improvement within an organisation. Likewise, Jagusiak-Kocik [72] presents similar findings in which a production company reduced the number of discrepancies by over 60% by utilising a PDSA cycle. Apart from this research, additional research indicates that such methods can positively contribute in a practical manner [51, 153]. However, it is apparent that major principles like purpose-driven work, motivation and the ability to create value-creating processes appear to be absent. Moreover, research addressing CI and SWD simultaneously appears to be disregarded to a degree.

The importance of highlighting human-related aspects, especially in SWD, has conventionally not always been the case. Formerly, the argument that SWD primarily focuses on technical processes rather than the developers themselves can be made. However, with an increasing amount of research encompassing the topic, new findings suggest that SWD involves social and physiological factors that can massively affect organisational success [91]. Subsequently, research exploring the interplay between human-related behaviours and SWD to better understand the human aspects involved in the lifecycle of SWD has been titled Behavioural Software Engineering (BSE).

The term emerged as an interdisciplinary field drawing multiple disciples from other human-related work fields like psychology, sociology and anthropology. Furthermore, research fields including Human-Computer Interaction (HCI) and Empirical Software Engineering (ESE) have been examined to materialise the term researchers now perceive as BSE [91]. Lenberg et al. [91] argue that the definition should fundamentally encompass factors including communication, collaboration, decision-

making, motivation and emotions. In the context of SWD, the benefits associated with acknowledging BSE include improvements in overall software quality. Moreover, collaborative and communicative improvements amongst software developers have been shown [91]. Besides this, new BSE research indicates numerous factors typically found in the surrounding CI research [32]. However, the requirements of implementing CI in SWD remain inadequately researched, indicating that additional research encompassing the topic is required.

1.1 Statement of Problem

Notably, researchers point out the numerous implications associated with the current state of research encompassing BSE. Although the research field has seen a dramatic increase over the last decade, Lenberg et al. [91] argue that the previously conducted research commonly chooses to explore particular factors. Ultimately, this disregards other important factors less frequently examined like motivation and emotions. Additionally, Graziotin et al. state there is a lack of research regarding methodologies and theories addressing human factors within SE [32]. Consequently, to gain a better understanding, more research is required. Besides this, due to the fact that BSE derives from other interdisciplinary research fields, collaborative research from disciplines is suggested [91]. Apart from this, Lenberg et al. [91] emphasise that throughout their own conducted research, less than 5% of examined publications consider human aspects. This arguably underscores the reason why BSE is fundamentally not considered in organisational environments as of yet. Additionally, it is noted that developing and implementing methods for studying human behaviour in larger, more complex, SWD environments can present practical challenges.

While CI is already a well-recognised and widely implemented philosophy within global organisations, it is evident that BSE has not received similar attention. However, significant overlaps are apparent between the two research fields. For instance, CI research underscores the importance of factors like work culture, leadership, managerial commitment and focusing on stakeholder needs as primary drivers for organisational success [148, 86]. Similarly, BSE research also emphasises these behavioural aspects affecting SWD [2, 90, 149]. Additionally, among the findings mentioned above, BSE research also recognises factors like team diversity, psychological safety, and group dynamics to be primary drivers towards increasing performance and perceived job satisfaction.

Given these shared interests and the conceivable potential for cross-disciplinary benefits, it is particularly glaring that the lack of research bridging the two research fields exists. Furthermore, this gap in cross-disciplinary research may hinder an effective approach to implementing CI in SWD. Consequently, this also underscores the argument for a subject that requires further research. Therefore, highlighting the insights of BSE research should conceivably give a better understanding to practitioners and professionals wanting to achieve CI in SWD.

1.2 Aim

The thesis aims to identify key factors and methods that should ultimately be considered by software developers when attempting to implement or integrate continuous improvement processes into their development. This will conceivably be achieved by initially conducting a systematic literature review (SLR) which will aid in understanding the broader context of associated research, identify gaps in the current knowledge and confidently assist in structuring the qualitative study. Secondly, the study conducted at Polestar Performance AB will utilise interviews as the primary data-collecting method and a thematic data analysis (TDA) to analyse and to generate a richer understanding of the various software processes within the specific organisation. By analysing and comparing the findings from both data-collection methods, the research questions should conceivably be answered.

The findings should optimistically provide a suitable proposal for successfully implementing continuous improvement processes in Polestar's software development systems. Besides this, the findings should provide justifiable information to researchers and the software industry altogether.

1.3 Research Questions

The formulated research questions stand to bridge the gap between the published research regarding CI and BSE and seek to provide knowledge and understanding for practitioners attempting to accomplish the implementation of CI organisationally from a perspective with the human in center. Therefore, RQ1 aims to discover the determining factors that inherently create a work environment in which CI can prosper in the context of Software Engineering (SE) focusing on behavioral aspects.

RQ1: What mutual key factors between the fields of CI and BSE should fundamentally be taken into account when aiming to successfully achieve and sustain CI in SE?

Additionally, solely recognising what factors drive CI can expectedly result in no major changes being implemented organisationally likely due to a lack of inapplicability. Consequently, RQ2 seeks to determine what underlying key factors (requirements) a company should be investing in when aiming to implement CI in the context of SE. In this case, the BSE requirements are of particular interest as we seek to understand how CI can be fulfilled through emphasising human aspects.

RQ2: Which BSE requirements should an organisation fulfill when aiming to successfully achieve and sustain CI in SE?

Focusing on the mutual factors might prove successful in finding effective key factors to emphasise a prosperous CI work environment. However, it might overlook important key factors that are indirectly attained through the achievement of particular

CI outcomes sharing requirements with certain BSE outcomes. Thus, by emphasising the BSE requirements for that particular BSE outcome, the CI outcome at hand can indirectly be fulfilled. Therefore, RQ3 elicit this relation to ensure no key factors are overlooked, while still having the perspective of BSE.

RQ3: What further attainable CI outcomes are achieved indirectly through BSE outcomes that are shared with CI requirements?

In particular, the perspective of BSE is the focus, where matches in key factors found between the two fields are deemed interesting. However, there might exist key factors that are not *mutually* outcomes between the two fields, but in the form of a factor that is an outcome in BSE and a requirement in CI. Ultimately, these also fulfill whatever CI outcome it is connected to. Therefore, this procedure (RQ3) ensures this study also encapsulates them, as these key factors are otherwise overlooked.

The study will also feature interviews, RQ4 therefore ought to find differences between the found literature and responses from the interviews. By comparing the two analyses, novel insights and otherwise overlooked aspects are optimistically revealed. This is primarily to identify factors arising from the interviews that stand out from the found literature.

RQ4: What differences in key factors arise between the two analyses; the literature analysis and the analysis of the interviews?

Lastly, as the desired outcomes may have limitations affecting their fulfillment, these will also be examined. The limitations will be discussed in terms of how they may be prevented and other practices ultimately affecting the degree of fulfillment for each outcome. By comparing the results from the SLR and TDA, such limitations will be elicited.

RQ5: Which limitations can cause a concern for the fulfillment of the shared outcomes?

By analysing the published research regarding CI and BSE respectively, in addition to the conducted study with the collaboration company, the formulated research questions shall conceivably be answered.

1.4 Thesis Outline

Chapter 2 involves related work to the study. It brings up similar studies made but also address the need for more research within the field. Chapter 3 describes the research method adopted for the thesis. It outlines the research strategy, data collection methods and data analyses respectively. Chapter 4 comprehensively reviews published research on both CI and BSE. This chapter serves to provide an extensive understanding of both research fields. Moreover, the section serves as the

initial data collecting method for gathering data the papers of the SLR. Chapter 5 is dedicated to presenting the findings derived from the conducted SLR. These findings will be utilised to formulate interview questions which will be implemented in the qualitative research method. Chapter 6 presents the the findings derived from the TDA. This section is derived in to two different sections which both presents results; one from a more subjective analysis and second the default write-up part of the TDA. Chapter 7 discusses the results presented in the previous chapter and chapter 8 provides a summary of the thesis and concludes findings based on the research outcomes.

2
Related Work

The software engineering industry is rapidly expanding and has no intention of stopping. Software architecture and frameworks are quickly surpassed by new, improved ones and require engineers to be flexible. Continuously improving an organisation is therefore essential for its survival in the competitive industry that the software engineering industry is.

Birk and Rombach unfold a practical approach of applying continuous improvement practices in SE, focusing mainly on explicitly defined improvement goals and management improvement as well as the infrastructure for improvement and organisational learning regarding improvement [10]. Their approach has been implemented to different extents in a variety of companies including NASA Software Engineering Laboratory, Dräger Medical Electronics and Ericsson Finland to name a few. However, the approach does not account for human factors, except in the light of sharing and reusing knowledge between individuals, which is typical for CI's overall focus on organisational aspects.

Costa et al. created a cause-effect relations map regarding Lean Manufacturing to discover interrelationships between different factors making the CI method successful [24]. The method employed in this thesis shares similarities with Costa's research with regards to the critical success factors used in their research [24], that is, the extraction of key factors from literature and investigating interrelationships between them. Additionally, in comparison to Birk and Rombach, Costa et al. focused on *soft practices*. This is more closely connected to the work and aspects of interest in this thesis. However, there is no explicit notion regarding BSE, but rather the factors to take into account regarding successfully implementing *lean manufacturing*.

As defined by Lenberg et al, BSE is the study of behavioral and social aspects of software engineering activities performed by individuals, groups or organizations [91]. Human behaviour is a complex concept that requires a lot of experimentation and investigation to understand fully. The individual engineer is what makes up the foundation of every company. As the term BSE was coined in 2015, there is limited research regarding human aspects in SE [91].

Similar to the study conducted by Beecham et al. [129], this study will also involve a SLR. This way, a considerable breadth of studies regarding different elements of CI and BSE ought to unveil aspects of importance when aiming to answers the given research questions. Elements of the SLR, the quality assessment in particular, is thereby partly influenced by Beecham et al.'s work.

Overall, the bridge between BSE and CI is under-researched and requires further investigation. Therefore, this master thesis aims to explore ways to merge the two fields, as we believe they can complement each other to create thriving organisations and work environments.

3
Methodology

This section outlines the thesis methods, including a brief introduction to the collaborating company and selection of research method. It also presents the data collection methods used with their corresponding analysis steps.

3.1 Research strategy

3.1.1 Interview study at Polestar Performance AB

Interview studies are one of the most promising ways of collecting qualitative data [138]. Interviews, especially semi-structured, provides the opportunity of gathering rich data but also emerging new concepts, which is very valuable when inspecting and discussing human behaviour, as BSE revolves around. Additionally, due to some interviewee's worked abroad, remote interviews were established to all interviews for coherence. By using effective video and recording software, the process of interviewing also become very time efficient. Remote interviews are also deemed to benefit from the later processing of the results [138].

Polestar is an automotive company that strives towards producing electronic vehicles that emphasise performance, design and cutting-edge technology [1]. They challenge the industry norms and assert that the automotive industry has stagnated in terms of innovation, resulting in vehicles looking, feeling and essentially being the same. Determined to redefine the industry standards, the organisation pushes for excellence, challenging established conventions and never settling for mediocrity [1]. Furthermore, central to their idealogy is a commitment to emphasise sustainability, responsible sourcing and ultimately, produce vehicles with a zero carbon footprint. Currently, the organisation is working on enhancing the sustainable facets of its car batteries by repairment, refurbishment and repurposing [1]. Additionally, Polestar utilises blockchain technology to ensure the ethical and transparent tracking of risk minerals in their supply chain [1].

The organisation is composed of a global, creative and innovative team, all driven by a shared interest and passion for electric mobility [1]. Their Software & Electronics department currently consists of 120 employees and is growing rapidly. However, with rapid growth, it can easily become challenging to understand every team member's needs, identify where changes should be made to facilitate continuous improvements and measure overall efficiency across the department.

Nonetheless, considering the nature and aspirations of Polestar as an organisation, alongside the criteria for what constitutes a suitable case study candidate, it is evident that Polestar aligns well with these parameters. Their emphasis on continuously being creative and innovative in all areas of the organisation underscores their potential as an ideal candidate for implementing continuous improvement into their processes.

3.1.2 Research Steps

The following steps represent how the study was conducted. Firstly, a systematic literature review (SLR) was conducted, following the numerous stages associated with conducting an SLR which will be more thoroughly discussed in later sections [87]. The SLR provide sufficient findings to address RQ1 and, subsequently, formulate interview questions for the qualitative study. Secondly, additional qualitative data was collected through interviews with software developers working at Polestar. Moreover, the interviews adopt a semi-structured format, which allowed the interviewees to express themselves more openly regarding the subjects being discussed. This approach was expected to yield greater quantities of qualitative data over structured interviews. Lastly, the qualitative data was analysed through thematic data analysis (TDA), following the general stages of a TDA in accordance with Braun & Clarke [15], which is addressed in section 3.3.

Through the examination of the published literature associated with continuous improvement and behavioural software engineering respectively, with the addition of a qualitative study, it aims to bring new insights, nuances and perspectives to the matter of integrating continuous improvement practices in software engineering and development.

3.2 Data Collection

The data collection primarily occurred during the qualitative study in the form of interviews. However, as the SLR covers a large portion of not only addressing RQ1 but also served to formulate the interview question that ultimately is used to collect said data, the data collection section also covers the SLR.

Furthermore, this allowed for key findings in each research method to be compared, potentially yielding new insights and shedding light on unexplored areas on the topic at hand. Conversely, the findings from the qualitative study could either confirm prior research and beliefs or present new considerations.

3.2.1 Systematic Literature Review

The goal of the SLR was to identify as many primary studies associated with the research questions as possible, necessitating the requirement for a rigorous search strategy [87]. The means of identifying primary studies for both CI and BSE varied

due to the relative novelty of the term "behavioural software engineering".

Following the methodology of Kitchenham [87], specific search strings combined terms like “software engineering” and “software development” with findings from BSE research reviewed during the Master’s thesis proposal. Throughout the initial literature review, particular terms repeatedly surfaced as recurring facets within the broader BSE research field. These specific terms encompassed aspects like “Communication”, “Team Work”, and “Innovation”, among others. Therefore, their consistency within the published BSE research evidently underscores their relevance in this specific research field. Subsequently, with these identified terms, the structured search string was structured as:

((Software Engineering OR Software Development) AND [Identified term])

This framework was chosen to capture primary studies explicitly associating software engineering or development with the key human behavioural aspects identified. Using this approach, the search string for BSE was formed as:

((Software Engineering OR Software Development) AND Communication OR Creativity OR Culture OR Environment OR Innovation OR Job Satisfaction OR Leadership OR Motivation OR Performance OR Productivity OR Team Work)

Likewise, the search for publications associated with CI consistently followed a comparable approach, however, instead utilising the term "continuous improvement" in conjunction with aspects recurring throughout that particular field. Consequently, the search string for CI resulted in:

`((Continuous Improvement) AND Autonomy OR Customer Satisfaction OR Employees OR Kaizen OR Leadership OR Lean OR Performance OR Resources OR Six Sigma OR TQM OR Quality OR Waste OR Work Culture)`

Furthermore, following the methodology of Kitchenham [87], the SLR’s material selection was contingent on specific inclusion and exclusion criteria, detailed subsequently.

Include

■ Papers published between 1980 - 2023
■ Papers which include the search term in the title (or exceptionally similar)
■ Papers that include both positively and negatively charged titles[1]
■ Papers able to answer the research question directly or provide perspectives closely related to the topic.
■ Papers written in English

[1]Papers are included regardless of the title’s tone. Ideally, such a strategy promotes a more objective selection of papers and ensures a balanced representation of the respective topic.

Exclude
- Books
- Presentations
- Opinion Pieces & alike (no references)
- Papers that do not emphasise software engineering & development
- Papers written in other languages

Following the specified combination of search strings, they were systematically moved through each selected database. The databases used for identifying primary research papers were:

- IEEE Xplore
- ACM Digital Library
- Springer
- Researchgate
- ScienceDirect
- Semantic Scholar
- Academia
- Google Scholar
- Emerald Insight

After gathering potential primary studies, each study was subjected to a two-step assessment process. First, by reviewing the title and abstract, particular studies could be disregarded, based on our predefined inclusion and exclusion criteria. Subsequently, a full-text review would also allow for certain research papers to be disregarded, based on the same criteria. The reviews were conducted individually followed by a validation phase, ensuring both reviewers agree on the quality of the selected paper. This step was believed to mitigate papers of insufficient quality caused by subjective biases. However, it ended up seeming unnecessary, as no papers were disregarded in this step. The studies that passed this initial screening were then exposed to a rigorous quality assessment, elaborated upon in section 3.3.

3.2.2 Interviews

Effectively measuring and analysing behavioural aspects was already a challenge; however, the rich data collected from qualitative research methods typically provide a more nuanced perspective compared to quantifiable data collected through other quantitative research methods. Additionally, qualitative data enables researchers to explore human perception in a more comprehensive and complex way. Besides this, the flexibility associated with qualitative research allowed for a deeper understanding of the subject being studied. Lastly, as qualitative research generally encompasses the importance of context, the research allows for an understanding of social, cultural and environmental factors, all influencing human behaviour.

Consequently, interviews were conducted to collect additional qualitative data on the matter, apart from the analysis of the SLR. The interviews followed a semi-structured format to encourage the interviewees to speak more openly and candidly about the topic, allowing for more in-depth and rich data. The aim was to facilitate an interview environment in which the interviewee can express their genuine thoughts and perspectives, rather than merely responding based on the structure of the question. The interviews were conducted through Microsoft Teams, rather than in person due to some interviewees being located in other countries. It could be said that conducting interviews in person creates a more authentic atmosphere compared to online alternatives, but the option of conducting some of the interviews in person, if viable, was rejected as it would create dissimilar atmospheres for some interviewees. Additionally, Microsoft Team' recording option was used to record the interviews.

A total of 9 interviews were held with employees from Polestar's software & electronics department. Interviewees were selected by contacting different team managers from various software teams at Polestar and asking if team members would be interested in participating in an interview. When reaching out to participants suggested by team managers, attempts were made to keep it as diverse as possible was made with regard to roles, experience and cultural aspects, so as to mitigate potential response biases. A list featuring background information about the participants can be seen in the Results & Data Analysis section, in Table 6.1.

3.3 Data Analysis

The data analysis was divided into two distinct parts, an analysis of the literature review and a thematic data analysis, which were based on the qualitative data gathered from the semi-structured interviews. The combination of these, together with earlier findings from the literature review, would yield sufficient information to address the research questions.

3.3.1 Literature Review

Apart from including inclusion/exclusion criteria, it is generally considered vital to also assess the general quality of primary studies used in an SLR to provide a more detailed assessment, investigate whether quality differences explain differences in findings and guide recommendations for further research to name a few [87]. Additionally, using weighted measurements instead of a single metric in terms of reporting scores for measured qualities was reflected in the studies' own quality assessment. (See Table 3.1)

Each research paper used in the SLR was subjected to the corresponding assessment criteria shown in Table 3.1 and 3.2 respectively. Unfortunately, the assessment criteria, strongly influenced by Beecham et al.'s SLR on motivation within SE [129], were not validated by a third party. Nonetheless, considering the widespread recognition and frankly cited nature of the source of inspiration, the suitability of the

specific criteria was deemed acceptable for this SLR. Furthermore, since no papers were rejected solely based on low scores, the assessment should be viewed more as a heuristic than strict guidelines for quality.

Table 3.1: Assessment Criteria

Criteria	Option	Corresponding Score
Discussion and Conclusion section	Both / Either / Neither	1 / .5 / 0
Backed up by references	100+ / 100 > 50 / 50 > 10 / < 10	1 / 0.66 / 0.33 / 0
Participant sample size	Refer to Table 3.2	
Accounting for biases	Yes / No	1 / 0
Sample technique	Random / Non-Random / Not Disclosed	1 / .5 / 0

Table 3.2: Criteria Options

Method	Option	Corresponding Score
Questionnaires	< 10 / 10 < 50 / 50 < 100 / 100+	0 / 0.33 0.66 1
Interviews	< 3 / 3 < 10 / 10+	0 / 0.5 / 1
Observation (Individuals)	< 10 / 10+	0 / 1
Observation (Groups)	< 3 / 3+	0 / 1

3.3.2 Theory Analysis (O/R/L Analysis)

After the initial assessment steps were performed, the remaining papers of interest were subsequently analysed. The analysis process primarily consisted of identifying **key factors**. To make these key factors easily interpretable, the analysis was structured in a way that recognised key factors as being either Outcomes (O), Requirements (R) or Limitations (L). The theory section, which is the summarisation of the papers produced by the SLR, acts as the foundation on which these key factors are created. For each research paper, the task of identifying key factors was simply based on the questions:

■ **What** is the main objective the paper is focused on achieving (O)?

■ **How** are they achieving/accomplishing it (R)?

■ **Is** there anything that might prevent the process of achieving/accomplishing the outcome, given the requirement is fulfilled (L)?

This trio of outcome, requirement and limitation is what is called a **key factor relation**. In case multiple key factors are possible as outcomes, requirements or limitations, such is noted. That is, a certain requirement may have multiple outcomes, and vice versa. The papers are not limited to only a single key factor relation. In some scenarios, a limitation is not necessarily found. This leaves the key factor relation to only consist of an outcome and a requirement, and never the opposite. Additionally, the limitation can be seen as a requirement for the requirement, which is not always illuminated in all cases and might therefore be left empty.

Important to note is that the process induces much subjectivity to the analysis. In an attempt to receive unbiased interpretations of the theory, each paper was investigated by both researchers, individually. Then, the results were compared between researchers to conclude what key factors relations best reflect that particular research paper. This approach of identifying key factors was performed on every paper extracted from the two research fields.

The purpose of the **key factor relations** is to extract from the theory and understand how each key factor ultimately relate to each other. An example of such relations are illustrated in Table 3.3.

Table 3.3: Example of 3 Key Factor Relations

Outcome	Requirement	Limitation	Source
Motivation	Salary	Job Design	[3]
Job Satisfaction	Work Culture	Colleagues	[5]
Involvement	Managerial Commitment		[12]

This analysis aimed to identify which key factors were of greater importance and how they intercorrelated with other key factors through finding matches where the two fields share key factors, ultimately finding an answer to RQ1. In particular, the outcomes from the key factor relations in both fields are desired, where the requirements for these are discussed in RQ2 and RQ3. Besides this, these findings were also utilised to construct interview questions that will later be implemented when conducting the qualitative research method.

3.3.2.1 Interview Questions

To appropriately formulate interview questions, the decision was made to base them on associated research findings. Consequently, this entailed that the SLR and subsequent analysis had to be realised beforehand. This allowed for structuring interviews that aimed to further strengthen the already established findings or possibly bring new insights. Each formulated interview question was derived from earlier findings, which in itself was derived from the theory section, creating the themes for the interviews. Therefore, if particular SLR findings recognise certain key factors as more considerable, it indicated, to a degree, that an interview question should likely be formulated around that theme.

3.3.3 Thematic Data Analysis

A thematic data analysis (TDA) represents a method for systematically identifying and organising themes across a set of data [15]. Furthermore, the researcher could see and make sense of collective or shared meanings and experiences. The analysis method was chosen because it granted accessibility and flexibility and constitutes an entry for people fairly new to qualitative research [15].

The TDA followed the typical six-phase approach of thematic data analyses, with an addition to a quantitative analysis of the interviewed data. Phase 1 consisted of familiarising oneself with the data by reading and subsequently re-reading textual data like audio data or transcripts for instance [15]. The recorded audio collected through the interviews was listened to at least once before being transcribed.

Phase 2 consisted of generating the initial codes that were later used for creating themes. Codes provided a label for a feature of the data that was potentially relevant to the research question by highlighting any noteworthy phrases, ideas and sentences [15].

Phase 3 consisted of initially searching for themes as the shift from codes to themes occurred. A theme captured something important about the data in relation to the research question and represented some level of patterned response or meaning within the data set [15]. This process reasonably needed to be repeated and refined or executed in phase 4 (reviewing potential themes) as themes generally needed to be altered in a recursive process. Essentially, it was particularly important for novice researchers and for working with very large datasets, where it was simply not possible to 'hold' the entire dataset in their heads [15]. Additionally, to cluster the codes in a comprehensible way, a systematic approach was also taken towards the interviewees responses. An additional O/R/L analysis was performed to elicit possible relations between key factors.

Phase 5 consisted of defining and naming themes by clearly stating what was unique and specific about each respective theme. In certain cases, subthemes emerged from themes and were considered when one or two overarching patterns occured within the data [15]. It could be argued that the separation between phases 5 and 6 was often slightly blurry, but ultimately, phase 6 should visually present how the themes connected logically and meaningfully with a thematic map established during phase 5 [15].

The result of the TDA is presented in two separate ways: an analytical approach based on the frequency and interconnectedness of codes (more quantitative) and the normal approach of finding novel insights through the respondents answers towards the research questions (more qualitative). These two are referred to as the quantitative and qualitative part of the TDA respectively, later on in the study.

3.3.3.1 Phase 1

The initial step of the thematic data analysis involved orthographically transcribing and listening to the interviews. The interviews were recorded using Microsoft Teams' video recording feature, which facilitated the transcription process. This approach enhanced the quality of the transcription by capturing the tone of the answers in conjunction with the respondent's body language, making for a clearer picture of the spoken answers. Moreover, it allowed for the replaying of the material in cases of unclear audio, multiple people speaking concurrently, or similar occurrences, which further improved the quality of the data to be analysed.

3.3.3.2 Phase 2

As a second revisit of the material, coding of particular answers of importance began to be captured, starting the second phase of the analysis. During the initial coding phase, emphasis was put on responses to answering the questions. As the interviews were semi-structured, the respondents' reflections on certain situations were sometimes brought up differently, inevitably derailing from the initial question in some cases. Nevertheless, this posted no issue as the interviews were carefully structured to allow for discussion and reflection. The answers could in some cases bring up other interesting points, touching upon other aspects not necessarily in the focus of the question, which was naturally also coded.

To ensure consistency in the coding of the interviews, a coding framework was followed. The framework follows a chronological order of instructions applied to each interview segment, in which a segment is recalled as a response paragraph. Consequently, longer responses to a specific question were divided into multiple segments, mainly to have a low codes-per-segment ratio, which helps future analysis steps. The framework can be seen in Table 3.4. Additionally, an example of a coded response can be seen in Table 3.5.

Table 3.4: Coding Framework

1	With the help of the list of key factors received from SLR analysis, use the most relevant ones to code the segment.
2	Does the segment feature an aspect not currently present in the key factor list? Code the new aspect and mark it with an asterisk (*)
3	After an interview is done, check in with the other researcher – is there a consensus? Otherwise, discuss, especially novel aspects found.
4	Take a break – check in again, was something missed? Or simply coded incorrectly? Repeat the process for the next interview.

Table 3.5: Example of Generated Code

Question	Do you think the level of motivation affects your performance?
Answer	Yes definitely, I have been experiencing this recently actually...
Coded	Motivation, Performance

3.3.3.3 Phase 3

The initial stage of creating the thematic map involved assessing the adequacy of the codes. A thorough examination was conducted to identify inter-dependencies among the codes, in a similar manner to the O/R/L analysis of the theory.

This process served three primary purposes:
- Establish correlations between the codes.
- Creating a measurement for the importance of a particular key factors.
- Clustering key factors to help ease the process of constructing the thematic map.

Additionally, this step was seemingly necessary due to the considerable number of codes involved. As part of this process, a "code map" was generated. The code map serves to encompass all the codes employed during a specific interview and elucidate the relationships between codes based on the interviewee's responses, similar to the key factor relations. This emphasises the synthesis of previously unrecognised connections, extending the scope of prior observations. Ultimately, the process is not solely confined to clarifying the differentiation between diverse codes, it also endeavours to categorise these codes and uncover relationships that may not be readily discernible through intuitive means.

The structure of the code map entails dependencies between nodes, where the nodes are the codes (key factors with additional codes) and the arrows between them are the relationships between them expressed through the interviewee's responses. Additionally, this process resembles creating requirement-outcome relationships, but disregards limitations (however, this will be discussed in RQ5).

To reflect on the example in Table 3.5, there would be an arrow from Motivation to Performance, indicating that Performance is influenced or affected by an individual's level of Motivation. As it may seem clear that such a connection can be made in this case, the creation of these dependencies is made through the interpretation of the interviewee's response, meaning the connection might not always seem clear. Therefore, it's important to note that these connections include subjectivity from both sides, both the interviewee and the researcher coding the response. The inter-dependencies might not always represent an ontological truth about a certain aspect, as they are a mere interpretation from the researcher's perspective of the interviewee's response. The researcher has therefore no implication to confirm nor disregard

if the interviewee's response holds an objective truth. It is also worth noting that the dependencies have a neutral stance, meaning that they don't imply being favourable or unfavourable in a sense, but rather an indication that it affects the other concept.

In some situations, two nodes might exhibit a mutual dependency. This is indicated by the presence of bidirectional arrows, accompanied by a colour gradient on the arrow itself. The significance of these dependencies lies in their ability to visually portray an even stronger relationship, thereby aiding the categorisation of nodes and simplifying the process of theme creation. For example, Cognitive- Bias, Style and Diversity are very similar concepts in comparison to e.g. Job Satisfaction.

Figure 3.1 illustrates what a typical coded response look like with the interpretation that Motivation influences Performance and a mutual dependency between Employee Emotions. Again, as this dependency is created through the researchers' interpretation of the response, the particular dependency stands with little dignity. However, if this dependency would be found over multiple interviews, it is deemed an interesting connection worth discussing and putting emphasis on.

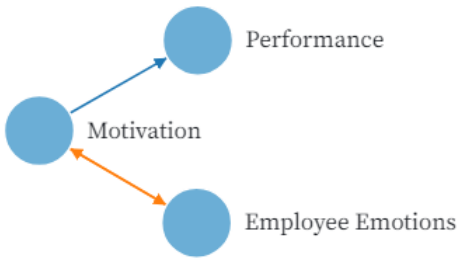

Figure 3.1: Example of a Dependency

Through this process, certain key factors will emerge as the most interdependent. Their counts will be noted and compared (the quantitative part) to other key factors but also used to indicate which key factors to examine further in the interview responses (the qualitative part). Additionally, other profound aspects interesting to the interviewer are naturally also discussed in the qualitative part of the TDA.

3.3.3.4 Phase 4/5/6

The determination of the thematic map was influenced by the frequency of the codes in the code map. Codes that appeared less frequently were given less weight, and vice versa. The weight is indicated in the thematic map by the number next to the leaf, representing its interconnectedness. This approach was adopted to ensure that the thematic map was derived from the more prevalent and significant aspects of the data, rather than being disproportionately influenced by codes with limited occurrences. By considering frequency, the thematic map ideally reflects a more accurate representation of the importance of each code and a better generalisation

of the transcribed data. It also serves to address bias in the analysis, as researchers may tend to favour certain aspects, despite evidence to the contrary.

Given that the code map become an important part of creating the thematic map, it is bound to differ from traditional thematic maps. The most significant key factors constructing the code map are also featured in the thematic map, in unison with the sub-categories of the theory. The sub-categories of the theory section effectively make up the foundation of the thematic map as these also lay the ground for the interview questions. For example, key factors showing high levels of interconnectedness and frequently discussed during the interviews likely end up in the thematic map. Ultimately, the thematic map captures and presents the major aspects discussed during the interviews but also provide novel ideas and interests, which guides the further discussion in the last, write up, phase of the TDA.

4

SLR Theory

This theory section is the result of the SLR performed as the first step of this study. To clarify, the following material is *not* related work to the study, but the results from investigating every paper and bringing out valuable insights. It entails the findings from each paper in a summarised form, laying the foundation for the upcoming analysis. In particular, it acts as the material for eliciting key factors and key factor reations regarding the desired outcomes for both CI and BSE and providing a guiding step in constructing the interviews. Furthermore, in order to later map back the relations constructed to the location of the theory text, footnotes with an ID will identify the source of the relation, that is later seen in the results.

The subsections of the following chapter will later be seen as themes within each field, especially for BSE, as we will be interested in the requirements for achieving CI from BSE.

4.1 Continuous Improvement (CI)

4.1.1 Kaizen

Kaizen, as a concept, revolves around CI, however, CI is still generally highlighted as a process-oriented approach whilst Kaizen represents a philosophy that emphasises CI in all aspects of an organisation's processes and operations [6].[1] Berger et al. [6] suggest that for organisations that seek to acquire a competitive advantage in today's already competitive business environment, implementing CI becomes increasingly important. Alternatively, certain organisational designs similar to those found in the Kaizen philosophy can be implemented to effectively promote employee involvement in CI initiatives. For instance, by adopting certain team-based approaches like "quality circles" which are defined by a smaller group focused on problem-solving and "suggestion systems", which are described as employee-driven idea-generating processes, organisations are able to balance product and process standardisation likely resulting in a reduction of variability and improve quality [6]. However, it is noted that implementing such designs should never halt creativity and innovativeness inside the organisation as Kaizen's philosophy encompasses a work culture that values such aspects. Furthermore, Al Smadi [136] argues that if Kaizen is properly implemented, it can drastically contribute and drive organisations towards a higher level of competitiveness, without needing major investments. Similarly, aspects re-

[1] Relation [1]

garding creating a work culture that emphasises employee involvement, teamwork and managerial commitment are presented. Additionally, practical implications are also presented as the findings point to the organisation needing to be of a suitable type that encourages creativity, actively pursues improvements and never settles on a status quo [136]. Moreover, it requires organisations to create a work environment where employees feel empowered and are encouraged to identify problems and suggest solutions. Besides this, strong communication is vitally recognised for organisational learning when a philosophy like Kaizen is implemented with regard to goals and overall understanding [136].[2]

Glover et al. [151] examined established Kaizen Event (KE) programs to identify probable outcomes of such programs. Several attributes associated with the 16 examined KE programs were highlighted as considerable factors and included leadership support, clear goals and objectives and employee involvement [151]. In terms of identified outcomes associated with the KE programs, improvements in quality, productivity and safety were reported, however, practical implications like resistance to change were also found [151]. The researchers suggest that practitioners looking to implement KE programs should initially act with caution and attempt to identify obstacles associated with the initiation process. It is also noted that strong managerial support is bound to increase the likelihood of successfully implementing KE programs [151].[3] Martin Di [99] argue that methodologies derived from CI, which are integrated into organisations do not inherently represent a quick-fix solution to the companies' issues. Companies are therefore suggested to slowly adopt philosophies like Kaizen, which could aid to evolve a work environment that better suits employees and other stakeholders. The researchers suggest that by adopting such an approach, organisations are likely to see increases in employee motivation and job satisfaction as Kaizen emphasise employee involvement in terms of decision-making and problem-solving [99]. Moreover, operations were also reported to incrementally become more streamlined. Comparably, Kaizen's effect on employee motivation was also examined by Cheser et al. [21]. Likewise, higher levels of motivation and job satisfaction were reported by organisations that consider Kaizen. In addition, outcomes attributed to Kaizen included higher levels of skill variety, task identity and significance, autonomy, feedback and need for growth among employees [21]. Besides this, the researchers emphasise that although Kaizen can be an effective tool for improvements, organisations must actively commit to the philosophy and accept change before it can take effect.[4]

In conclusion, the findings emphasise the importance of considering Kaizen as a philosophy that can be implemented in organisations to promote continuous improvement across all areas of an organisation's operations and processes. By adopting particular job designs, companies are likely able to encourage employee involvement with presented alternatives such as quality circles or suggestion systems, for instance. Conceivably, benefiting factors associated with Kaizen regard productivity, job satis-

[2]Relation [2]
[3]Relation [3]
[4]Relation [4]

faction, communication and perceived employee motivation. Moreover, the findings also suggest that companies are able to achieve higher competitiveness when implementing Kaizen principles are considered. However, findings have pointed out that contingent factors like an organisation's suitability to Kaizen are aspects affecting whether or not it is achievable. For instance, "suitability" can refer to a company's work culture and managerial commitment which are key for effectively implementing Kaizen. Moreover, certain conceptual barriers to implementing Kaizen have also been found with resistance to change being the more recurring one. Nonetheless, Kaizen can serve as an effective philosophy for organisational improvement, provided there is an active commitment to change from the entire organisation.

4.1.2 Six Sigma

The methodology of Six Sigma (SS) is generally defined as a data-driven methodology consisting of tools and techniques used for improving operational processes, with the aim of reducing defects and minimizing variability [75]. By identifying the cause of defects, errors and other variations, SS's objective is to achieve performance that is near perfect with a set defect rate lower than 3.4 defects for million opportunities (DPMO). Additionally, the term itself also refers to the statistical concept of maintaining a process within six standard deviations, defined with sigma, from the mean or average which corresponds to the aforementioned low defect rate [75].[5]

Formerly, research aimed to identify effective ways of implementing CI, while emphasising the methodology of SS has been conducted. Eguren et al. [81] highlight the importance of managerial involvement and that it represents a crucial part of achieving desired outcomes. Additionally, it is argued that projects that involved lower levels of committed management tended to be far weaker in development learning and accomplishing their objectives. Besides this, the researchers suggest that the advantageous benefits associated with a successful implementation include a reduction in defects and improved customer satisfaction [81].[6] However, it is noted that training programs directed towards organisational learning with regard to CI are likely required for achieving such integration. Similarly, Dahlgaard et al. [75] examined benefits associated with the successful implementation of SS, organisationally. Likewise, to previous outcomes, findings suggest improvements in employee engagement to be a primary outcome. However, this requires proactive management that emphasises creating a work culture where employees are encouraged to identify problems and find solutions respectively [75]. Moreover, better decision-making processes were reported, arguably due to the data-driven aspects of SS.[7]

Pfeifer et al. [142] conducted a case study with organisations of varying sizes, examining how each company's approach to implementing SS occurred, based on their respective needs and requirements. Similar benefits were reported in all three cases including quality improvements, increases in both efficiency and customer satisfac-

[5]Relation [5]
[6]Relation [6]
[7]Relation [7]

tion, and reduced costs, for instance. Besides this, the inclusion of quality management systems (QMS) was also reported when implementing SS which is described by a set of processes, policies and procedures that are ultimately designed to ensure consistency in products and services [142]. However, the researchers argue that organisations should initially start by identifying their own needs and requirements before deciding on what approach to take regarding SS [142].[8] Comparably, Ehie et al. (2005) [69] found similar outcomes in integrating SS, however, with the addition of the Theory of Constraint (TOC). TOC is generally defined as a management philosophy that focuses on identifying and improving various constraints that ultimately limit an organisation to achieve its objectives. The findings suggest that for organisations that possess complex manufacturing systems with multiple sources of variation occurring, SS together with TOC may be particularly effective. Similar to Pfeifer et al. [142], it is indicated that organisations are to proceed with caution as it likely requires careful planning and thorough coordination between departments [69].[9]

The dynamics of organisational learning with regard to SS integration were also examined by Savolainen et al. [139] where, in their case study, three multinational companies based in Finland were examined. In all three cases, requirements which have previously been identified by Eguren et al. [81], for instance, were reported as well. Additionally, a supportive organisational culture was identified as a key factor which can be argued basis itself in presented factors like work culture and managerial commitment [139]. Besides this, the researchers suggest that monitoring and evaluation processes should be considered to ensure that improvements are sustainable over a period of time. Moreover, the paper highlights the importance of developing information systems that support progressive learning with regard to CI.[10]

In conclusion, the findings emphasise the importance of considering data-driven principles to foster improvements associated with reducing defects and minimising variability in an organisation's operational processes. Furthermore, the research surrounding SS highlights other major factors associated with the successful implementation of the philosophy including managerial commitment, employee engagement and creating a work culture that emphasises SS. Conceivably, companies are likely to see benefits in areas like improved customer satisfaction, increased employee motivation, reduced organisational costs and higher levels of productivity and efficiency. Besides this, integrating SS with other associated management philosophies like QMS and TOC may also prove advantageous to companies, depending on a company's specific requirements. Therefore, we argue that organisations initially identify their own needs and consider what approach is most suitable for them, by carefully planning, coordinating and monitoring to ensure sustainability over time.

[8] Relation [8]
[9] Relation [9]
[10] Relation [10]

4.1.3 TQM

Total quality management (TQM) is yet another methodology that bases itself on the context of CI. Despite the fact that TQM shares similar characteristics to SS and Lean respectively, TQM should be perceived as its own philosophy. The core premise of TQM is that organisations should systematically and continuously examine their operations and processes to identify areas of inefficiency and find opportunities for improvement. Since CI aims to incrementally improve products, services and processes over time, it is clear to see their resembles. Comparably, Dahlgaard et al. [75] define the methodology as a philosophy that seeks to continuously improve the quality of products or services by involving all employees in the improvement process. Additionally, the researchers argue that TQM emphasises process focus, rather than specific products or services. By including all employees during the entire improvement process, from top management to front-line workers, organisations are more able to meet and exceed customer expectations [75].[11] Moreover, outcomes generally associated with SS were also reported, however, their weight of significance appears to be prioritised less in the context of TQM. Since each methodology has its core agenda and principles, this is likely an argument for why some outcomes are more desirable.

Samson et al. [38] examined the most noteworthy predictors associated with operational performance with regard to TQM. By conducting a regression analysis, the findings suggest that leadership and managerial commitment, in particular, were particularly strong predictions of operational performance. Moreover, the level at which TQM is practically considered, organisationally, appears to explain the significant proportion of variance in performance across several organisations [38].[12] Besides this, the means of achieving a competitive advantage utilising TQM was examined by Powell et al. [119]. Similar to previous findings, the researchers' findings suggest that without committed management that highlights the importance of creating a work culture that emphasises employee empowerment, the beneficial outcomes associated with TQM become critically difficult to achieve. Moreover, organisations are recommended to also create a work culture in which the principles and practices associated with TQM can thrive [119]. This is further strengthened by Jung et al. [79], suggesting that implementing TQM is highly correlated with achieving competitiveness. In addition, creating a closer supplier relationship was also reported to directly affect performance. Besides this, a positive relationship was found between emphasising leadership, employee empowerment and organisational learning, and increases in employee motivation [79].[13]

The perceived practicality of TQM has also been examined among employees using surveys in previously conducted research. Based on the findings, Zeitz et al. [60] highlight two barriers that likely affect the organisations' success in implementing TQM. The first barrier describes a shortfall between employees and organisational structure, in which discrepancies between the demand for TQM programs and work-

[11] Relation [11]
[12] Relation [12]
[13] Relation [13]

force needs exist. The second describes poor monitoring of variables critical to success [60]. Furthermore, the researchers highlight the importance that organisations should initially focus on understanding their work culture and needs and subsequently assess the company's readiness for TQM programs.[14] Comparably, Whalen et al. [106] identified common barriers to implementing TQM organisationally. By collecting data from multiple manufacturing firms based in Canada using surveys, 6 major barriers were ultimately identified. Out of the 6 barriers, a lack of managerial commitment was found to be the most critical factor affecting successful TQM implementation [106]. Moreover, inadequate training programs, reluctance to change, poor communication, lack of employee involvement and insufficient resources were also found to be considerable barriers.[15]

Besides this, Hackman et al. [65] identified various empirical, conceptual and practical implications regarding TQM and how it can be a cause for consideration among organisations. The researchers argue that there is no correct way of conceptualising TQM organisationally, but rather, different perspectives are to be had depending on a company's own needs [65]. Furthermore, evaluating if TQM-related practices have been implemented correctly can be difficult as it requires different monitoring strategies depending on the circumstances. For instance, assessing factors such as organisational performance or improvements in customer satisfaction requires both qualitative and quantitative data collection methods [65].[16]

In conclusion, the findings express the numerous ways organisations can benefit from implementing TQM into their operations and processes. The primary aim of TQM appears to root itself in the way organisations evaluate their operations and processes in the context of improving them by identifying inefficiencies and opportunities for improvement. By acknowledging the strong predictors associated with TQM such as employee involvement, customer satisfaction and leadership, companies are likely to see improvements in operational performance and the CI of operations and processes. Furthermore, by emphasising the importance of creating a work culture where TQM can prosper, the chances of successfully sustaining TQM in organisations increase. Like other methodologies, the main barriers to implementing TQM appear to be associated with a reluctance to change, inadequate training, poor communication and a lack of managerial commitment. Besides this, it is suggested that there is no correct way to conceptualise TQM, therefore, organisations are encouraged to initially identify their own needs and tailor their approach accordingly.

4.1.4 Lean

Like other methodologies, Lean's philosophy encompasses a set of principles that focus heavily on minimising waste and maximising efficiency by optimising the utilisation of available resources. Furthermore, Lean highlights the importance of CI by incrementally improving products, services and processes. As previously stated,

[14]Relation [14]
[15]Relation [15]
[16]Relation [16]

one of Lean's primary key principles is to continuously identify and eliminate waste, which generally describes any activity or resource that basically does not add value to a product or service. Dahlgaard [75] describes lean production as a production philosophy that tries to combine the principles of traditional craftsmanship with mass production. In traditional craftsmanship, customers' needs are seen as one of the most important factors to consider, however, no initial production will be made until orders come in. However, once it does, full commitment is required from the workforce to ensure high customer satisfaction. By considering this, companies are likely able to reduce waste in aspects like overproduction, waiting time, unnecessary transportation and excess inventory for instance [75]. Besides this, the researchers emphasise practices which should be considered important in Lean production like Just-in-Time (JIT), Continuous Flow Manufacturing (CFM), Total Productive Maintenance (TPM) and Visual Management Systems (VMS). For instance, JIT is described as a method of production that only produces products or services when it is required, reducing inventory and other correlated costs [75].[17] Moreover, organisations are able to quickly respond to any changes in customer demands.

Pettersen et al. [118] expressed numerous conceptual and practical implications regarding Lean and its fundamental definition. One concern was that the past literature appeared to skew Lean's definition which results in an imprecise description of the methodology. Moreover, some researchers tend to use different terms and analogies when describing aspects associated with Lean [118]. Besides this, former research appears to emphasise the importance of factors differently, with some highlighting waste whereas others highlight CI or customer satisfaction for instance. To effectively implement Lean, the researchers suggest that organisations should initially have a clear understanding of the methodology to effectively implement it as a lack of consensus might imply implications regarding a shared understanding of goals and objectives [118].

Besides this, Lean is one of the many methodologies that have garnered attention in the context of software engineering and development. Ifechukwude et al. [68] examined how quality-related management principles derived from Lean have been implemented in Agile software environments. By utilising surveys, the researchers identified various factors associated with Lean that positively correlated with organisational performance. Notably, JIT, TPM and Strategic HR Management, in particular, were all highlighted to be highly important factors for improving performance [68]. Furthermore, emphasising leadership was found to be a critical consideration for creating a work culture that acknowledges Lean.[18] Balachander et al. [5] further strengthen these findings with their research examining how Lean should optimally be integrated into Agile software development. Similarly, the findings suggest that creating a work culture that values Lean facilitates efficiency, reduces waste and improves software quality.[19]

[17]Relation [17]
[18]Relation [18]
[19]Relation [19]

Middleton et al. [104] conducted two case studies examining how Lean practices affected software development in the financial and healthcare sector respectively. In both cases, multiple Lean practices like visual management, stand-up meetings and pull systems for Work-in-Progress (WIP) had been implemented. Both organisations reported a significant reduction in lead times, with one company averaging down from 12 weeks to approximately 3 weeks. Additionally, defect rates were notably reduced by 50% and both organisations saw a drastic increase in customer satisfaction. However, certain challenges regarding the implementation of Lean were introduced. The researchers suggest that organisations should start small when initially proposing Lean and gradually scale up if positive results are reported, largely due to employees' resistance to change [104].[20] Fortunately, De Treville et al. [137] examined the relationship between job design and intrinsic motivation among employees in the context of Lean production. However, the findings suggest that Lean can, in some cases, impede intrinsic motivation depending on the scenario. For instance, job designs that lack autonomy or have higher levels of task fragmentation have been reported to negatively affect intrinsic motivation [137]. Moreover, the researchers highlight the importance of considering factors like skill variety, task significance and feedback, suggesting organisations structure their job designs based on these findings.[21]

Middleton et al. [105] conducted a case study over 2 years examining how Lean can be applied to software engineering with regard to management. The researchers argue that Lean should not be confined to software developers explicitly, but rather, a wide-effort approach including everyone, from senior management down the hierarchy as the findings collected over the two years indicated that Lean does transfer well across the entire organisations [105].[22] Moreover, Boyer et al. [14] examined the degree of managerial commitment in organisations emphasising Lean production. However, it should be noted that this study was conducted in manufacturing companies. By measuring the average commitment rating for JIT, the findings found a moderate level of commitment among managers. Still, the researchers argue that although the aforementioned levels of commitment may facilitate CI, it likely requires higher levels of commitment for sustaining success over time [14]. This is potentially due to the fact that JIT associates with reducing overproduction, excess inventory and other processing costs related to reducing waste and requires an utmost commitment to sustain.[23]

Similarly, Melton et al. [102] conducted a case study where the benefits of lean manufacturing in process industries. During their data collection phase, the researchers identified one key problem which had to do with the company's process mapping. A total number of 34 steps occurred in total counting steps occurring both inside and outside the manufacturing plant whereas 60% of the steps included travel or waiting

[20]Relation [20]
[21]Relation [21]
[22]Relation [22]
[23]Relation [23]

time, which was considered waste [102]. By identifying where changes can be made and implementing lean principles, the researchers suggest that the organisation can see significant improvements in efficiency, productivity, and profitability.[24] Other organisational practices for lean production were identified by Olivella et al [80] by examining successful lean production factories. Comparably, many of the examined factories had implemented practices found in other reviewed research papers like visual management systems and standardized work procedures, but also, practices like cross-functional teams and employee involvement in problem-solving. Moreover, the findings suggest that these practices are interconnected and reinforce each other to prosper a culture of CI [80]. Besides this, emphasising the importance of considering both technical and social aspects of work is key and likely requires a shift in mindset.[25] Besides this, Niepce et al. [152] further emphasise other sociotechnical aspects to consider when examining characteristics of job design in lean production. The results show that workers receiving personal responsibility and self-managing work reported higher levels of job satisfaction than those in traditional production sections [152].[26] Additionally, there was a positive correlation between job satisfaction and performance.[27]

In conclusion, Lean emphasises minimising waste and maximising efficiency by identifying inefficiencies and optimising the use of resources. The findings suggest various Lean practices that could aid in improving operations and processes like JIT, CFM, TPM and VSM to name a few. However, past research has indicated that Lean lacks a clear definition which should be considered by practitioners. Moreover, organisations are encouraged to initially have a clear understanding of what benefits are sought after and, subsequently, thoroughly communicate this with everyone involved before proceeding. Besides this, companies should consider factors like autonomy, skill variety, task significance and feedback in their job design as these are shown to facilitate waste reduction, improved quality and higher levels of motivation among employees. Higher levels of managerial commitment are also highlighted as highly important as moderate levels of commitment among managers might not be sustainable long term. Findings have also pointed to Lean being effectively integrated into software engineering with Agile system development being the most researched area. Likewise, findings point to Lean's quality-related practices like JIT, TPM and strategic human resources management being successfully integrated into Agile work environments resulting in improvements regarding performance, efficiency and software quality. However, certain barriers to effectively integrating Lean's philosophy into software development have been identified with individuals' resistance to change being the most prominent factor. Organisations are suggested to initially start off small and gradually scale up so that everyone affected is well-informed about the changes occurring.

[24]Relation [24]
[25]Relation [25]
[26]Relation [26]
[27]Relation [27]

4.2 Behavioural Software Engineering (BSE)

4.2.1 Soft Skills

Previously, it was commonly believed that the technical aspects of software engineering and development were the primary factor to consider. However, alternative perspectives soon arose as more research focusing on so-called "soft skills" emerged. Highlighting the importance of addressing physical, mental and emotional health quickly became increasingly more frequent as it served as an essential core part of sustainable software engineering [116]. For instance, a recent study examined the effect of software developers practising interventions associated with mindfulness like meditation, breathing exercises and yoga. The findings suggest a positive relationship between frequently practising mindfulness and an increase in perceived well-being and productivity [116]. However, although these interventions serve to promote well-being, the researchers note that certain barriers like stigma and time commitment could intervene in these interventions being adopted in organisations. Therefore, organisations are encouraged to acknowledge the effects of practising mindfulness during work and create a work culture that emphasises it [116]. Comparably, the effect of practising mindfulness was examined on software engineering students where similar results were found [7]. Similar to Penzenstadler [116], the researchers argue that the adaptation of mindfulness interventions requires companies to initially mediate employees of the associated benefits and provide support to sustain like creating an appropriate work culture, guidelines and follow-up meetings.[28]

Capretz et al. [53] examined which soft skills were in high demand and which were being neglected. In the study, 500 information technology job posts were analysed based on their job descriptions. The findings suggest that particular soft skills like communication and alike were highly sought after by hiring companies [53]. Additionally, interpersonal, analytical and problem-solving skills were highlighted as important. However, the researchers argue that soft skills associated with being creative and adaptable appeared to be neglected by hiring organisations although being equally important. Moreover, it is argued that a lack of understanding perhaps exists as past research indicates that said soft skills are associated with software developers' ability to perform efficiently [53].[29] Therefore, by neglecting soft skills like creativity and adaptability, organisations may be limiting themselves in terms of software development processes and performance.

González-Morales et al. [31] examined the effect of teaching various soft skills like communication, teamwork and time management to software engineering students. By collaborating with local organisations, the researchers were able to collect feedback regarding students' ability to utilise their soft skills in real-world scenarios. In all cases, higher levels of satisfaction were reported by companies, suggesting that

[28] Relation BR1
[29] Relation BR2

emphasising soft skills should be acknowledged by organisations [31].[30] Similarly, Gotel et al. [62] present a comparable model that fosters soft skills and technical skills respectively. The Global Software Development (GSD) model aims to facilitate communication, collaboration, cultural awareness and problem-solving skills to name a few which are all important soft skills in the context of software development [62]. However, the researchers note that the model is intended for an educational environment, rather than an organisational environment. Nevertheless, the findings presented by González-Morales et al. [31] indicate that teaching students soft skills in advance likely results in positive outcomes once their careers start. Likewise, Gotel et al [62] argue that the GSD model constitutes an effective way of preparing students for their future careers.[31]

Besides this, research concerning soft skills in an organisational setting has also been previously conducted. Defranco-Tommarello et al. [76] examined how Groupware technology affected globally distributed software teams. Groupware is a software tool which facilitates collaboration among team members and supports teams to work more interconnectedly and effectively. The findings suggest that particular soft skills like communication, decision-making and trust were all positively correlated with teams integrating Groupware into their software development processes [76]. Additionally, an increase in productivity was found as time spent on administrative tasks decreased. However, to ultimately achieve the benefits associated with Groupware, the researcher argue that it must be implemented in a correct way that initially builds the trust of teams using the tool [76].[32]

Lastly, the importance of soft skills appears to heavily apply to project professionals, managers and leaders alike in the context of software engineering and development. Agrawal et al. [109] examined the effect of soft skills among managers with regard to software projects. The results highlight the importance of recognising and acknowledging managers who possess exceptional soft skills and rewarding them accordingly. Moreover, organisations are encouraged to design their management strategies in a way that ensures an effective transition for software professionals who are transitioning into leadership roles [109]. The researchers suggest that by creating a learning environment where the necessary soft skills can effectively be taught, organisations are better able to facilitate required soft skills.[33][34]

In conclusion, the findings show a significant association between soft skills and the effect it has on software development, recognising it as a contributing factor to enhancing overall well-being, productivity and organisational success. The requirement for soft skills, in particular, also appears to have seen an increase with factors like communication, interpersonal relationships and problem-solving all being important in the context of software development. Additionally, the findings

[30]Relation BR3
[31]Relation BR4
[32]Relation BR5
[33]Relation BR6
[34]Relation BR7

suggest that specific skills like creativity and adaptability have been recognised less, although being vital soft skills that should be considered by companies. Teaching soft skills to software developers and students respectively has previously been attempted, using techniques like the GSD model and Groupware technology. In both cases, the findings suggest that it effectively enhanced soft skills like communication, decision-making and collaboration. Besides this, the importance of soft skills extends to software professionals and managers alike in which findings indicate that organisations that emphasise effectively teaching soft skills are better able to transition software professionals and managers into leadership positions.

4.2.2 Personality

It can be argued that personality is thus far an extensive and complex concept to fully interpret due to everyone possessing individual characteristics, emotions and other cognitive aspects. Furthermore, this makes past conclusions associated with personality increasingly more difficult to generally apply. However, as more research surrounding the topic of personality is continuously published, more correlations between software developers' personalities and the effect it has on work are found. In a recent study, Russo et al. [35] examined whether a relationship between the need for cognition (NFC) and personality exists among software developers. The study was conducted by using the HEXACO model where data was collected from 483 respondents. The findings show that particular personality traits like openness to experience were positively correlated with higher levels of NFC [35]. However, respondents who were reported to be agreeable had lower levels of NFC. It was argued that this likely relates to an individual's intellectual curiosity thus making challenging cognitive activities more sought after [35].[35] Ultimately, the researchers suggest that organisations should consider these findings, not only to retain their software developers by acknowledging their NFC but also to attract new ones.[36] Furthermore, research suggests that women report significantly higher levels of openness to experience than their male counterparts [128].

Moreover, Capretz [19] explored the relationship between software developers and personality traits using the Myers-Briggs Type Indicator (MBTI). The findings suggest that among software developers, higher levels of introversion, sensing, thinking and judging were commonly reported when compared to non-software developers. The researcher argues that the software industry likely attracts certain personality traits associated with more traditional software-related aspects like programming that require more thinking and less communication [19]. However, a lack of particular soft skills like communication could be a cause for concern as software development encompasses more than technical aspects. Therefore, Capretz [19] suggests that organisations ought to balance teams in the context of personality traits to encourage communication and collaboration. This is further strengthened by Cruz et al. [26] who attempted to examine similar correlations between software developers and personality traits. Although the researchers' results were not statistically sig-

[35]Relation BR8
[36]Relation BR9

nificant, they suggest that attempting to diversify personalities in teams is likely the best option [26].[37] Comparably, Capretz et al. [96] examined if particular personality traits are better suited for certain stages of a software development cycle. Similar to Capretz [19], the MBTI was utilised when conducting the study. The findings show that distinct personality traits that generally relate to having greater soft skills become more relevant during specific software stages [96]. The researchers suggest that it likely stems from the fact that communication and interpersonal skills, for instance, are arguably more important when attempting to understand stakeholder requirements and needs [96].[38] While soft skills are not entirely discarded as important during programming phases, problem-solving, creativity, and teamwork are emphasised more. Ultimately, by recognising personality traits in teams, project managers could make more informed decisions about who is best suited for particular project stages.

In the paper *"What makes a good programmer"*, Cegielski et al. [49] examined several predictors of what ultimately makes a good programmer. In the study, they measured theoretical value beliefs, cognitive abilities and personality traits in relation to their overall programming performance. Although all three predictors appeared to affect programming performance, it was noted that personality traits, in particular, were the strongest predictor of increasing programming performance [49]. More specifically, people with higher levels of conscientiousness and openness to experience were positively correlated with having higher programming performance. However, the researchers note that people who reported higher levels of neuroticism had the opposite effect in terms of programming performance [49].[39] Besides this, Mellblom et al. [50] suggest that higher levels of neuroticism have a strong correlation to workplace burnout, specifically among software developers. [40] Moreover, former research has also indicated a positive relationship between higher levels of extroversion and a developer's ability for exploratory testing with regard to software development [132].[41] By highlighting the importance of particular personality traits, organisations could conceivably improve software quality and performance. Comparably, it appears that emotional intelligence represents a considerable factor in software development. By collecting data from 279 MSc students, Kosti et al. [98] argue that a correlation between individuals' emotional intelligence and work preferences exists. Additionally, emotional intelligence has been argued to be a strong predictor of work performance and career success. However, it should be noted that this claim is concretely grounded in psychology and not BSE.[42]

Besides this, there has been research conducted attempting to identify correlations between personality traits and job satisfaction with regard to software development. Silvia et al. [134] examined how personality, team processes and task characteristics relate to job satisfaction and software quality. By analysing 35 software teams,

[37] Relation BR10
[38] Relation BR11
[39] Relation BR12
[40] Relation BR13
[41] Relation BR14
[42] Relation BR15

the findings suggest that team members who had higher levels of conscientiousness reported greater job satisfaction [134]. Additionally, these personality traits, in particular, appeared to also improve teams' software quality. Aside from personality traits, teams who reported higher amounts of task conflicts saw a drop in both job satisfaction and team cohesion [134].[43] The researchers suggest that organisations should consider these insights when monitoring software teams as pairing compatible personalities in teams could impact job satisfaction and, conceivably, software quality. Comparably, Bradley et al. [78] examined personality types and their effect on cross-functional software teams. Generally, cross-functional software teams refer to software developers with varying expertise, skillsets and backgrounds, working together in unison to accomplish their goal. The researchers argue that highlighting the importance of understanding the team's composition with regard to personalities is key. By considering this, teams are likely more able to acknowledge team members' various strengths and weaknesses and, subsequently, learn to appreciate the contribution of team members and create greater team cohesion [78].[44]

Moreover, Shirley et al. [26] examined the relationship between personality traits and individual performance among software developers. Likewise, higher levels of extroversion in software teams were found to notably affect communication and coordination during software projects. Furthermore, the findings suggest that particular personality dispositions in software teams also positively affect team dynamics [26].[45] Similarly, Darcy et al. [39] identified that certain personality traits like conscientiousness, increase performance in low-complexity tasks whilst no significant effect regarding high-complexity tasks was found. On the other hand, people with higher levels of openness to experience resulted in the opposite outcome. Consequently, the researchers suggest organisations recognise the possible performance differences associated with personality traits when delegating tasks in teams [39].[46]

Karn et al. [84] examined the relationship between personality traits and software developers' ability to adhere to team cohesion. Usually, team cohesion refers to the degree that team members are able to communicate, connect and share team goals while maintaining a sense of unity. In software development, teams that possess higher levels of team cohesion are typically more productive and efficient, and report being more satisfied overall [84]. Although the findings did not find any significant correlations between particular personality traits and perceived team cohesion, the researchers suggest that certain traits like being extroverted could aid in communicative team aspects.[47] Besides this, due to the small sample size, more research is likely required. Comparably, Licorish et al. [93] examined personality compatibilities in software teams. The researchers argue that conceivable implications regarding software projects and personality incompatibilities exist as the likelihood of the project derailing increases [93].[48] It could be argued that extreme differences

[43]Relation BR16
[44]Relation BR17
[45]Relation BR18
[46]Relation BR19
[47]Relation BR20
[48]Relation BR21

in personality traits like high extroversion and introversion, for instance, likely lead to challenges regarding communication and collaboration that affect project outcomes. This is further strengthened by Omar et al. [111] who examined optimal team composition in software teams. Similar to Capretz et al. [96] whose findings indicate that particular personality traits are potentially better suited for certain stages of software development, Omar et al. [111] suggest that a good balance appears to be the optimal choice. However, the findings suggest that higher levels of extroversion in teams have been positively correlated with team performance [111].[49]

Lastly, Peslak [117] examined the impact of personality traits on software projects and like previous studies, this MBTI was utilised for identifying personality types. Similarly, the results show that there are particular personality traits impacting software projects like higher levels of extroversion being highly associated with increasing project success [117]. Furthermore, the researchers argue that individuals who have higher levels of extroversion are likely better suited for leadership roles. Whereas individuals who have higher levels of intuition are better suited for problem-solving [117]. However, among software developers, higher levels of introversion, sensing and judging were usually found. Therefore, organisations are suggested to acknowledge team composition in terms of personality traits to find a good balance.[50]

In conclusion, the relationship between personality and its impact on software development appears to be significant in several aspects. Organisations should recognise personality traits like openness to experience, extroversion and conscientiousness as findings show improvements in team performance. Moreover, the same personality traits have been found to improve key factors like communication. Furthermore, companies are encouraged to acknowledge particular traits often found among software developers like higher levels of intellectual curiosity and the need for cognition. Recognising these traits and structuring their job design accordingly, could promote higher levels of job satisfaction. However, research also suggests that software developers who possess higher levels of neuroticism typically perform worse with regard to overall programming performance whilst having a greater probability of burnout. Besides this, a well-diverse team in terms of personality traits have been shown to positively affect project outcomes. Therefore, organisations are encouraged to diversify their teams to facilitate communication, collaboration and team performance.

4.2.3 Motivation

Past research indicates that a shift has occurred where technical aspects no longer represent the primary factor of software development. Alternatively, organisations are suggested to emphasise human-related aspects like motivation for instance. Understanding software developers' needs and what keeps them motivated is key to creating a work culture that facilitates creativity, innovation and productivity [58].[51]

[49] Relation BR22
[50] Relation BR23
[51] Relation BR24

In the research paper *"Critical success factors in software projects"*, Reel [122] argue that applying the classic theories regarding social science will assist in creating a rigorous understanding of motivation in the context of software development. By recognising researched motivational theories and applying them accordingly, it can foster more understanding and create a reliable body of knowledge about motivating software developers and, conceivably, improve software quality. Although it could be argued these findings are relatively outdated, increasingly more research regarding motivation and software development has been published in recent years. César et al. [58] examined factors that affect motivation and job satisfaction among software developers. By observing 4 software organisations located in Brazil, the findings suggest that automation and recognition, in particular, were highlighted as being most important. However, due to potential cultural biases, the researchers emphasise that the findings may not be generally applicable to software development and that more research is required [58].[52] Nonetheless, software professionals and managers alike are encouraged to acknowledge the findings and to act accordingly to help facilitate greater motivation and job satisfaction. Similarly, Beecham et al. [145] found autonomous processes to be a primary motivator in software developers. Furthermore, the findings suggest that team-oriented aspects like collaboration and teamwork increased motivation whereas a lack of growth opportunities was found to be a primary de-motivator.[53] Likewise, software professionals and managers alike are encouraged to take responsibility for providing opportunities that keep their subordinates motivated [129].[54] This suggestion is further strengthened by Graziotin et al. [33] whose findings indicate that organisations that prioritise and emphasise motivation and satisfaction as key factors generally see higher levels of productivity.[55][56]

Comparably, França et al. [56] examined motivation in software developers using structured interviews, diary studies, and documental analysis over 7 months. Aside from similar factors presented in previous studies, task variety and the degree of technical challenge were found to be primary motivators in software developers. Although not stated in this particular study, it could be argued that findings presented in earlier sections like higher levels of intellectual curiosity and NFC in software developers justify the findings presented by França et al. [56].[57] Moreover, França et al. [57] highlight the importance of recognising motivation as a primary factor in software development as higher levels of motivation have been shown to not only affect productivity and performance, but retention success. Additionally, the findings suggest that work dynamics, work culture and leadership style represent considerable factors affecting motivation in software developers [57].[58] Besides this, organisations are proposed to implement various data-collection instruments like surveys, interviews and observations for a better understanding of motivation at work.

[52] Relation BR25
[53] Relation BR26
[54] Relation BR27
[55] Relation BR28
[56] Relation BR29
[57] Relation BR30
[58] Relation BR31

Motivation has been observed in other countries where a 1992 study examined motivational factors in software jobs located in Hong Kong. By collecting data from 66 software companies using surveys, Burn et al. [73] concluded that intrinsic factors were more prominent. Moreover, the findings suggest that purposefulness was a primary motivator among respondents. However, it should be noted that particular extrinsic motivators did occasionally present themselves like salary and work benefits [73]. Besides this, the researchers argue that the type of job should be considered as particular motivators were frequently found in specific jobs. Lastly, similar findings have been concluded in countries like Korea and Thailand, suggesting that these results are not a singular phenomenon. Although, since the specified countries appear to be located in Asia, it could be argued that cultural biases exist and should be considered [73].[59]

Fortunately, older research published back in 1994 did compare the self-assessed motivation of Spanish, Finnish and American information technology personnel was compared. The researchers found significant discrepancies between all examined employers with regard to their country of origin. Job security appeared to be more crucial among Spanish employees whilst Finnish employees tended to prefer opportunities for growth in their workplace [70]. Lastly, recognition and feedback were shown to be the most important factor among American employees hinting at the fact that considering cultural differences play a part in perceived work motivation. The researchers suggest that when designing strategies specifically encouraging motivation at work, these insights are worth taking into account.[60] It should be noted, however, that due to a small sample size and potential bias, further research is likely required. Moreover, Japanese computer personnel were also examined and compared to their American counterparts in the same sense as previously described. Although similarities were found for both countries, some differences were also found. For instance, middle managers based out of Japan rated their opportunity for growth higher than American middle managers [71]. However, overall satisfaction among American first-line managers was shown to be higher than among Japanese first-line managers. The researchers pointed out that the varying results found can be explained by cultural factors that may have influenced their findings. It is noted that Japan generally values harmony and loyalty to a company in higher regard than America whilst America typically values individualistic factors to be more important, thus making recognition more paramount [71]. Like Couger et al. [70], it is suggested that cultural factors should be considered. It should be noted, however, that in the case of Couger et al. [71], managers were examined and not developers. Fortunately, past research examining differences between project managers and software developers and the factors that motivates them respectively have been conducted.[61] Sharp et al. [131] suggest that although the findings did not specifically present factors yielding higher levels of motivation in project managers, the project managers themselves should take into account that the factors they per-

[59]Relation BR32
[60]Relation BR33
[61]Relation BR34

ceive to be motivators might not be applicable to their subordinates e.g. software developers.[62] Although Feratt et al. [54] findings suggest that no significant differences are found between information system employees and non-information system employees, changes in motivation can have occurred, due to the study being older. Organisations based in Brazil have also undergone research studies with one case being a smaller software company and the other, being a government-owned organisation. In the case of the smaller software company, learning and growth-related factors were the most prominent drivers of motivation whilst the larger government-owned company saw factors found in findings papers like task- variety, autonomy and significance, team- cohesion, communication and leadership style and management aspects like recognition to be more important [29, 128].[63] However, the specific factor which affected motivation the most is not clearly stated. Moreover, a study conducted in 2012 utilised questionnaires to collect data from respondents consisting of 176 software engineers from 20 software organisations. The results show that software engineers generally view similar factors to be key motivators like autonomy, competence, relatedness and purpose to name a few [30].[64]

Normally in software development, it is not uncommon that distributed development occurs which generally describes teams being geographically dispersed across multiple locations, rather than working together in a centralised location. Farias et al. [41] aimed to identify key success factors specifically associated with distributed software development and motivation. Comparably, the results showed multiple similarities to the findings previously presented with autonomy, feedback and effective communication for instance all representing success factors and motivators [41].[65] SCRUM teams have also been examined with regard to upkeep motivation and job satisfaction among their developers. Team members expressed that several factors contributed to their perceived motivation, a few being ownership of work, variety of tasks, the significance of work and regular feedback to name a few [11].[66] Consequently, the researchers suggest that when teams are granted enough freedom to create their own environment, it likely empowers team members and accelerates productivity. Feedback specifically has also been shown to have a significant impact on motivation among software engineers, both positive and negative [37]. Whilst similar findings regarding positive feedback and its effect on motivation remain, the researchers also suggest that negative feedback in particular generally produces the opposite effect. Although many of the findings can be said to constitute common motivators, the researchers suggest that companies should adopt both traditional motivational practices and adapt them to better suit their teams from a distributed perspective as it likely would yield collaborative improvements and overall productivity [37].[67] Cross-case analyses have also been conducted in an industrial setting with the aim of identifying factors which influence motivation. In this case, one larger, more mature organisation was compared with a smaller one [50]. The results

[62]Relation BR35
[63]Relation BR36
[64]Relation BR37
[65]Relation BR38
[66]Relation BR39
[67]Relation BR40

indicate that for the larger company, the most vital factor correlated with motivation was employees' perceived job satisfaction whilst autonomy was the most important factor for the smaller company. Furthermore, recognition and work-life balance did not appear to be significant factors in the smaller organisation. The findings suggest taking company size and maturity into consideration when attempting to facilitate motivation and, additionally, explore how different types of reward systems affect employee motivation over time.[68] Comparably, in the case of [29] and [128], two different-sized companies perceived different factors to be more/less important.

Changes in motivation, however, can present themselves as a scenario, given enough time. Cougar et al. [25] compared changes in motivation among information systems managers over a decade and the findings pointed to certain factors being less important than others over a 12-year span. Satisfaction levels appeared to be significantly lower in the recent findings compared to the former ones when speaking about female managers signalling that top managers need to pay closer attention to female managers [25]. Additionally, the perception of inadequate feedback also appears to be present among both male and female managers and since individuals who possess the need for growth are especially attentive to feedback, a lack thereof can likely affect performance [25].[69] An organisation may also face a scenario where the belief that motivated employees equal satisfied employees and vice versa which then produces similar benefits. However, in a 2014 research paper published by Sharp et al. , essential differences between motivation and job satisfaction and how each respective factor can impact software engineers. Based on their findings, the researchers express that the two factors should be perceived as distinct concepts that likely require separate strategies to prosper [28]. The results also show that higher levels of motivation generally produce higher levels of productivity whilst higher levels of job satisfaction more align with outcomes regarding mental health.[70][71][72]

In conclusion, human-related aspects including motivation, satisfaction and happiness have shown to significantly influence the performance of software engineers. The findings have shown that certain factors contribute to perceived motivation and satisfaction, including recognition, automation, teamwork and collaboration, opportunities for growth, task variety and technical challenges. Additionally, not all factors may be of equal importance, as cultural differences and organisational context influence their relevance. As motivation is something that changes and evolves over time, managers should remain attentive and periodically update their beliefs about the motivational factors affecting the developers. Also, companies should strive for employee satisfaction as it has been suggested to improve productivity. They should also provide feedback to their employees, positive or negative, as it has proven to significantly impact motivation. Ultimately, by applying the insights from these research findings, practitioners can develop methods and strategies to suffice

[68] Relation BR41
[69] Relation BR42
[70] Relation BR43
[71] Relation BR44
[72] Relation BR45

the diverse needs of software engineers and teams, promoting successful outcomes of software development.

4.2.4 Cognition

The ways we acquire, process and store information are often referred to as our cognitive abilities. In software engineering, the cognitive aspects of humans play a crucial role in the performance of the profession due to the complex nature of software development.

It has been demonstrated that the level of need for cognition (NFC) plays a significant role in achieving job satisfaction at an individual level [113]. Moreover, the researchers of the study suggest that managers should take cognitive factors such as task complexity and NFC into consideration when striving to enhance job satisfaction. Job satisfaction is not the sole aspect influenced by cognitive factors.[73] From the perspective of software project managers, making decisions without being influenced by behavioural factors can be a difficult task. A study by da Cunha et al. [82] has shown that cognitive biases can negatively impact the effectiveness of decisions, highlighting the importance of addressing these biases in decision-making processes [82].[74]

Various studies have indicated that software engineers' work is affected by diverse cognitive factors [120, 110, 107, 82]. A study conducted on over 200 participants confirmed the existence of cognitive phenomena such as the IKEA effect, endowment effect, and the 'I-designed-it-myself' effect. These effects were found to be prevalent in software development and shown to have an influence on the over-requirement phenomenon [110]. In short, these effects are connected to the over-estimation of one's owning (endowment), one's self-assembled (IKEA) and one's self-created ("IDIM") products and services. Over-requirement refers to a situation where a product or service is specified beyond the actual needs of the customer. This phenomenon can lead to a waste of resources and time if not appropriately addressed. In a similar vein, Jørgensen [83] also highlights this phenomenon of over-estimation, but in the context of over-confidence and over-optimism when estimating the time required for a project, in which the effect could be explained as an illusion of control. Conversely, Jørgensen suggests too much risk identification can have counter-intuitive outcomes, due to the 'false sense of security' received when assessing software development effort estimates. Conclusively, a combination of risk management and effort estimation is deemed promising to mitigate these effects [83].[75] Another study conducted by Jørgensen together with Moløkken provided further evidence of the existence of over-optimism bias. In their experiment, software professionals were found to be more optimistic in their estimations regarding a web-development project in comparison to those with non-technical roles and a non-technical background [107].[76]

[73] Relation BR46
[74] Relation BR47
[75] Relation BR48
[76] Relation BR49

When looking for software defects, confirmation bias is an evidently occurring bias in the construction of software tests. An empirical analysis conducted by Calikli & Bener in 2010 showed high levels of defect rates in products due to the direct cause of confirmation bias in software tests [18]. The tendency is that the tests are more likely to be structured to pass, rather than fail the code, ultimately introducing software defects and a false sense of quality. This effect had already been discovered in a previous analysis, stating the need for methods against the cause [64].[77] Cognitive biases and social interactions that are affecting the development and testing of software were further explored [17].

Mitigating these types of effects may not be as simple as raising awareness of them, as concluded by Mohanani et al. [120]. However, with a better understanding of the theoretical foundations of these common problems and practices, we can better address the biases and alleviate the problems created by them [120].[78]

Cognitive style is a term used to express how an individual acquires and processes information, solves problems and makes decisions [103]. Since 1984, considerable interest has been shown in this subject, which was then referred to as "cognitive sciences" [27]. The different cognitive styles, according to Kirton's Adaptation-Innovation theory, range from being highly adaptive to highly innovative. According to Chilton et.al. [103] in order to optimise performance and minimise stress and strain, it is crucial for an individual's perceived cognitive style to align with the style required by the job environment.[79] Stress' negative affection on cognitive tasks has been reaffirmed in a more recent study [140]. Thus, a highly innovative individual is deemed to experience the lowest strain levels in an environment requiring highly innovative people, the same principle applies to the adaptive counterpart.[80] Furthermore, when not matched, dissatisfaction and rejection ensue as natural reactions, whereas a match is probable to perform well [103].

Similar to cognitive style, cognitive and cultural diversity seemingly have an effect on the performance of software teams. Jablokow & Myers [85] suggests applying a mix of Kirton's Adaption-Innovation theory and the understanding of Hofstede's cultural dimensions in situations where the team is composed of individuals from diverse cultural backgrounds. Furthermore, they argue that a team of heterogeneous cultural and cognitive problem solvers is well suited for the global IT challenges businesses encounter every day [85].[81] A study conducted in 2011 conducted on sixty-five individuals, software engineerings and non-software engineers, proved the imagery dimension of the verbal/imagery dimension of software engineers' cognitive style is significantly preferred [45]. Although being of considerable age, further research has recognised this imagery dimension as being significant in problem-solving

[77] Relation BR50
[78] Relation BR51
[79] Relation BR52
[80] Relation BR53
[81] Relation BR54

for developers within software development [97]. To summarise, as a manager, being aware of and taking cognitive styles into consideration when forming, structuring and delegating work seemingly has an impact on the individuals as well as the team's performance.[82]

In conclusion, the cognitive aspects of humans play a crucial role due to the complex endeavour that software engineering is. The findings have shown that software engineers' work is affected by both cognitive style and biases. Practices to mitigate certain cognitive biases are also present. The NFC has been found to be an important factor in achieving job satisfaction, and managers should take cognitive factors into consideration when ensuring this. Finally, cognitive and cultural diversity seemingly have an effect on the performance of software teams, where a heterogeneously cultural and cognitive team is well suited to tackle many of today's global IT problems, yet a challenge to manage.

4.2.5 Emotions

While the software is developed by humans, the research surrounding the topic primarily emphasises the technological aspects of various methods and principles while disregarding human-related aspects that likely need to be taken into consideration. Torkar et al. [125] suggest that although research including human aspects in software engineering has been conducted, it is limited to a degree. Additionally, it should be recognised as a missed opportunity as increasing our understanding of how humans interact with software development can conceivably lead to more efficient software development [125]. Psychometric factors like personality traits and cognitive-related aspects have been examined in earlier sections but broadening one's perspective to also consider emotions is likely required as recent research has highlighted the importance of it and by collecting additional psychometric data, it could aid and help tailor development processes based on individual developers' needs [125].[83] Graziotin et al. [34] further strengthen this claim, emphasising that considering psychoempirical software engineering and the effect it has on software development can significantly impact developers' well-being and overall productivity.[84] The concept of emotion-based collaborative software engineering was explored by Dewan [46] in which the study aimed to identify the numerous task-based emotions typically found in software development. The findings identified 4 primary factors associated with emotions including interruptability, difficulty perception, frustration, and attention by analysing methods such as keystroke analysis, facial expression analysis and speech analysis to name a few. Additionally, the paper suggests that these emotions can be used as predictors to enhance collaboration, scheduling and feedback [46]. For example, if a team member displays frustration regarding a particular task, other team members possessing the required expertise to help can assist. Moreover, if two collaborators are both identified as bored with their current task respectively, they can likely be put together to work on a more interesting and

[82]Relation BR55
[83]Relation BR56
[84]Relation BR57

engaging task [46].[85] While this only scratched the surface, in short, by leveraging insights from both software engineering and psychology, researchers and practitioners can develop techniques for achieving better outcomes in software development.

Colomo Palacios et al. [23] explored how emotions affect decision-making among software professionals in software development by collecting survey data from 50 software professionals and conducting a case study to analyse decision-making processes. The findings show that although project complexity and team dynamics played a role in decision-making processes, the case studies revealed that team members' emotions and perceptions were significantly associated with decision-making processes as well. The researchers suggest this finding is likely related to the fact that hard decisions generally involve numerous stakeholders' interests, perspectives and priorities and, therefore, professionals should acknowledge emotional factors to create a supportive environment [123].[86] Moreover, accounting for emotions can conceivably affect creativity as Graziotin [63] explored the dynamics of creativity in software development. It is suggested that creativity is cognitive and, consequently, is influenced by cognitive processes like emotions and moods. Therefore, organisations should highlight the importance of measuring the emotions and moods of their software developers as it can feasibly facilitate higher levels of success in software development.[87] Graziotin et al. [34] further highlight this claim, arguing that emotions, moods and feeling all have an impact on the cognitive activities of software individuals. By conducting a regression analysis examining the relationship between numerous affect-related variables with the addition of engagement and self-assessed productivity, the results show a significant correlation. The researchers concluded that organisations may benefit from interventions aimed towards increasing positive affect, like emotions, among software developers by providing opportunities for social interaction and recognition for instance [32].[88] Moreover, positive affect has been shown to significantly influence software developers' perception of job satisfaction, motivation and commitment to name a few [32].[89] The causes of perceived frustration among software developers were more thoroughly examined by Ford et al. [43] by analysing survey responses. The results show a significant degree of frustration among software developers with 67% of respondents acknowledging it as a severe problem with the reason causing it being spread out between numerous categories. For instance, adjusting to new programming tools and languages respectively was presented as a primary cause of frustration whilst the fear of failure, limited time and lack of resources and experience among peers were described as other causes of frustration and could conceivably affect software outcomes long term [43].[90] The researchers suggest that recognising and addressing frustration experiences among software developers, it can serve to improve learning outcomes for organisations.[91][92]

[85] Relation BR58
[86] Relation BR59
[87] Relation BR60
[88] Relation BR61
[89] Relation BR62
[90] Relation BR63
[91] Relation BR64
[92] Relation BR65

In conclusion, acknowledging and incorporating emotional factors in software development can likely aid organisations to achieve better software-related outcomes whilst also positively affecting their developers. The findings suggest that accounting for emotions can leverage cognitive and collaborative aspects of software teams like scheduling, communication (feedback) and decision-making to name a few. Additionally, a correlation between positive affect-related variables and self-assessed productivity and creativity among software developers has been reported which suggests that organisations should highlight the importance of instating interventions, organisationally, aimed at increasing positive affect.

4.2.6 Teams

The factors that fundamentally make a good team member in software development are a question many researchers have examined over the past decades. Turley et al. [124] highlight the importance of the individual in software development and argue that there are many factors that, ultimately, contribute to the success of software development. The study aimed to find what differentiates exceptional and non-exceptional developers in the context of performance. The results show that one primary driver associated with exceptional performers was their ability to be team-oriented [124]. This competency was defined as valuing the synergy of a group effort by balancing the various strength and weaknesses of team members, promoting constant communication and investing the effort required to create team solutions [124].[93] Rasch et al. [121] further strengthen this claim, suggesting that team composition significantly affects performance, which can be argued to relate to balancing out members' strengths and weaknesses. Additionally, teams who possess a more directive leadership style were found to have a negative correlation with performance, perhaps suggesting that valuing team synergy where every team member has a saying in the matter is the more suitable approach [121].[94] Similarly, Guinan et al. [114] reviewed the existing literature on software development teams affecting team performance. Likewise, the findings suggest that a team's leadership- and communication quality both tended to perform better and are described equivalently to Turley et al. [124].[95]

The communicative aspects of software development and its effect on performance have been more thoroughly examined by numerous researchers. Brodbeck [16] conducted a quasi-longitudinal study, collecting data from 21 software development projects including 170 participants with various backgrounds. The results show that internal communication was essential and that communicative barriers can potentially lead to project failure, suggesting that organisations may need to consider different forms of communication depending on the needs of a given project.[96] Dutoit et al. [3] examined various communication artefacts attributed to software

[93]Relation BR66
[94]Relation BR67
[95]Relation BR68
[96]Relation BR69

development in the context of project outcomes. Certain metrics, like message volume and response time, appear to be significantly correlated with schedule delays and code quality and, moreover, teams possessing higher levels of communication typically perform better [3]. As the study highlights that these findings have been evaluated in real-world settings, organisations are suggested to consider such metrics to improve team performance.[97] Besides this, the social nature of Agile teams has also been examined in previously conducted research. Whitworth [150] explored the association between Agile software development and positive team chemistry by conducting a literature review, followed up by 22 semi-structured interviews with Agile team members. Comparable to being team-oriented and valuing team synergy, creating a shared identity was found to be a key driver in creating positive team chemistry in Agile teams as it creates a sense of belonging [150]. Furthermore, effective communication was reported as being critical in staying aligned with project-related goals and, additionally, mitigating misunderstandings. These factors, among others, are suggested to facilitate a high-performance environment in which team members can grow both individually and collectively.[98] Mishra et al. [42] further highlight the significance of a favourable workplace environment being associated with effective communication and overall performance among Agile eXtreme Programming (XP) teams.[99] Furthermore, Layman et al. [95] identified essential communication practices associated with globally-distributed XP teams by conducting observational research methods. The researchers note that while XP teams have seen successful implementations in co-located environments, their effectiveness in globally-distributed teams has not been as promising in terms of understanding, likely due to numerous cultural differences including language barriers, time zones and work styles for instance. The findings suggest that, among others, establishing a common ground in terms of communication, tools and team requirements is vital for adapting to cultural differences whilst facilitating understanding among XP team members.[100] Comparably, Last [89] further highlights the issues global software virtual teams generally face like zone differences, language barriers, and technical issues for instance, suggesting that establishing trust early on was vital for teams to effectively function early on by getting to know each other on a personal level, sharing interests and demonstrating a willingness to collaborate.[101]

However, the communicative aspects associated with improvements in software teams are not the only factor to consider. Kang et al. [66] used surveys to gather data from software teams based in South Korea and, subsequently utilised statistical analysis techniques for evaluation. The results show that cognitive similarities far outweighed demographic similarities in the context of team effectiveness. Comparable to earlier findings, the paper suggests that building cognitive similarities is conceivably achieved by organisations emphasising shared understanding and communication among their software teams [66].[102] In addition, task cohesion appears

[97] Relation BR70
[98] Relation BR71
[99] Relation BR72
[100] Relation BR73
[101] Relation BR74
[102] Relation BR75

to significantly influence group performance as suggested by Bahli et al. [12]. Furthermore, the researchers highlight the importance of team-building activities as a positive correlation between it and affecting both task and social cohesion was found. However, the findings argue that higher levels of social cohesion among software teams did not directly affect group performance, but rather, affects task cohesion which, as a result, affects group performance [12].[103] Similarly, Janz [74] examined the effectiveness of software teams in the context of work outcomes by collecting data from 231 software professionals from 28 software development teams across 13 organisations. The findings suggest that although previously stated factors like autonomy, for instance, inherently affect perceived satisfaction, motivation and performance among software teams, the level at which cooperative learning occurs may be more important for achieving improved work outcomes.[104] The level at which a project's perceived innovativeness appears to also correlate to a team's level of performance. Hoegl et al. [100] found that for more high-innovative projects, teams typically performed better than moderate-innovative ones. The researchers suggest that this is likely due to team members requiring more collaboration and coordination while being more creative, experimental and risk-taking. Similar to previous findings, the paper suggests that this is feasibly achieved by establishing a work environment that considers diverse skill sets among team members, common goals and effective communication [100].[105] Pair programming dynamics and their associated effect on overall team collaboration were examined by Choi et al. [88] by pairing up 40 participants who were asked to complete pair programming sessions and subsequently answer a questionnaire assessing their satisfaction in the context of pair programming experience. The results show a significant positive correlation between listening ability and pair programming satisfaction. Accordingly, it is suggested that soft skills, like listening abilities, should be considered in pair programming.[106] Members from Agile software teams also gave their perceptions of factors impacting productivity in a case study conducted by Melo et al. [101] including surveys, interviews and observational research methods to collect data over 6 months. The findings show that the primary driver affecting productivity among Agile teams was proper team composition and allocation highlighting the importance of including all required skills in larger teams. It should be noted, however, that differences in perceptions of productivity were found suggesting that the findings may not be generalisable to all Agile teams [101].[107] Intra-team relationships and their effect on software development were examined by Rosen [127] arguing that although technical skills are essential for producing high-quality software, they are not the end all be all as highlighting human factors are just as important. Among the three identified themes, two have been recurring findings being effective communication and establishing trust, however, conflict resolution was identified as a crucial aspect of intra-team dynamics arguing that conflicts are inevitable. Therefore, if team members possess the required skills, intra-team conflicts are likely to

[103]Relation BR76
[104]Relation BR77
[105]Relation BR78
[106]Relation BR79
[107]Relation BR80

be resolved constructively.[108] Purna et al. [61] and Thomas [141] further strengthen this claim, suggesting that teams that are able to resolve conflict effectively were generally more successful and are achieved by identifying the root cause, acknowledging everyone involved and finding a mutually acceptable solution.[109] The effects of team-related conflict in software development were identified by Sawyer [130] by examining 40 software teams, each consisting of three to six members. The study asked team members to rate their level of agreement with regard to statements related to team conflicts. The results show that a combination of teams, team member characteristics and existing levels of intra-group conflict accounted for nearly half of the variance between the best- and worst-performing software development teams [130].[110] Furthermore, the level at which managing conflict occurred was found be increase the likelihood of mitigating the negative effects associated with intra-group conflict and its effect on team performance. Gobeli et al. [40] further highlight the importance of managing conflicts in software development as conflict intensity was found to negatively affect project success. It is noted, however, that certain conflicts in the context of finding a compromise can be positively correlated with the project outcome. Therefore, software managers and professionals are suggested to pay attention to the context of a given conflict [40].[111]

Research regarding how software organisations should approach team building and formation has also been previously conducted. Silva et al. [52] conducted semi-structured interviews with software managers and team members respectively and subsequently conducted a survey to collect qualitative and quantitative data on team building criteria in software projects. Although a significant variance in criteria was found, common themes associated with technical skills, communicative abilities and work experience emerged [52].[112] On the other side, similar personalities and backgrounds did not appear to have a significant impact on success. However, previously presented findings argue against these claims but it can be said that this paper does not focus on global software teams [95]. Additionally, Narasimhaiah et al. [108] did collect data using surveys from 30 smaller software teams, examining four dimensions of personality to identify which team member should work with who. Based on their findings, the researchers suggest that personality composition does, in fact, significantly impact performance in smaller software teams, suggesting that software managers should acknowledge preferable personality attributes for each role on their team [108].[113] It can be argued, however, that the sample size was not large enough to generalise the findings and that more research is likely required. Nonetheless, Silva et al. [52] concluded that considering a combination of technical and communicative skills when selecting team members conceivably leads to better project outcomes.[114] Another aspect to consider was brought forward by Lewis et al. [92] in which team member's problem-solving styles should be considered when forming

[108]Relation BR81
[109]Relation BR82
[110]Relation BR83
[111]Relation BR84
[112]Relation BR85
[113]Relation BR86
[114]Relation BR87

software teams as these preferences significantly impact team performance. Moreover, teams that possess numerous dominant problem-solving styles were reported to have higher levels of intra-group conflicts affecting overall performance [92, 146].[115] Lastly, Mcgrew et al. [77] argue that typical software group formation occurs in four formative stages, forming, storming, norming and performing. By analysing 10 smaller software teams, however, the researchers also highlight the need for an extensive stage model which includes de-norming, storming and forming as the data suggests that as teams grow older, they tend to experience a decline in performance due to factors like communicative breakdowns, lack on innovation and motivation [77]. The paper suggests that software managers should be aware of the potential decay stages in software teams and try to mitigate it by encouraging communication among team members and providing opportunities for learning and growth.[116]

In conclusion, the numerous factors associated with an effective team and contributing to overall team performance appear to be fairly extensive. On one hand, the communicative aspects of software teams have consistently been highlighted as important in that effective communication practices among team members positively influence reported team performance. On the other hand, factors like cognitive similarities, appropriate leadership styles and task cohesion, for instance, are all suggested to be key drivers of high-performing software teams. Moreover, findings show that cooperative learning and team-building activities among team members also positively correlate with improvements in project outcomes. Furthermore, increased productivity has also been reported in software teams if team composition is acknowledged, however, in Agile software development environments. Besides this, teams who moderately manage their intra-group conflicts were more likely to see declines in overall performance and accordingly, are suggested to emphasise effective conflict resolution to mitigate the negative consequences of intra-group conflicts. When forming teams, software managers are encouraged to acknowledge factors like technical skills, communicative skills, similar problem-solving styles and arguably personality attributes. Additionally, software managers should be aware of the potential decay stages in software teams and subsequently try to mitigate it from occurring accordingly.

4.2.7 Diversity

In recent years, the topic of diversifying teams has become increasingly highlighted by both researchers and practitioners as new insights into the challenges faced by software developers in work environments in the context of diversity have been identified. Menezes et al. [154] examined what to consider when diversifying software teams and the benefits team are likely to experience by conducting a systematic literature review (SLR). The findings show that most studies conducted heavily emphasised gender and cultural diversity as the main drivers of diversifying teams in software development.[117] In terms of how diversifying teams affect software devel-

[115] Relation BR88
[116] Relation BR89
[117] Relation BR90

opment in particular, certain potential benefits like increased creativity and innovation were identified, however, a lack of empirical evidence was expressed. Additionally, several challenges were identified as work-related barriers regarding diversifying teams with communication difficulties, cultural differences and a lack of understanding being the key findings [154].[118] Nonetheless, the researchers suggest that more research is likely needed to draw any significant conclusions. Fortunately, Earley et al. [112] did examine transnational teams and what to consider when creating a hybrid team culture from an empirical point of view. The field study was based on a qualitative research method where participants from different nationalities worked together on various tasks, to develop a model of the effects of transnational team dynamics. The study found that homogeneous and highly heterogeneous teams outperformed teams that were moderately heterogeneous. Additionally, creating a hybrid team culture mediated the relationship between cultural diversity and team performance [112]. The researchers suggest that in the case of homogeneous teams, higher levels of shared values, norms and communication strategies likely facilitate cooperation whilst heterogeneous teams are likely more creative and innovative as more diverse perspectives and ideas are to be considered.[119]

Similarly, Liang et al. [143] analysed 16 software teams with an average team size of 6, all of whom had diverse backgrounds in terms of education, work experience and expertise. The results show that there is a significant relationship between team diversity and project performance as diversified teams can facilitate a wider range of knowledge sharing and learning that likely leads to better overall project outcomes. However, the paper also suggests that team-related conflicts are factors to consider and that organisations should focus on managing conflicts effectively to reap the benefits of knowledge diversity in teams by creating a culture for open communication and collaboration among team members [143]. Liang [143] further emphasises the probable conflicts associated with team diversity and how to address them accordingly. By considering informational diversity which refers to differences in knowledge among team members, it is likely to positively mitigate certain task-related conflicts and, additionally, create learning opportunities that will conceivably improve software quality.[120] Besides this, Silveira et al. [133] explored the benefits associated with diversifying software teams by conducting a systematic mapping study. The importance of cognitive diversity was highlighted which refers to the differences in how team members think and approach particular problems and, besides this, is suggested as a key factor in building better software teams with regards to team performance as a wider range of perspectives is considered when making decisions. Furthermore, having team members from different backgrounds and with varying experiences can help identify numerous biases and assumptions that will likely go unnoticed otherwise [133].[121] Moreover, Diegmann et al. [47] identified psychological safety in the context of team diversity and performance as a considerable factor, especially in Agile development systems. It is argued that due to Agile's

[118]Relation BR91
[119]Relation BR92
[120]Relation BR93
[121]Relation BR94

circumstances of working under conditions of uncertainty and ambiguity, psychological safety becomes particularly important during software development.[122] Lastly, Pieterse et al. [147] explored various factors affecting project success in software development teams. Comparably, team composition was identified as a vital factor for team success, especially teams who possess a higher level of mixed members from the perspective of being technical and non-technical. Other factors included aspects like communication, leadership and management practices, for instance, suggesting that teams that communicated more frequently, had strong leaders who provide clear directions and support and applied methodologies like Agile for example, all outperformed teams who do not acknowledge these aspects [147].[123]

Research regarding the importance of gender diversity in software engineering has also seen an increase in recent years, however, the findings suggest that imbalances between the genders still appear to be a recurring issue in software development. Trinkenreich et al. [9] note that although many information technology-based organisations have begun highlighting the significance of gender diversity, women are still underrepresented in software development teams. The researchers identified the most common challenges faced by women in software engineering with a lack of role models and mentors, unconscious bias, and a lack of work-life balance being the most frequent ones [9, 67]. Additionally, they suggest that women likely feel isolated in male-dominated teams which can affect their careers due to gender-based discrimination. Moreover, they found that differences in cultural backgrounds among women may have the repercussions of creating challenges associated with language barriers and cultural norms. The study suggests that particular strategies like creating mentorship programs, providing flexible work arrangements and promoting gender diversity may both attract and retain more women in software development [9].[124] The topic of breaking through a male-dominated industry was further emphasised by Canedo et al. [48] in which more challenges are presented. The findings show that in smaller teams consisting of less than 10 team members, women are often underrepresented. Besides this, factors like a lack of trust, credibility, confidence and recognition all appear to be frequent challenges faced by women in software teams. Subsequently, this entails a higher likelihood of fewer women in leadership positions as they might be overlooked for promotions [48].[125] Similar to Trinkenreich et al. [9], certain initiatives regarding mentorship programs and diversity-related initiatives are presented as viable alternatives for addressing these issues. The topic of women not feeling recognised was addressed by Ford et al. [44], in which women that use Stack Overflow were examined and found that women who encountered other women were more likely to engage sooner than those who did not. This finding can arguably be associated with factors affecting software like communication suggesting that more diverse teams can likely result in a more inclusive culture where increased participation and engagement occurs [44].[126] Catolino et al. [59] explored differences

[122]Relation BR95
[123]Relation BR96
[124]Relation BR97
[125]Relation BR98
[126]Relation BR99

in diverse teams and the associated outcomes of it where data was collected from 50 software development teams, including both open- and closed-source environments. The results show that the amount of community smells was significantly lower in diverse teams which typically refers to patterns that indicate suboptimal communication within software teams. Moreover, the findings suggest that teams without any women team members generally had notably higher community smells and were also indicated as the strongest predictor of higher community smells [59].[127] The researchers suggest that striving toward gender balance in software teams can likely improve aspects associated with communication and organisation, ultimately leading to better project success.[128]

In conclusion, the findings suggest that organisations should emphasise the importance of cultural and gender diversity as reported benefits include increased creativity, innovation, knowledge sharing and improved decision-making to name a few. Additionally, considering the significance of factors like cognitive diversity and physiological safety is likely to yield improvements associated with team performance. However, organisations are suggested to act with some caution before diversifying their software teams as challenges and implications may arise if inefficiently executed. Particular strategies are presented as approaches for fostering diversity including mentorship programs, flexible work arrangements and creating an inclusive culture can help. Moreover, it was suggested that teams who had a strong sense of communication, leadership and management principles, for instance, generally performed more efficiently. Lastly, organisations are encouraged to acknowledge the numerous barriers found in today's software industry like gender imbalances, lack of role models for specific genders and various biases that might be unconsciously occurring.

4.2.8 Culture

Culture can be referred to the shared patterns of beliefs, values, behaviours, and artefacts that characterise a group or society. It is a complex concept that takes many different shapes dependent on a plethora of different factors. Culture could be described as an omnipresent feature of human interaction, including but not limited to work environments. As such, especially as a manager in software engineering, an understanding of culture is essential to effectively navigate diverse workplace environments and enforce collaboration among employees from varying cultural backgrounds [115].[129] Similarly, as described by Tolfo et al. [144] when trying to adopt an agile culture, it requires an understanding of the company's cultural aspects to assert whether an agile culture is even suited for a company.[130]

Social presence is, as Lowry et al. [115] cites, "the degree to which a medium facilitates awareness of the other person and interpersonal relationships during the

[127] Relation BR100
[128] Relation BR101
[129] Relation BR102
[130] Relation BR103

interaction". Furthermore, social presence can be defined as the degree to which a conversation through a particular medium of communication is perceived as authentic and personal. In their study on measuring trust in technology-supported decision-making groups, Lowry et al. [115] discovered significant differences in the level of trust between homogeneous Chinese groups and heterogeneous groups consisting of both Chinese and U.S. individuals. The social presence of the mean of communication seemingly had an effect on interpersonal trust [115], where video calls, avatars and personal profiles were examples of features promoting social presence. Subsequently, the extent to which individualism affects interpersonal trust is seemingly dependent on the group's level of heterogeneity. Individualism positively affected heterogeneous groups whereas homogeneous groups experienced negative results [115]. However, as the experiment was conducted on students, insights from additional studies covering an organisational environment could strengthen the findings of the study.[131]

Divergent cultural backgrounds have long been a familiar occurrence among individuals in the software engineering field. Dubé & Robey [94] found, through their interview study conducted on 38 members of a company engaged in software development in partnership with another company, that uncertainty and cultural differences are themes that were widely expressed within the company.[132] Different from the study conducted by Lowry et al. [115], there was no emphasis on the national backgrounds of the individuals taking part in the study, but on the different cultures of the two companies in the aspect of the organisation. Overall, their study shows that when different company cultures clash, it can result in suboptimal practices, where a mutual agreement on the way of working would be more efficient.[133] However, in aspect to reduce uncertainty, Lenberg & Feldt [90] suggest adopting and clarifying distinct norms to improve team performance. Given the potential impact of differing norms on cross-company collaboration, it might be beneficial to prioritize a clarification of such norms at an early stage.[134]

Knowledge management (KM) is another field of software engineering affected by culture. Simplified, KM can be explained as how the knowledge of the company is shared and exchanged [4]. According to Boden et al. [4], the culture of international software development teams exists in aspects subdivided into three different groups: national, organisational and professional. Moreover, they suggest cultural and social issues influence how knowledge is exchanged within organisations. Furthermore, they argue cultural factors are concurrently intertwined with various intricate and multifaceted matters, such as social ties, micro politics and informal communication, and not a sole matter of national identity [4].[135] However, as their research presents a case study, they argue it is not representative, and that more research is to be conducted within the area. Similar to KM, Verma & Amin [20] conclude the

[131]Relation BR104
[132]Relation BR105
[133]Relation BR106
[134]Relation BR107
[135]Relation BR108

importance of organisational culture in the field of risk management.[136]

A study conducted by Shih & Huang [22] explored the organisational culture's effect on the deployment of software process improvement. Their study suggests that the organisational culture type played a significant role, where a hierarchical culture is favourable when compared to the other cultures of the competing values framework (CVF) [22].[137] Unfortunately, the study investigations were only based in Taiwan and the software process improvement method utilised only one strategy, capability maturity model integration (CMMI), it is important to note that these results should not be overgeneralised.

In conclusion, many different aspects of software engineering are affected by culture. Both the organisational culture as well as the national culture of the individuals supposedly affect communication, organisational politics, and interpersonal trust to name a few. The findings suggest managers in software engineering recognise the weight of understanding the company culture to navigate diverse workplaces and promote collaboration among employees with diverse cultural backgrounds. Lastly, the level of which social presence is present through the communication medium enforces interpersonal trust, where examples in which to increase it were provided.

[136]Relation BR109
[137]Relation BR110

5

Results & Data Analysis - SLR

5.1 Systematic Literature Review (Quality Assessment)

As addressed earlier in Section 3.3.1, the method of extracting research was performed by utilising a combination of search terms. The method of extracting research papers was set up so that if a page did not yield any significant results, the next search term would be switched. This approach was performed on all respective databases listed in Section 3.3.1. In total, 384 research papers were extracted from the numerous databases, consisting of 121 CI and 227 BSE research papers respectively. However, during the initial evaluation of the extracted research papers, it became evident that many of them were excluded due to their inability to answer the research question or their vague connection to SE. Moreover, some research papers were not accessible. This was largely because certain databases direct results to other websites, which were not accessible. Ultimately, 213 research papers were disregarded, resulting in 135 remaining research papers, where further details can be seen in Table 5.1 . The publication year for each research paper is shown in Figure 5.1, indicating that several of the remaining research papers appear to have been published around 2010. It should be noted that Figure 5.1 accounts for both CI- and BSE-associated research papers.

Reason	#
Initial Screening of Titles	384
Accessible	368
Not Books	359
In Scope	338[1]
Time Constraints[2]	135
Feasibility Issues during Quality Assessment	132

Table 5.1: Publications Left in Each Step

[1]This number is most likely inflated. Only papers that had time to be examined from the last step are considered. That is, some papers were removed because they were out of scope, yet there is a high probability additional ones were not excluded here and instead removed in the next step.

[2]In a late mid-term meeting, it was decided that there was no time for further theory analysis as it was already quite extensive, and therefore some of the papers were skipped for no further reason. At this point, the 135 research papers were considered valuable for the study.

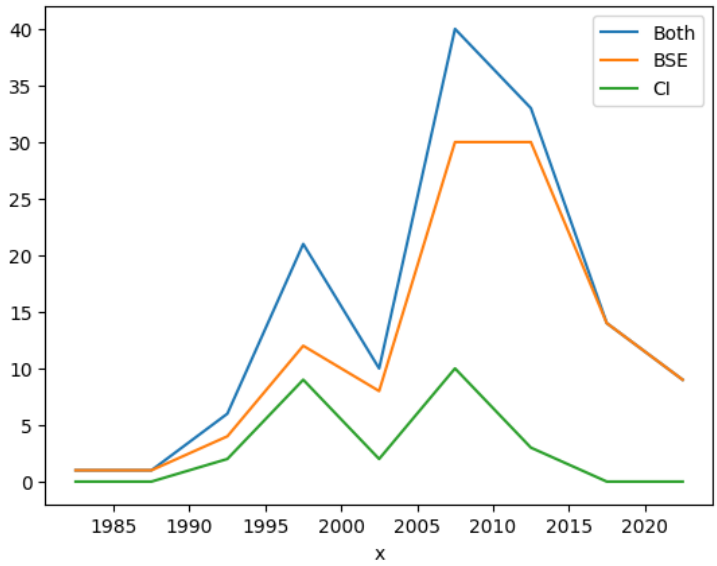

Figure 5.1: Publication Years & Frequency

The 135 remaining research papers were subjected to a quality assessment, addressed in Section 3.3.1. The results are shown in Table 5.2. However, during the assessment, 3 research papers were disregarded which consisted of 2 CI- and 1 BSE-related research paper. In one instance, one paper primarily consisted of findings derived from several other research papers, making the quality assessment process unfeasible. Another paper was found to vaguely emphasise the subject of software engineering, in addition to having a very unclear way of describing what was being assessed. The latter was also present in the third research paper. Therefore, the results shown in Table 5.2 encapsulated the results from the remaining 132 research papers. The results also show that most research papers appear to be categorised as either "Good" or "Great". Moreover, the results do not appear to overrepresent any research papers in any category, conceivably indicating that the established quality assessment is sufficient. Although these results do not necessarily impact the thesis conclusion, it provides insights into the quality of the papers used in the SLR.

Table 5.2: Quality Assessment Results (SLR)

Quality (%)	Poor (0-20%)	Fair (20-40%)	Good (40-60%)	Great (60-80%)	Excellent (80-100%)
# Papers	23	24	40	31	14

5.2 Theory Analysis (O/R/L Analysis)

In order to effectively answer RQ1 in a concrete and grounded way, the entirety of section 4 is addressed and analysed in a rigorous manner. However, the theory regarding CI and BSE is rather extensive and acknowledges hundreds of research papers. Therefore, the decision to create a systematic approach to appraise the many findings adequately was made.

The approach consists of perceiving the findings presented in the research literature as outcomes, requirements and limitations. As explained in the methodology, these key factor properties are explained as:

- **Outcome:** the main objective the paper is focused on achieving

- **Requirement:** how are they achieving/accomplishing it.

- **Limitation:** something that might prevent the process of achieving/accomplishing the outcome, given the requirement is fulfilled.

By distinguishing the researchers' conclusions in this manner, it facilitates a method to effortlessly see similarities and differences. Additionally, it allows for a practical way to discover associations between specific outcomes and the requirements and limitations affecting them. It should be noted that in certain instances, some research papers do not concretely address conceivable limitations or implications regarding their findings. If this scenario occurs, the limitation field is simply left empty. Furthermore, the term "limitations" should not distinctively be perceived as negative as the identified limitations in particular research papers could be recognised as considerations. However, the argument that these considerations do not necessarily associate with the specified requirements affecting a particular outcome could be made. Therefore, the decision to categorise them as limitations was made. Lastly, when analysing the research literature, some researchers allude to similar conclusions, however, they may express it differently.

An example of this scenario would be the researcher's suggestion that "committed-", "competent-" and "attentive managers". Acknowledging every variety would create a scope that is far too broad, therefore, the decision to narrow down similar occurrences was made. This approach was applied throughout the entire analysing process and was continuously revised whenever a previously unrecognised key factor emerged (as in the example above).

Table 5.3 illustrates 3 examples of how the appraisal of particular research findings was addressed. It illustrates the places in the theory where the given key factor relations were made and the associated key factors. This way, key factors are elicited and relations between the found key factors are constructed. In the cases where multiple key factors are present of any particular type, it should be seen as if they all affect the other key factors *individually* – not in unison. That is, if two require-

ments are present in a relation but there is only one outcome, the outcome is deemed fulfilled by each of the requirements separately. On the other hand, eliciting relationships where a group of requirements are all needed for a certain outcome would be interesting, but was quickly realised to become very complex and was therefore discontinued.

The tables and figures presented in this section are designed to offer a comprehensive overview of the identified key factors in both CI and BSE research. Tables 5.4 and 5.5 map all created key factor relations from the reviewed literature and Tables 5.6 and 5.7 catalogue key factors extracted from the relations. Figures 5.3 to 5.6 were created to visually depict the relationships among these key factors, providing a complementary illustration to the tabular data.

Table 5.3: Identifying Key Factors and Key Factor Relations

Outcome (O)	Requirement (R)	Limitation (L)	Citation
Customer Satisfaction	Soft Skills		González-Morales et al. (2011) examined the effect of teaching various soft skills like communication, teamwork and time management to software engineering students. By collaborating with local organisations, the researchers were able to collect feedback regarding students' ability to utilise their soft skills in real-world scenarios. In all cases, higher levels of satisfaction were reported by companies, suggesting that emphasising soft skills should be acknowledged by organisations [31].
Job Satisfaction & Software Quality	Personality & Conflict Management	Monitoring	By analysing 35 software teams, the findings suggest that team members who had higher levels of conscientiousness reported greater job satisfaction [134]. Additionally, these personality traits, in particular, appeared to also improve teams' software quality. Aside from personality traits, teams who reported higher amounts of task conflicts saw a drop in both job satisfaction and team cohesion [134]. The researchers suggest that organisations should consider these insights when monitoring software teams as pairing compatible personalities in teams could impact job satisfaction and, conceivably, software quality.

Providing the citation for all the key factor relations created would become exhaustively large. Instead, each relation have an ID which is connected to a footnote on the page of the citation. Therefore, Table 5.4 and Table 5.5 illustrates the same information but without the detailed citations for each key factor relations, but with relation IDs, linking to each corresponding citation in the theory. Apart from the above, these tables also include a separate column for the source from which the key factors emerged.

Table 5.4: Key Factor Relations (CI)

ID	OUT	REQ	LIM	SRC
CR1	Competitive Advantage Quality Reduce Variability	Employee Involvement	Creativity Innovation	[6]
CR2	Competitive Advantage	Work Culture Employee Involvement Team Work Managerial Commitment Employee Empowerment Communication	Organisation	[136]
CR3	Quality Productivity Safety	Leadership Goals Employee Involvement	Managerial Commitment Resistance to Change	[151]
CR4	Motivation Job Satisfaction	Decision-Making Problem-solving Skill Variety Task Identity Task Significance Autonomy Feedback Growth Needs	Managerial Commitment	[21]
CR5	Reduce Defects Reduce Variability	Data-driven Tools		[75]
CR6	Reduce Defects Reduce Variability Customer Satisfaction	Managerial Commitment Organisational Learning	Managerial Commitment	[81]
CR7	Employee Involvement Decision-Making	Managerial Commitment Work Culture		[65]
CR8	Quality Customer Satisfaction Reduce Costs Efficiency	Identify Requirements		[142]
CR9	Quality	Planning		[69]

	Customer Satisfaction Reduce Costs Efficiency			
CR10	Quality Customer Satisfaction Reduce Costs Efficiency	Managerial Commitment Monitoring Work Culture		[139]
CR11	Quality Identify Improvements	Monitoring Customer Requirements Employee Involvement		[75]
CR12	Quality Identify Improvements Performance	Leadership Managerial Commitment	Managerial Commitment	[38]
CR13	Competitive Advantage	Managerial Commitment Work Environment Employee Empowerment Work Culture Supplier Relationships		[79] & [119]
CR14	TQM	Work Culture Identify Requirements	Employee Needs Monitoring	[60]
CR15	TQM		Managerial Commitment Organisational Learning Resistance to Change Communication Employee Involvement Resources	[106]
CR16	TQM	Identify Requirements Monitoring		[65]
CR17	Customer Satisfaction Reduce Waste	Managerial Commitment Identify Improvements Organisational Learning		[75]
CR18	Performance Work Culture	Leadership		[68]
CR19	Lean	Work Culture		[5]
CR20	Reduce Defects Customer Satisfaction		Resistance to Change	[104]
CR21	Motivation	Job Design Autonomy Skill Variety Task Significance Feedback Managerial Commitment	Autonomy Task Fragmentation	[137]
CR22	Quality	Managerial Commitment		[105]

CR23	Competitive Advantage	Managerial Commitment	Managerial Commitment	[14]
CR24	Efficiency Productivity Profitability	Identify Waste		[102]
CR25	Work Culture	Cross-functional Teams		[80]
CR26	Job Satisfaction	Responsibility		[152]
CR27	Performance	Job Satisfaction		[152]

Table 5.5: Key Factor Relations (BSE)

ID	OUT	REQ	LIM	SRC
BR1	Productivity Well-Being	Organisational Learning	Work Culture	[116, 7]
BR2	Performance	Communication Creativity Innovation Work Culture	Soft Skills	[53]
BR3	Customer Satisfaction	Soft Skills		[31]
BR4	Project Success	Soft Skills Cultural Aspects		[62]
BR5	Productivity	Soft Skills		[76]
BR6	Leadership	Soft Skills	Organisational Learning	[109]
BR7	Soft Skills	Organisational Learning		[109]
BR8	Quality	Employee Personality	Monitoring	[35]
BR9	Retention Recruitment	Monitoring	Cognitive Style	[35]
BR10	Collaboration	Team Diversity	Employee Personality	[19] & [26]
BR11	Project Success	Soft Skills	Team Composition	[96]
BR12	Performance	Employee Personality	Monitoring	[49]
BR13	Well-Being	Employee Personality	Monitoring	[50]
BR14	Quality	Employee Personality	Monitoring	[49]
BR15	Job Satisfaction	Emotional Intelligence	Monitoring	[98]
BR16	Quality Job Satisfaction	Employee Personality Team Cohesion Conflict Management	Monitoring Managerial Commitment	[134]
BR17	Team Work	Team Diversity	Employee Personality Managerial Commitment	[78]
BR18	Communication	Employee Personality	Team Diversity	[26]
BR19	Performance	Employee Personality	Organisational Learning	[39]
BR20	Collaboration Productivity	Team Cohesion		[84]

	Job Satisfaction			
BR21	Project Success	Team Diversity	Employee Personality	[93]
BR22	Performance	Communication	Team Diversity	[111]
BR23	Performance Project Success Problem-Solving Leadership	Team Diversity Employee Personality	Team Composition	[117]
BR24	Work Culture Creativity Innovation Productivity	Employee Needs	Organisational Learning	[58]
BR25	Motivation Job Satisfaction	Autonomy Recognition	Managerial Commitment	[58]
BR26	Quality	Motivation	Organisational Learning	[145]
BR27	Motivation	Growth Needs	Managerial Commitment	[129]
BR28	Productivity	Job Satisfaction		[33]
BR29	Performance Productivity Retention	Motivation	Managerial Commitment	[33]
BR30	Motivation	Task Variety Task Significance	Managerial Commitment	[56]
BR31	Motivation	Monitoring		[57]
BR32	Motivation	Salary Benefits Job Satisfaction	Managerial Commitment	[73]
BR33	Motivation	Growth Needs Recognition Feedback Security	Managerial Commitment	[70]
BR34	Managerial Commitment	Organisational Learning		[71]
BR35	Motivation	Organisational Learning	Cognitive Bias	[131]
BR36	Motivation	Growth Needs Task Variety Autonomy Task Significance Team Cohesion Communication Leadership Recognition	Organisation	[29, 128]
BR37	Motivation	Autonomy Technical Expertise Task Significance Team Cohesion	Managerial Commitment	[30]

BR38	Motivation	Autonomy Feedback Communication	Managerial Commitment	[41]
BR39	Motivation	Ownership of Work Task Significance Task Variety Feedback	Managerial Commitment	[11]
BR40	Motivation	Feedback Organisational Learning	Managerial Commitment	[37]
BR41	Motivation	Job Satisfaction Autonomy Organisational Learning	Organisation	[50]
BR42	Motivation	Growth Needs	Feedback	[25]
BR43	Employee Needs	Organisational Learning	Managerial Commitment	[28]
BR44	Productivity	Motivation		[28]
BR45	Well-Being	Job Satisfaction		[28]
BR46	Job Satisfaction	Task Significance	Managerial Commitment	[113]
BR47	Decision-Making	Cognitive Bias	Managerial Commitment	[82]
BR48	Project Success	Risk Management	Cognitive Bias	[83]
BR49	Project Success	Skill Variety	Cognitive Bias	[107]
BR50	Quality		Cognitive Bias	[18, 64]
BR51	Performance	Organisational Learning		[120]
BR52	Performance Job Satisfaction	Job Design	Managerial Commitment Cognitive Style	[103]
BR53	Performance	Employee Emotions	Planning	[140]
BR54	Problem-Solving	Cognitive Diversity	Team Composition Managerial Commitment	[85]
BR55	Problem-Solving	Cognitive Style		[45, 97]
BR56	Performance	Psychometric Data	Employee Needs	[125]
BR57	Productivity Well-Being	Psychometric Data		[34]
BR58	Collaboration Feedback	Employee Needs	Monitoring	[46]
BR59	Decision Making	Employee Emotions	Monitoring	[123]
BR60 BR61	Project Success Employee Emotions	Employee Emotions Communication Recognition	Monitoring Organisational Learning	[63] [32]
BR62	Job Satisfaction Motivation	Employee Emotions		[32]
BR63	Innovation	Job Design	Employee Emotions Resistance to Change	[43]
BR64	Organisational Learning	Employee Emotions	Employee Needs	[43]

BR65	Employee Emotions	Job Design	Planning	[43]
BR66	Team Work	Team Cohesion Communication	Soft Skills	[124]
BR67	Performance	Team Composition	Team Cohesion	[121]
BR68	Performance	Team Cohesion	Managerial Commitment	[124]
BR69	Project Success	Communication		[16]
BR70	Performance	Communication		[3]
BR71	Team Cohesion	Work Environment Communication	Employee Engagement	[150]
BR72	Communication Performance	Work Environment	Team Composition	[42]
BR73	Team Diversity	Communication Team Requirements		[95]
BR74	Distributed Teams	Trust Relationship Building	Employee Engagement	[89]
BR75	Efficiency	Cognitive Style Communication	Team Composition Managerial Commitment	[66]
BR76	Performance	Team Cohesion	Team-Building Employee Engagement	[12]
BR77	Performance	Organisational Learning Innovation	Managerial Commitment Employee Empowerment	[74]
BR78	Performance	Task Significance Communication Team Cohesion	Work Environment	[100]
BR79	Pair Programming	Soft Skills	Employee Engagement	[88]
BR80	Productivity	Team Composition	Managerial Commitment	[88]
BR81	Performance	Communication Trust Conflict Resolution	Soft Skills	[127]
BR82	Performance	Conflict Resolution	Soft Skills	[61, 141]
BR83	Performance	Conflict Resolution	Employee Personality Conflict Management	[130]
BR84	Project Success	Conflict Management	Managerial Commitment	[40]
BR85	Team Work	Team Building	Technical Expertise Communication Work Experience	[52]
BR86	Performance	Employee Personality	Managerial Commitment Team Size	[108]
BR87	Project Success	Team Composition	Technical Expertise Soft Skills	[52]
BR88	Performance	Problem Solving	Cognitive Styles	[92, 146]
BR89	Reduce Team Decay	Growth Needs		[77]

		Organisational Learning		
BR90	Innovation Creativity	Team Diversity	Cultural Aspects	[154]
BR91	Team Diversity	Managerial Commitment Communication	Cultural Aspects	[154]
BR92	Performance Creativity Innovation	Team Diversity Team Cohesion Team Norms	Distributed Teams Communication	[112]
BR93	Performance Organisational Learning	Team Diversity Communication Collaboration Cognitive Diversity	Managerial Commitment Conflict Resolution	[143]
BR94	Performance	Cognitive Diversity	Managerial Commitment Cognitive Bias	[133]
BR95	Performance	Psychological Safety	Uncertainty	[47]
BR96	Performance	Team Composition Communication Leadership	Technical Expertise Managerial Commitment	[147]
BR97	Gender Equality	Team Diversity Employee Empowerment Employee Needs		[9, 67]
BR98	Gender Equality	Employee Empowerment		[48]
BR99	Gender Equality	Work Environment Work Culture	Communication Employee Empowerment	[44]
BR100	Quality	Team Diversity	Communication	[59]
BR101	Communication	Gender Equality		[59]
BR102	Collaboration	Work Culture	Managerial Commitment	[115]
BR103	Work Culture	Organisational Learning	Managerial Commitment	[144]
BR104	Trust	Team Diversity Social Presence Ownership of Work	Managerial Commitment Communication Team Diversity	[115]
BR105	Distributed Teams		Cultural Aspects Uncertainty	[94]
BR106	Performance	Team Cohesion	Cross-Company Collaboration	[94]
BR107	Performance Reduce Uncertainty	Team Norms	Cross-Company Collaboration	[90]
BR108 BR109	Knowledge Management Knowledge Management	Organisational Learning Work Culture	Cultural Aspects	[4] [20]
BR110	Performance	Work Environment		[22]

Subsequently, a table consisting of every key factor regardless of specification (outcome, requirement & limitation) was established. Tables 5.6 and 5.7 are composed of every identified key factor associated with CI and BSE key factors respectively. Both tables consist of 4 columns which represent an ID, Key Factor, Type and Source. It should be noted that Column 3, "Type", describes whether a corresponding key factor is an outcome (O), requirement (R) or limitation (L). Column 4, "Source", simply cites the referenced research paper that presented the corresponding key factor.

Table 5.6: Key Factors (CI)

ID	Key Factor	Type	Source
C1	Autonomy	R/L	[21] [137]
C2	Communication	R/L	[21] [106]
C3	Competitive Advantage	O	[6] [14] [79] [119] [136]
C4	Creativity	L	[6]
C5	Cross-functional Teams	R	[80]
C6	Customer Requirements	R	[75]
C7	Customer Satisfaction	O	[69] [75] [81] [104] [139] [142]
C8	Data-driven Tools	R	[75]
C9	Decision-Making	O/R	[21] [65]
C10	Efficiency	O	[69] [102] [139] [142]
C11	Employee Empowerment	R	[79] [119] [136]
C12	Employee Involvement	O/R/L	[6] [65] [75] [106] [136] [151]
C13	Employee Needs	L	[60]
C14	Feedback	R	[21] [137]
C15	Goals	R	[151]
C16	Growth Needs	R	[21]
C17	Identify Improvements	O/R	[38] [75]
C18	Identify Requirements	R	[60] [65] [142]
C19	Identify Waste	R	[102]
C20	Innovation	L	[6]
C21	Job Design	R	[137]
C22	Job Satisfaction	O/R	[21] [152]
C23	Leadership	R	[38] [68] [151]
C24	Managerial Commitment	R/L	[14] [21] [38] [65] [75] [79] [81] [105] [106] [119] [136] [137] [139] [151]
C25	Monitoring	R/L	[60] [65] [75] [139]
C26	Motivation	O	[21] [79] [137]
C27	Organisation	L	[136]
C28	Organisational Learning	R/L	[75] [81] [106]
C29	Performance	O	[38] [68] [152]
C30	Planning	R	[69]
C31	Problem-solving	R	[21]

C32	Productivity	O	[102] [151]
C33	Profitability	O	[102]
C34	Quality	O	[6] [151] [142] [69] [139] [75] [38] [105]
C35	Reduce Costs	O	[69] [139] [142]
C36	Reduce Defects	O	[75] [81] [104]
C37	Reduce Variability	O	[6] [75] [81]
C38	Reduce Waste	O	[75]
C39	Resistance to Change	L	[104] [106] [151]
C40	Resources	L	[106]
C41	Responsibility	R	[152]
C42	Safety	O	[151]
C43	Skill Variety	R	[21] [137]
C44	Supplier Relationships	R	[79] [119]
C45	Task Fragmentation	L	[137]
C46	Task Identity	R	[21]
C47	Task Significance	R	[21] [137]
C48	Team Work	R	[136]
C49	TQM	O	[60] [106] [65]
C50	Work Environment	R	[79] [119]
C51	Work Culture	O/R	[136] [65] [139] [79] [119] [60] [68] [5] [80]

Table 5.7: Key Factors (BSE)

ID	Key Factor	Type	Source
B1	Autonomy	R	[29] [30] [41] [50] [58]
B2	Benefits	R	[73]
B3	Collaboration	O/R/L	[19] [26] [46] [84] [90] [94] [115] [143]
B4	Communication	O/R/L	[3] [16] [26] [29] [32] [41] [42] [44] [52] [53] [59] [66] [95] [100] [111] [112] [115] [127] [143] [147] [150] [154]
B5	Cognitive Bias	R/L	[18] [64] [82] [83] [107] [124] [131] [133]
B6	Cognitive Diversity	R	[85] [133] [143]
B7	Cognitive Style	R/L	[35] [45] [66] [92] [97] [103] [146]
B8	Conflict Management	R/L	[40] [130] [134]
B9	Conflict Resolution	R/L	[61] [127] [130] [141] [143]
B10	Creativity	O/R	[53] [58] [112] [154]
B11	Cross-Company Collaboration	L	[90] [94]
B12	Cultural Aspects	R/L	[4] [62] [94] [154]
B13	Customer Satisfaction	O	[31]
B14	Decision-Making	O	[82] [123]
B15	Distributed Teams	O/L	[89] [94] [112]

B16	Efficiency	O	[66]
B17	Emotional Intelligence	R	[98]
B18	Employee Engagement	L	[12] [88] [89] [150]
B19	Employee Emotions	O/R/L	[32] [43] [46] [63] [123] [140]
B20	Employee Empowerment	R/L	[9] [44] [67] [74]
B21	Employee Needs	O/R/L	[9] [28] [43] [58] [67] [125] [126]
B22	Employee Personality	R/L	[19] [26] [35] [39] [49] [50] [78] [93] [108] [117] [130] [132] [134]
B23	Feedback	O/R/L	[11] [25] [37] [41] [46] [70]
B24	Gender Equality	O/R	[9] [44] [48] [59] [67]
B25	Growth Needs	R	[25] [29] [70] [77] [129]
B26	Innovation	O/R	[43] [53] [58] [74] [112] [154]
B27	Job Design	R	[43] [103]
B28	Job Satisfaction	O/R	[32] [113] [103] [58] [33] [73] [50] [113] [98] [134] [84]
B29	Leadership	O/R	[147] [29] [117] [109]
B30	Knowledge Management	O	[4] [20]
B31	Managerial Commitment	O/R/L	[115] [144] [115] [154] [143] [133] [147] [124] [66] [74] [101] [40] [108] [113] [82] [103] [85] [58] [129] [56] [33] [57] [73] [70] [71] [30] [41] [11] [37] [28] [134] [78]
B32	Monitoring	R/L	[46] [123] [63] [57] [35] [49] [50] [132] [98] [134]
B33	Motivation	O/R	[32] [145] [58] [129] [56] [33] [57] [73] [70] [131] [30] [29] [41] [11] [37] [50] [25] [113]
B34	Organisation	L	[29] [50]
B35	Organisational Learning	O/R/L	[144] [4] [143] [74] [77] [32] [43] [120] [58] [145] [71] [131] [37] [50] [28] [126] [39] [116] [7] [109]
B36	Ownership of Work	R	[115] [11]
B37	Pair Programming	O	[88]
B38	Performance	O	[94] [90] [22] [112] [143] [133] [47] [147] [121] [124] [3] [42] [12] [74] [100] [127] [61] [141] [130] [108] [92] [146] [125] [120] [103] [140] [33] [49] [126] [39] [111] [117] [53]
B39	Planning	L	[43] [140]
B40	Problem-Solving	O/R	[92] [146] [85] [45] [97] [117]
B41	Productivity	O	[101] [34] [58] [33] [113] [84] [116] [7] [76]
B42	Project Success	O	[16] [40] [52] [63] [83] [107] [96] [117] [62]
B43	Psychometric Data	R	[125] [34]

B44	Quality	O	[59] [18] [64] [145] [35] [132] [134]
B45	Recognition	R	[32] [58] [70] [29]
B46	Recruitment	O	[35]
B47	Reduce Team Decay	O	[77]
B48	Reduce Uncertainty	O	[90]
B49	Relationship Building	R	[89]
B50	Resistance to Change	L	[43]
B51	Retention	O	[33] [35]
B52	Risk Management	R	[83]
B53	Salary	R	[73]
B54	Security	R	[70]
B55	Social Presence	R	[115]
B56	Soft Skills	O/R/L	[124] [88] [127] [61] [141] [52] [96] [53] [31] [62] [76] [109]
B57	Task Variety	R	[56] [29] [11]
B58	Task Significance	R	[100] [113] [56] [30] [29] [11]
B59	Team Building	R	[52]
B60	Team Cohesion	O/R/L	[94] [112] [124] [121] [150] [12] [100] [30] [29] [134] [84]
B61	Team Composition	R/L	[147] [121] [42] [66] [101] [52] [85] [96] [117]
B62	Team Diversity	O/R/L	[115] [154] [112] [143] [9] [67] [59] [95] [19] [26] [78] [111] [117]
B63	Team Norms	R	[90] [112]
B64	Team Requirements	R	[95]
B65	Team Size	L	[108]
B66	Team Work	O	[124] [52] [78]
B67	Technical Expertise	R/L	[147] [52] [30]
B68	Trust	O/R	[115] [89] [127]
B69	Uncertainty	L	[94] [47]
B70	Well-Being	O	[46] [113] [50] [116] [7]
B71	Work Culture	O/R/L	[115] [144] [20] [44] [58] [116] [7] [53]
B72	Work Environment	R/L	[22] [44] [150] [42] [100]
B73	Work Experience	L	[52]

5.3 Mapping Analysis (O/R/L Analysis)

With the help of the key factor relations in Table 5.4 and 5.5, each extracted key factor is summarised in Table 5.6 and 5.7. In order to find mutual outcomes between the two fields, CI and BSE, the relations are consequently grouped together. By first examining the fields separately, it is easier to focus on the specific requirements of BSE, which is the primary interest of RQ2. Additionally, initially having the two fields separated helps answering RQ3 as it is easier to recognise which field a certain key factor stemmed from. In short, this analysis aim to merge the key factor relation tables in to one and elicit mutual outcomes between the two fields.

Firstly, it should be noted that for this analysis, if two key factors share the same name across the two fields, 'Performance' for example, we assert they are equivalent. That is, 'Performance' in CI is presumed identical to 'Performance' in BSE, unless specified otherwise. Whilst analysing the reviewed research literature, one could not necessarily distinguish key factors once they were compared. For instance, an outcome like B38, "Performance", is heavily considered a reported outcome in BSE. However, the researchers typically do not expand their findings further than this, resulting in a conceivably unclear conclusion. Cogitating upon the fact that team cohesion [94], work environment [22], job design [103] and motivation [33] to name a few, all represent requirements for achieving higher levels of performance, one may reason that increases regarding performance vary between the individual requirements.

The same reasoning applies to the impact of which various limitations affect the same outcome. Consequently, this creates two implications. For one, the research findings do not appear to be distinguishable in any practical way, resulting in the outcome being perceived as identical, regardless of its requirement or limitation. Secondly, it becomes increasingly difficult to conclude the measurable effect a requirement or limitation has on a particular outcome. Therefore, the aforementioned decision to perceive outcomes, requirements and limitations the same was made. Furthermore, they are all seen as endeavours which, if successfully strived for and fulfilled, achieve the given outcome.

The decision to also interpret the considerable impact that a requirement or limitation has on an outcome will not be accounted for. Instead, the number of requirements or limitations a particular outcome is correlated with is highlighted as an indication of its significance. This process is recognised to induces a lot of subjectivity, as explained earlier. However, as the extensive theory covers numerous aspects and topics, it is believed to provide an arbitrary amount of confidence in the outcome of the analysis, whereas the results would be even more biased if the theory was narrow. In particular, outcomes that are heavily connected (having many different requirements and limitations) and often recurring are of higher interest as these seemingly affect many of the aspects of achieving CI in SE.

The several key factors that happen to represent multiple types are not differentiated. For instance, key factor B31 represents an outcome, requirement and limitation. In the case of it being an outcome, it should be perceived as positive. When it represents a requirement, it alludes to the key factor being a considerable requirement that leads to the desired outcome. Lastly, when the key factor is the limitation, it should be recognised as something negatively affecting the desired outcome. Therefore, the context of the key factor becomes important when determining its impact.

Figure 5.2 illustrates an example of this, in which the colours green, yellow and orange represent an outcome, requirement or limitation respectively. In this example, "Gender Equality", "Collaboration" and "Job Satisfaction" all represent outcomes identified in the reviewed BSE research literature. In relation to Table 5.7, they constitute key factors B24, B3 and B28 respectively. Whereas "Work Culture (B71)" and "Managerial Commitment (B31)" represent a requirement and limitation. Here, an association is created between B71, B24 and B3 where work culture is a requirement for achieving both gender equality and collaboration for instance. This association is subjectively made through the examination and interpretation of the different sentences in the theory, received from the SLR papers. Given a certain research paper, key factors identified as outcomes, i.e. a desirable outcome, are traced for requirements needed to fulfill this. Arrows are then drawn between the particular key factors to represent the relationship:

'Meet this requirement or overcome this limitation, and you should suggestively attain this outcome'.

Also, managerial commitment, in the example, represents a limitation affecting both collaboration and job satisfaction. With the aforementioned statement regarding the interpretation of key factors, in this particular case, it should be evident that managerial commitment should be perceived as a lack of managerial commitment. To clarify, the limitation is seen as an external requirement in this sense, which possibly limits the extent to which the outcome is received no matter the degree of fulfilment of the requirement.

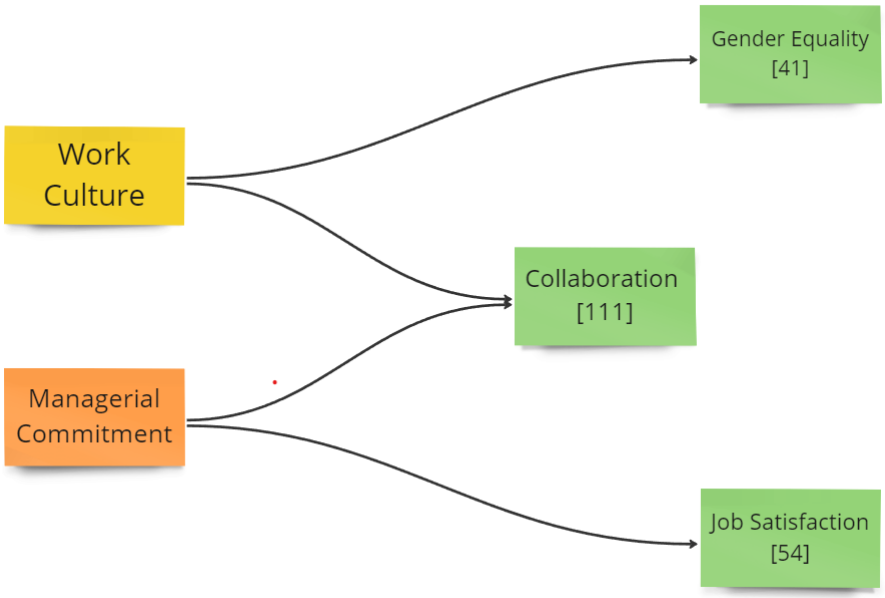

Figure 5.2: Example: Relation of Key Factors

Figures 5.3 and 5.4 illustrate the relationship between CI outcomes and requirements, and outcomes and limitations respectively, as elicited in Table 5.4 and 5.5. In both cases, outcomes are highlighted in blue whilst requirements and limitations are highlighted in green and red. Likewise, Figures 5.5 and 5.6 illustrate relationships regarding BSE. The reason to keep BSE and CI separated in the figures, outcomes/requirements and outcomes/limitations, is simply due to the vast amounts of relations found. By illustrating it in four images instead of one, readability is greatly improved.

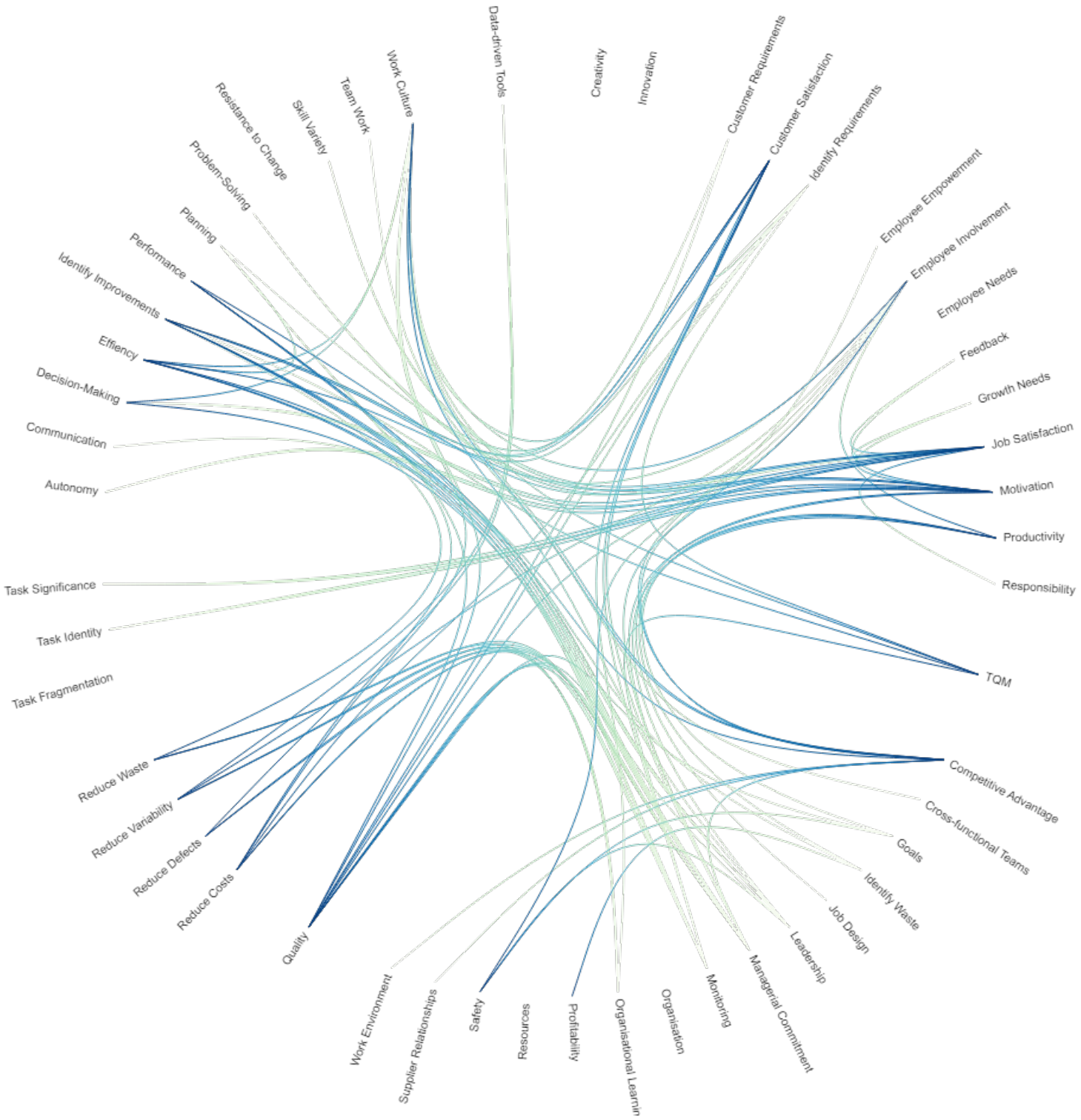

Figure 5.3: Relationship between outcomes (O) & requirements (R) (CI)

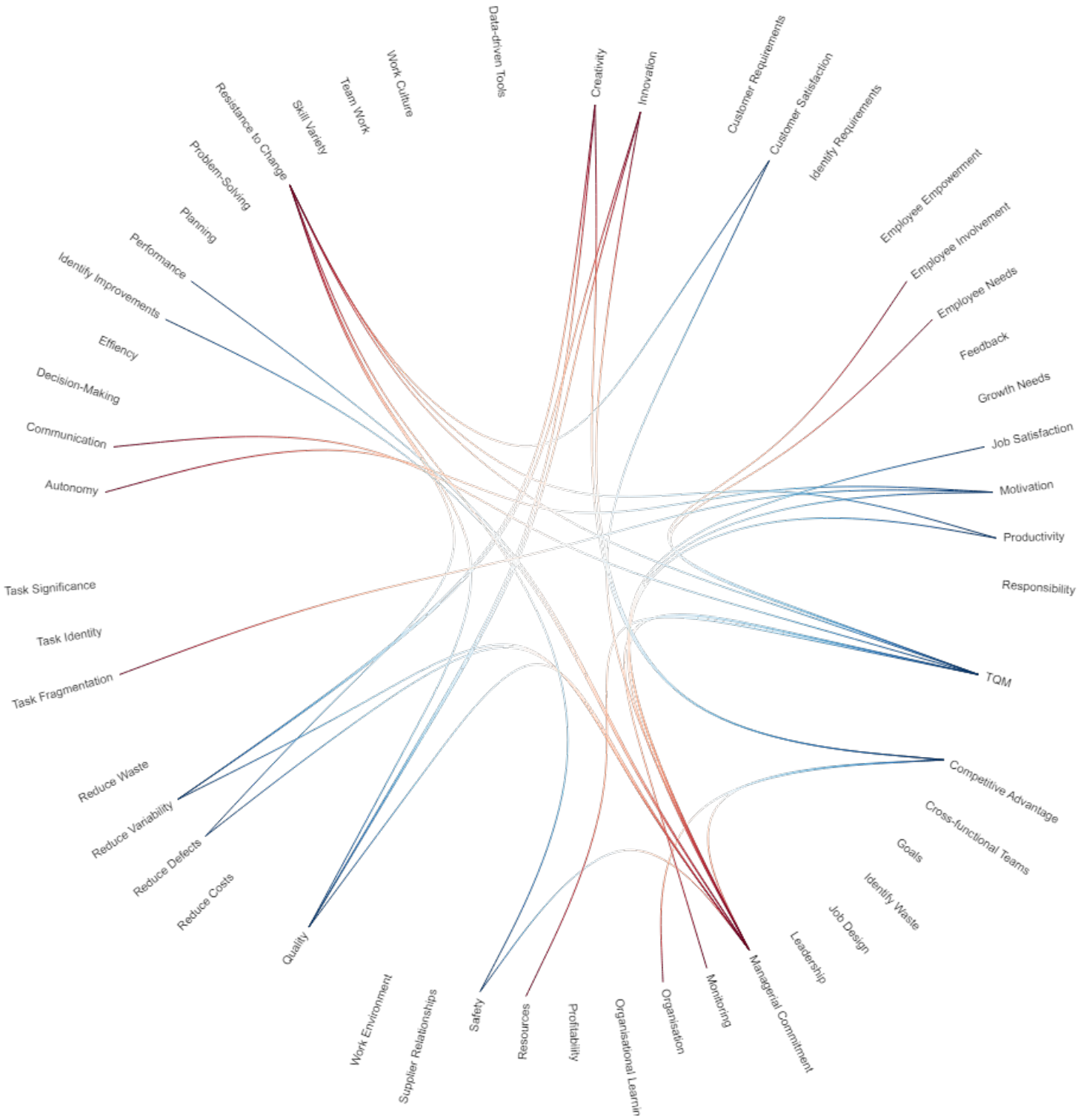

Figure 5.4: Relationship between outcomes (O) & limitation (L) (CI)

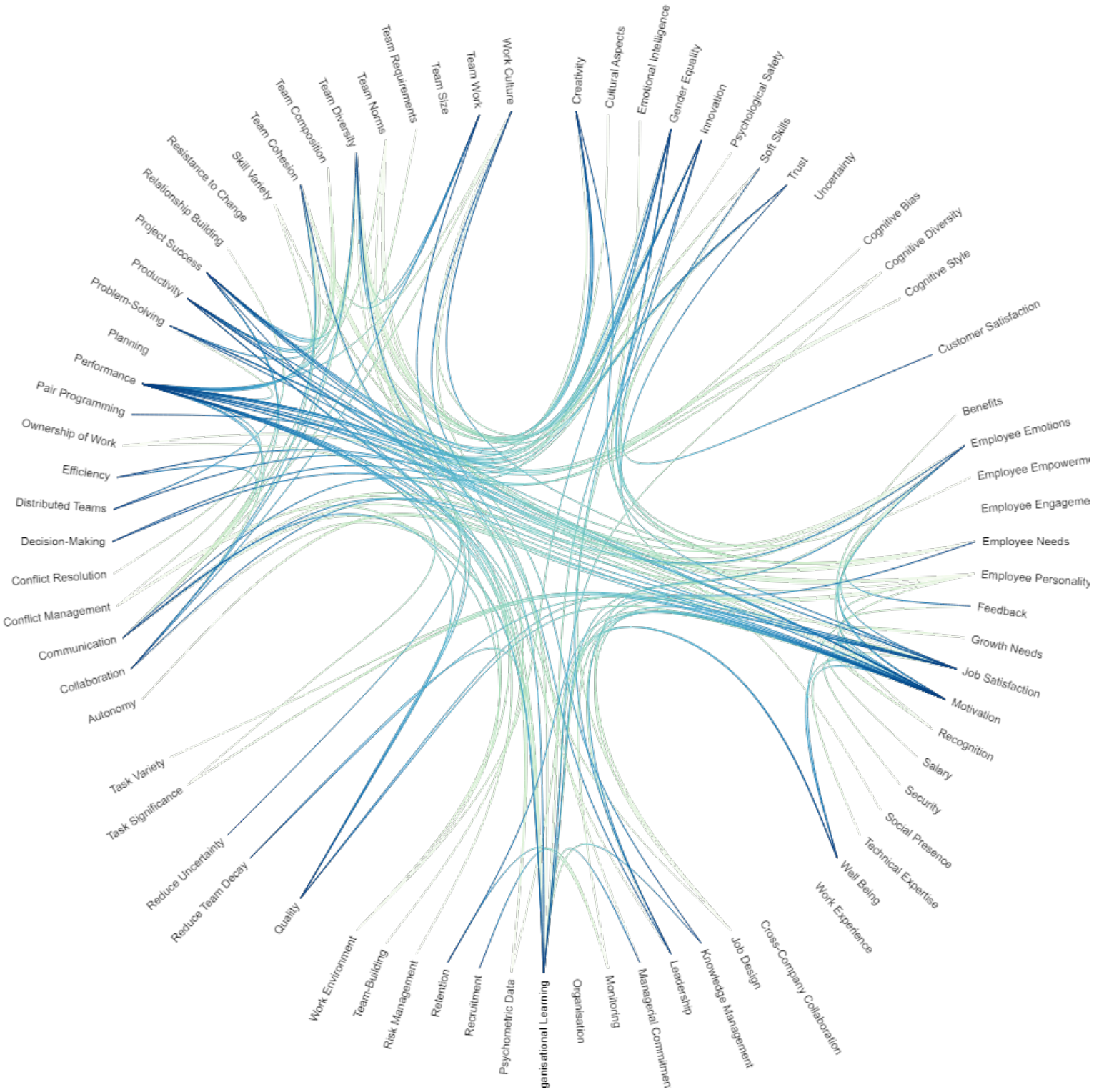

Figure 5.5: Relationship between outcomes (O) & requirements (R) (BSE)

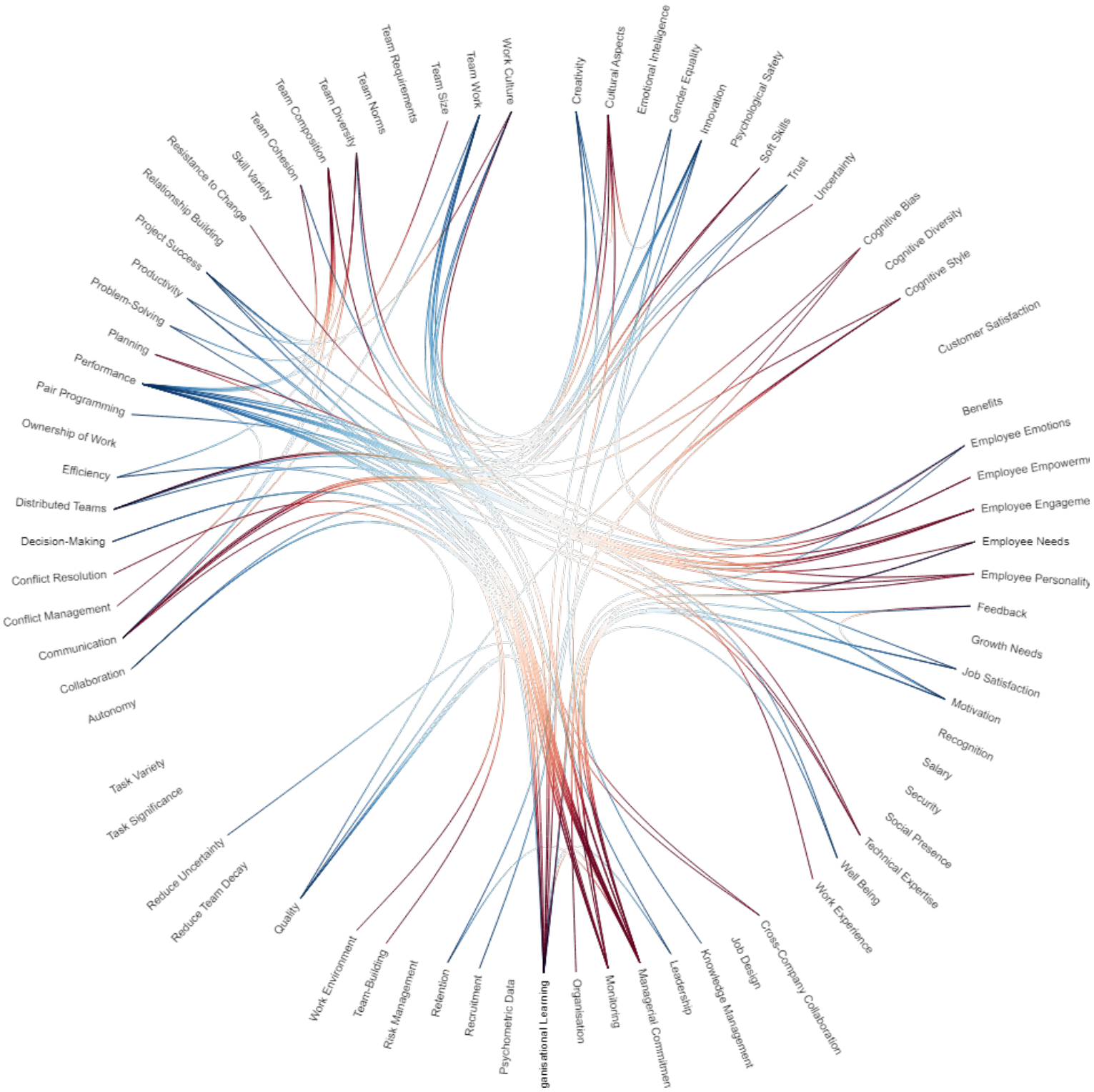

Figure 5.6: Relationship between outcomes (O) & limitation (L) (BSE)

5.3.1 Theory Analysis Results (O/R/L Analysis)

In total, 19 identified outcomes associated with successful CI implementation exist in the conducted SLR. Likewise, a total of 35 outcomes were identified in associated BSE research literature. Table 5.8 lists all the corresponding outcomes found.

Table 5.8: Outcomes (CI & BSE)

ID	CI		BSE
C3	Competitive Advantage	B3	Collaboration
C34	Costs (Reduced)	B4	Communication
C7	Customer Satisfaction	B10	Creativity
C9	Decision-Making	B13	Customer Satisfaction
C35	Defects (Reduced)	B14	Decision-Making
C10	Efficiency	B15	Distributed Teams
C12	Employee Involvement	B16	Efficiency
C17	Identify Improvements	B19	Employee Emotions
C22	Job Satisfaction	B21	Employee Needs
C26	Motivation	B23	Feedback
C29	Performance	B24	Gender Equality
C32	Productivity	B26	Innovation
C33	Profitability	B28	Job Satisfaction
C51	Quality	B29	Leadership
C41	Safety	B30	Knowledge Management
C48	TQM	B31	Managerial Commitment
C36	Variability (Reduced)	B33	Motivation
C37	Waste (Reduced)	B35	Organisational Learning
C50	Work Culture	B37	Pair Programming
		B38	Performance
		B40	Problem-Solving
		B41	Productivity
		B42	Project Success
		B44	Quality
		B46	Recruitment
		B47	Reduce Team Decay
		B48	Reduce Uncertainty
		B51	Retention
		B56	Soft Skills
		B60	Team Cohesion
		B62	Team Diversity
		B66	Team Work
		B68	Trust
		B70	Well-Being
		B71	Work Culture

Altogether, 9 shared outcomes were identified in both research fields. However, one may suggest that many of the identified BSE outcomes surround employee involvement, empowerment and engagement although not specified as an outcome. Furthermore, key factors B18 and B20 do encompass these viewpoints. Therefore, for this analysis "Employee Involvement" will be perceived as a shared outcome and highlighted later in the analysis, making the total number of shared outcomes 10.

It should be noted that outcome 16 is defined as "TQM" which represents Total Quality Management. TQM acts as its own entire methodology and is not necessarily a particular factor associated with CI in general. Therefore, the requirements to achieve TQM will be acknowledged but the outcome itself will not be perceived as a considerable factor. This decision is based on the fact that any given methodology encompasses several other factors that must be considered to fully understand.

Second, for every shared outcome, the respective BSE requirements are analysed to provide better insight into how said outcomes are achieved. It should be noted that achieving CI is what is ultimately wanted, however, in an area of work which has been scarcely explored. Therefore, the decision to examine the various requirements that will facilitate the implementation of CI should be assessed from the perspective of BSE.

It could be argued that neglecting CI requirements and solely focusing on BSE ones could be a cause for concern. However, through addressing RQ3 by eliciting backdoor-paths to CI requirements that are shared with BSE outcomes, not only BSE requirements are taken in to account but also overlapping CI requirements. Additionally, when examining the various requirements found in Table 5.6, it is evident that many CI requirements share similarities with BSE requirements.

Figure 5.7 illustrates how each shared outcome relates to the many BSE requirements. It is divided into 4 columns, "Requirements", "Outcomes", "Continuous Outcomes" and "New & Continuous Outcomes":

■ Column 1, Requirements, lists all the identified BSE requirements that relate to each outcome.

■ Column 2, Outcomes, presents the aforementioned 10 shared outcomes found in CI & BSE respectively. Furthermore, the analysis from the SLR indicated that particular outcomes also represent requirements for other CI-related outcomes (those present in both column 2 & 3). In column 2, these outcomes are displayed with an orange background, indicating they are also requirements.

■ Columns 3 and 4, Continuous Outcome and New & Continuous Outcomes, represents outcomes that are achieved by initially reaching outcomes found in column 2, ultimately answering RQ3. For example, Figure 5.7 shows that by attaining higher levels of motivation, which in itself is a requirement, higher levels of quality, productivity and performance can be achieved. These continuous outcomes are highlighted

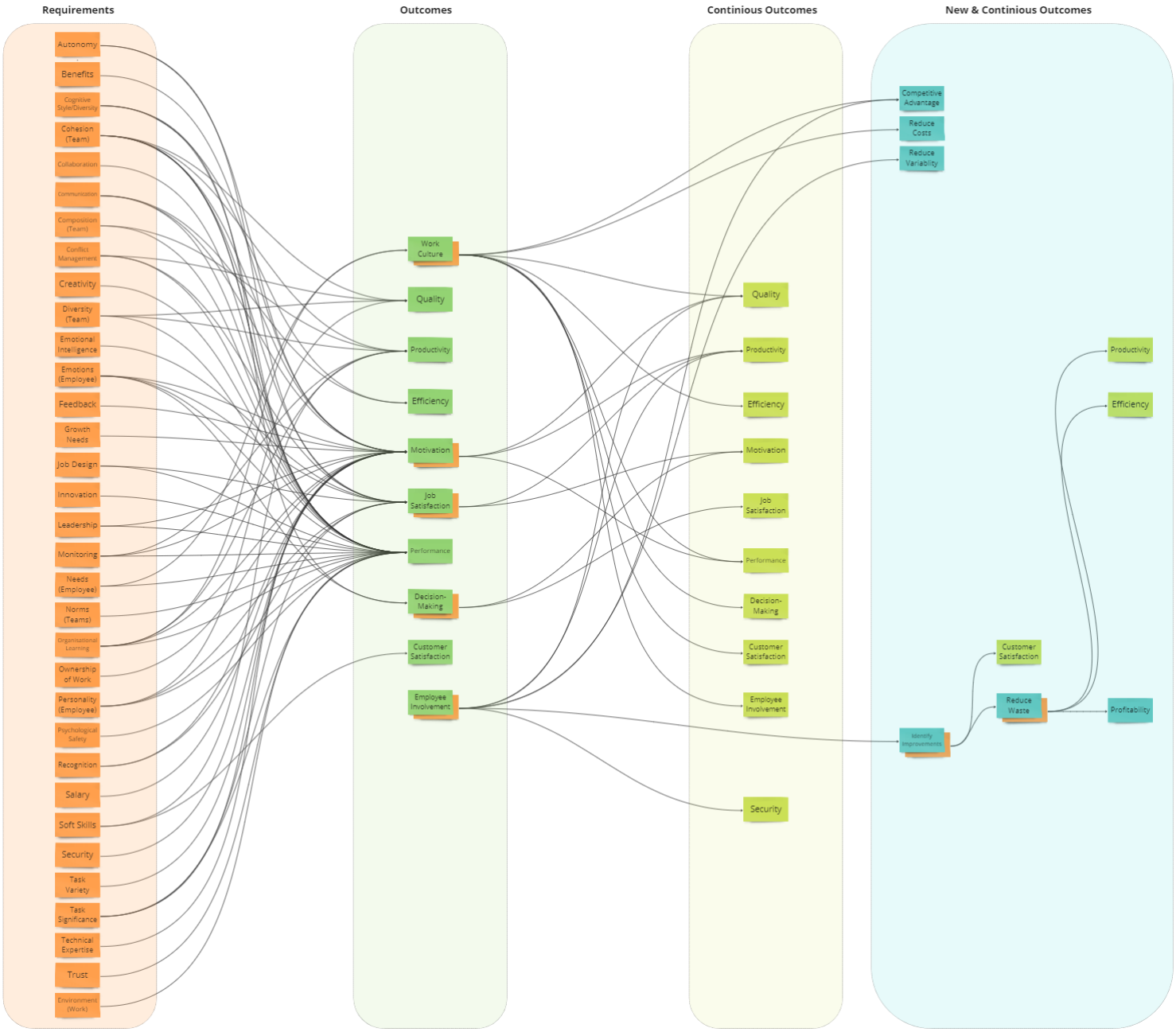

Figure 5.7: Fundamental Key Factors (CI & BSE)

in a darker yellow. Lastly, if an entirely new outcome is achieved by means of having an existing outcome represent the corresponding requirements for reaching said new outcome, the new outcomes are highlighted in blue.

It should be noted that the continuous outcome, "Security", found in column 3 should conceivably be highlighted in blue instead of dark yellow as it is not an existing outcome. However, as security originally represents a requirement in column 1, it is not necessarily a new CI outcome. Moreover, no clear relationship could be drawn since the reviewed research literature never directly associated employee

involvement as a reported outcome due to particular requirements. Instead, the outcome is talked about in a more general sense and is suggested to be an outcome that is achieved by emphasising the many requirements. However, the outcome still represents a requirement for other CI outcomes.

Similarly, the same approach of displaying the relationships between requirements and outcomes was performed when identifying limitations and their relation to outcomes. Figure 5.8 illustrates the relationship between the 10 shared outcomes and the limitations. Likewise, the Figure 2 columns, “Limitations” and “Outcomes”. As previously highlighted, the specified limitations should be perceived in a negative tone. For instance, Autonomy as a limitation should be interpreted as a lack of autonomy.

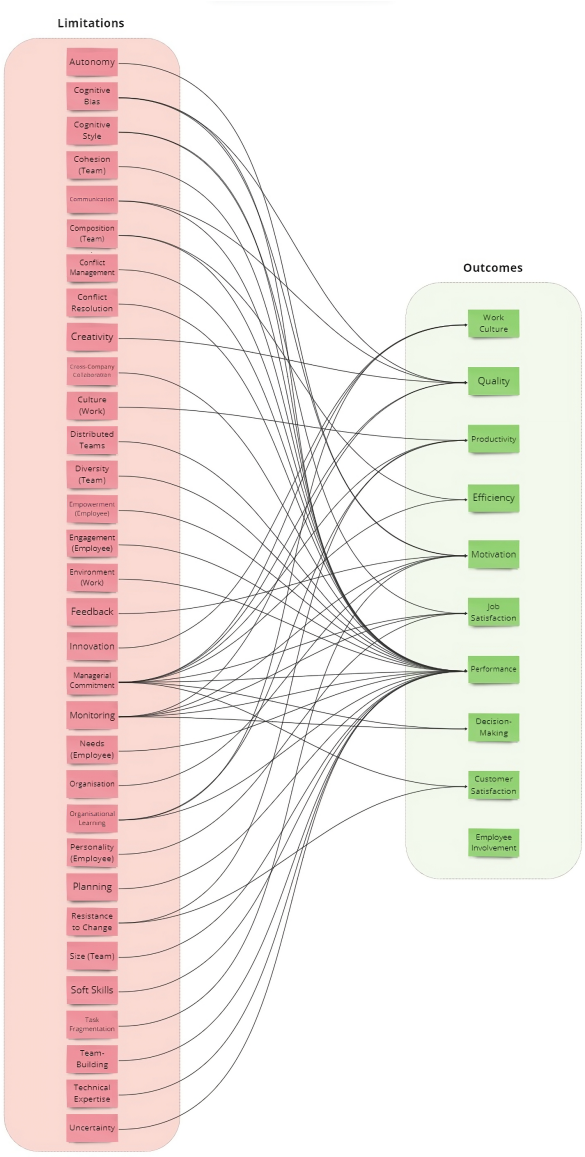

Figure 5.8: Limitations Affecting Outcomes

5.4 Formulating Interview Questions

Similar to the approach taken in section 5.3, the process of formulating the interview questions that would ultimately be used in the interviews occurred in steps. Likewise, the initial step of identifying shared outcomes that occurred in the reviewed research literature was performed. Having already established this in earlier sections, the findings presented in Table 5.8 were utilised. The argument for this decision is comparable to the one made during the analysis process of the SLR: Due to the fact that CI is what is ultimately sought after, it should be perceived from the perspective of SWD. Furthermore, the interviewees participating in the interviews all have a SWD background. Therefore, attempting to formulate interview questions that seek to answer how CI can be implemented without neglecting the associated BSE findings is likely the optimal choice.

This also implies that the correlated requirements that make the shared outcomes possible should be appraised from the perspective of BSE. Consequently, for each shared outcome, an emphasis will be put towards the corresponding BSE requirements. By doing this, it allows for achieving the desired outcome which stems from CI. However, it is achieved from the perspective of BSE. It could be argued that neglecting CI requirements and solely emphasising BSE requirements could be a cause for concern. Nevertheless, it still remains that many of the desired outcomes encompass aspects like motivation, job satisfaction and performance, for instance. Therefore, an increase in any of these aspects, regardless of whether the requirements emphasised stem from CI or BSE should be seen as a positive step towards CI. Besides this, the reviewed research literature regarding CI tends to present findings in a more general sense. For example, some researchers may suggest that to achieve CI, motivation is required. However, how to actually achieve higher levels of motivation is not clearly addressed. The findings may indicate that employee involvement, for instance, leads to higher levels of motivation without actually addressing what employee involvement encompasses. This makes it increasingly harder to formulate interview questions surrounding the topic as no clear indication of achieving particular factors (outcomes) is specified. That is, most of the outcomes have *many different requirements* pointing to them, there is no clear one-to-one relation between the different requirements and outcomes. Therefore, the decision to make the interview questions of a semi-structured nature was established to gather more in-depth and rich answers, creating discussion and reflection regarding the different causes and effects. On the contrary, a questionnaire would more easily answer the dichotomous approach of asserting the effect of different requirements on outcomes. That is, for example, on this likert scale of one to seven, how much do you believe this factor may effect this outcome? We believe, however, that much richer and intricate responses are received through semi-structured interviews as the subject is very complex and requires this to discuss it properly.

Once the requirements for achieving the respective outcomes are identified, they are subsequently mapped back to their respective theory section. Consequently, this ensures interview questions are created to discuss each of the discovered BSE themes,

the sub-sections of the SLR theory. The motivation behind this is to determine and give guidance in what factors are of greater importance than others, and likewise should be emphasised more. Concepts such as teams, motivation and culture, for example, recurred frequently throughout the literature review are deemed important and, consequently, became subsections of the theory. This procedure therefore ensures that the interview questions covers the concepts brought up in the theory. Figure 5.9 illustrates the relationship between all shared outcomes.

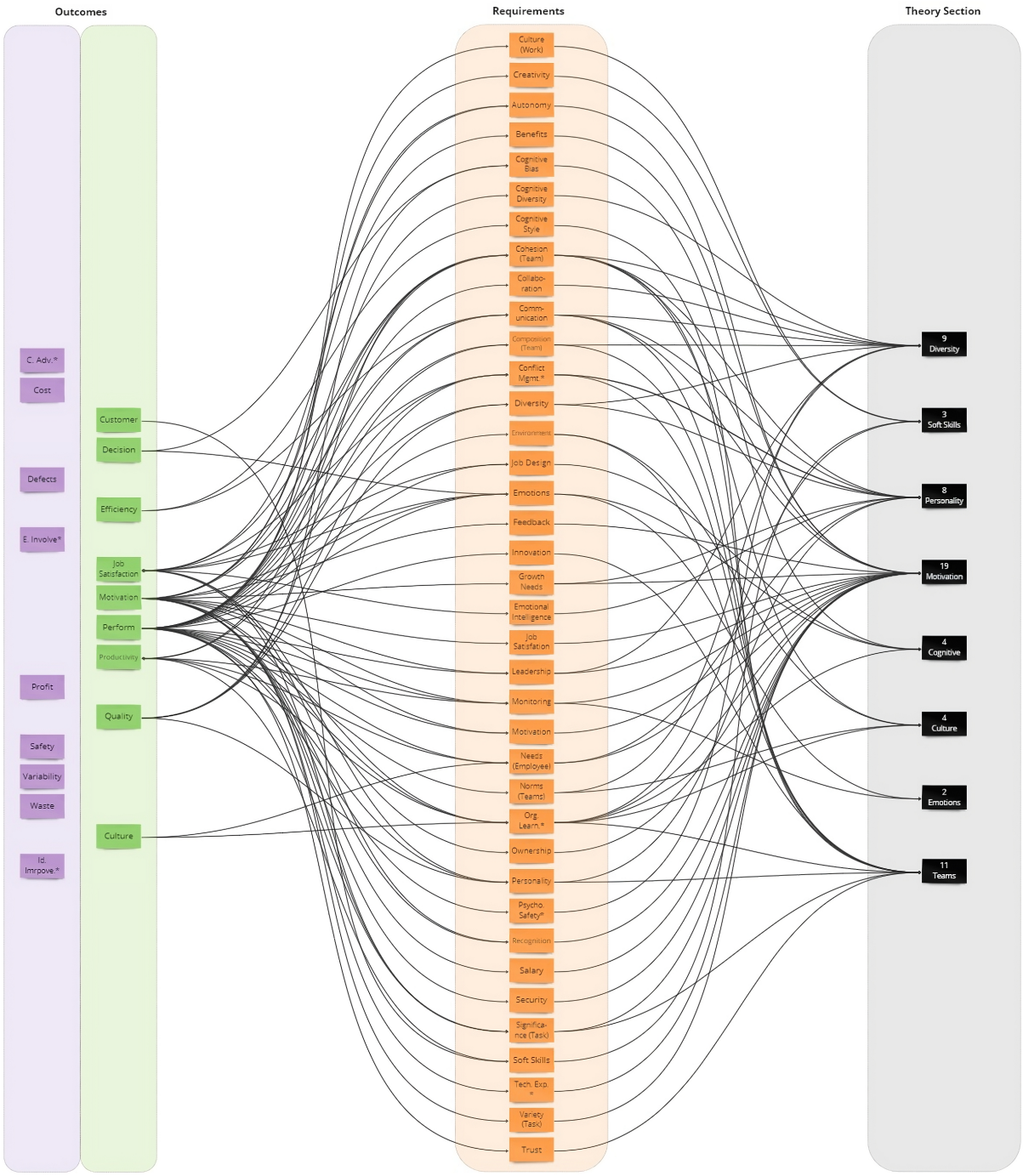

Figure 5.9: Theory Mapping

In total, 9 shared outcomes were identified. Dissimilar to the findings presented in Figure 5.7, "Employee Involvement" was not highlighted as a shared outcome due to the fact that employee involvement generally represents a requirement to achieve other outcomes. This method of identifying requirements and subsequently mapping them back to their respective theory section was performed on every shared outcome. This ensures every mutual outcome (RQ1) is discussed during the interviews to elicit solutions regarding RQ2 from the perspective of the interviewees.

By mapping back the requirement to each individual theory section, it is evident that particular theory sections are more recurring. Out of the 8 sections that encompass the BSE research literature, Motivation, Teams and Personality appear to be further highlighted. Because each outcome is subsequently related to a requirement, which in itself is mapped to a theory section, this gives an indication that more outcomes are conceivably related to that theory section. Therefore, as addressed previously, interview questions regarding these theory sections are given more attention. Although particular connections may appear evident, reverting back to specific theory sections ensures a comprehensive grasp of the reviewed material. This reversion offers a coherent trajectory and facilitates the ability to both replicate and expand upon the findings. Furthermore, particular behavioural terms, such as "motivation" are intricate and multifaceted, resulting in the not originating singularly from a specific theory section. Besides this, visually reverting back identified outcomes to theory relieves the work of relying on manual enumeration. Figure 5.10 illustrates the established interview questions.

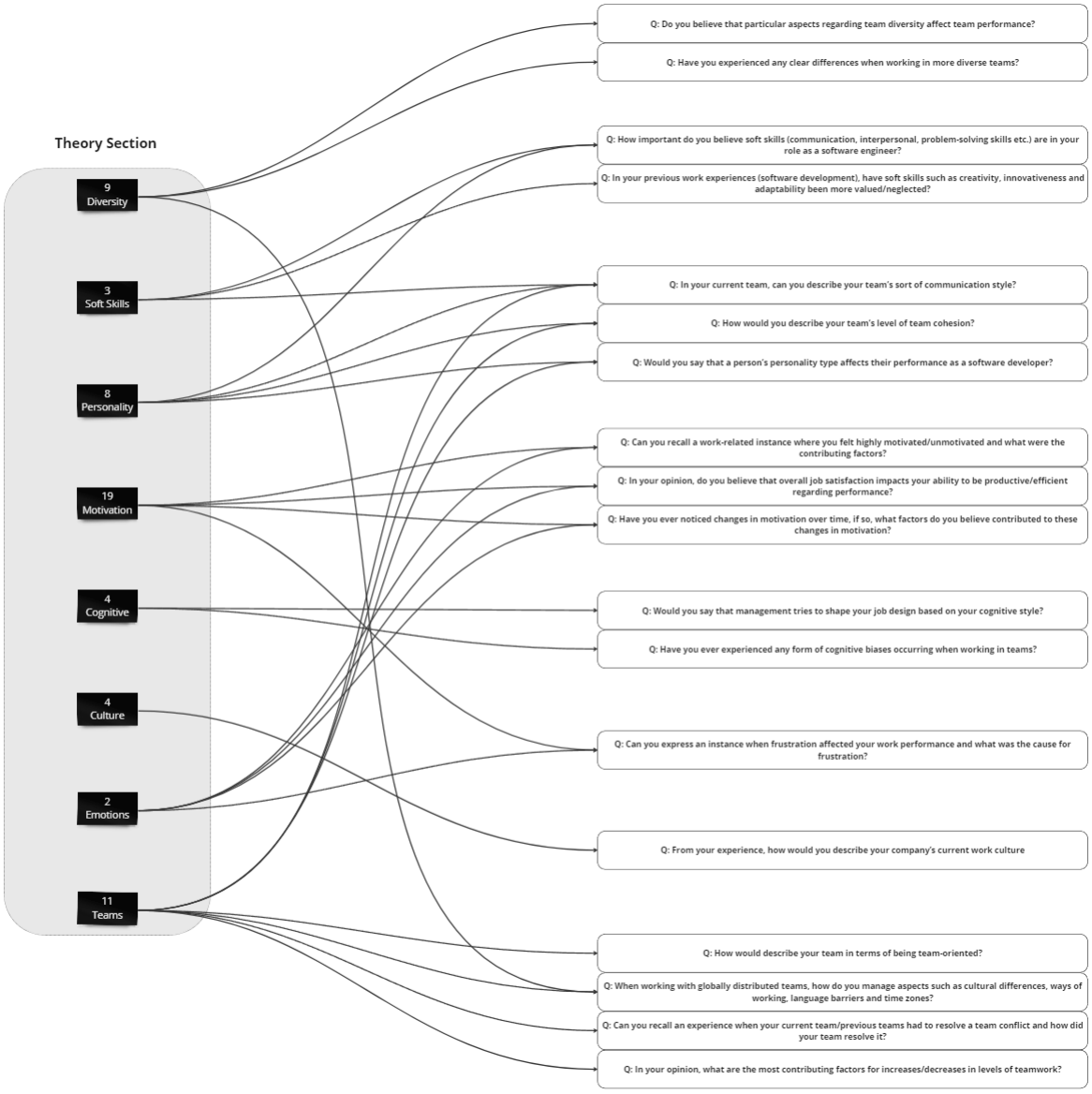

Figure 5.10: Interview Questions

6
Results & Data Analysis - TDA

This section will feature the result from two different parts of the TDA: the quantitative analysis using code frequency- and interdependencies and the qualitative write up in addition to the thematic map. These are separated in order to not create confusion, leaving the more subjective part (the quantitative) of the results on its own.

6.1 Quantitative

In order to receive a broad set of perspectives, the selection of interviewees aimed to include individuals with varying levels of experience. The initially scheduled length was one hour. However, as this was rather a recommendation than a limit, some exceeded this time frame. The primary factor for the varying interview lengths was the extent and depth of the discussions, which occasionally led to longer conversations. Table 6.1 illustrates the length of the interviews, their position as well as their experience within the SE field.

Table 6.1: Interview Participants

#	Interview Length	Position	Experience (SWD)	Team Size
1	59m	Electronic Engineer (Android Automotive Engineer)	14 years	11
2	1h	App Developer (Android Systems Automotive Engineer)	10 years	11
3	55m	Software Developer (Developer)	<1 year	13
4	44m	Android Developer (Developer)	"not many"	13
5	55m	Cloud & Backend Developer (Innovation Lead)	10 years	13
6	1h18m	Software Engineer	10 years	22
7	1h26m	Function Owner (ADAS Engineer)	5 years	9

8	52m	Analysis Engineer (ADAS Engineer)	9 years	9
9	54m	Risk Assessment Engineer (Cybersecurity Enginner)	N/A	11

The initial codes were overall derived from the respondents' sentences, but could also be derived from the interpretation of their answers. Some sentences may, in a conversation, feel redundant to speak just to emphasize a certain aspect, and therefore these answers were also coded accordingly. In these situations, the responses are coded in coherence with the question (example in Table 3.5).

In terms of the codes that came out from the coding phase, certain codes came out more frequently than others. The main reason behind this may simply be due to some categories have more questions regarding its subject, the level of abstraction or specificity of the codes but also a tendency from the researcher to be keener to find certain aspects in the transcripts. This type of bias is ideally reduced through continuous revision and reflection of the coded responses. Additionally, as the interview questions may include certain aspects to a higher degree than others, the nature of the questions may also prone the codes to be of a specific kind. This will be taken into account when discussing the results of the analysis.

Since the coding process is iterative, mainly due to recurring topics and patterns being less visible in earlier parts of the analysis, the initial codes required revision. This revision process involved partially rewriting specific codes and reorganising them.

Additionally, considering that the analysis aimed to provide insights and address RQ2, RQ3 and RQ4, the revision also accounted for the outcomes of the literature analysis. Codes exhibiting strong similarities between key factors from the analysis of the theory literature were renamed to the name of the key factor. This process would facilitate the creation of the code map and establish a connection to the factors from the literature analysis, simplifying the mapping of results to RQ2. An example of such occurences is visualised in Table 6.2.

Table 6.2: Revision of Generated Codes

Code	Revised Code
Communication Style Communication Enforce Communication	Communication
Stress Frustration Emotions	Employee Emotions

In some scenarios, responses introduced novel insights that lacked a discernible connection to existing key findings, distinct enough to form a new code. These responses were subsequently categorised to highlight the respondents' profound interest in the subject matter, ensuring that no data of explicit significance was overlooked during the renaming process, and also to later discuss differences between theory and interviews (RQ4). For example, Time Zones and Language Barriers were brought up in multiple interviews, however, no earlier key finding addresses it in such a way that it contains its context. For example, it could be argued that Communication addresses Language Barriers, but without a clear distinction, it might be overlooked as an important aspect of Communication. The degree of importance of these, i.e. Time Zones and Language Barriers, and whether they qualify as an individual code, are solely based on the perception of the respondent's attitude towards the concept. Nevertheless, despite the potential lack of association with other key findings, these concepts still contribute significantly to the overall discourse during subsequent phases of the analysis. These were denoted with an asterisk (*) in addition to their name in the code-frequency table to indicate their uniqueness.

Table 6.3 shows the final codes and frequency of their appearances in the interviews. The columns represent the different interviewees and the count is the number of times a certain key factor was brought up. These results indicate that certain topics are conceivably more of interest regarding the different sub-categories. Table 6.4 and 6.5 illustrates the most frequent codes (right-most column in Table 6.3) and how many times said factor has been recalled as a requirement for other key factors. By comparing the frequency of the summarized key factors, we propose this concise summary provides insight into their relative importance.

Code Name	1	2	3	4	5	6	7	8	9	#
Autonomy	0	2	1	0	1	1	0	0	0	5
Benefits	0	0	0	0	3	1	3	0	0	7
Collaboration	3	2	6	2	2	6	6	4	4	35
Communication	7	13	8	10	6	16	14	4	7	85
Cognitive Bias	2	2	3	1	3	2	1	1	1	16
Cognitive Diversity	1	1	2	0	3	2	0	1	0	10
Cognitive Style	0	1	2	0	2	3	1	0	1	10
Conflict Management	3	1	2	4	3	1	3	1	3	21
Conflict Resolution	4	4	1	0	2	4	2	0	0	17
Creativity	0	0	1	2	1	1	7	2	1	15
Cross-Company Collaboration	0	2	0	0	0	0	0	0	0	2
Cultural Aspects	2	2	2	3	2	1	1	3	3	19
Customer Satisfaction	0	0	0	0	1	0	0	0	0	1
Decision Making	3	0	1	0	5	1	0	0	0	10
Efficiency	2	1	1	1	0	0	1	0	1	7
Emotional Intelligence	1	2	1	2	3	1	3	3	6	22
Employee Engagement	4	1	2	1	0	2	4	0	2	16
Employee Emotions	9	6	3	1	2	4	2	2	0	29
Employee Empowerment	2	2	2	0	4	4	3	3	2	22
Employee Needs	1	0	1	1	2	0	2	0	0	7
Employee Personality	1	0	4	0	1	0	3	3	1	13
Feedback	1	0	0	0	0	0	0	0	2	3
Gender Equality	0	0	0	0	0	2	2	0	0	4
Growth Needs	1	0	2	0	1	1	2	0	1	8
Innovation	1	2	2	0	2	4	5	2	2	20
Job Design	0	0	0	0	0	0	0	0	1	1
Job Satisfaction	0	0	0	0	1	2	2	0	1	6
Leadership	3	1	1	0	1	0	5	1	3	15
Knowledge Management	2	0	0	0	0	0	0	0	0	2
Managerial Commitment	4	2	4	3	5	1	8	5	1	33
Monitoring	1	0	0	0	0	0	0	0	0	1
Motivation	4	4	3	6	4	4	5	6	3	39
Organisation	4	2	0	0	1	0	2	2	1	12
Organisational Learning	1	1	0	1	0	1	1	0	1	6
Ownership of Work	0	1	3	2	1	1	1	0	0	9
Pair Programming	0	0	0	1	0	0	0	0	0	1
Performance	4	0	1	1	0	1	0	4	1	12
Planning	0	0	0	1	0	2	3	0	0	6
Problem-Solving	1	0	0	2	0	5	1	0	0	9
Productivity	4	1	0	0	2	0	0	0	0	7
Psychological Safety	0	0	0	0	0	1	0	0	1	2
Quality	0	1	0	0	0	0	0	0	0	1
Recognition	4	1	1	0	0	0	2	1	0	9
Recruitment	0	0	0	0	0	1	0	0	2	3
Relationship Building	0	2	1	3	0	2	2	4	0	14
Retention	1	0	0	0	0	0	0	0	0	1
Resistance to Change	0	0	0	0	0	1	0	0	1	2
Salary	0	0	0	0	1	1	3	1	0	6
Social Presence	0	0	0	0	0	3	0	0	0	3
Soft Skills	3	0	3	2	5	5	2	2	6	28
Skill Variety	0	1	1	2	0	2	1	0	0	7
Task Variety	2	1	0	0	0	0	0	0	0	3
Task Significance	0	0	0	1	0	1	1	0	0	3
Team Building	1	1	2	2	2	1	2	1	0	12
Team Cohesion	4	1	3	1	1	2	2	3	3	20
Team Composition	1	1	1	0	0	1	3	1	2	10
Team Diversity	1	0	2	1	1	5	1	1	2	14
Team Norms	0	2	2	0	1	5	0	0	0	10
Team Size	1	0	0	0	0	0	0	0	0	1
Team Work	2	1	1	3	1	1	0	3	3	15
Technical Expertise	0	1	0	0	0	3	4	1	0	9
Trust	0	0	1	0	0	0	0	1	1	3
Uncertainty	2	0	0	2	0	0	0	0	0	4
Well-Being	1	1	0	0	0	0	0	1	1	4
Work Culture	6	4	2	1	2	6	12	5	11	49
Work Environment	1	1	0	0	2	4	1	1	2	12
Awareness of Bias*	0	0	1	0	3	1	0	1	0	6
Company Size*	0	0	0	0	0	0	1	0	1	2
Compulsory Office Attendance*	0	0	0	0	1	0	0	0	0	1
Freedom in the Job*	1	0	1	0	1	2	2	1	0	8
Language Barriers*	0	1	1	0	2	1	1	1	1	8
Time Zones*	0	0	0	0	1	1	2	0	0	4

Table 6.3: Code Frequency

Table 6.4: Most Frequent Codes

Code	Frequency
Communication	85
Work Culture	49
Motivation	39
Collaboration	35
Managerial Commitment	33
Employee Emotions	29
Soft Skills	28
Employee Empowerment	22
Emotional Intelligence	22
Conflict Management	21

Table 6.5: Most Interdependent Factors

Key Factor	Dependencies
Communication	20
Managerial Commitment	18
Work Culture	18
Soft Skills	17
Employee Personality	13
Team Cohesion	12
Cultural Aspects	11
Leadership	11
Cognitive Style	11
Team Diversity	10

Given the open-ended nature of the interview questions, the responses were multi-faceted and multifarious, ultimately leading to many different dependencies. Therefore, the importance of each code is mainly derived from the frequency of occurrence in the code map. It is important to note that the dependencies are manually generated from the interpretation of the interviewee's responses in aspects regarding the findings of BSE. Therefore, the code map should be treated as a way of finding relationships between the BSE findings, although the theory might not have supported these. Figure 6.1 illustrates the code map of one interview and Figure 6.2 represents the code map of all interviews merged into one. This is solely a summarisation of the interview regarding how the responses correlate with earlier created key factor relations. On the contrary, it also serves as an indication as to which key factors are seemingly of greater importance, as these will stand out in terms of their interconnectedness to other key factors (the amount of arrows going in and out of the key factor, i.e. indicating how often it is a requirement and an outcome).

The themes for the thematic map are based on the same themes as in the SLR theory section. As many key factors are present, each with their different implications on one another, only the five most seemingly important factors to each theme are shown. The reason to use five here is simply because the thematic map is otherwise fairly disorganised, while only maintaining important factors. Factors present expressed importance towards themes they were frequently associated with during the interviews. It could be argued that higher abstractions could be made. However, doing so would risk losing which particular factors were more important, and therefore the most important factors instead.

The different colors in the thematic map is solely used for readability purposes. The blue arrows are the BSE themes from the SLR theory which all point to CI (to indicate their mutual efforts to achieve a CI environment). The green arrows are the key factors that were important to a certain theme, but no other themes. This leaves the orange arrows left, indicating the key factors that were important to more themes than one.

Figure 6.1: Generated Code Map (One Interview)

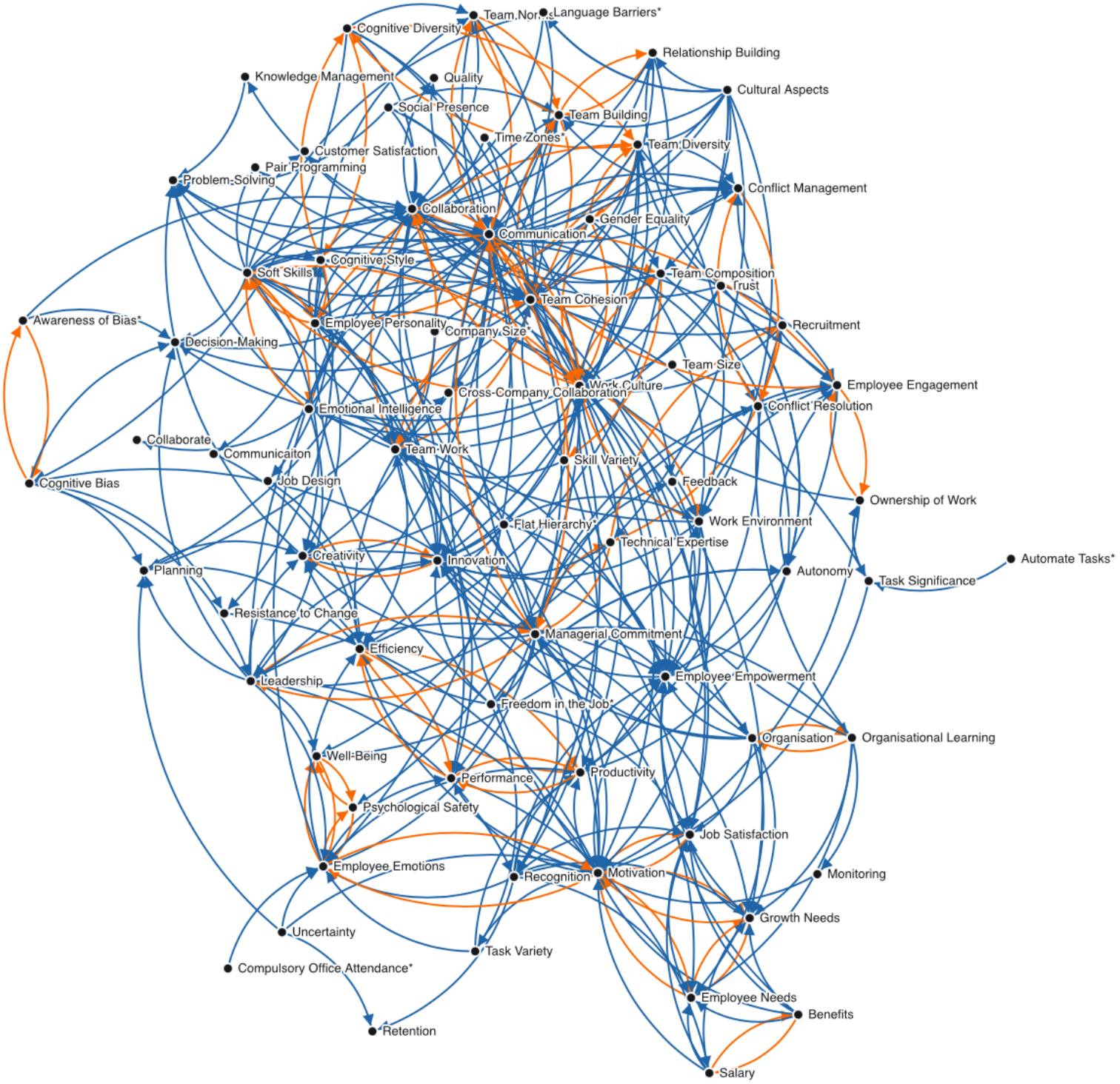

Figure 6.2: Final Code Map (All Interviews)

Figure 6.3: Thematic Map

6.2 Qualitative - Interviews

The result of the thematic map illustrates the interdependence of various BSE aspects and their relationship to the different themes. In the following subsections, the key findings with the highest interdependencies in the thematic map and most frequently appearing in the interviews will now be discussed and investigate cases that were found particularly interesting. Only a few will be brought up due to their elevated significance. Nevertheless, as they are extensively interconnected, they will inevitably encompass other important aspects, including other key findings of similar importance. Consequently, this will connect back to the outcomes which should fundamentally be taken into account (RQ1) and explore their requirements for RQ2 (brought up in Section 6.3). Subsequently, the key findings which influence the outcome in RQ1 will be brought up and discussed from the perspective of the fundamental key finding it affects. These key findings are further determined by the perceived importance interpreted from the interview responses as well as their interdependence and code frequency.

6.2.1 Communication

Many different aspects were emphasised regarding communication during the interviews – emotional intelligence, soft skills, team cohesion and teamwork, and cultural aspects, to just name a few. In particular, it was frequently mentioned that conflicts, misunderstandings and frustration often stemmed from a lack of communication.

> — *"Like, because every new people who are coming and wanted to prove themselves, if we do not allow them to push the code, like, they will definitely get anger. I mean, so it'll bit upset and anger so we used to, I mean, politely we used to talk with them, have a coffee with them, and so to explain the situation"* (I2)

> — *"My most frustrating time was at –*[1] *when we had a project that was very late and the management didn't, like, when we tried to explain the technicalities, like the reasons for being so late, it was like talking to a wall. And when we tried to escalate things they didn't get through because they didn't understand what we were dealing with. Yeah. That's frustrating.* (I7)

A common belief among the interviewees was that these issues were solved through simply having more or better communication, which can be interpreted in different ways. In some cases, it is suggested that management plays a role to enforce effective communication, others suggest that individual teams should construct effective ways of communication themselves.

[1] The company mentioned has no connection worth mentioning to the message itself and is being left out. Further notations indicate a similar situation.

> *—The communication should be like, uh, all the way. But what happened, like communication is only one way. I mean, upper management. And then only one developer, so we cannot talk with them directly. I have a friend so I can go with [through] them. They are not directly working with my related staff. They're, again, redirecting me with the other team member or team person. So I cannot reach them directly. ... I really hate this kinda conversation."* (I2)

Regardless, it is believed that the degree to which the individual and team possess soft skills and emotional intelligence effectively helps individuals understand each other and achieve a mutually acceptable outcome.

> *— "Having this sense of empathy could help a lot to understand each other's viewpoint. But if you remove that, from the engineering sort of environment, then you will end up with a lot of conflicts, with a lot of, like, heats in the discussions and so on."* (I9)

> *— "If, like, to have come team that performs very well, you need, they need to come together to have a good communication. ... If you have good communication, maybe other people of your team have done that before and, uh, can come with, uh, like a fast solution, instead of spending hours and hours or maybe days."* (I4)

Several interviewees also raised the concept of cultural aspects and their influence on communication. In a work environment where diverse cultural backgrounds coexist, it becomes important to approach teamwork with an open mind. It is been expressed that different cultures communicate in different ways, where politeness, openness and work-life balance are merely some factors that affect what is expected in communication.

> *— "I would say my English is pretty decent. Sometimes it was hard to understand some of these people. And I mean, yeah, language barrier can be a thing, but I mean, it's manageable."* (I5)

> *— "First of all, it was a language barrier. They were kind of forcing me to, to kind of speak in Swedish all right was like yeah, that should be something that you should ask me, right? Like yeah, I've been hired by what I know, not for, you know, the language that I'm able to communicate. That got addressed through my manager and I ended up changing teams, yeah, that was not a good vibe."* (I8)

Expectations that are built on earlier experiences throughout an individual's life may clash with another individual's perceptions. An example of this is how an extroverted wants an introverted person to speak up more whereas the introverted person feels the opposite about the extroverted.

To mitigate this problem of clashing cultures, one way might be to refrain from blending these cultures, by having teams of individuals with similar backgrounds. However, this notion is problematic due to a plethora of reasons. First, Polestar is a global company, with stakeholders at a global scale. This is hard to maintain if all the teams are working in isolation from each other. Eventually, these will need to collaborate, ultimately just pushing the potential conflicts into the future. Secondly, arguments from some interviews suggest that a team with little diversity is prone to groupthink-like behaviors.

> —*"Swedes have a consensus culture. Where if someone says something, you are just like, you have to agree. It's that bad. Which is bad because then you never challenge. If you have a, someone with a very strong opinion, no one would dare to challenge that. Yeah, exactly. Whereas I think consensus, often is bad because you need to challenge strong opinions too. And also ways working or whatever"* (I7)

This implies the fear of going against the status quo and deviation from the strongest opinions of a group, which ultimately can hurt both creativity and innovativeness as well as make bad decisions due to little discussion. Open communication was therefore strongly emphasised in the interviews.

> —*"Then there's the culture. You have to be in a team where you feel welcome and included where the team appreciates you even no matter your experience level. And that you're always welcome to ask any questions you'd like, you dare to, to be unknowing of things. And then you can also be the one who knows things and. Speak when that's my area of expertise, then I share my knowledge and then the team listens. There's nothing more demotivating than someone that pushes you down, even though you are, like, new."* (I7)

Lastly, a diverse team brings diverse perspectives. A diverse team may have an easier time eliciting risks and user expectations, identifying conflicts and resolving them. In the case of the latter, it was expressed that they was hard to touch upon, existed an underlying or hidden conflict.

> —*"I have those feelings that sometimes you have, like, uh, conflicts that are hidden. Like you don't know and you, therefore, you need to find, um, ways how to fix that"* (I4)

However, as it was left unaddressed, it gradually escalated into an unnecessary and significantly worse situation, creating complex conflicts which might have undesirable outcomes. Conclusively, there were strong beliefs among the interviewees that diverse teams are the optimal choice, as they foster an environment where individuals are encouraged to be their authentic selves, instead of feeling compelled to imitate an informal leader.

> —*"I would say, I mean the more diversity you have, the more balanced a mindset eventually will be created because then people have to adjust themselves. If you have a colleague who is Indian and who has his own culture and you want to talk with them and make the work happen, you need to sort of tune into that culture, yourself, as much as he should be tuning into yours. So this will make people become more flexible eventually."* (I9)

> —*"I think they, you know, just think about that people came from different culture and they need to, I mean, agree in a common, respectful way of things to go on. And it sometimes make it hard, but, uh, it makes us be more, maybe, conservative about what we are doing or being more respectful, in the way of behaving to others.* (I1)

It should not go unnoticed, however, that a team with little diversity and little amount of conflict suggestively work effectively together and may outperform a diverse team short term. But in the long term, conversely, effective means of communication will emerge and then the benefits are seemingly substantial, making the heterogeneous team the preferred one.

6.2.2 Work Culture

Work culture is not surprisingly one of the most interdependent and coded concepts due to the structure of the interview questions. Throughout the interviews, work culture has been discussed to be influenced by a plethora of factors. Seemingly, one important factor is diversity. It has been expressed that through having diverse teams, the team members have to "tune into" each other's cultures, which fosters both flexibility and collaboration.

> —*"So, work culture, first of all, very inclusive and open-minded. Very friendly. And happy. I would say we are in a, we've been in this growing phase and is a very self-confident company. I think the company has managed to attract a lot of people with high ambitions and good spirits. That's something that's been very positive for me."* (I7)

> —*"It's good to have different ways of being in a group. That's the biggest, like, diversity of different nationalities is, for me, really important to create a good team dynamic."* (I7)

Another crucial factor is the balance of the individual's hard and soft skills. It has been brought up that soft skills might be undervalued as some of the interviewees addressed situations where someone technically gifted ends up doing the wrong thing, due to the lack of soft skills and communicability.

> —*"I would say they are the most important.*
> *...*
> *When they have development units, you need the special software. So therefore you need to know someone somewhere in some department that helps you. So, you know, that kind of network is one of the most valued things. If I'm honest, knowing how to do the test or how to log or how to know, - Oh, it worked or not, that's the easy bit, but get to know everyone, get to think together when the car is not working.*
> *..*
> *So I would say they are like 80%."* (I8)

> —*"I think that soft skill, they're very important. And, uh, as we know, right now it's very popular with pair programming. And that's is also a social aspect, like you need to be able to communicate with other people and to work together."* (I4)

> —*"I will say that they [soft skills] are super important. So the reason why I started doing CICD things in my team was because I was only, let's say, software engineer with some software background and in order to work with CICD you first need to understand how to parse processes.*
> *...*
> *So you have to go around and talk with some skilled people, with people with 30 years of experience to learn."* (I6)

Therefore, hard skills are of course important, but soft skills such as empathy, communication and emotional intelligence, may be essential to create a more healthy work environment, both between individual team members but also from managers above.

> —*"It's like everyone has had this different expectation of each other and that we kind of cleared out just now and it's apart from that, I think, uh, they could uh, do it more effectively. Like a, a lot of people assume that they just, they have their thing, they're gonna work on their thing, but I think they [Polestar], or managers, could prioritize the soft skills more.* (I3)

Especially emotional intelligence, as it allows individuals to have a more comprehensive perspective on things, considering well-being and psychological safety as well as the business goals of the company.

Trust and freedom were also reported as essential components of work culture. Managers trusting their employees to work remotely and giving them the freedom to choose their working environment fosters a sense of autonomy and self-discipline. Throughout the interviews, this sense of freedom has been deeply appreciated and expressed in the overall work culture at Polestar.

> —*"I would say that, It [Polestar's work culture] gives us the opportunity to do really cool things. It gives us a lot of freedom. Like a lot of freedom. Like they, at least in my team, they don't want to tell you what you do. They want you to tell them what you [want to] do."* (I5)

> —*"Company or management didn't try to push us to another way, so we have some kind of, some degree of freedom in our job and if we want to switch, we can easily do that."* (I1)

The work culture is shaped by inclusivity and open-mindedness, where everyone feels welcome, included and appreciated, regardless of their expertise. This has been experienced by the interviewees with relatively low experience as something highly appreciable. Building relationships and trust within a team, emphasises a more effective collaboration and a respectful and supportive environment which motivates individuals to contribute with their ideas and expertise.

However, multiple interviews have shown disconcert towards the company size affecting the work culture. Currently, the interviewees express that the work culture at Polestar is characterised by inclusivity, open-mindedness and friendliness. The company fosters a sense of happiness and self-confidence among its employees, attracting individuals with high ambitions and positive spirits. The atmosphere is conducive to collaboration, with people engaging in conversations and forming connections even during coffee breaks. Many of the interviewees feel that this might be ruined as the company expands, expressing it may be hard to maintain the current work environment.

> —*"I think the more processes and the more like rules you apply and the bigger the company, the less creative and less room for ambitious ideas. Like if you were to apply Agile to the whole company, I think that would really damage the culture. I think like right now we have a, like you have freedom to work in the way that your team prefers which I think is great because like the, the teams in – which do software development, they work agile because that's a perfect way of working for their task. But for our team, for example, that would just add administration and meeting time, which we don't need."* (I7)

> —*"We don't feel any boundary. I didn't, for instance, have this in my previous job. I mean, it could also be very much dependent on the size of the team that you are working with. And also the size of the company because I mean, the work, my previous workplace, thousands of people were working there. And here it comes down to less than a thousand. So that also is something that influences the way people communicate with each other. It's pretty much like if you compare a small village to a very big city. So in a small village, people are closer together. They, if someone, if something happened to someone, everyone eventually would know about that. And these communications and things are happening much*

> *easier than when you have more population and you have more people in the culture."* (I9)

> *—"And, uh, yes, but in Polestar, I think at present still, we have a good atmosphere. We are growing and you know that when more people are being added to the team, it's a bit tricky to just keep the atmosphere well as well."* (I1)

Even though this challenge might seem difficult, it is an important factor as it seemingly contributes to employee satisfaction and productivity.

6.2.3 Collaboration

Very closely related to the earlier concepts is collaboration. It is intertwined with many of the concepts already mentioned, where team diversity, cultural aspects, decision-making and work culture are some bigger ones just to name a few. Similar to communication, the concept of collaboration is very interconnected with the other studied aspects of BSE, which may result in some redundant concepts being brought up. Nevertheless, collaboration encaptures how individuals of a team, or teams in between, work together. This is affected by earlier mentioned concepts, but also time zones, social presence, team norms and problem-solving to name a few. Many of the interviewees showed strong appreciation to work in a collected workplace, as it is easier to, not surprisingly, communicate and collaborate when the body language and atmosphere are different to when working online.

> *—"...But we try, you know, if we are having lunch, then we'll like, oh, I'm having lunch at this time. You know, we're sitting at the big kitchen. And everyone will come, so it's like small things like that that makes the team feel like a team."* (I3)

However, this wasn't the case for all interviews, as some much rather work from home.

> *—"The only thing that I don't like that much about the work you culture in here is that, um, is that they kind of make, the office attendance compulsory for a couple of days a week, which I personally prefer working from home, but I mean, it's not a deal breaker"* (I5)

On the contrary, in both cases, the relationship between each individual seemed to have a big impact on how well they collaborated and the overall job satisfaction of the team. A team who shares a close relationship seems to have better team cohesion, better communication, better conflict management, and perhaps most importantly, a sense of enjoyment while working together.

> —*"We laugh together. We share stuff together. We continuously keep in touch about different things and we try to keep this communication on a fairly good level so that we can think together as a team, decide together as a team and – yeah – basically act as a team. And that feeling is actually really good because that is not something you would be experiencing every workplace."* (I9)

Another concept that's very intertwined with collaboration is work culture and environment. Many of the interviewees emphasise that the experienced work culture and environment are very inclusive and open to ideas and thoughts. It empowers employees to speak and be recognised, even though you might be inexperienced within their field and also new to the company. A few of the respondents expressed that even though someone had years of experience and was much more competent in the matter, it didn't affect their ability to let less experienced people share their ideas and be listened to.

> —*"I always think that creativity and innovativeness is something that the culture brings out. I mean, I think everyone more or less can be creative and innovative if they get the right prerequisites. And I think in, in Polestar, it's very – how do you say – welcoming to come with ideas and for them to be listened to. Like, there's more space to come with ideas. I just compared to –, where I felt more, everything was more squared and pre-decided and I was very far down on in the hierarchy and there was no space to do anything in a different way or come with a new idea. It was harder to get through. I think that really strangles creativity and innovativeness.* (I7)

> —*": I will just tell you one simple word. Freedom. You have freedom to think differently, to come with different ideas and to implement them in a different way.*
> ...
> *I hope that Polestar will keep this culture of giving people to them.* (I6)

This was also addressed as a contributing factor to answering employee needs for growth, motivation and recognition.

Overall, the interviewees emphasised clear team norms, closer relationships, high team cohesion and great means of communication emphasised good collaboration. Other factors also influenced the collaboration within and between teams but weren't as heavily emphasised as uniformly spread over the interviews such as the above.

6.2.4 Motivation

The third most interdependent aspect was motivation. Just like the other two, motivation seems to be rooted in the different aspects of BSE. Aspects such as performance, productivity, efficiency, communication and job satisfaction all seemingly get affected by the degree of motivation an individual experiences. According to the interviewees, the most significant factors that affect motivation seem to be benefits, salary, ownership of work, work culture, management and task significance.

> —*"Like I value a lot an environment where I can learn from, from like other people and other experiences. And I would say that is my, like my primarily motivator and also of course„ salary and benefits are also a really nice motivator"* (I5)

> —*"There's so many reasons for being demotivated or motivated. One key aspect is management. Having a manager that sees you and that pushes you and challenges you. I've had managers or a manager specifically at – who did not do this, didn't see the team, didn't see the needs of the team, didn't see me as an individual. When we tried to raise things, he just neglected it. He was too shy."* (I7)

> —*"So if I feel that there is not, uh, I'm not motivated about what I'm doing at present, I will try to find something to get rid of this feeling. And. I don't think people is like, I mean, feeling like this because I haven't heard any complaint, so it means that it's still something, uh, new for some people."* (I1)

> —*"so again, about this project, uh, very motivated. At first I thought it was very interesting, innovative, all that, very happy to be part of it.*
> *...*
> *You get in into that flow when you can, uh, produce stuff and you can make stuff. And it's challenging. But it's not too easy. If it's too easy, it's boring. It has to be challenging enough. But also when I get to this point where it's now, it's super hard. I don't know what to do. That's also, also makes me a bit less motivated."* (I3)

> —*"I haven't been motivated in a year. So I've been delivering like 15% of what I can deliver. Okay. Because yeah, it's like you are not motivated. And on top of that, you have no tasks or, you know, it's like they come together, right? You have no tasks, therefore you're not motivated. And the fewtasks that you have, are not your strength."* (I8)

Benefits and salary might be self-explanatory to how they correlate with motivation, but the connection between the others might not be as transparent. Some of the interviewees experienced that they felt motivated when being part of something they perceive as genuinely remarkable.

> —*"... And one day just to tell my kids, OK, that car was built by your mother. So that is actually my biggest motivation. Just to see the results of my work... When you're making some apps for the cell phone and stuff like that, unfortunately that is just virtual... But with cars it's completely different. You have them on the roads and it's something physical.* (I6)

Others reported feeling motivated of taking ownership of a task and do it correctly, giving them intrinsic motivation for a job well done. Experiences from companies where the interviewees felt less motivated led to a higher chance/risk of switching jobs, due to them not being satisfied with their current situation.

> —*"There might be some different reasons to stay and keep your job doing, but. The main reason I think is kind of feeling that you have about your job.*
> *...*
> *There are I think some factors or some, uh, thing that can trigger to not having this kind of feeling. Uncertainty, which is lots of changes from different level or maybe not having a clear perspective or where are you going or what you are doing. The second thing is not being respected. The third thing is not being seen, you know, people needs to be seen to get some maybe energy from what they have done. So if you are doing your job and no one is seeing you I think most probably you will leave."* (I1)

In particular, one interviewee reported a feeling that they wanted to leave, but as soon as they got a little recognition, they got the feeling that they wanted to stay in the company forever.

> —*"One week you consider looking for a new job and then the next week you, you get recognized or you get a challenge and you get recognized and someone says something and then you're like, I want to be here forever and work to, you know, grow or climb in the company."* (I7)

An interesting finding was that it might not always be clear what motivates people. People early in their careers seemed to prioritise salary over cognitive stimuli, whereas people later in their careers tend to do the opposite and chose comfort and psychological safety.

> —*"I would say like what, what keeps you motivated at work is the, the fact of like the last thing you said being challenged and be a feeling that you are part of something you're delivering. Whereas in the long run, getting benefited for your, your work is important. Like if you don't get the benefit in the end, like the carrot that you run for, that will not make you stay in the long term.*
> *...*

> *I feel like if I'm not happy, I have opportunities to go to do something else. At least I'm in that part of my life where I don't, I'm not hindered in that sense. But yeah, maybe it would be different in 10 years, I will be more easily satisfied."* (I7)

This suggests that when an individual earns enough to satisfy their daily needs, the focus is rather towards mental health and well-being while still working with something they find intrinsically fulfilling.

It was also shown that emotions played a big role in the degree of motivation. In situations where the interviewees were frustrated or felt negative emotions due to certain circumstances, reported a decrease in their motivation. Some reported that these emotions were affected by the general work culture and the people around them.

> —*"So even if you are highly motivated and you are surrendered with people who are slow in their actions, in their thoughts and not so much fond of new ideas... So that could definitely influence your motivation."* (I9)

If they felt included and recognised, they experienced less fear regarding e.g. proposing bad ideas or being rejected, ultimately making them feel more motivated.

Interviewees also reported the management's effect on motivation. Just as they could feel empowered through recognition and support from the management they could also get demotivated if the management was holding them back.

> —*"When I was at –, I had an awesome manager who like from the day one saw me and I pushed, put tasks on me that I thought were like, oh, this is challenging. But in the end, he motivated, motivated me and gave me the tools to deliver my tasks, which made me feel like I was awesome."* (I7)

> —*"I'm the kind of person that, you know, I want to get this done. Then I will be frustrated if I'm stuck.*
> *...*
> *I think it's important for management to be emotionally intelligent and know these things, but it's also important for everyone to, you know, to take ownership of your work and, if anything is wrong, then you have to express it."* (I3)

This went hand in hand with the relationship shared between the individuals and their managers. One interview reported having a highly emotionally intelligent manager who early addressed if the employee felt troubled in their current work environment, ultimately being able to switch tasks to ensure they're not hitting the wall and affecting their mental health and, of course, their overall motivation.

> —*"I have the feeling that at least when it comes to my closest management level, it happens. Like, you know, with this big decision of changing platforms, both – and –, that is his manager, they are really aware, like this is going to bring a seat of loads to do, you know, in our team and we need to be smart about it. And, of course, they worry about those things."* (I8)

In addition, some interviewees experienced that the significance of their task also affected their motivation. Redundant and easy tasks quickly became demotivating and this was also something that they felt that the management could do something about.

> —*"Whenever you try to do some new stuff or some interesting stuff you, if it keeps blocking me, it's not allowing you to touch it, then how you will get interested. I mean, I was just keep getting postponed this, all this stuff and it's come to belonging to this, infrastructure setup or something.* (I2)

> —*"The problem of my old department at –, our department is like, managed by dinosaurs, you know, they have like a dinosaur on top saying this is the way that should be, things should be done. And even though you have new managers that maybe want do things in different ways, they get stopped by the upper management because that's not the way that it's supposed to work."* (I8)

However, when they felt cognitively challenged and that their work had an impact on the end product, they reported feeling very intrinsically motivated, as if the things they were doing weren't necessarily "work".

> —*"I think it's important to do something that you have a passion for.*
> *...*
> *If I am super passionate, then I will work more. Because it won't feel like work. It's fulfilling.* (I3)

Conclusively, there seems to be a set of criteria that needs to be fulfilled to be motivated. For example, feeling challenged at work might not be the motivational factor if they feel that their salary is too low. Consequently, if they don't feel respected and recognised at work, the salary seemed less motivational as it is at the cost of their mental health.

> —*"I think they go hand in hand. And they are equally important. And maybe at different time points, but I would say like what, what keeps you motivated at work is the, the fact of like being challenged and have a feeling that you are part of something you're delivering. Whereas in the long run, getting benefited for your, your work is important.*
> *...*

> *Like in my old job I felt challenged, but then in the end I wasn't benefited in the way that I thought was I should be. Then I left for another company. So it's it's always a combination, I think.* (I7)

Combined, this reasoning emphasises a good work culture where people feel welcome, respected, and cared about, in addition to a salary that tangents with their efforts.

6.3 Qualitative - Analysis cont. (RQ2)

The findings presented in the previous sections make it evidently clear that several requirements exists that suffices the outcomes found in RQ1. The interdependency rate of certain key factors is also an indication that these have an importance on many different key factors, ultimately meaning the fulfillment of such key factor improves many different aspects of engineering. At first glance, particular parts of the result associated with either the SLR or TDA may be difficult to interpret. However, these illustrations merely exemplify the level of complexity. Furthermore, both research methods attempt to ultimately create illustrations that are more easily interpretable, as seen in Figure 5.7 & 6.3. When considering either of the aforementioned figures, it begins to seemingly indicate that particular key factors may be of greater importance as they appear to be further emphasised. From this perspective, we argue that these specific key factors represent the most important requirements to fulfill. This is due to the fact that RQ1 aimed to address what key factors should fundamentally be taken into account whilst RQ2 provides further insights into how these fundamental key factors are actually achievable. In other words, RQ1 outlines the outcomes that ultimately make CI possible, whereas RQ2 outlines the requirements to facilitate those outcomes.

Besides this, it should be feasible to comprehend that the manner in which data was extracted differs between the two research fields. Consequently, the manner in which we argue for particular suggestions regarding considerable methods differs. In the Appendix, we can clearly indicate the most considerable key factors based on their recurrence. However, it was increasingly harder to make similar correlations based on the conducted interviews. The reason for this revolves around the fact that interviewees do not explicitly conclude their own perceptions in a manner that a researcher would. Therefore, the alternative option was to analyse the occurrences where a particular key factor was associated with a fundamental key factor. For instance, in Figure 6.1, one may note that Team Cohesion was associated with Job Satisfaction. In other words, in this particular interview, the interviewee expressed that they perceived higher levels of team cohesion to be a key factor affecting their perceived job satisfaction. This approach was ultimately performed in every conducted interview as shown in Figure 6.2. However, as previously stated, it becomes increasingly difficult to interpret. Therefore, the Appendix solely illustrates how each key factor directly associates with a fundamental key factor and lists them accordingly. Unfortunately, we were not able to explicitly account for every occurrence of any given key factor associated with a fundamental key factor. Consequently, the associated TDA findings will instead highlight key factors that were

frequently spoken about. The following sections discuss the 10 fundamental key factors presented in RQ1 and how they relate to the associated SLR and TDA findings.

Recognised through the analysis of the SLR, Table 6.6 present the following key factors those with significant implications towards the identified fundamental key factors with respect to their frequency (number of sources mentioning the key factor being a requirement for a fundamental key factor (outcome)):

Table 6.6: Key Factor Requirement Interdependencies

Key Factor	#
Team Cohesion	11
Communication	10
Employee Personality	9
Organisational Learning	7
Autonomy	6
Task Significance	6
Motivation	4
Team Diversity	4
Feedback	4
Recognition	4
Employee Emotions	4
Employee Needs	3
Growth Needs	3
Monitoring	3
Job Satisfaction	3
Task Variety	3
Team Composition	3
Team Norms	2
Soft Skills	2
Leadership	2
Conflict Resolution	2
Job Design	2
Cognitive Bias	2
Cognitive Diversity	2
Conflict Management	2
Work Environment	2
Innovation	2
Psychological Safety	1
Creativity	1
Salary	1
Security	1

6.3.1 Work Culture

Recognised through the TDA, the following key factors represent those with significant implications towards Work Culture:

- Communication
- Collaboration
- Soft Skills
- Team Cohesion

As discussed upon in the previous section, the interviews emphasised a good work culture to have effective collaboration. A mutual opinion among the interviewees was the freedom they have to be creative and innovative, made possible through low amounts of restrictions and the perception of a flat hierarchy, making for good collaboration. They emphasised that these aspects were positively affecting how the work culture was perceived. The open communication experienced at Polestar also enforces a perceived satisfactory work culture. Interviewees report friendly talk at the coffee machine and being listened to and recognised by experienced people, arguing the communication aspect is important to create a respectful atmosphere. Connected to communication, as also mentioned earlier, are soft skills and team cohesion. People possessing soft skills make communication easier and more effective, while also contributing to the degree of team cohesion. Individuals experiencing high levels of team cohesion connected their current work culture as a positive one.

6.3.2 Quality

Recognised through the TDA, the following key factors represent those with significant implications towards Quality:

- Communication
- Collaboration

Important to note in this scenario is that quality has stronger relations to the outcomes of CI than BSE. As the discussion about quality in the interviews was very narrow, there's limited material to reflect upon. However, one interview brought up the concept, expressing it was affected by communication and collaboration. In particular, the lack of people not being aligned with each other.

> —*"People are still following some old prototype or old architecture designs for developing application. We are not aligned. I would say, better we could have some kind of discussion in order to, I mean, how we can make the quality of the product. So when I was randomly discussing with the other team who are working with the application, I realised people are being out of date"* (I2)

It was emphasised that if there are good communication channels and collaboration is enforced between different teams, the quality of the product will be improved.

6.3.3 Productivity

Recognised through the TDA, the following key factors represent those with significant implications towards Productivity:

- Conflict Resolution
- Motivation / Employee Emotions

In terms of productivity, the most common factors affecting it seemed to be on an individual level and team level. From an individual point of view, multiple interviews reported their emotions affected their productivity.

> —*"Yeah. If I am, uh, super passionate, then I will work more."* (I3)

> —*"But with a team that if you cannot get along with that, so you will be in trouble. I think the feeling can directly affect your performance and productivity.* (I1)

> —*"Yes. I can say that, yeah.* (I4)

The overall conclusion is that their productivity is much higher if they are more motivated and in the right state of mind, whereas the opposite would facilitate the other. On a team level, the ways conflicts were addressed and resolved seemingly affected productivity. This touched upon the idea of reasoning about the significance of the conflict, where there seemed to be a fine line between when conflicts should or shouldn't be addressed. In particular, smaller conflicts may end up feeling more significant since they were addressed, ultimately killing productivity as conflicts have to be resolved. On the contrary, bigger conflicts that remain hidden might kill productivity in the long run, as it may affect how people communicate and collaborate.

6.3.4 Efficiency

Recognised through the TDA, the following key factors represent those with significant implications towards Efficiency:

- Communication
- Problem-Solving
- Work Culture

Unsurprisingly, the interviews emphasised communication to enforce efficiency. Other aspects that seemingly were important were aspects affecting how the team operates. For example, one of the interviews brought up the idea of having a very homogeneous team where all the participants communicate in their natural language.

> —*"I mean, if you have maybe 10 Swedish people in the same room, they might do the job faster. They might get things rolling much more quickly.*

> *And if you have a more diverse culture, then, things might be a bit slower. But eventually in the long run, I think everyone will gain from that diversity. Because it also brings more dynamics to the team – brings more flavors"* (I9)

Such a team may excel in terms of communication, but as mentioned, lacks the diverse perspectives and nuances that a more heterogeneous team can bring. Another factor is the work culture. One of the interviewees experienced that the current work culture lets teams work in the way they feel most efficient, but as the company grows, they fear it will hurt the current work culture, ultimately affecting the efficiency of the teams.

> *—"I think at present, we have a good atmosphere. We are growing and, you know, that when more people are being added to the team, it can be tricky to just keep the atmosphere well as well."* (I1)

Lastly, problem-solving evidently had an impact on efficiency. One of the interviews reported an occasion where a problem would occur in a predictable future. The situation involved their team getting affected by an external problem they weren't responsible to fix, ultimately affecting their efficiency. By identifying this, and collaborating with the team responsible, they were able to handle the problem more efficiently. Therefore, it can be argued that by maintaining an established structure for solving upcoming problems, efficiency can be kept at a desired level. However, to conclude, the primal factor to great efficiency originates from eminent means of communication.

6.3.5 Motivation

Recognised through the TDA, the following key factors represent those with significant implications towards Motivation:

- Job Satisfaction
- Growth Needs
- Employee Emotions
- Employee Needs

While motivation has already been discussed in the previous section, its significance in regard to the different aspects of BSE can not be overstated, as it emerges as one of the profound key findings of the analysis. In general, motivation takes many different forms and is an important factor to address to retain employees. Accounting for and taking action to fulfil these demands, the company is sure to have a thriving community and healthy employees.

6.3.5.1 Job Satisfaction

Recognised through the TDA, the following key factors represent those with significant implications towards Job Satisfaction:

- Motivation
- Benefits
- Salary
- Work Culture
- Freedom in the Job*

Very closely related to motivation, the most significant factors leading to job satisfaction are seemingly intuitive. Despite salary may be one of the main objectives when seeking employment, the interviewees highly appreciated the level of freedom in their current work, especially as this experience at other workplaces was very slim.

> —*"I will just tell you one simple word. Freedom. You have freedom to think differently, to come with different ideas and to implement them in a different way. So the freedom is a keyword"* (I6)

> —*"I would say that they give us the opportunity to do really cool things. They give us a lot of freedom in the sense that, like, being able to influence decisions and drive the change we wanna drive."* (I5)

Multiple interviewees also emphasise the importance of satisfactory work culture and close relationships. This way, they argue the work seemingly becomes more like an amusing activity you do with your friends.

> —*"When I'm at work in this current role, I feel more like I'm doing something with my friends. We laugh together. We share stuff together. We continuously keep in touch about different things and we try to keep this communication on a fairly good level so that we can think together as a team. Decide together as a team and basically act as a team. And that feeling is actually really good because that is not something you would be experiencing every workplace."* (I9)

> —*"We had the time to build a friendship relationship on that sense. So we trust enough on each other, like have informal conversations, talk like to friends. So that's something that we try to push into new members of the team because, you know, it's a really good vibe. We work really good in that sense. We don't want to break it."* (I8)

6.3.6 Performance

Recognised through the TDA, the following key factors represent those with significant implications towards Performance:

- Motivation
- Productivity
- Team Cohesion
- Employee Personality

The aspect of performance is very intertwined with both productivity and motivation, as expressed earlier. However, the interviews have also shown that the teams' cohesiveness and the personality of the employees within the teams have an impact on performance. In particular, teams seem to perform better when the employees share deeper relations.

> —*"I feel like we have a really good spirit when it comes to like being team oriented. Every one of us have our, you know, own traits as individuals. One thing that I notice around here is that we usually refer ourselves as the team. We use the word "we" much more than we use the word "I"."* (I5)

Since each individual's personality is different, it affects to which degree acquaintance is done, ultimately affecting team performance. Another notable implication regarding team cohesion is that teams have experienced improved performance when considering the strengths and weaknesses of the team members when assigning tasks. Regarding one specific interview, there was ample time to familiarise themselves with one another before a specific project. That way, as the project started, they were quick to address tasks accurately in terms of their strength and weaknesses.

6.3.7 Decision-Making

Recognised through the TDA, the following key factors represent those with significant implications towards Decision-Making:

- Soft Skills
- Communication
- Leadership
- Cognitive Bias

During the interviews, it was heavily discussed how decision-making is influenced by cognitive biases. In almost every interview, decision-making seemed to be influenced by over-estimation bias, meaning decisions fell often victim to over-optimistic deadlines.

> —*"Yes. Specifically the estimation bias, which I acknowledge that I have. I actually have a rule for whenever I need to estimate something. ...*

> *We usually try to get around these, estimating biases by pretty much doing a planning poker using fibonacci."* (I5)

> —*"This happens a lot. I would say it's usually when I've been in agile teams, there have been occasions where the product owner has a very different understanding or different calculation of how much time a task requires."* (I7)

> —*"I always put extra estimation. But I think other people overestimate. It has shown at some point, like we'll say, oh, this will take one week, and then the week passes and it's not done. So it does show itself.* (I3)

However, it should not go unnoted that this is a very complex task, as the decisions regarding certain projects are often taken by other people than the ones taking on the actual tasks, supposedly more experienced people setting deadlines for less experienced. On the contrary, in situations where a less technically experienced person or team are responsible for determining deadlines for the people who possess more knowledge about the required time for the task at hand, a similar outcome is received.

It was also emphasised that the degree of soft skills an individual possess influences their ability to affect decision-making processes.

> —*"And a lot of times you'll need to, you know, prove your points and convince your peers to, you know, take a certain decision. And soft skills may even help, maybe even more, than hard, technical skills."* (I5)

Strong communication and negotiating skills can effectively aid in shaping outcomes in favour of one's own beliefs and values. These types of skills are also desired in great leadership, whereas a lack of these in a leader might affect the trust towards them. One of the interviewees had experienced this, as they had a manager who much rather worked with the coding stuff over managing, evidently had their current position due to a stagnated career where the only option was to opt for management. The interviewee expressed disappointment towards the matter and further emphasised that soft skills are important in those types of decision-making practices as the management role is.

> —*"When we tried to raise things, he just neglected it. He was too shy. Like he was so cautious. Like, he wasn't a manager. He'd rather be working technically, but I think he was old enough to, like, he was stuck in his career path and then the only way to become, take a step upward was to become a manager. That was super demotivating."* (I7)

6.3.8 Customer Satisfaction

Recognised through the TDA, the following key factors represent those with significant implications towards Customer Satisfaction:

- Soft Skills

Just as quality, customer satisfaction is a key finding more present in CI. Therefore, the interviews barely touched upon the concept. However, it was addressed in one of the interviews that soft skills are important to manage a good connection with customers.

> —*"Soft skills are super important because we need to deal with stakeholders all the time. And you gotta be really well versed in like the ways of communication, to really understand what they want because it is very easy for miscommunications to happen and, like, expectations not to be aligned."* (I5)

This can be argued as it might be necessary to negotiate deadlines and outcomes of the product.

6.3.9 Employee Involvement

Recognised through the TDA, the following key factors represent those with significant implications towards Employee Involvement:

- Ownership of Work
- Communication
- Employee Personality
- Soft Skills
- Autonomy
- Employee Engagement

An important factor influencing employee involvement is communication. In the interviews, much emphasis has been put on how effectively the communication is done, which has been discussed in terms of employee personality. An introvert might not speak up the same way an extrovert does, which might affect the degree to which the introvert engages in discussions. Therefore, such aspects should be taken into consideration when aiming for employee involvement. One of the interviews brought up a situation where they, as an extrovert, attempted to make an introvert in the team become more social through regular dialogue.

> —*"I'm super communicative and extrovert person and then I got, I'll say that my mission was for one guy in my former team to make him be more social, to become not like a real social butterfly, but at least to have more friends to come to some common events and stuff like that. And it turned out like that. So after three years at that team, he started joining*

us for beer break afterwards." (I6)

The outcome was satisfactory, as the person in question started attending more team activities than before the dialogues. However, such methods might not always be appreciated, as they could instead leave the individual uneasy, ultimately resulting in them leaving the company. Therefore, such methods should be used carefully.

Ownership of work has also been expressed as a factor that emphasises employee involvement. The primary reason is that the individuals believe they are part of something they find interesting and innovative, leading to increased engagement.

6.4 Additional Insights (RQ4)

Certain concepts arose from the interviews which had no clear connection with the rest of the key findings. In particular, these concepts weren't recognised by the literature review but were seemingly of high importance in the interviews, and were coded with an asterisk (*). Therefore, these concepts should be discussed to avoid overlooking crucial information derived from the interviews. These were:

- Freedom in the Job
- Language Barriers
- Awareness of Bias
- Time Zones

The following subsections will discuss these concepts with examples derived from the interviews. The aim of this discussion is to capture the broader perspective of the interviewees' responses and gain deeper insights into the concepts already discussed.

6.4.1 Freedom in the Job

When the interviewees were asked to explain the current work culture at Polestar, the most unanimous answer was freedom. They expressed they had the freedom in their job to contribute and solve things in a very unstructured and unrestrained way which sparked ambitious and unique ways of solving problems, which was previously mentioned.

This freedom was also expressed through the ability to work remotely. The interviewees highly valued the trust and autonomy given to them, emphasising that it fostered a sense of empowerment and ownership of their work. However, it was also shown through another interview that this freedom could lead to conflicts. In particular, this sense of freedom could give rise to people thinking their way is the superior approach, resulting in conflicts regarding how things should be done. Additionally, one interviewee feared this would be affected by the rate at which the company grows, as a larger company requires more structure. The interviewee stresses such

a structure would damage the degree of freedom, missing out on the benefits it suggestively provides.

> —*"It's frightening to me that if we grow, that we will lose this spirit, you know? We don't want to become old and demotivated. We have to keep the spirit even though we grow."* (I7)

Another aspect brought up regarding the subject was the aspect of compulsory office attendance. It was addressed that compulsory office attendance affected the interviewee's overall job satisfaction, desiring the option to work fully remotely.

> —*"The only thing that I don't like that much about the work you culture in here is that they kind of make the office attendance compulsory for a couple days a week. I personally prefer working from home, but I mean, it's not a deal breaker."* (I5)

Furthermore, the interviewee stated the seemingly increased tendency to have an open-office structure within tech-related companies, which they did not value. Suggestively, offering the ability to work fully remotely would alleviate this frustration.

Overall, the sense of freedom the interviewees experienced in their work was mostly positive with an emphasis on the impact it has on creativity and innovation. It stands as an important aspect of achieving job satisfaction and continuously eliciting creative solutions.

6.4.2 Language Barriers

When discussing communication and diverse teams, the concept of language barriers was frequently brought up. In almost every interview, language barriers were addressed as a factor negatively affecting communication. In particular, repetition or clarification is sometimes needed in order to properly understand one another, impacting the efficiency of information delivery and reception.

> —*"I think language barriers can affect a bit because it makes it more difficult to understand each other. And sometimes I notice I say something and another person might not understand 100% what I'm saying, so I'll have to repeat myself. I'm quite used to things like that due to my background, but I know that, for other people, it might be extra frustrating because you're so used to always being understood."* (I3)

Its impact on informal scenarios was also expressed through one interview, where people struggled to understand or missed the humour in jokes told, all being due to cultural or linguistic differences.

> —*"In my mother language, I used to make a lot of joke. I keep the environment very, I mean, very positive and they used to enjoy it. But when I come to Sweden, like I rarely do joke, I miss that. Because that was*

> *completely different. If I make any joke or something, people are not understanding, they're not laughing at all."* (I2)

Although this posed a problem for effective collaboration, it suggestively emphasised the engagement needed from individuals to properly understand each other. As mentioned by one interviewee, they expressed it being less severe if it is handled properly. In particular, if language barriers are thought about already in the onboarding process, it might mitigate the problem even further, as people are flexible and keen to tune in to each other's culture from the beginning. This emphasised attitude towards effective communication between culturally different individuals is seemingly achieved through patience, understanding and effective communication practices. Furthermore, since one of the interviewees had grown up experiencing such cultural clashes, they had become used to this phenomenon, rendering it even less of a concern. They expressed that they understand that other people might see problems with language barriers, but for them it was familiar, and therefore they knew how to handle it. Conclusively, with flexibility and patience when communicating, the problems stemming from the concept of language barriers might be well mitigated.

6.4.3 Awareness of Bias

The discussion about cognitive biases was also included in one of the interview questions. During the interviews, a mixed perception of the concept emerged. Some were familiar with the concept, whereas others had given little consideration to it in a professional setting. Moreover, the most mentioned bias was over-estimation bias, where some even expressed an awareness of this bias in their work.

In the aspect of present biases, the interviews gave insightful details on how one could address and mitigate certain biases. Planning poker, doubling the first estimation and general awareness of the existing biases have all been methods used. One of the interviewees also mentioned that it was something completely new to them, in the aspect of work, which could be a consideration to take into account.

> —*"I never thought about it in a work perspective. I only knew about it when you have your opinion on news and politics and stuff like that. I never thought about it until you mention it now in a work environment. But yeah, I think definitely because you kind of ignore what is being said until someone says something that applies to you and reinforces your ideas and stuff. So yeah, that affects the work."* (I3)

In particular, making people aware that biases may be present can make them more cautious when making important decisions. It is therefore emphasised that it is a good practice to self-check oneself for biases and try to recognise faulty thought patterns.

6.4.4 Time Zones

In addition to language barriers and communication, the issue of time zones was also addressed and discussed. In particular, the collaboration between teams located in Europe and Asia was heavily impacted by time differences. It was addressed that this situation posed a challenge for teams working from different parts of the globe, as the Europeans would quit their work day as the Asians start theirs, heavily impacting time for meetings and communication in general as both parts have to adapt to this phenomenon.

Suggestively, one of the interviewees favoured working in the physical facility, as this made the communication between both parties much more authentic and less room for misunderstandings.

> —*"When everyone is at the office, then it's, it comes more naturally. We go to take a coffee and then maybe we discuss a little bit about the project and the team dynamics and stuff like that. It like pops up naturally."* (I3)

Another interviewee stated they felt much more engaged and connected with the team and company after relocating to Sweden, compared to their initial experience of working remotely the first year at the company.

> —*"I am having a lucky team and friendly people. I mean, I never had any conflict with any of the team members since I came to Sweden"* (I2)

Furthermore, the interviews emphasised the importance of being close to the team and the possibility of talking to them freely, suggesting having the possibility to meet and have face-to-face discussions is preferable, especially when problems arise.

7
Discussion

This section will feature a discussion about the results and their contribution to answering the research questions, how they can help practitioners of implementing CI through the eyes of BSE in SWD, the significance of the study and threats to the validity of the work done.

7.1 RQ1: Mutual key factors between CI and BSE

Through heavy investigation of the particular key factors and interview responses, certain aspects stood out more than others. By examining the results from the cross-matching of outcomes and requirements received through the SLR analysis, 10 particular key factors were seemingly of greater importance, as seen in column 2 of Figure 5.7. Although some factors might have greater importance than others, our analysis has merely elicited interesting factors that, when fulfilled, possibly foster a continuously improving environment with a focus on the individuals of the company. As seen in Table 5.7, performance and motivation are two outcomes which came out as frequently in the SLR analysis. Motivation, in particular, was also very discussed in the interviews (partly due to the nature of the concept of having a stronger connection to people in general, whereas performance may imply many different things). As stated in the results about motivation, some of the most significant factors that seem to affect motivation as expressed through the interviews are benefits, salary, ownership of work, work culture, management and task significance.

Seemingly, this is also seen in the literature. Although salary is not surprisingly a motivational factor for people to work, it holds strong as an important motivational factor [73, 70]. But more interestingly, the work itself and its significance were reported as motivating both in the literature [70, 11, 58, 56] and interviews. Generally, having motivated people often results in a very collaborative and effective workplace [56]. Therefore, we believe having the right person doing the right thing consequently might be more beneficial than one might assume, instead of simply leveraging salaries.

Limitations regarding the different outcomes are also interesting. Of all the limitations affecting the fundamental key factors, two that affected multiple outcomes are managerial commitment and monitoring. However, each of these might affect the outcome for various reasons. Monitoring too much might become oppressive whereas

too little risks losing effectiveness and creating complex individual conflicts, more easily solved if dealt with quickly [122]. This goes hand in hand with managerial commitment, as we also deem it to be a complex task to retain committed managers. Some theory even indicates a close relationship between engineers having a proactive role with management [124], making the line between management and employees less distinct. However, this requires management to receive and evaluate the feedback from lower down the hierarchy in the first case, which does not always come naturally.

In general, we believe most of the fundamental key factors are in some way associated with team efforts and team performance. The organisation's success relies on the individual and the team's performance as it creates the foundation for all work. Maintaining higher degrees of job satisfaction for managers and engineers equally is crucial for a successful company. Ensuring effective and thriving teamwork is therefore a necessity BSE brings that we believe is essential for CI to function in a SWD environment.

7.2 RQ2: Requirements

As seen in Figure 5.7, the requirements affecting the fundamental key factors elicited through the SLR analysis, construct a quite extensive list. Table 6.4 & 6.5 presents the most coded and interdependent key factors from the interviews as a list of the top 10 in a descending order. However, these results can be examined from two different perspectives: either focusing on the most frequently discussed requirements or considering those that impact the most fundamental key factors. That is, the different factors may be important for different reasons, making it difficult to determine which has a greater impact on achieving CI. Therefore, key factors arising from both perspectives will be discussed.

7.2.1 Frequency

Unfortunately, the frequency of certain relations between key factors expressed in the interviews was not recorded as this task was initially considered redundant. However, the code frequency was, and it indicated communication as a factor that stood out particularly well. Communication is the concept that has by far brought the most attention when discussing the different interview questions. Compared to other codes, approximately 10% of all the codes in the final revision of codes seemingly discussed the concept, as can be seen in Table 6.3. Nevertheless, it was realised early on that it would be one of the most important factors and it was a result we expected to see, considering its deep connections to BSE [91].

As soon as a single engineer becomes a part of a team, communication plays a big role in the effectiveness of the work performed. Everything from getting to know workmates to resolving conflicts and expressing dissatisfaction through body language is a form of communication. This has been seen in literature, as research suggests team-oriented employees balance the strengths and weaknesses of the indi-

viduals within the team to enforce great performance [124, 121]. We strongly believe this is the case, as this was also expressed in the interviews. The interviewees who expressed communicative aspects as issues for an effective work environment also experienced cultural differences. Suggestively, ensuring heterogeneous teams in terms of cultural backgrounds, diverse skill-sets and personalities may create better inclusive work cultures as every individual is demanded to make an effort to collaborate with people of different kinds and meet each other halfway as people have different ways of being.

Although most interviewees suggested heterogeneous teams over homogeneous ones, research has found that highly heterogeneous and homogeneous perform better than moderately heterogeneous [112]. A highly homogeneous team likely requires low efforts in effective communication as the engineers likely share opinions and attitudes. However, where then dissimilarities arise, these might not always be addressed as they might come out as unpopular or foolish ways of thinking. This concept is what is commonly called groupthink and can be very dangerous, as issues arising are not addressed properly if the ones with power neglect them. Problems like these, considering biases and assumptions likely going unnoticed have been seen to be more mitigated by more heterogeneous teams [133]. Likewise, we believe a highly heterogeneous team performs better in the long run as we believe it will more likely create an environment open for discussion.

7.2.2 Interdependency

Revealing as the most interdependent key factors in regards to affecting most fundamental key factors can be seen in Table 6.6 recognised from the SLR analysis as well as the thematic map for the for the TDA. Factors standing out here include communication, work culture, soft skills and team cohesion.

Another interesting factor that seemingly is very interdependently connected with the fundamental key factors is employee personality. In the literature, personality is often discussed in terms of introversion and extroversion, particularly noting that successful teams usually have a mix of both traits [78]. This was somewhat addressed in the interviews as well, where respondents believed diversity creates the need to discuss in a broader sense than a more homogeneous team. However, this is not believed universally, as some research has seen no significant results in diversifying teams [117, 26]. It seems that personality traits, still, affect group behavior in different ways, and how they are mixed ends up in different results depending on situation and context. No team situation is the other one alike and it is hard to draw general conclusions regarding what team composition is best in every situation. On the other hand, extroverts have been seen to perform well in smaller teams [108]. Suggestively, this is a good idea because only a few then possess the drive to claim a leading role; there are not too many opinions and thoughts to attune to. However, this can have multiple implications. Firstly, introverts might instead stay quite, eliminating good thoughts and ideas to arise in discussions due to fear of rejection. Secondly, a false sense of mutuality is spread, creating an atmosphere

for complex conflicts to grow and create diversion within groups. Similar to these thoughts, research has found where different levels of knowledge diversity and value diversity in a team positively respectively negatively affect team performance [143]. Therefore, it is a very intricate problem that is highly complex to take full advantage of. We believe, just as mentioned in the interviews, that a work culture that fosters discussion and the opportunity to speak up will lead to performance in the long run. Therefore, investing in team building activities and creating diverse teams to fully capture the power of different skill-sets and personalities might be beneficial to achieve a highly performing teams, as such a balance of diverse personalities has seen success in teams before [111].

Another interesting factor is organisational learning. Throughout the interviews, the respondents expressed the importance of feeling listened to by the corporate. This necessity becomes increasingly important as everyday life has grown increasingly stressful and is crucial for maintaining employee morale, and ensuring a welcoming work environment and overall productivity. Similar to the mentioned above, listening to the needs of the employees and accounting for their personality can be beneficial in having successful projects [143]. However, it is also important to recognise that what motivates one individual does not necessarily motivate another. Particularly, in the context of developers against managers as these seem to be motivated by different factors [131]. Therefore, assuming everyone strives for the same goal is ambitious and foolish when trying to satisfy people's needs, especially, recognising as a manager that what motivates them does not necessarily motivate the developer [131]. Organisations need to pay attention to this to retain their employees. It further emphasises the importance of satisfied employees as recruiting new members in software engineering often may come with a big upfront cost due to extensive learning curves.

The most prominent factors to successful SE through means of focusing on CI-related outcomes seem to lie in communication and the ability of a team to collaborate and work together, and there seems to be much stress on cultural factors. Multiple interviewees mention background and cultural diversity as factors. This is highly interconnected with the other factors mentioned in the first paragraph; soft skills, work culture and team cohesion. The general issue seems to be individuals feeling that they feel like outsiders and do not fully integrate with the group, and this has multiple reasons. Some expressed language to be a form of barrier whereas others felt that differences in time zones made it difficult to connect with team members. As expressed by Russo et al. in a relatively new study, due to the pandemic forcing more hybrid work opportunities, face-to-face communication will occur less and concerns the way communication is established within organisations [36]. This fact in unison with things like social anxiety and fear of being an outsider highly threatens how employees feel about their workplace.

Conclusively, creating a work environment that fosters and encourages ideas in a safe space, where employees feel listened to and not instantly judged, is crucial for companies that strive to be continuously improving. Through this, it helps the companies retain competitiveness and innovation while keeping employees motivated and satisfied. However, there are many different ways to incorporate such communication, we believe a constant dialogue between employees, managers and higher-ups is the best way to ensure the companies' smooth operation.

7.3 RQ3: Further attainable factors

This research question solely fetch the CI outcomes that are indirectly achieved through the BSE outcomes that are also CI requirements. These were elicited analytically by tracing each fundamental key factor that is a requirement for a particular mutual outcome, and can be seen in the continuous and new outcomes model in Figure 5.7. In general, these key factors, not surprisingly, reflect more organisationally focused factors. However, managerial commitment and work culture come out as two factors that seem to affect many of the continuous outcomes. Once again, there seems to be a positive correlation between satisfied and motivated employees and managers and organisational success.

However, as this whole assumption is based off a partly subjective interpretation (SLR analysis), the validity of these factors alone remains questionable and requires further empirical investigation to confirm their generalizability and relevance. What is clear, however, is that these various factors are deeply intertwined. By fulfilling certain requirements, more outcomes are seemingly worked towards than are visible through our analysis. However, as this effect is rather unmeasurable, emphasis is still put on the major, more frequently appearing factors present throughout our analyses.

7.4 RQ4: Differences between TDA- and SLR-analysis

When examining the differences between the key factors arising between the two analyses performed, multiple factors stood out. As the coding of the interviews aimed to also find novel insights, certain key factors arose that was not initially found in the SLR analysis. These were noted by an asterisk (*) in the Code Table (Table 6.3) and is also shown in the list below:

- Awareness of Bias
- Company Size
- Compulsory Office Attendance
- Freedom in the Job
- Language Barriers
- Time Zones

One factor that was somewhat expected were the *Awareness of Bias*. This is due to one of the interview questions being targeted specifically towards cognition. The question came out rather leading where nearly all interviewee's agreed that bias was not something they frequently considered. This is closely related to decision making and estimation practices. Efforts in detecting risks that is currently not present suggestively mitigates over-optimism and over-confidence in estimation work [83]. Therefore, by making such risk factors (different biases) known, engineers may make more accurate and less ambitious estimations.

Other factors that stood out majorly focused around work environment, team work and work in itself. For example, multiple interviewees expressed a positive attitude towards being able to work from home. Together with autonomy, the interviewees felt both empowered and motivated as they had freedom with responsibility. This type of autonomy and responsibility has seen success before [74] and is perfect in the occasions where the task is challenging enough to not feel insignificant yet manageable without supervision. Also, communicational matters in terms of language barriers and time zones was seemingly affecting the engineers. The interviewees expressed mixed attitudes towards language barriers and negatively on time zones. As discussed before, language barriers can impact a team negatively short term but positively long term [143, 85]. Constant misinterpretations and language difficulties can be frustrating for both parties, but can foster a common ground on which all communication should be established if handled correctly. This idea is grounded on the fact that some interviewees found it troublesome to communicate effectively with their team. Others emphasised the necessity with diversity in background and culture to bring a variety of perspectives on the challenges and tasks the team faces. On the other hand, research has also indicated matching cognitive styles tend to be more important than diversity in terms of cultural and demographic aspects for effective team work [66]. We believe therefore that a diversity in technical, cultural and demo-graphical aspects of the engineers may foster great communication whereas more similar cognitive styles throughout the team is preferred.

However, it is important to note that these are aspects coming from different types of engineers (mostly software) of an organisation, and no managers. Therefore, these factors may not be important for a successful organisation, but rather for employee satisfaction. Nonetheless, making the distinction still feels necessary in this case, as using the employee emotions *solely* as a compass for the organisations needs could be dangerous, as these ideas might not always prioritise company wealth and growth.

7.5 RQ5: Limitations

A cause for concern when striving to fulfill the outcomes is the mentioned limitations. Throughout the SLR and TDA, multiple limitations has been brought up. As for the SLR, Figure 5.8 embodies the connections found in SLR analysis. From this figure, it is evident that certain factors are brought up more than others; in partic-

ular, monitoring and managerial commitment is vastly more mentioned than other factors. In terms of affected outcomes, performance seemingly has most limitations affecting its fulfillment, with job satisfaction, motivation, work culture and quality emerging at a much lower level. This result is rather expected, due to the level of abstraction between the different factors. 'Performance' is arguably a more broad and abstract factor than, for example, decision-making, making it stand out to a higher degree than what might be reality. Additionally, outcomes as like 'Productivity' and 'Efficiency' are closely related to 'Performance', one might suggest many of the limitations affecting 'Performance' seemingly affect them as well to some degree.

In terms of monitoring, research regarding the potential hire of new programmer seems to emphasise employee personality over cognitive aspects when recruiting new programmers [49] (reflecting on BR12 in Table 5.5). Seemingly, by reflecting on these results, monitoring the current personality aspects of the recruiting team, performance may be achieved. This becomes increasingly difficult as it might not always be easy to monitor such factors. In a study determining the need for cognition in software engineers, a key finding suggest personality to some degree can explain their need for cognition [35] (BR9). As need for cognition has been correlated with high performing individuals, these two findings suggest that closely monitoring specific attributes of software engineers may enhance team and company performance.

As for the interviews, this phenomenon becomes less obvious and requires one to delve deeper. For example, some interviewees expressed feeling frustrated and demotivated when they were limited by their manager or organisation regarding certain tasks. From the company's perspective, if such initiatives are better monitored, it can improve the team and/or individual performance by addressing these issues proactively.

Another significantly mentioned limitation is managerial commitment. In the interviews, uncommitted managers was neither a common nor rare occurrence in the engineers career. People who had experienced this, similar to the example above, expressed mostly feeling frustrated and demotivated in their work. It could include feeling limited in their task, expressing their creativity and innovativeness decreased, but also not working with their area of expertise. Evidently, managerial, or at least organisational, efforts ultimately refrain the engineers from doing their work. Touching upon a similar subject, a study in which same-gender teams cohesiveness was examined resulted in the feeling of higher levels of satisfaction, communication and compatibility if addressed from a managerial perspective [88]. Although the study brings up a different matter, both situations require the issue to be seen by the managers in order for it to be fulfilled.

Additionally, as issues regarding the degree of managerial efforts and managerial commitment in general concerns individuals in a negative way, it is a difficult and intricate topic to study from an ethical perspective. Therefore, we believe careful measures must be taken when investigating and monitoring the behaviors of managers within a company to ensure the privacy and well-being of those involved.

On a finishing note, managers play a big part of the overall satisfaction and well-being of engineers within a company. They can both become the enabler and limiter of certain tasks but also in the future of someone's career. Throughout this study, the discussed factors were the seemingly most apparent. It is also evident that the way the expressed limitations affect outcomes in certain situations is rather complex. We believe a mindful attitude towards limitations is sound in the endeavour of achieving said outcomes.

7.6 Significance of Study

In this thesis, we wish to shine a light on the human aspects of having a continuously improving SWD environment. The fundamental key factors and requirements found are aspects that seemingly foster such desires. Although the steps taken in both analyses include subjective parts, particular aspects come forward as more recurring and important. We believe the results found in this thesis can act as pillars of importance in creating a continuously improving work environment with humans in focus. Additionally, even though this study tries to elicit requirements for the desired outcomes, *how* they achieve certain outcomes is less clear. Therefore, examining and measuring how particular key factors affect certain aspects of the CI-integrated SWD organisation is an interesting topic for future research.

Polestar Performance AB is an automotive company with an emphasis on performance, design and cutting-edge technology. Throughout this interview study at Polestar, it is clear that the employees are highly satisfied with their work environment. Polestar seems to be excelling in fostering an innovative and creative work environment that offers both opportunities for growth and freedom with responsibility. Communication emerged as a key theme throughout this thesis, and we recommend Polestar to keep an inviting and friendly work culture which encourages open dialogue. While social interactions are very complex and unique, we believe by actively listening to their employees and strive for concrete organisational goals, Polestar can continue to improve and maintain a human-centered approach.

7.7 Threats To Validity

The thesis follows certain frameworks to achieve its results, nonetheless, it may give rise to certain threats to the validity of the undertaken work. Therefore, this section aims to inform certain threats in addition to methods undertaken to alleviate their impact. Furthermore, this section will also address the limitations imposed to delimit the scope of the study and the reasoning behind them.

7.7.1 Systematic Literature Review

Although an SLR uses a strict and methodical approach to collect, assess and interpret relevant research on a particular topic, they are not without potential threats to validity. Biases like publication-, selection-, language- and assessment bias, for instance, could all occur when conducting an SLR and should be taken into account. This was considered during the selection phase of the research material through raised awareness of potential biases. Additionally, a mutual agreement was established, requiring the approval of both researchers to include the paper in the study, alleviating the impact of confirmation bias.

Another likely threat is the amount of papers not considered in the SLR due to shortage of time. As the number of initially screened papers was more than cut in half, the combined knowledge from all papers could have emphasised other factors, resulting in a current insufficient background. Although the size and diversity of the papers are quite broad, it is hard to claim saturation between the papers, posing a threat to the validity of the study.

Given that the primary objective of the quality assessment of the SLR is to increase the trustworthiness of the selected papers, the choice of applied measurements and their respective thresholds may influence the overall rating of a paper. Therefore, the score applied to a particular paper might deviate from the broader perspective, especially considering the thresholds are cut-off points instead rather than continuous measurements.

Besides this, throughout the process of identifying primary papers, no explicit documentation was performed. For instance, documenting exact counts of search hits for each search string used for each database. This decision suggestively implies a lack of replicability.

7.7.2 Thematic Data Analysis

Apart from the SLR, the thesis will only be conducting one qualitative study in the form of interviews largely due to time constraints and available resources, consequently leaving other research methods on the table. Including quantitative research methods could arguably provide more insights into the matter at hand.

Conducting interviews as a research method can expectedly provide rich, qualitative data, offering in-depth insights into participants' perceptions and experiences. However, similar to SLRs, numerous biases can present themselves like interviewer-, response-, recall-, selection- and confirmation bias to name a few which should be considered.

Due to a finite experience of previously conducting thematic analyses, handling larger amounts of data can become difficult to efficiently interpret. Therefore, the amount of data that will be collected will be narrowed down slightly to 9 interviews

in total. One consequential drawback of this is that it could potentially cause a loss of important data and, additionally, become harder to generalise.

Additionally, the coding of the interviews might induce bias, as more frequently appearing codes are more likely to be re-coded, potentially leading to the oversight of less frequently appearing codes when relating them to the key factors. To mitigate such errors, multiple revisits of the codes were conducted.

7.7.3 Limitations

The decision to exclusively examine software-related departments in the thesis work was made, largely due to the limited amount of research previously conducted in this particular field of research. Additionally, because of time and available resources, other departments will not be accounted for in the study. Consequently, the findings should provide justifiable information that could be applied specifically to the software engineering and development field.

Attempting to map human aspects in a comprehensible way is truly a complex task. The complex nature of human experiences and accurately mapping their multifaceted aspects is a remarkably intricate endeavour, one that calls for a comprehensive and thoughtful discussion. The complexity inherent in this undertaking stems from the profound relations that exist within the area of human existence. The deeper one might search, the more apparent this interconnectedness becomes.

Interestingly, this interplay was not immediately clear to us. In the beginning, we naively thought certain human aspects held substantially more things in common with particular features, only to realise this imaginary reality was merely a simplified attempt to map the different aspects into particular groups of importance.

In this light, making conclusions regarding the importance certain aspects have in a SWD environment is a complex task, and should be treated as such. Therefore, it should not come as a surprise that the true relationship between certain aspects most likely reveals a similar picture as the map described in Figure 6.2. Furthermore, it is therefore important to emphasise that our results may be difficult to simplify since every aspect is deeply intercorrelated and may not stand alone. However, as certain aspects appeared more broadly and frequently than others, we insist their importance in successfully implementing CI lies in the frequency they appeared in our analysis.

Evidently, there are a lot of feelings intertwined regarding organisational change, the impact of managerial initiatives, and the overall approaches to work. Amongst other things, the employees of the SWD environment desire motivation and empowerment, and they might hold diverse perspectives regarding their attainability. Considering these factors might significantly impact overall work-life balance, job satisfaction and psychological safety, we regard them pivotal pillars to be of fundamental importance for a firm foundation of a successful company. Given that CI has not previously employed strategies to address these concerns, we deem BSE a well-suited approach to effectively and successfully implementing CI practices within a SWD setting.

Reflecting back on the introduction, our research trajectory and findings have led us to recognise the vast nuances and complexities that exist and fundamentally should be acknowledged. The two research fields appear to be natural allies, with CI's emphasis on purposeful and continuous improvement dovetailing adequately with BSE's emphasis on the human behaviours affecting SWD. Yet, despite these

compatibilities, the reviewed literature in this thesis appears to insufficiently investigate the interplay between them. Consequently, the deeper we delved, the more encounters of intertwined feelings, motivations and aspirations amongst software professionals existed. Thus, reshaping our understanding and appreciation for the human aspects and behaviours in SWD. Furthermore, we have sought to address a pressing research gap by providing a better understanding of how the core principles of CI can be realised in SWD by emphasising the tenets of BSE. As such, it is apparent that this thesis not only builds on the current foundation that exists but also addresses the inherent requirements and potential outcomes therein. Ultimately, this research began by acknowledging the profound impact of CI on organisations and has culminated in a nuanced understanding of its potential role in SWD, by emphasising human aspects encapsulated by BSE. Optimistically, the findings serve as a testament to bridging theoretical frameworks with empirical realities to drive meaningful advancements in the SWD field.

8

Conclusion

Although the published research surrounding BSE never directly addresses CI, the findings presented in this thesis confidently suggest that it is possible to implement CI from the perspective of SWD. By subsequently examining and analysing the existing research regarding CI and BSE, the results show that many of the identified key factors associated with successfully implemented CI are achievable through emphasising BSE. Furthermore, the results suggest that additional key factors associated with successfully implemented CI are achieved by initially attaining the fundamental key factors. These fundamental key factors represent those key factors that are shared between the two research fields. Besides this, an alternative approach to establishing correlations between desired CI key factors without necessarily disregarding BSE research is provided. This approach consists of initially recognising CI relations and subsequentially mapping in over to BSE research. However, this method of drawing correlations evidently shows that a lack of research exists and that additional BSE research addressing the missing links is required.

Nonetheless, the primary analysis conducted in this thesis recognises 10 fundamental key factors to be of greater importance. Furthermore, the fact that CI should be perceived as a methodology that is continuously strived towards, the 10 fundamental key factors represents a sufficient first step towards achieving CI in SWD. Moreover, the means of ultimately achieving these fundamental key factors are also addressed from two perspectives. For one, the conducted SLR analysis indicates particular key factors to be of greater consideration. This conclusion is drawn predominantly from the fact that they occur more frequently in the reviewed research literature. Secondly, the qualitative research method consisted of conducting 9 interviews and subsequently performing a TDA. The associated findings assisted in strengthening established findings, in addition to providing new perspectives. Besides this, the associated TDA findings also presented entirely new insights that were not necessarily discovered in the reviewed research data.

In conclusion, the implementation of CI in SWD is most definitely a possibility in SWD, provided that particular key factors are acknowledged and continuously strived towards.

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A

Appendix 1

Performance	#
Communication	7
Team Cohesion	5
Employee Personality	5
Team Diversity	3
Cognitive Diversity	2
Innovation	2
Team Norms	2
Team Composition	2
Org. Learning	2
Work Environment	2
Conflict Resolution	2
Job Design	1
Leadership	1
Collaboration	1
Motivation	1
Employee Needs	1
Psychological Safety	1
Task Significance	1
Employee Emotions	1
Creativity	1
Conflict Resolution	1
Trust	1
Work Culture	1
Monitoring	1

Motivation	#
Autonomy	5
Task Significance	4
Feedback	4
Recognition	3
Task Variety	3
Org. Learning	3
Growth Needs	3
Job Satisfaction	2
Communication	2
Team Cohesion	2
Leadership	1
Monitoring	1
Benefits	1
Ownership of Work	1
Salary	1
Security	1
Employee Emotions	1
Technical Expertise	1

Job Satisfaction	#
Team Cohesion	2
Autonomy	1
Conflict Mgmt.	1
Emotional Int.	1
Employee Emotions	1
Employee Personality	1
Job Design	1
Recognition	1
Task Significance	1

Work Culture	#
Org. Learning	2
Employee Needs	1

Quality	#
Employee Personality	3
Conflict Mgmt.	1
Cognitive Bias	1
Motivation	1
Team Cohesion	1
Team Diversity	1

Productivity	#
Motivation	2
Employee Needs	1
Job Satisfaction	1
Monitoring	1
Org. Learning	1
Soft Skills	1
Team Cohesion	1
Team Composition	1

Decision-Making	#
Cognitive Bias	1
Employee Emotions	1

Efficiency	#
Cognitive Style	1
Communication	1

Customer Satisfaction	#
Soft Skills	1

Work Culture
Collaboration
Communication
Company Size*
Cultural Aspects
Employee Personality
Gender Equality
Organisation
Organisational Learning
Recruitment
Relationship Building
Social Presence
Soft Skills
Team Cohesion
Team Diversity
Team Size
Trust
Work Environment

Motivation
Benefits
Employee Emotions
Employee Needs
Growth Needs
Innovation
Job Satisfaction
Leadership
Managerial Commitment
Monitoring
Ownership of Work
Recognition
Resistance to Change
Salary
Task Significance
Task Variety
Team Work
Uncertainty
Work Culture
Work Environment

Efficiency
Communication
Employee Emotions
Job Design
Motivation
Performance
Planning
Productivity
Team Composition
Team Diversity
Team Work

Productivity
Autonomy
Conflict Resolution
Efficiency
Employee Emotions
Motivation
Recognition
Performance
Task Variety
Team Cohesion
Work Environment

Job Satisfaction
Benefits
Employee Needs
Freedom in the Job*
Growth Needs
Motivation
Organisation
Recognition
Salary
Team Cohesion
Team Work
Work Culture

Performance
Efficiency
Employee Emotions
Employee Personality
Motivation
Productivity
Team Cohesion
Team Work

Decision-Making
Awareness of Bias*
Cognitive Bias
Communication
Leadership
Soft Skills
Team Cohesion
Work Culture

Customer Satisfaction
Communication
Soft Skills

Quality
Collaboration
Communication

Employee Involvement
Managerial Commitment
Soft Skills
Feedback
Team Composition
Communication
Work Environment
Ownership of Work