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Master Thesis Report

Sustainability: A Requirement in Projects

An exploratory research to develop a framework for sustainability requirements management in Transmission System Operators' (TSO) projects

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MSc Construction Management and Engineering

DELFT UNIVERSITY OF TECHNOLOGY

Sustainability, A Requirement in Projects

An exploratory research to develop a framework for sustainability requirements management in Transmission System Operators' (TSO) Projects

In partial fulfilment of the requirements for the degree of
Master of Science in **Construction Management and Engineering**
at **Delft University of Technology**

In collaboration with **Aratis B.V.** & **TenneT**

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January 2023

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Preface

This master thesis marks the final step for my MSc degree in Construction Management and Engineering and concludes my 2.5 years at TU Delft. These years have been full of learning and fun experiences that will always be close to my heart.

This journey would not have been possible without the support of several people. I would like to express my sincere gratitude to my graduation committee for guiding me these past seven months. I would like to thank my first supervisor, Martijn, for always providing me with your guidance and showing me the direction whenever I was unclear about the next steps. Your positive attitude and feedback helped me significantly in carrying out my research. Dear Paul, I greatly appreciate you chairing this committee despite your busy and packed schedule. Your critical feedback helped me understand the research fundamentals and improve my work. Thank you, Johan, for your insightful feedback during the meetings, without which I would have missed the small important details. A special thanks to my company supervisor, Tijs, for always motivating me and putting your complete faith in me and my decisions. I would also like to thank Johan Dekker for your words of encouragement. I extend my sincere gratitude to everyone from TenneT who participated in my semi-structured interviews and provided valuable insights for my research.

I am glad to have made some amazing friends and acquaintances during these past 2.5 years at TU Delft. They have some way or another, made my journey memorable. But I would like to mention a few special ones, starting with the P group (Mehna, Aditya, Vikas, Karan, Adhil, Zac, and Rahul). Thank you for all the wonderful, fun, and crazy moments we had and for being there throughout the masters. I seriously wouldn't have had it any other way. A big thank you to Mehna for constantly reminding me that we are in this together and literally being a phone call away whenever I needed help. Also, thank you, Namrata, for calmly listening to all my rants, being my cheerleader, and for all the travel and non-travel plans. Special thanks to Aditya for your constant support and patience whenever things got overwhelming for me. You and your food made things easier. I would also like to express my gratitude to my friends back in India, who kept checking up on me all this time.

Lastly, I would like to thank my parents, without whom this journey wouldn't have been possible. Even though you are miles away, you both kept supporting, motivating, and pushing me to do my best. Thank you for everything, for your sacrifices, and for keeping your faith in me. I hope I have made you both proud. This is for you, Deta and Maa, and also for me!

I hope you enjoy reading!

Barshaleena Das

Delft, January 2023

Executive Summary

Sustainability has become a prominent term in policy-oriented research as an expression of what public policies seek to achieve (Kuhlman & Farrington,2010). It has been a developing idea, frequently receiving attention from society, governmental agendas, and the innovative field (Tamak,2017). Organisations are now rapidly taking steps towards incorporating sustainability in their activities and projects. However, even though there are guiding principles mentioned in the literature, practice reveals that organisations still have trouble in the long-term implementation of sustainability in projects (Kammerl et al., 2017; Stewart et al., 2016). One of the most difficult challenges TSOs (Transmission Grid operators) face in successfully integrating sustainable requirements in projects is translating high-level sustainability goals into quantifiable and measurable sustainability aspects. There is the need to translate these goals into concrete sustainability requirements and to be managed properly for their successful implementation in projects. This will be addressed through this research.

The main aim of this research is to develop a framework for managing sustainability requirements in TSO projects. The objective of the research is to successfully reduce the gap present in managing sustainability requirements in TSO projects by developing a framework. The following research question is proposed based on the research objectives.

How can sustainability requirements be better managed by actors in TSO projects?

The research is conducted through a qualitative method. The research is divided into three phases. The first phase includes the study of literature regarding the topic. For this research, sustainability is considered a requirement in project and thus has been linked with requirements management. A comprehensive study on sustainability requirements in the context of a TSO was done. The importance of sustainability requirements in projects was gathered from the literature. It was also known that sustainability requirements are often not implemented in projects because of uncertainties that are present. Thus, the literature identified 12 uncertainties related to sustainability requirements management. The literature review also highlighted the actors' role in sustainability implementation, the attitude needed in the organisation for this challenge, and many more. Further, phase one also includes a document review, which addresses what the case company aims to do and is currently doing. The second phase of this research is the empirical study done through semi-structured interviews. A total of 14 interviews were done, and data was gathered through recordings (audio). The data was then analysed via Atlas.ti software. The main purpose of the semi-structured interviews was to understand the current situation of sustainability requirements in the case company and to identify uncertainties that actors face in practice.

The uncertainties found in the literature were presented in semi-structured interviews to understand if those were faced in practice. This phase identified additional uncertainties, and together with the ones found in the literature, a total of 20 uncertainties were identified related to implementing sustainability requirements management. The 20 uncertainties were then prioritized in Phase three to identify the ones that have a more significant impact than the others and thus need to be tackled first. Then recommendations are provided to tackle those uncertainties. Table 0.1 shows the 20 prioritized uncertainties.

Table 0.1: Total 20 uncertainties identified from literature and interviews

Sl no.	Uncertainty
1	Lack of Knowledge, training, and necessary skill set
2	Lack of clear responsibility identification and distribution
3	Mindset
4	No proper framework and document reporting
5	Lack of awareness of the changing dynamic environment in practice
6	Not managed throughout the life cycle
7	Vagueness in understanding about the topic
8	Resource limitation
9	Lack of Transparency
10	Low management commitment
11	Poor quality of stakeholder involvement
12	Different perceptions of stakeholders and project managers
13	Very few pilot projects
14	Lack of cooperation
15	Cost over sustainability
16	Sustainability gets lost in the top-down process
17	Lack of clear and strict requirement from management in tenders
18	High Cost and lack of funding support
19	Lack of tools to measure sustainability in tender
20	EU procurement law has impact on implementation of SR

Phase three also addresses the third objective of the research, which is to develop the framework for sustainability requirements management. The framework consists of five main steps and is an iterative process. The framework aligns with the requirements management process discussed in the literature but is modified to focus mainly on sustainability requirements. The framework must be used at the program level for its practical implementation. The framework is developed to take the strategic objectives of the TSO related to sustainability as the input and, through its different steps, produces concrete sustainability requirements as the output. The framework is aligned at the program level and is focused on achieving long-term strategic objectives. Generally, the

requirements management process is project-oriented (Kumar, 2006). But the qualitative framework developed in this research is a goal-oriented process. The practicability of this framework is at the program level because aligning a project's sustainability requirements to strategic sustainability ambitions is critical for overall sustainability performance (Tam, 2010). The program level overviews projects and their activities and aims to realize the organization's strategic benefits. The framework of this research is an iterative process and aims to translate ambitions into concrete requirements that can be implemented in projects. It will lead to the gradual achievement of long-term strategic goals and result in strategic benefits. Being a goal-oriented process, this framework will assist program managers in starting with the end benefits in mind. It will help program managers track the project's activities by managing sustainability requirements. This framework will provide project managers with operationalized ambitions and help them understand how sustainability requirements contribute to the big picture and to daily activities, which according to Tam (2010), is important to understand to include sustainability practices in projects and programs.

Figure 0.1 shows the Final sustainability requirements management framework.

Recommendations for practice and future research

For ***practice***, it is recommended that the program manager should be able to develop competence in understanding various sustainability issues and identifying the impacts of the project options. The project managers should look beyond the immediate life-cycle of the project and, together with the program manager, build a sustainability management plan. This will help the project managers take in the vision of the long-term strategic benefits that their project will contribute to. The TSO's sustainability KPIs must be specific, covering different projects of the TSO. Sustainability is also recommended to be considered a separate topic with equal importance as safety.

For ***future research***, it is recommended that practical validation of the framework can be done and how it can be adapted to different industries and phases. A quantitative study can be done to understand how the incorporation of sustainability requirements can be assessed in projects. Future research exploring contractor/supply chain perspectives can also be done, along with exploring the competencies needed for project managers at the execution level to incorporate sustainability in projects successfully.

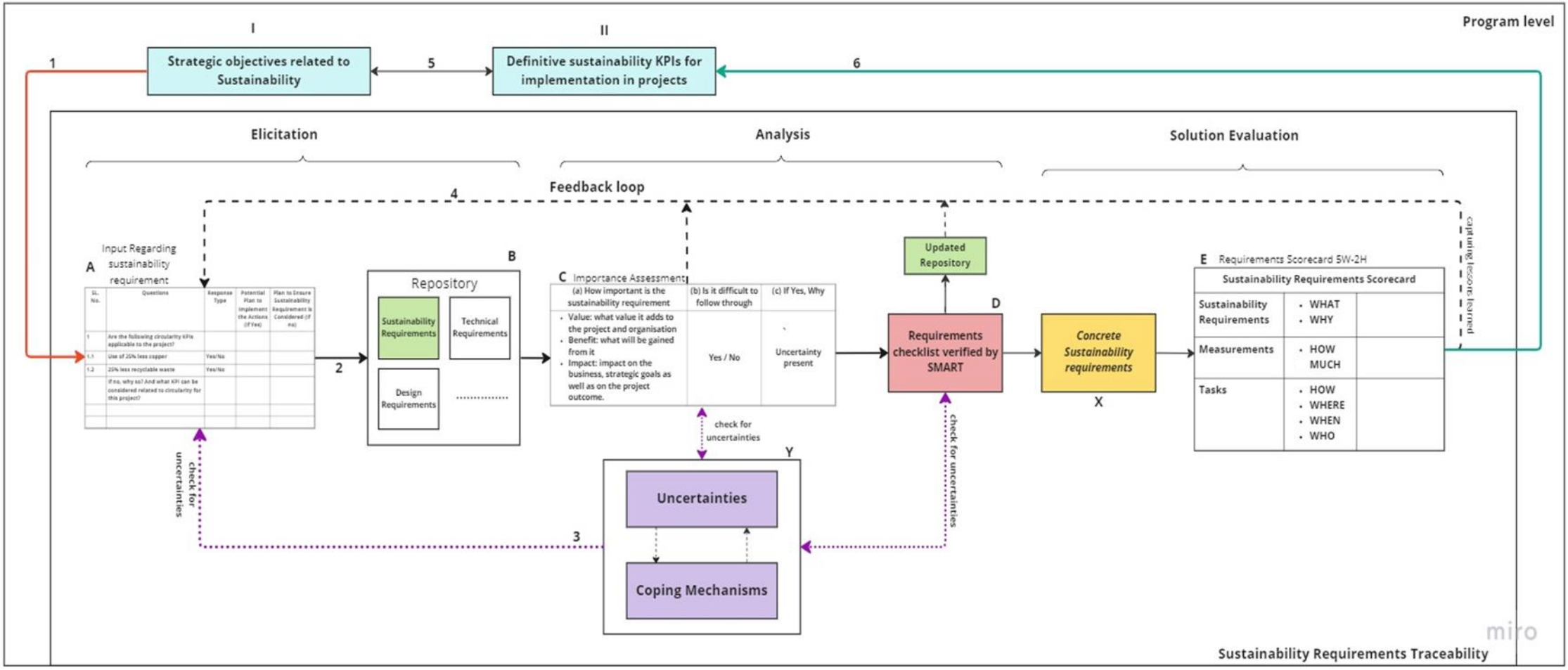

Figure 0.1: Final Sustainability Requirements framework

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List of Abbreviations

- MRQ: Main Research Question
- SRQ: Sub-Research Question
- TSO : Transmission Operator System
- CSR: Corporate Social Responsibility
- UN: United Nations
- SDGs: Sustainable Development Goals
- TBL: Triple Bottom Line
- 3P: People, Planet, Profit
- RM: Requirements Management
- SR: Sustainability requirements
- KPI: Key Performance indicators
- PMBOK: Project Management Body of Knowledge
- PMI: Project Management Institute
- IAR : Integrated Annual Report
- ISO: International Organization for Standardization
- GHG : Greenhouse Gas
- ESG: Environmental, Social, and Governance
- MEAT: Most Economically Advantageous Tender
- SRM: Sustainability Requirements Management

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CHAPTER 1: INTRODUCTION

In this chapter, section 1.1 provides some background information on the research topic. Section 1.2 and 1.3 defines the problem and the research gap, respectively. They are followed by Section 1.4 and section 1.5, which describe the research objective and questions. Section 1.6 provides the structure of this report.

1.1 Background Information

1.1.1 Sustainability

Sustainability is one of the most critical challenges that currently must be addressed (Silvius et al., 2017). Sustainability involves social and economic impacts in addition to the conventional environmental impact. The Paris Agreement (United Nations, 2015) is the most recent agreement between countries where the aim is to keep the global temperature rise for this century below 2 degrees Celsius to fight climate change. There is a global trend toward greater sustainability, both in international accords on a big scale and in developing projects and businesses on a smaller scale.

Due to the significance of sustainability on a global scale, businesses are now contributing to the sustainability application, which also has positive effects(e.g., financial and social) for them (Martens et al., 2016). There are guiding principles mentioned in the literature; however, practice reveals that organisations still have trouble incorporating sustainability into their daily activities and projects. "*Although the term sustainability has been established in science and everyday life, the content and especially the operationalization of the basic idea remains controversial*" (Kammerl et al., 2017). Hence, there is a need to research how sustainability can be better integrated into practice throughout the project process.

1.1.2 Requirements Management

Integrating sustainability requirements in projects and managing them is an integral part of stimulating sustainability through projects and procurement. As defined by Kumar (2006), requirements are characteristics that a project needs to meet to satisfy stakeholders' goal of solving a problem. Managing requirements is about having the knowledge to create, maintain and test requirements during a project's life cycle (Jansson, 2013). However, requirements uncertainty exists in a project independent of its size, scope, and environment (Ebert & Man, 2005). Therefore, by understanding the uncertainties faced during the project phase, this research will study how sustainability requirements can be managed. This will provide a way forward and could contribute towards better implementation of sustainability requirements in practice.

1.1.3 Case Company- TenneT

TenneT is a leading European grid operator. They provide a secure and reliable supply of electricity throughout the day, during the whole year, while contributing towards a more sustainable, affordable, and bright energy future, thus helping the energy transition. TenneT is driven by its strategic goals (see Figure 1.1) towards responsible growth and fulfilling its role in the energy transition (TenneT IAR, 2021). TenneT is the sole Transmission System Operator (TSO) in the Netherlands and one of four TSOs operating in Germany.

TenneT has already established its sustainability objectives for the near future through its Corporate Social Responsibility (CSR) 2025 Ambition Document. The objective areas outlined in the 2025 ambition statement seek to improve the energy transition sustainably, allowing TenneT to maximize social contribution while minimizing its environmental impact as a TSO (TenneT IAR, 2021). Defining sustainable requirements and following them through the project process can be seen as a way of stimulating sustainability through projects and procurement. That is especially true for TSOs like TenneT, who can promote sustainability through their project process as well as through their newly built assets to support the energy transition. TenneT will be the case company for this research.

Figure 1.1: Strategic goal of TenneT (Source: TenneT B.V. IAR, 2019)

1.2. Problem Statement

There has been an increased interest in incorporating sustainability objectives in business due to the concerns of policymakers, investors, and other external stakeholders, as well as enterprises' aims connected to strategic and market positioning interests (Bey et al., 2013). However, implementing long-term sustainability strategies is still a challenging task (Stewart et al., 2016). There are a few frequently cited reasons why organisations struggle to incorporate sustainability into their daily operations. These reasons include the ambiguous and broad definition of sustainability without a distinct set of sustainability aspects, the availability of numerous methods to evaluate the impact

of sustainability but their limited use in actual operations (Kammerl et al., 2017; Martens et al., 2016; Økland, 2015). López et al., (2002) highlight in their literature the need to translate the general principles of sustainability into operational definitions and practices. The sustainability objectives can be translated into project requirements here, as requirement management is about formulating, analysing, implementing, and managing project requirements that need to be present in the project to satisfy stakeholder demands (PMI,2016).

There is a gap between the sustainable goals that are decided at the top level as well as the initial level of a project and their implementation during the execution phase (Økland, 2015). This means that even though actors agree on achieving certain sustainable objectives at the strategic level, difficulty is faced in implementing them in later phases. Actors involved during the project's strategic phase of planning and pre-tendering formulate, articulate, and communicate which sustainability ambitions need to be on the table. However, during the tendering phase as well as the execution phase, those ambitions are not further extended and are left behind (Jallow et al., 2008; Jallow et al., 2010). One of the challenges is the lack of an appropriate framework for integrating sustainability requirements with management practices (Parsanezhad et al., 2016; Elkhair, 2009). Research shows a direct link between effective management of requirements and project success (Kumar,2006). In other words, understanding how to manage sustainability requirements in projects effectively might result in better project outcomes.

TSOs can promote sustainability through their project procuring and execution processes. However, translating TSOs' high-level sustainability goals into quantifiable and measurable sustainability aspects is one of the biggest challenges they face in successfully integrating sustainable requirements in projects. Therefore, there is a need to understand the issues faced by the TSOs which challenge implementing sustainable requirements. This objective of the research is explained in Section 1.4.

1.3 Research Gap

Many empirical studies have focused on the challenges in implementing sustainability(Stewart et al., 2016). Research has also been identifying the drivers and barriers of sustainability in different industries, and few articles have focused solely on specific countries (Stewart et al., 2016 and Opoku & Ahmed, 2014). However, not much study has been done to understand the challenges faced by TSOs while implementing sustainable requirements in their projects. Apart from this, not much literature is present on how these sustainability challenges influence the management of sustainable requirements during the project process (Hootegem, 2020). The role of requirements management with respect to sustainability is also less explored and needs to be looked

into. Moreover, there is a need for a practical framework in facilitating the implementation of requirements management in the operation industry (Ann & Shen,2013). Thus, it is important to address these as they will ultimately impact the shift to a sustainable economy and build a more resilient organisation.

1.4 Research Objective

In order to approach the research problem and deal with the research gap, a research objective needs to be developed. The objective of this research is to successfully reduce the gap present in managing sustainability requirements in TSO projects. The objective consists of three parts (Figure 1.2). The first part is to create a comprehensible study on the topic of sustainability requirements in the context of a TSO. The second part is to identify uncertainties associated with sustainability requirements and provide recommendations to TSO on tackling these uncertainties. The final part of the research is to develop a framework for the potential integration and management of sustainability requirements in TSO projects.

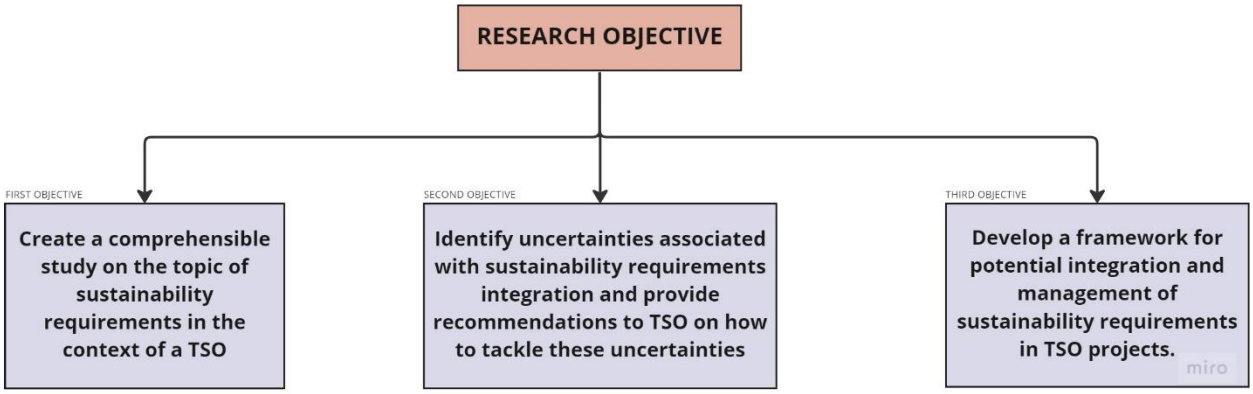

Figure 1.2: Research Objective

1.5 Research Question

The following main research question(MRQ) will be addressed during this thesis:

> *How can sustainability requirements be better managed by actors in TSO projects?*

The following sub-research questions (SRQ) are formulated to answer the main research question:

Understanding sustainability requirement

SRQ1: What is known about sustainability requirements in projects from the literature?

Identifying uncertainties faced by actors in managing sustainability requirements

SRQ2: How is the current situation of sustainability requirements in TSO's projects?

SRQ3: What uncertainties are faced by actors in managing sustainability requirements in TSO projects?

Developing recommendations and framework for better implementation of sustainability requirements

SRQ4: How can the existing requirement management process be modified to manage sustainability requirements in TSO projects?

SRQ5: How can the developed framework be applied in practice to better impact the implementation of sustainability requirements in projects?

1.6 Structure of the report

The structure of the report is explained below:

The introduction consists of Chapter 1 and 2, which gives the background context and the research design. It is then followed by the theoretical background, which consists of Chapters 3 and 4. Chapter 5 consists of the empirical part of this research and its results. Chapter 6 provides the framework developed for this research. It is then followed by Chapter 7, where the results and limitations of this research are discussed. The research is concluded, and recommendations are given in Chapter 8.

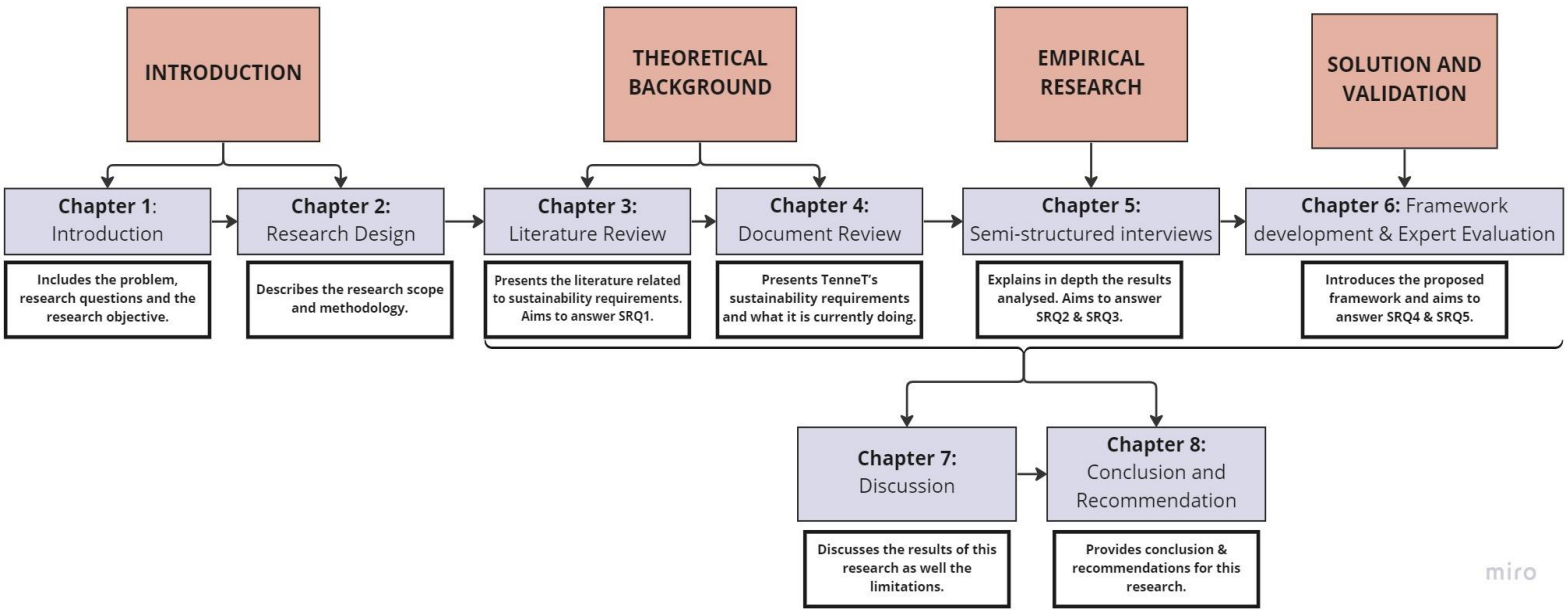

Figure 1.3: Structure of the research report

CHAPTER 2: RESEARCH DESIGN

This chapter sets the research boundaries by defining the research scope in Section 2.1. It then describes the methodology adapted for this research in Section 2.2 and the research relevance in section 2.3.

2.1 Research Scope

The research scope helps identify the limits of the research and what is included and excluded in the research.

The research focuses on how project requirements management with respect to sustainability is done. It also focuses on TSO's current challenges in translating its strategic sustainability ambitions into concrete sustainability requirements. The research will be conducted from a TSO (client) perspective and will focus on TSO projects in energy transmission, distribution, and services. The research also focuses on understanding the difference in viewpoint of actors at the program and project levels of TSO to explore the gap between strategy and implementation. For this research, interviews will be conducted with actors from TenneT. The empirical data will be collected from interviews. The interviewees are mostly actors in sustainability activities at the program and project levels.

2.2 Research Methodology

The research will be conducted using a Qualitative methodology. As mentioned in Section 1.3, not much research is done regarding sustainability requirements management in TSO projects; hence this research will explore that. Creswell & Creswell (2017) states that a qualitative approach is appropriate if a concept needs to be explored and understood because it involves little research or is understudied. As this research will be exploratory in nature, with the objective of developing a framework, it can be said that qualitative research methodology is best suited for this research.

The research consists of three phases, as shown in **Error! Reference source not found.**. The three phases are explained in detail below.

2.2.1 Phase 1: Theoretical Background

This phase consists of Literature review (Chapter 3) and Document Review (Chapter 4).

- Literature Review

Literature Review examines the body of research available regarding the selected topic. It involves journals, papers, books, reports, conference proceedings, and other

publications. Different keywords are used to understand a few academic concepts related to the topic. Firstly, how sustainability in projects is recognized is reviewed. Secondly, a base review of requirement management is done to understand sustainability requirements. Uncertainties related to the management of sustainability requirements are identified. Literature review answers SRQ1.

- Document Review

The main purpose of Document Review is to collect insights and data from different documents within the company (TenneT) regarding the selected topic. The annual reports of TenneT, internal presentations on CSR, and second-party opinion reports are reviewed. The document review helps understand the case company's sustainability ambitions and the current work that they are doing regarding sustainability requirements.

2.2.2 Phase 2: Empirical Research

This phase consists of semi-structured interviews (Chapter 5) as the main source of data collection. This phase answers SRQ2 and SRQ3.

- Semi-Structured Interviews

Semi-structured interviews are the main method of collecting data for this research.

This methodology was selected as semi-structured interviews are suitable for collecting data for exploratory qualitative research (DeJonckheere & Vaughn, 2019). It also provides the researcher to ask open-end questions to the interviewees, which can be used to understand different perspectives. It also allows open discussion regarding the topic between the interviewee and the interviewer.

For the semi-structured interviews for this research, a total of 16 interviewees of TenneT (case company) are approached. 14 of them responded, which included sustainability advisors and project managers. The semi-structured interviews aim to understand what is currently happening with sustainability requirements management in practice and, if a gap exists, related to it.

2.2.3 Phase 3: Framework and Validation

This phase involves the solution: framework development and expert evaluation (Chapter 6).

- Framework development

This part involves developing the framework of the research. First, the uncertainties are prioritized, and recommendations are given on how TSO can tackle the uncertainties related to sustainability requirements management. The framework for sustainability

requirements management is developed, considering input from Phases 1 and 2. The framework is proposed based on the insight gained on uncertainties, the process of sustainability requirements management, and other valuable inputs from the interviews, thereby answering SRQ4.

- Expert Evaluation

Once the framework is developed, it is evaluated through expert evaluation. The goal of expert evaluation is to receive feedback and suggestions from the experts on the practicality of the proposed framework. It is done through a discussion session where experts comment on the findings. Based on their feedback, required improvements are made, and SRQ5 is answered.

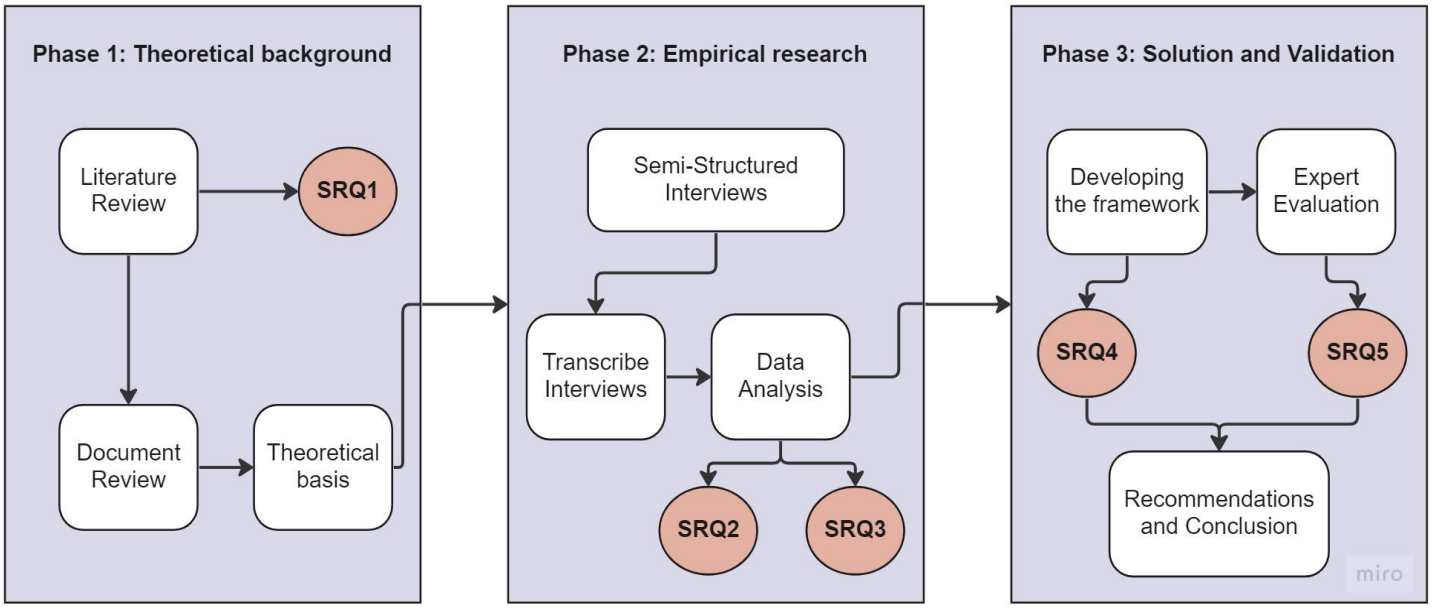

Figure 2.1: Flowchart of Research Methodology

2.3 Research Relevance

This research contributes to academia as well as practice and is explained below.

- From an academic perspective, this research adds to the body of knowledge. A lot of study has been done on sustainability requirements integration and management in the construction and other industries but a very little on TSOs. There is currently little research on sustainability integration and its associated challenges from the context of a TSO. Further, there is limited research on requirements management in the operation industry (TSO) and far fewer when zoomed into the requirements management process with respect to sustainability. Thus, this research adds to the existing knowledge body and provides insight into the TSO perspective on sustainability requirements integration in their projects.

- In practice, TSO has set its sustainability ambitions to be achieved by 2025. To do so, they are motivated to gain insights into how those ambitions can be turned into tangible actions. This research assists the TSO, and its actors in developing a better grasp of sustainability requirements. It is also crucial for TSO to understand the challenges that hinder the successful integration of sustainability in their projects. This research provides insights into the challenges as well as recommendations for the TSO that can enhance the way sustainability is integrated into their projects. The framework developed in this research will also assist TSO in overcoming the challenge they face in translating strategic sustainability ambitions into concrete requirements.

CHAPTER 3: LITERATURE REVIEW

This chapter aims to briefly provide theoretical knowledge to understand sustainability concepts in the TSO industry, organisations, and projects in section 3.1. It is followed by the section of Requirements management in section 3.2, which explains the process followed while formulating and selecting requirements for projects. Section 3.3 mentions the situation of sustainability requirements in projects as per literature, followed by section 3.4, which describes the relation between stakeholders and sustainability requirements. Uncertainties are identified from the literature associated with implementing sustainability requirements and are discussed in section 3.5. The chapter concludes with Section 3.6. This chapter answers SRQ1.

SRQ1: *What is known about sustainability requirements in projects from the literature?*

3.1 Concept of Sustainability

There are numerous definitions of sustainability in the literature, described as a process, evolution, and vision (Clough et al., 2006; Cortese & Rowe, 2015; Glavič & Lukman, 2007). While several definitions are possible, in principle, they are similar to the one from 1987. (Glavič & Lukman, 2007). The most commonly used definition of sustainability is: "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*"(Brundtland, 1987).

The UN defined 17 Sustainable Development Goals (SDGs) are subdivided into 169 targets, covering a wide range of issues from environmental and human rights to sustainable cities and economic growth. As seen in Figure 3.1, these goals are to be realized between 2016 and 2030 and cover the holistic approach needed when addressing sustainability.

Figure 3.1: United Nations Sustainable Development Goals (Source: UN,2015)

3.1.1 Sustainability in the TSO industry

Earlier energy and electricity were not considered factors for sustainable development. However, sustainability now plays an essential role in the global energy transition (Kabeyi and Olanrewaju, 2022). The TSO industry has a significant role in the energy transition process. TSO organisations follow the holistic approach of sustainability in terms of three dimensions: social, economic, and environmental (Kuhlman & Farrington,2010). Elkington (1997) first introduced the term Triple Bottom Line (TBL) and mentioned that the three dimensions need to be addressed in more of an integrated way rather than an individualistic manner in Elkington (2004). The TBL concept was summarised by Elkington (2001), centring it around three words: People, Planet, and Profit (3P) (Pereira & Martins, 2021), which TSOs also use for their sustainability practices, as seen in Figure 3.2.

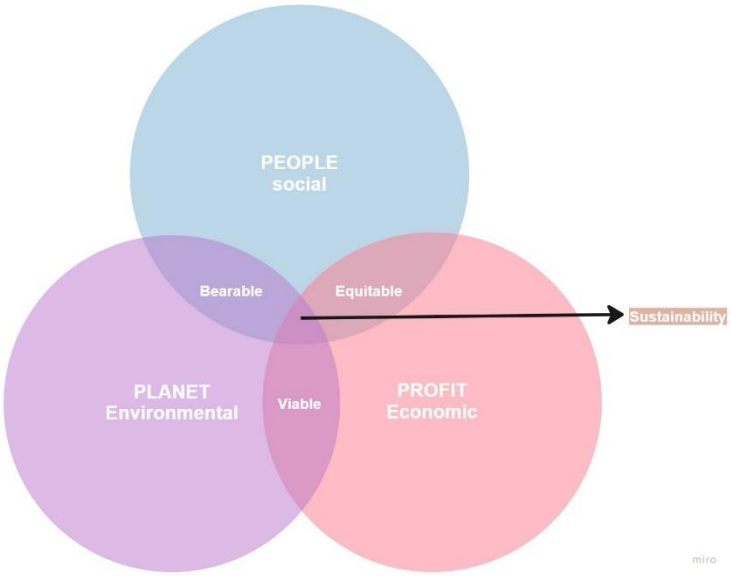

Figure 3.2: Three aspects of sustainability

The three aspects of sustainability with respect to the TSO industry are defined below (Kabeyi and Olanrewaju, 2022):

Social Sustainability: Social sustainability is concerned with the community's rights as assessed by the people's level of social acceptance and access to energy resources and systems.

Environmental sustainability: Environmental sustainability is concerned with mitigating the adverse effects of energy production and consumption on society while amplifying or extending the positive effects.

Economic sustainability: Economic sustainability in energy and electricity production and consumption refers to the ability to meet demand cost-effectively to ensure the energy system's economic viability and feasibility.

Sustainability in energy organisations should be able to bridge the gap between the policies and the requirements of businesses. Proactive assessment and management of sustainability can be an integral objective for the long-term success of these business operations (Kabeyi and Olanrewaju, 2022). Moreover, understanding how sustainability is seen in organisations, in projects, and by people is also considered crucial.

3.1.2 Sustainability and organizations

The concept of Corporate Social Responsibility (CSR) in the context of organizations addresses the triple bottom line (Silvius et al., 2017). The International Organization for Standardization (ISO) promotes that sustainability is the equal responsibility of businesses and organizations as it is of governments and societies through its definition of CSR (Silvius & Marnewick, 2022). According to the definition, CSR is "*an organization's responsibility for the impacts of its decisions and activities on society and the environment, through transparent and ethical behavior that: contributes to sustainable development, including health and the welfare of society; takes into account stakeholder expectations; is in compliance with applicable law and consistent with international norms of behavior; is integrated throughout the organization and practiced in its relationships*" (ISO, 2010). According to Garies et al., (2013), the term also states that organizations are affected by the activities and behaviours of their stakeholders, whether internal or external and that they share responsibility for them. As a result, this could impact all TBL-related factors locally and globally.

The attitude of an organization toward sustainability is critical in the transition process of its sustainable development. According to Tulder et al., (2014) (in Silvius & Marnewick, 2022), this organizational attitude can be classified as "responsibility" (when organizations recognize the value of their own obligations to fulfill their corporate strategies) or "liability" (when legal frameworks direct the organisation's behaviour toward sustainability to avoid legal claims arising from societal impact). Organisations need to have a responsibility mindset to incorporate sustainability issues into their actions and policies (Silvius & Marnewick, 2022). As a result, an organization's project, program, and portfolio management should reflect its commitment to sustainability (Silvius & Marnewick, 2022). Sustainability can also be incorporated into an organisation in various other ways (Martens & Carvalho, 2017). Among the methods are considering sustainability while developing corporate plans, encouraging sustainable practices through cooperative and new agreements, and adding sustainability standards into their initiatives.

3.1.3 Sustainability and projects

Although "sustainability" has been around for a long time, its value in projects has gradually increased over time (Økland, 2015). Projects play an essential role in the implementation of sustainability measures. With the increased understanding of the relationship between sustainability and project management, numerous academic papers have highlighted this relationship, referring to it as sustainability by the project (Silvius & Marnewick, 2022 and Huemann & Silvius, 2017). According to Silvius et al., (2017), when sustainability components are implemented in a project, its value, profitability, life cost and business enhancement, and quality will improve. Projects are currently governed by the three constraints of cost, time, and quality; however, this does not reflect how projects are managed (Silvius & Schipper, 2010). According to Silvius and Marnewick (2022), sustainability affects how projects are managed and designed, planned, executed, and governed. Incorporating and addressing sustainability criteria into project planning and management can lead to project effectiveness as well as project success (Goedknegt & Silvius, 2012; Yu et al., 2018; Coventry, 2015). It will be addressed in section 3.3. Further, to understand how sustainability requirements can be managed in projects, a review of requirements management is done, which will be explained in section 3.2.

3.2 Requirements Management

Requirements exist in all organizations (Coventry, 2015). In their literature, Jallow et al., (2014) discuss the importance of managing requirements throughout the project development lifecycle. Experts have defined Requirements Management (RM) in various ways to identify its application within a specific industry, and the term itself can be considered somewhat ambiguous (Fernie et al., 2003). According to PMI (2016), requirement management is the process of formulating, analysing, implementing, and managing project requirements that must be present in the project in order to meet stakeholder demands. According to Hood et al., (2007), Requirements Management is the process of managing the requirements of a project's products and components, as well as identifying uncertainties between those requirements and the project's plans and work process. The requirements management process results in an awareness of the needs of the key stakeholders, a well-defined scope, and baseline documentation of requirements (Lopez, 2011). RM has a long history in the field of software development and is well-known in the aerospace industry (Fernie et al., 2003). Other industries employ RM, but on a much smaller scale than software and aerospace. There is substantial literature on the aforementioned areas; nonetheless, parallels can be found in that material concerning initiatives in the operation industry (TSO projects in this research). According to Coventry (2015)'s literature, successful requirements management improves essential parts of organizational strategy, project, or operations management. According to

research, effective projects rely on well-managed and understood requirements, making requirements management a vital part of a project (Wiegers, 2002 and Kumar, 2006).

The requirements management process consists of needs assessment, requirements planning, requirements elicitation, requirements analysis, solution valuation, and requirements monitoring and controlling. The requirements process is explained in detail in Appendix A. According to PMI (2016), the requirements process for projects can be as iterative as required. This requirements management process consists of different sets of activities in different phases of projects. Figure 3.3 illustrates the requirements management process and its relationship to the project management process groups, which consist of the various tasks required to establish the project scope and set the course of action necessary to achieve the project's objectives (PMBOK, 2017, 6th Edition). The planning process includes activities carried out to establish the project's scope, goals, and actions required to achieve them. As shown in Figure 3.3 (the grey boxes), the requirements process consists of requirements planning, elicitation, analysis, and evaluation. The requirements management plan should be prioritized throughout the project planning phase and targeted at both the strategy and project levels (Lopez, 2011). As a result, the primary focus of this research will be on the steps of the requirements management planning process, as they include the tasks completed during the project planning phase.

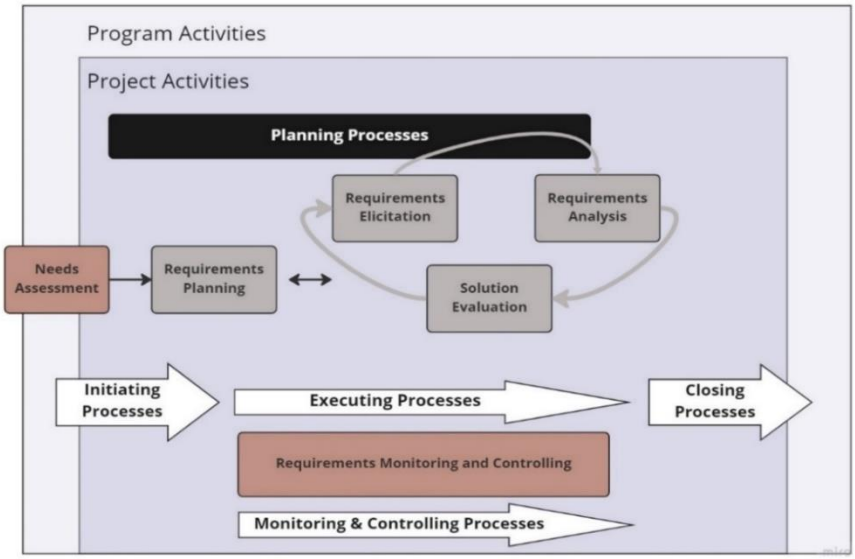

Figure 3.3: Requirements Process diagram (adapted from PMI, 2016)

These steps that occur within the planning process (PMI, 2016 and Lopez, 2011) are briefly explained below:

- Requirements planning: This step provides direction on developing and managing the requirements over the project duration. The plan is developed, reviewed, and

revised in different phases of the project. Initially, a proper stakeholder analysis is done to identify the crucial stakeholders, understand their positions and expectations, and how to engage them during the project. It is followed by gathering their requirements and identifying the organisations' standards and guidance. The last part is to develop the requirements plan by focusing on the scope of requirements activities, including information from the remaining steps in the planning process. Requirements elicitation, analysis, and solution evaluation provide components of information included in the requirements plan and is an ongoing iterative process (as seen by the left-right arrow in figure 3.3).

- Requirements Elicitation: In this step, information relevant to the project or program is gathered from stakeholders. The aim is to derive information that can be used to develop a set of requirements for the project that is comprehensive enough to be implemented. It is then used to define the different requirements needed in a project (such as stakeholder, business, project, quality, etc.). Once the requirements are defined, it is then analysed. Elicitation of requirements needs to be conducted as early as possible in the project and is expected to evolve as the project progresses.
- Requirements Analysis: In this step, the requirements defined are analysed to understand further how a particular requirement can be justified, prioritized, and verified, so that they are aligned with the organisation's strategic goals and objectives. The justification of why the particular requirements were selected is an important step as it involves understanding it from different views to capture varying perspectives. Prioritization of requirements is done to identify the most critical ones and helps focus on the relevant key stakeholders. Once this is done, the requirements are allocated to the appropriate functions and activities of the project or program. Verifying the requirements is done once allocation is completed to see that quality standards are met and detect any errors or uncertainties.
- Solution Evaluation: After analysis, the requirements are validated to ensure that the needs of the critical stakeholders and the organisation are met. In this step, new or changed requirements can also be identified, leading to a new requirement elicitation, analysis, and so on.

Requirements management has become more challenging and complex due to uncertainties in the process. These uncertainties of the requirements exist in a project independent of its size, scope, and environment (Ebert & Man, 2005), which is addressed in section 3.3. This research will look into how sustainability requirements are managed in projects.

3.3 Sustainability requirements in Projects

Ye et al., (2009) and Parsanezhad et al., (2016), practitioners in the engineering and operation industry, consider sustainability one of the top categories of through-life requirements and emphasize the importance of analysing, verifying, actualizing, and measuring those requirements. There is a need for an automated system for sustainability requirements management in projects (Parsanezhad et al., 2016). Integrating sustainability requirements into a project entails developing the process, intended outcome, and quality criteria in conjunction with a large number of stakeholders from the perspectives of the project as a whole (Garies et al., 2013; Eskerod & Huemann, 2013 in Silvius & Schipper, 2014).

Incorporating sustainability ideas into project criteria influences project quality and output (Silvius & Schipper, 2014). The planning phase of a project is critical in determining project success (Zwikael et al., 2005 and Kerzner, 2003 in Isa et al., 2014); alternatively, in this research, project success can be referred to as 'successful inclusion of sustainability requirements.' According to studies, sustainability needs are considered and typically concentrated in the early stages of a project (Jallow et al., 2010). Sustainability requirements are acquired, analysed, and documented at the planning stage and utilized as the basis for designing and tendering (Jallow et al., 2008 and Parsanezhad et al., 2016). However, once a project's planning phase is completed and additional development begins, these sustainable requirements are frequently not continued to the later phases (Jallow et al., 2010 and Jallow et al., 2008). According to Abidin (2009) in Isa et al., 2014, addressing sustainability requirements and related activities in the planning phase may be the vital stage to have the most significant influence on the whole project. Addressing the sustainability requirements after the planning stage will be viewed as a hassle and will most likely increase the budget (Isa et al., 2014).

As stated in section 3.1.3, projects are currently governed by the three constraints of cost, time, and quality. It emphasizes the profit (economic) part of the TBL (Silvius & Schipper, 2010). It is supported by literature suggesting that the TBL's economic dimension is emphasized above the other two dimensions (Hahn et al., 2015). The social and environmental aspects of sustainability standards are given less attention and are more challenging to integrate and manage in programs and projects (Silvius & Schipper, 2010; Martens & Carvalho, 2016; Silvius et al., 2017; Hahn et al., 2015). The translation of these concepts into action remains challenging (Engert & Baumgartner, 2016). Long-term implementation of these sustainability requirements is frequently unsuccessful, highlighting the issue's complexity (Bey et al., 2016). It is necessary first to identify and address the uncertainties in the requirements management process to manage sustainability requirements.

3.4 Stakeholders and Sustainability Requirements

Sustainability is a complex concept in projects with diverse stakeholders (Bal et al., 2012). Bey et al., (2013) and Zhang et al., (2018) state that stakeholders' proactive involvement, policy pressure, market pressure, and strategic business directions are among the few for which implementation of sustainability requirements in projects and organisations are now rapidly increasing. A typical project lifecycle includes numerous stakeholders at various stages. The client, investors, and other stakeholders' demands and expectations regarding sustainability requirements significantly influence an organization's sustainability (Jallow et al., 2014 and Perrini & Tencati, 2006). Managing the sustainability requirements with several interested and involved stakeholders necessitates a structured strategy (Bal et., 2012 and Jallow et al., 2014). According to Okesola et al., (2020), engagement between various stakeholders about sustainability requirements management is essential. Stakeholder involvement in the project should be encouraged so that their expectations on sustainability requirements are recognized early on. These help the organisation develop its business (Perrini & Tencati, 2006). According to Liu et al. (2011), the relationship between stakeholder involvement and requirement uncertainty is frequently overlooked. Managing uncertainties to the benefit of stakeholders and actors can be viewed as an effective strategy for project success (Liu et al., 2011).

In projects, the idea of sustainability is highly ambiguous, and this ambiguity confuses actors and stakeholders. It influences actions connected to managing and applying sustainability requirements in practice. Introducing sustainability thinking to project actors and stakeholders might aid in meeting their expectations regarding sustainability requirements (Okland, 2015). The implementation of sustainability requirements also depends on the accountability of key project and program actors (Goedknegt and Silvius, 2012). Magano et al., (2021) mention that project and program managers can significantly contribute to the organisation's sustainability practices. Yet, these key actors still do not have a proactive approach for integrating sustainability practices. Other uncertainties, such as no proper assessment of these practices, among many, are the issues. These uncertainties are further discussed in section 3.5.

3.5 Uncertainties identified from Literature

The requirements are uncertain (Ebert & Man, 2005). The presence of requirements uncertainty has a negative impact on project performance (Eva, 2001; Jiang et al., 1998; Jiang & Klein, 2000; Nidumolu, 1995 in Jiang et al., 2009). According to Jiang et al., (2009) and Ye et al., (2018), addressing these uncertainties early in the project can lead to coping with them. Because long-term implementation of sustainability requirements is frequently unsuccessful (Bey et al., 2016), it is critical to address the uncertainties that accompany it. The first step is identifying the uncertainties associated with managing

sustainability requirements in literature to understand the theoretical background. As a result, a detailed literature review is conducted to identify uncertainties.

The protocol followed for the literature study is adapted from Kordi et al., (2021). The literature paper mentions that a systematic search strategy should be followed to identify, evaluate, and summarize all available research studies relevant to the topic area. Appendix B explains in detail this procedure of narrowing down the relevant literature. There are four main phases for the systematic literature review search strategies: identification, screening, eligibility, and inclusion, as seen in Table 3.1.

Table 3.1:Systematic search strategy (adapted from Kordi et al., 2021)

Phase	Database
Phase1: Identification	Keywords:("sustainability" AND "implementation" AND "challenges" , "sustainability" AND "requirements" AND "challenges", "requirements" AND "uncertainties", "requirements" AND "challenges", "sustainability" AND "requirements" AND "uncertainties")
Phase 2: Screening	Timeline: 2007-2022, Document Type included: Journals and Conference proceedings, inclusion criteria included: sustainability, sustainability implementation, requirements management, articles which addressed challenges and uncertainties
Phase 3: Eligibility	Relevant title, keywords, abstracts, summaries using inclusion criteria
Phase 4: Inclusion	Full paper analysis and synthesis. Redundant articles and unrelated articles were removed. Resulted in 12 literatures.

After following the procedure shown in Table 3.1, 12 pieces of literature are selected, which cover the keywords of sustainability, requirements, uncertainties, and challenges. The literature papers have many uncertainties, as seen in Appendix C.1. The uncertainties that occurred the most are selected. The detailed selection process is in Appendix C.2. Table 3.2 shows the list of 12 uncertainties found from the literature study that are associated with managing sustainability requirements. The 12 uncertainties are given a code for future reference in the research.

Table 3.2: List of Uncertainties associated with sustainability requirements management and the relevant literature

Code	Uncertainty	References
U1	Lack of Knowledge, training, and necessary skill set	(Khan et al., 2018), (Ohene et al., 2019), (de Souza Dutra et al., 2017), (Jallow et al., 2014), (Zhang et al., 2019), (Elkhair, 2009), (Ann & Shen, 2013), (Stewart et al., 2016), (Khan et al., 2021), (Bey et al., 2013), (Suprayoga et al., 2020), (Becker et al., 2016)
U2	No proper framework and document reporting	(Jallow et al., 2014), (Zhang et al., 2019), (Elkhair, 2009), (Ann & Shen, 2013), (Stewart et al., 2016), (Bey et al., 2013), (Suprayoga et al., 2020)
U3	Low management commitment	(Khan et al., 2018), (Zhang et al., 2019), (Stewart et al., 2016), (Khan et al., 2021)
U4	Different perceptions of stakeholders and project managers	(Khan et al., 2018), (Zhang et al., 2019), (Khan et al., 2021), (Suprayoga et al., 2020), (Becker et al., 2016)
U5	Resource limitation	(Khan et al., 2018), (Zhang et al., 2019), (Stewart et al., 2016), (Khan et al., 2021), (Bey et al., 2013)
U6	Lack of cooperation	(Jallow et al., 2014), (Zhang et al., 2019), (Stewart et al., 2016), (Khan et al., 2021), (Bey et al., 2013), (Suprayoga et al., 2020)
U7	Lack of awareness of the changing dynamic environment in practice	(Ohene et al., 2019), (Zhang et al., 2019), (Stewart et al., 2016)
U8	Vagueness in understanding about the topic	(Khan et al., 2018), (Zhang et al., 2019), (Elkhair, 2009), (Stewart et al., 2016)
U9	Poor quality of stakeholder involvement	(Khan et al., 2018), (Stewart et al., 2016), (Suprayoga et al., 2020)
U10	Lack of clear responsibility identification and distribution	(Elkhair, 2009), (Ann & Shen, 2013), (Stewart et al., 2016)
U11	High Cost and lack of funding support	(de Souza Dutra et al., 2017), (Zhang et al., 2019), (Suprayoga et al., 2020)
U12	Not managed throughout the life-cycle	(Jallow et al., 2014), (Ann & Shen, 2013)

As discussed in section 3.3, sustainability requirements' social and environmental aspects often receive less attention and are more challenging to manage in projects than the economic aspect. Hence the uncertainties identified from the literature are primarily related to the social and environmental aspects. Moreover, when the keywords mentioned in Table 3.1 were used, not much literature related to uncertainties regarding the economic aspect of sustainability was found compared to social and environmental aspects.

3.6 Conclusion

The literature review highlights that for an organisation to move forward in the area of sustainability, a responsibility attitude is needed rather than a liability attitude. Literature also provided insights into how sustainability requirements are essential for projects and affect a project's performance. However, it was also observed that long-term implementation of sustainability requirements is often not successful. There is a need to analyse, document, and manage the sustainability requirements. These sustainability requirements often do not get carried forward to the later phases of projects because of uncertainties in sustainability requirements management. The literature provided a list of 12 uncertainties related to sustainability requirements implementation.

Moreover, the literature also mentioned that managing these uncertainties is important, along with early involvement from stakeholders and actors. It further stated that the implementation of sustainability requirements is dependent on the responsibility of actors at the project and program levels. Yet, a lack of proactive approach was seen from the project and program managers' side. The literature study also provided insight that a gap exists between policies/strategies and requirements/implementation with respect to managing/integrating sustainability requirements in projects.

CHAPTER 4: TENNET'S SUSTAINABILITY AMBITIONS

This chapter provides an overview of the sustainability goals of the case company TenneT. Section 4.1 discusses what TenneT aims to do in the area of sustainability, and Section 4.2 discusses what TenneT is currently doing and has achieved. Section 4.3 provides the conclusion of this chapter. The following information is gathered through reading TenneT's annual reports, green financing reports, internal presentations, and second-party opinion reports.

4.1 What TenneT aims to do

Aiming to reduce Greenhouse Gas (GHG) emissions and to improve the energy efficiency of its states, there has been several agreement and frameworks drafted by the European Union (EU). The Netherlands also aims to contribute by reducing its share of renewable energy production by 14% by 2020 and 16% by 2023. The national Transmission System Operator (TSO)TenneT, the government, market participants, labor unions, and environmental groups are all part of it. TSO is responsible for transmitting electricity in high voltage grids and thus plays a vital role in implementing sustainability requirements throughout their project process.

TenneT, a pioneering green grid operator, is aware of its obligation to advance the energy transition sustainably. Through its actions, it seeks to contribute to accomplishing national and international agreements and goals, such as the UN SDGs. Additionally, it aspires to make decisions that benefit people and the environment while providing a sufficient return for its capital suppliers. TenneT has already established its sustainability objectives for the near future through its Corporate Social Responsibility (CSR) 2025 Ambition Document. TenneT's ambition regarding People, Planet, and Profit is connected

Figure 4.1: Overview of TenneT's sustainability ambitions (Source: TenneT's internal presentation)

with the UN's SDGs. People focus on society, diversity, and safety. Planet focuses on circularity, climate, and Nature, and Profit focuses on Profitability. Figure 4.1 gives an overview of these ambitions connected to the UN SDGs. KPIs (Key Performance Indicators) are defined against the ambitions and are shown in Table 4.1.

The TSO primarily focuses on SDG 5 (Gender equality) and SDG 8 (decent work and economic growth for its People (social) dimension. For its profit (economic) dimension, it focuses on SDG 7 (Affordable and clean energy). For its planet (environmental) dimension, it focuses on SDG 7(Affordable and clean energy), SDG 9(Industry, Innovation, and Infrastructure), SDG 12 (Responsible consumption and production), SDG13(Climate Action), SDG 14 (Life below water) and SDG 15(Life on land).

4.2 What TenneT is doing

The following information was gathered through TenneT's annual and second-party opinion reports. The following provides information on what the TSO is currently doing regarding sustainability performance.

- ESG performance

ISS ESG, a third party, evaluates the total sustainability performance of TenneT. In a report on the sustainability quality of TenneT's green financing instrument, ISS ESG evaluated the company's utilization of funds, green bonds principle, and project selection and review procedure. The energy grid's development, building, maintenance, and reconstruction to increase its capacity for renewable energy transmission are all mentioned by ISS as key contributions made by TenneT. Out of 58 firms, TenneT's ESG performance was ranked 5th in the Gas and Electricity Network Operators sector. As a result, TenneT now outperforms its competitors regarding sustainability on the major ESG problems the sector is dealing with.

- Sustainability work and impact

TenneT has also implemented group-wide health and safety management systems. While the accident rate is similar to the industry, contractors have been involved in fatal incidents, which may indicate shortcomings. TenneT employs various strategies to lessen the transmission system's harmful environmental effects, such as bird protection measures. The reduction of greenhouse gas emissions (SF6 leaks and indirect emissions through transmission losses) and the potential effects of its transmission network on biodiversity are key environmental issues. The company has set science-based objectives for its climate strategy that are in line with the emission reductions required to keep the increase in the world temperature to 1.5°Celsius over pre-industrial levels.

TenneT's sole business is constructing and operating grids in Germany and the Netherlands through electricity generated from fossil fuels (natural gas, coal, lignite, oil),

renewable sources (wind, solar, biomass, geothermal energy), and nuclear energy flows. As the contribution to and hindrance from the transmitted energy differs depending on its source, ISS ESG mentions that TenneT's total operations have no impact on sustainability objectives.

- Governance opinion

An independent sustainability committee is not in place. However, sustainability performance objectives are, to some extent, integrated into the variable remuneration of the executive management team members.

Table 4.1 below shows the KPIs defined against the ambition and how much TenneT managed to achieve.

Table 4.1: What TenneT achieved in their sustainability KPIs (Source: TenneT IAR, 2021)

Sustainability Aspect	Ambition	KPIs	Status
People	Society	To be determined	-
	Diversity	In 2023, – 22% female management – 22% female population – Executive and board members 30% female	31% female inflow in workforce
	Safety	In 2020, total recordable incident rate < 3.74	5.8 incident rate was recorded in 2021, stating the target was not met and it impacted the overall performance
Planet	Circularity	In 2025, – 25% less virgin copper use – 25% less no. recyclable waste use	In progress, more insights are being gained
	Climate	– In 2025 fully climate neutral	Increase in percentage of greened Carbon footprint from 62.0% to 69.0%

	Nature	In 2020, zero net impact on nature.	positive nature measures and a reduction of almost 66% of oil leakages.
Profit	Profitability	Return on Invested Capital > Return on Equity	Positive results

4.3 Conclusion

This chapter of the document review highlights the case company, TenneT's sustainability ambitions, what the TSO aims to do, and their current work regarding sustainability integration.

An overview of the sustainability ambitions, along with the respective KPIs, was gathered. TenneT's sustainability ambitions are connected to several UN SDGs, thus covering board range of topics. It was observed that the KPIs set for each ambition were quite vague in nature. For example, KPI for its nature ambition says zero net impact on nature but doesn't have a definite limit, and the KPI for its ambition of Society has not been developed yet. Furthermore, this chapter also reviewed what the TSO is currently doing. It was seen that even though TenneT is contributing to sustainability in its sector, reports showed that its operations had no impact on the achievement of its sustainability ambitions. There were no specific details on achieving a few KPIs; instead, it was pretty ambiguous and general. Thus, it can be said that the ambitions are not adequately translated into actions. Chapter 5 discusses more on the current situation of sustainability requirements in the TSO's projects.

CHAPTER 5: SEMI-STRUCTURED INTERVIEWS

This chapter aims to explain the use of semi-structured interviews as the main qualitative research method for gathering empirical data for this research. Section 5.1 gives a detailed introduction to the interview protocol and how the interviewees are selected. Section 5.2 explains in depth the data analysis method. It is followed by section 5.3 and 5.4, which discusses the results. Section 5.3 explains the results regarding the current situation of sustainability requirements in TenneT and answers SRQ2.

SRQ2: *How is the current situation of sustainability requirements in TSO's projects?*

Section 5.4 explains the results regarding the uncertainties associated with sustainability requirements and thus answers SRQ3.

SRQ3:*What uncertainties are faced by actors in managing sustainability requirements in TSO projects*?

5.1 Introduction to empirical study

Semi-structured interviews were chosen as the methodology because they are appropriate for gathering information for exploratory qualitative research (DeJonckheere & Vaughn, 2019). They also allow the researcher to ask open-ended questions to the interviewees, which can be used to understand different perspectives. Additionally, it enables open conversation between the interviewer and the interviewee about the topic.

The semi-structured interviews aim to understand what is currently happening with sustainability requirements management in practice. It includes understanding the current trends, which uncertainties from Table 3.2 are most faced in practice, actors' perspective, and identifying additional uncertainties present in the process. It also includes understanding the requirements process mentioned in section 3.2. As TenneT is the case company for this research, the semi-structured interviews are done with TenneT's employees to understand the topic from the context of TSO.

5.1.1 Interviewee selection

One of the semi-structured interview aims is to understand the requirements process shown in Figure 3.3. The interviewees selected were the actors related to and involved in the program and project activities. The actors involved in program activities are sustainability advisors, the head of the strategy department of CSR (Corporate social responsibility), and CSR program managers. The actors involved in project activities are Project Managers and Procurement manager. They were involved in different projects

(offshore, land station) to get a holistic idea of sustainability requirements in TenneT's projects.

A total of 16 employees of TenneT were approached, out of which 14 accepted the interviews. The interviewees were classified into a set of 2 actors: Advisors and Project Managers. Each of them is given codes for future reference: 7 Advisors (S1, S2, S3, S4, S5, S6, S7) and 7 Project Managers (P1, P2, P3, P4, P5, P6, P7). Table 5.1 shows the overview of the selected interviewees. The interviewees with lesser experience are those that recently moved to new jobs (so overall 10+ years' experience) except for S1 and S3, who recently joined the case company. The procurement manager is assumed as the project manager (P7) due to the interviewee's involvement and experience in almost all the project management-related work.

Table 5.1: Overview of the selected interviewees

Category	Code	Role	Years of experience in this role	Involved in
Advisors (actors involved in program activities)	S1	CSR Program Manager	2	Corporate level
	S2	Advisor	9	Supply Chain
	S3	CSR Program Manager	2	Supply Chain
	S4	Advisor	4	Grid Field Operations
	S5	Advisor	40	Corporate level
	S6	Head of Strategy Department	11	Corporate level
	S7	Advisor	4	Grid Field Operations
Project Managers (actors involved in project activities)	P1	Project Manager	7	Land station
	P2	Project Manager	25	Offshore project
	P3	Project Manager	20	Offshore project
	P4	Project Manager	13	Offshore Project
	P5	Project Manager	40	Land stations and Offshore project
	P6	Project Manager	5	Offshore project
	P7	Project Manager	18	Overhead line works

5.1.2 Interview Protocol

An interview protocol acts as the interviewer's guide during the interviews. It consists of what the interviewer would say during the interview and the interview questions. The interviews are held online (Webex) and are approached through email. It was ensured that prior to the interviews, the interviewees had an idea about the purpose of the research and the interviews. Before the interview date, an informed consent form was provided to all the interviewees to ensure that they were clear regarding the data-gathering method and its use. All the interviewees signed the consent form. The interviews started with a self-introduction and an overview of the research problem and objective. Permission was asked, and the interviewees were made aware of the meeting

being recorded (audio) to ensure the interviewee's confidentiality and privacy. Each interview had a duration of 60 minutes.

The interview starts with introductory questions about their roles, projects they are involved in, and their years of experience. The introductory question is followed by the main questions used for data collection. The main questions focused on four stages, explained in Table 5.2. Appendix D provides the interview questions associated with each stage.

Stage 1 and stage 2 focus on answering SRQ2: How is the current situation of sustainability requirements in TSO's projects? And Stage 3 focuses on answering SRQ3: What uncertainties are faced by actors in managing sustainability requirements in TSO projects? Stage 4 focuses on coping the uncertainties.

Table 5.2: Different stages of the interview questions

Different stages of interview questions	What was it intended to understand
Stage 1	It was intended to understand if actors were aware of TenneT's sustainability ambitions and their thoughts on integrating sustainability requirements in TenneT.
Stage 2	It was intended to understand if actors knew about how requirements were formulated and how sustainability requirements were selected in TenneT
Stage 3	It was intended to understand if actors agreed with the Literature statement and how much they related to the uncertainties (found in literature) in practice
Stage 4	It was intended to understand how actors cope with the uncertainties and what improvements they think could be made within TenneT's sustainability ambitions.

5.2 Data Analysis

The semi-structured interviews provided with empirical data needed for this research. Data analysis helps identify phrases, quotes, themes, patterns, and views discussed in the interview as well as any other relevant information. The data was first transcribed using

Microsoft Word online and the software otter.ai before being analysed. For the data to be structured and interpreted, the latest version (22.2.5.0) of the software ATLAS.ti was used. ATLAS.ti is a qualitative data analysis software that can assign codes to structured data using open coding.

The codes were assigned in an inductive and deductive approach. The inductive approach means the data is first read through, and codes are allowed to emerge. The deductive approach means predefined codes are applied to the relevant data. The codes are assigned based on the information needed from the four stages of the interview (Table 5.2 & Appendix D). It is assigned to actors' views regarding the sustainability requirements, uncertainties, suggestions on coping with the uncertainties, current trends, and others. A total of 133 main codes are generated. The codes with similar meanings are assigned the same code and later put in the code group. For example, Figure 5.2, which shows the interviewee's quotation mentioning the need for TenneT to have concrete goal to improve SR management, is labeled as 'Improvement: ambition should be specific.' So, all recurring quotes related to this are assigned with the same code. Figure 5.1 overviews the codes assigned, and the code groups made in ATLAS.ti.

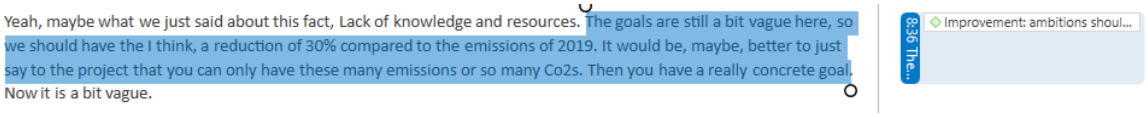

Figure 5.2:Code assigned

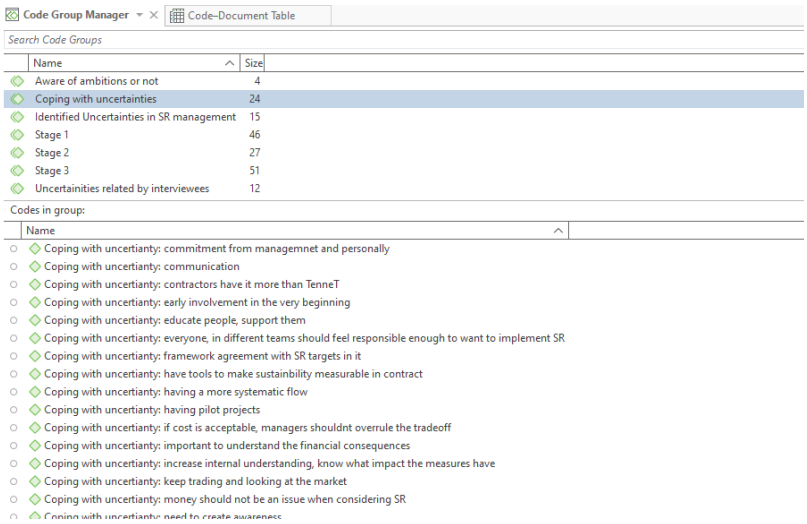

Figure 5.1:Codes assigned to code groups

The data analysed through developing codes resulted in the findings discussed in Sections 5.3 and 5.4. The first findings of stage 1 and stage 2 are explained (Section 5.3). The findings of the third stage are explained (section 5.4).

5.3 Situation of sustainability requirements in TSO project of case company

From the findings of this stage, it was known if the interviewees were aware of TenneT's sustainability ambitions and their thoughts on whether those ambitions are being translated into requirements in TSO projects. This stage also provides if actors know how requirements are formulated and how sustainability requirements are selected for TSO projects was also known from this stage.

5.3.1 Advisors' viewpoint

This section explains the viewpoint of advisors regarding sustainability requirements in TSO projects.

- Sustainability ambitions into requirements

Upon analysing the responses of the advisors, the majority of them are aware of TenneT's ambitions and its KPIs (as shown in Figure 4.1), and when asked, they could state them. Additionally, it is noted that some of them are unaware of all of TenneT's sustainability goals and the associated KPIs. For instance, Interviewee S4 mentioned, *"there is planet, that is the part where my focus is,"* and interviewee S7 mentioned, *" I've read it once or twice, but it doesn't affect daily work, so I don't know."*

Advisors are also asked whether TenneT's sustainability ambitions (an example of Society and Circularity was taken from Table 4.1) are being translated into concrete requirements. The most common response is that it depends on the projects and the people involved. Interviewee S4 stated, "It r*eally depends per project. We have a few projects with people who are really concerned with the whole sustainability part. So, for instance, we have substation X, and one of the engineers has a very sustainable mind. So, he really pushed it*." Interviewee S3 mentioned, "*But there are also measures, where I at least see, that the ambition is not really reaching the business units. So one of them, where I can give an example, is reducing non-recyclable waste. We have, of course, colleagues working on ways like operational waste management. But with my exchange with them, I see that the ambition was maybe not even aware to them*."

Advisors acknowledged that sometimes a TSO project might not have any sustainability requirements. One of the causes of this is the absence of a standardized procedure for including sustainability requirements in the TSO project tender documents. Interviewee S7 quoted, "*I think for parts within TenneT, we even forget to put in our requirements when we tender something. So that's, I think, the first mistake we make; as long as it's not a standard practice in our tendering documents, then you can forget it anyhow. Because then you can press as hard as you want, but since it's not in your tender, you can't implement it."* The responses received, particularly when asked whether TSO's society and circularity

ambitions are translated in practice, are similar to those explained above. It is shown in Table 5.3.

Table 5.3: Statements based on Advisors' responses (on circularity and society ambition)

Sustainability ambition and KPI of TenneT	Statements (based on the response) of Advisors
Circularity: 25% use of less non-virgin copper	• Less non-virgin copper has been used, but on a small scale and not to its maximum. • The main challenge is currently how to track how much of the ambition is achieved. • There is indeed difficulty in translating it to practice.
Society: Stakeholder (KPI is shown as to be developed)	• Currently work on human rights document is going on. • The work related to society was not known by a few other advisors.

- Selection process of sustainability requirements

The advisors are asked whether they know how requirements are formulated in the TSO projects. Most of the advisors had an overview of how the requirements were formulated. Interviewee S4 mentioned, *"For instance, asset management, who decides how or what we build, the GFO department decides how. So, for instance, I am trying to get more reuse of components, and we need asset management for that. And asset management is very reluctant to have second-hand components in their grid because they think it is a risk. So, then we have to find the right people, convince them, make business cases, whatever. And then, if we have an agreement, it's a matter of taking the requirements into policies."* Interviewee S2, Interviewee S1, and Interviewee S7 had similar responses. Thus 4 out of 7 advisors had an overview of how the requirements are formulated.

When asked how sustainability requirements were selected for TSO projects, advisors responded that it was mainly done through active communication between different parties involved. Interviewee S3 mentioned, *"There is dialogue from both sides, which is done very proactively."* Interviewee S1 mentioned, *"I think it's communication, a lot of it. So, we have specific people for specific growth to understand expectations."* There was not much explanation or elaboration by the advisors on selecting sustainability requirements

in TSO projects. It can imply that there seems to be a lack of a procedure (or framework) followed. Moreover, as mentioned by interviewees, there is not much initiative taken internally on this topic. Interviewee S1 said, *"So far, sustainability requirements don't really come from internal stakeholders except the sustainability department. Or if there's a really sustainable project lead who wants to do something about sustainability. So, it's mostly not internally driven."* It was also observed that sustainability requirements are not considered hard criteria for implementation, further showing the topic's complexity.

Interviewees are also asked to give their thoughts on stakeholders' involvement in the sustainability requirements process of a TSO project. Interviewee S3 further mentioned, *"I think our stakeholders are very proactively asking us about our CSR performance. So, we get a lot of questionnaires, for example from our investors, where they really ask us about how we are tackling sustainability in areas. So, they just give those requirements to us, I would say we don't have to ask."* It can be implied from this that stakeholders are actively involved in the requirements process and have frequent meetings with the advisors. However, most advisors did not know how the sustainability requirements were managed and monitored. Interviewee S4 mentioned, *"But the actual managing and monitoring of the sustainability requirements, that's a bit unclear."* It was also interesting to see that only one of the advisors mentioned following the proper requirements management process, as seen in Figure 3.3. Interviewee S5 mentioned, *"We really write down the requirements, discuss it, analyse and purchase and then test them."*

5.3.2 Project Managers' viewpoint

This section explains the viewpoint of project managers regarding sustainability requirements in TSO projects.

- Sustainability ambition into requirements

After analysing the project managers' answers, it was discovered that all but one knew TenneT had sustainability goals in place but were unsure of what they were. Interviewee P1 mentioned, *"I have a sustainability advisor within the project. He is responsible for CSR. So, I can't name one or two of them. I have to check with him, to be honest."* Interviewee P7 stated, *"I can't remember. I'm aware that these calls exist."* Further, interviewee P3 was not fully aware and stated, *"Honestly, I can't say that I'm fully aware of what our sustainability goals are. So that's why I rely on my sustainability advisor to bring that information into the tenders and into the process. But I am aware that we have relative high standards on that, and I think that's important. So, I support the sustainability advisor fully. But to say that I'm fully aware of all these rules. Not really."* It can be observed that even though the project managers knew about TenneT's ambitions, they were not very keen on knowing what those specifically were. The project managers seemed to be dependent on the sustainability advisors regarding whether their project will have sustainability

requirements, which often wasn't the case. The same is observed from the response of one of the advisors, where Interviewee S3 mentioned, *"The CSR department is the strategy team at TenneT; it is mainly there for policymaking and steering. But we see a lot that business units more perceive us in the driver's seat and owning the responsibility for implementing."* It is reflected when asked if TenneT's sustainability ambitions (an example of Society and Circularity was taken from Table 4.1) are being translated into concrete requirements. Most project managers agreed that sustainability requirements were not incorporated into their projects. The reasons stated were cost, purchasing issues, and TenneT's sustainability KPIs being generic. Interviewee P2 stated, *"to do so we need more mutual understanding of the necessity of this. And the breakdown of it in target points. I think the KPIs formulated in the CSR document are pretty much at a generic level.''* Interviewee P1 mentioned, *"Cost. there's so much pressure on the cost in the current market situation. If, for example, other sustainable topics like use of concrete is available, but we'll just go for the cheapest option and that might be prefab, and prefab is so high on concrete that it isn't anything near sustainable."* This can be connected with the literature that organisations run their projects predominately, keeping the triple constraint of cost, time, and quality at the top. It is observed that project managers emphasized that top management needs to put more pressure on this issue. For instance, interviewee P4 mentioned, *"I think it is important to have sustainability as a requirement from the upper management towards all the projects and within the execution phase of working departments."* However, it is also interesting to see two project managers agreeing that sustainability requirements are getting incorporated into their projects. The main reason is the MEAT criteria in tenders, against which there is a heavy MEAT penalty if sustainability is not being integrated into projects. Interviewee P3 mentioned, *"So, we will actually during execution, make sure that the contractors deliver what was promised. Because there is such a MEAT penalty connect to it. So yeah, I think it's quite well integrated."* Table 5.4 shows the statement based on the responses of project managers regarding if the society and circularity ambitions of TSO were translated into practice.

Table 5.4: Statements based on project managers' responses (on circularity and society ambition)

Sustainability ambition and KPI of TenneT	**Statements (based on the response) of Project managers**
Circularity: 25% use of less virgin copper	• The copper ambition is not for all types of projects. For example, copper used in land stations is much less to make an impact. • The main challenge is currently how different projects can check with circularity ambition.

	• Needs to be tracked how much is delivered in practice.
Society: Stakeholder (KPI is shown as to be developed)	• Society needs to be operationalized • Did not know

- Selection of sustainability requirements

The project managers knew in detail about the requirements formulation process. Interviewees P1, P3, P5, P6, and P7 had almost similar responses. This can be summarised in Interviewee P3's quote, *"So, the whole idea of that is we're using system engineering processes. So, you start with your stakeholder requirements, which can also be internal, it can be asset management, or it can be authorities. So, you get those requirements from them. And then you start implementing them in employer requirements. So, we did this using System Engineering. it's a very structured process. And as I said, we harmonize those requirements with Netherlands and Germany. So yeah, that has been quite a task. And also, the verification and validation processes of those requirements are also a lot of times given. And it should speed up the process of validation, verification."* However, when asked how the requirements related to sustainability come into their projects, Project managers are unaware of it. Interviewee P2 mentioned, *"I must admit that I do not have a very clear picture on how these sustainability operational targets, as you call it, flow into the projects. I don't know where they are and how to put them clearly in the project scope at the moment."* Interviewee P3 quoted, "*how the CSR requirements came to be and what was the process of that? I don't know. I've only seen let's say the end results. So, I was not that involved in those processes."* Their answers varied, but the majority said it comes predominately from the CSR department of TenneT. When asked as a follow-up question if the project managers wanted some sustainability aspects in the projects and how it was communicated to the other departments, the response was that it was not generally done that way. Interviewee P6 mentioned, *"We haven't done yet. But of course, if we come up with new ideas, we will do our best."* It is similar to the advisors' viewpoint discussed in section 5.3.1, that internally there is not much initiative taken to get involved in the process of sustainability requirements management.

5.3.3 Conclusion: Situation of sustainability requirements in TSO project of case company

Section 5.3.1 discussed advisors' viewpoints on sustainability requirements in TSO projects, and Section 5.3.2 discussed project managers' viewpoints on the same. These sections combined explain the sustainability requirements management situation in TSO projects. It was interesting to see the difference in viewpoints between advisors and

project managers. It can be seen from the statements in Table 5.3 and Table 5.4. Advisors had knowledge about society's ambition, and there is currently work going on, but project managers did not know. For the ambition of circularity, the project manager knew more in detail than the advisors. Project managers stated that the circularity ambition of using less virgin copper did not apply to the different types of TSO projects. It was also observed that project managers were not acquainted with the work done at the corporate level and, similarly, advisors with the work at the project level. Project managers depended on the CSR department for project sustainability requirements, whereas advisors stated that people involved in projects are not fully aware of TenneT's sustainability ambitions. Even though both the responses have a similar meaning, it is interesting to notice that if looked at from the advisors' viewpoint to the project manager's, the information on sustainability ambitions might get lost in the top-down process. In addition, project managers do not have a proactive approach to integrating sustainability requirements into the project. This was observed in two instances. First, one of the advisors mentioned that the rest of the business unit views the former in the driver's seat for putting sustainability requirements in projects. And second, one of the project managers said there is hardly any time when project managers themselves want to put sustainability requirements in their projects. From there, it could also be noted that project managers may not be enthusiastic enough to join the conversation about sustainability requirements but are more focused on the traditional way of working with cost, time, and quality.

Both actors' views were contrasted regarding sustainability requirements incorporation in projects. Project managers were optimistic about it as the tenders have MEAT criteria and a heavy penalty. However, advisors stated that one of the reasons for sustainability requirements not being incorporated in projects is the lack of standard practice in putting sustainability requirements in tender documents. This raises a question as to whether both actors are on the same page and if they are aware of whether most of the tender documents have the same criteria or not. Furthermore, it was observed that sustainability requirements were less of a priority for project managers than advisors based on the former's responses on not knowing how sustainability requirements get selected for projects. Moreover, both actors agreed that translating the goals into requirements is difficult. The sustainability ambitions and KPIs set are quite generic, because of which there is difficulty in breaking those into target points. In addition, the ambitions currently only focus on particular projects, for example, the copper KPI (of the circularity ambition), which is used much less than the prefab concrete in land station projects. Hence making the copper KPI and, thus, the circularity ambition not widely applicable to land station projects. This insight was gathered from the project managers' view. It shows a gap between policies at the corporate level and implementation at the project level. Thus, a knowledge gap, so to say, is observed between Advisors and project managers.

5.4 Uncertainties associated with sustainability requirements in TSO projects

From the findings of this stage, interviewees were asked how much they related to table 3.2 of uncertainties in practice. Moreover, additional uncertainties were also identified from the interviews.

5.4.1 Uncertainties related by actors in practice

From chapter 3, it was concluded in section 3.6 that sustainability requirements set for the project often do get carried forward beyond the planning level towards the later phases due to the uncertainties encountered during the process. Most of the actors (advisors and project managers) agreed that there is difficulty in taking sustainability requirements ahead in TSO projects. Interviewee P2 mentioned, *"Yeah, it exists. I think that ambitious change during the development phase."* Literature study showed that long-term incorporation of sustainability requirements is often not successful, and it was reflected in the interviewees' responses. Interviewee S1 stated, *"Well, just my view on the thing that there are uncertainties when it comes to translating these goals into actions."* Interviewee P7 mentioned, "*it's easy to set a certain goal in the early stage of a project, but later on, when the details come, it becomes more sophisticated and more complex. So, some problems can arise."* The reason for this was also asked, and the following responses were captured:

Interviewee S4 mentioned, "*I think the most important one is how much the team wants. Because if the project team wants something, it's easy to get it done. So, I think that's the first one. The second one is time. The projects are under a lot of time pressure. And people think that sustainability is expensive, it takes a lot of time."*

Interviewee P2 mentioned, *"I think that our CSR ambitions are not the first ones that needs to be thought, because TenneT needs to build and maintain a grid. And I think that's the first priority. And if we can do that in a sustainable way, that's still the second priority. First priority is to have the energy security in the grid and to realize that with our projects."*

Interviewee P1 mentioned, "*in the end, project managers are scored based on planning and budget, not so much on sustainability*."

It can be interpreted from the responses that incorporating sustainability requirements is currently not a priority in TSO projects. Actors involved in TSO projects put the triple constraint above sustainability requirements, as was seen in section 3.3. Moreover, sustainability requirements incorporation is not a hard rule in TSO projects, because of which also it stays low on the list of goals that need priority. Interviewee P1 mentioned, *"I think in the end, especially for the first projects, time is of the essence together with cost. But in the end, it's the project manager's responsibility, and to be honest, if we are late and*

high on cost, but we will use a solar system, for instance then that I think we will be negative in the media and also internally. Well, the other way around isn't the case if we are within budget and within planning but without a PV (sustainable) system. No one cares."

Table 3.2 was shown the interviewees to know the responses. Figure 5.3 shows how many interviewees faced uncertainties in practice. It was observed that U1: lack of knowledge, training and necessary skill was the most related by actors in practice. It was followed by U12, not managed throughout the life cycle, and then U5, U8 and U10. Table 5.5 shows one quote each for the uncertainties that the interviewee mentioned.

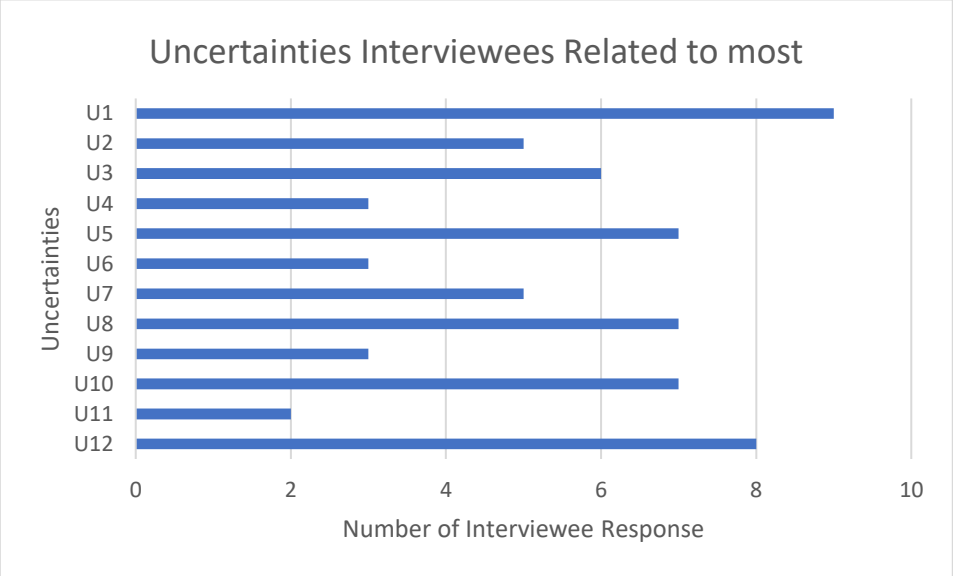

Figure 5.3: No of interviewee responses against uncertainties in practice

Table 5.5: Responses of Interviewees related to the uncertainties

Code	Uncertainty	Mentioned by number of interviewee	Quotes by Interviewees
U1	Lack of Knowledge, training, and necessary skill set	9	*I think it's very important when you look at sustainability requirements, that you really train the whole business. So that, as I mentioned before, that everybody is aware of our ambitions, everybody knows why we have those ambitions and how to integrate them into their businesses*
U2	No proper framework and document reporting	5	*I think reporting is a is an integral part of knowing where to steer on. And if you don't have that transparency, that's just very difficult. We're trying to improve that at the moment.*

			But I think in the past, that has definitely been an issue. We just didn't know where to act on.
U3	Low management commitment	6	*If there is a clearer way, also from the upper management towards all the people with transparency and good communication. Then I think it is possible to have a standardized way of consideration of this sustainable requirements into the project execution.*
U4	Different perceptions of stakeholders and project managers	3	*We have a very tight delivery, and we have to deliver a lot. And that means sustainability wouldn't be a priority for some people. And that's okay. I think because at the end of the day, we are TSO, we work for securing supply. the NGO (stakeholder) notices that we don't work in sustainability, So that in this context could be the challenges or that's what I see project manager says I want to be delivered now. But if you have to research on alternatives to SF six (for example) that would take an extra day.*
U5	Resource limitation	7	*You see that there's basically only one person really involved with these topics, at least within our departments. So, I think that is a problem that he is really quite alone. Yeah, so he's a department for himself. that's a risk.*
U6	Lack of cooperation	3	*I think U6 is related to U4*
U7	Lack of awareness of the changing dynamic environment in practice	5	*I would think that's true in some cases, especially in those projects that are further away from the policymaking because in some cases, our projects are really close to our category management and procurement, for example. Then I think that awareness is higher, but for some projects where that link is not that close. I think there it's also harder to put those requirements in place.*
U8	Vagueness in understanding about the topic	7	*I think we have to do a better job in creating the understanding about the whole topic and about the necessity of integrating sustainability among our colleagues. And most of them know that we have some ambitions, but they don't really know what that means for their everyday practices*

U9	Poor quality of stakeholder involvement	3	*Due to the fact that it's hard for such a topic to push or to follow through and that people involved need to have willingness to try it out in projects.*
U10	Lack of clear responsibility identification and distribution	7	*For now, It is not really clear, is it the responsibility for project management or is it the responsibility for procurement. So that could be improved.*
U11	High Cost and lack of funding support	2	*There's an example within our projects, can we put in grass stones. But we didn't put in any requirements for the maintenance. So, we didn't put it in a docking station, for instance. Because the costs to do that, within the project that should come off from the project budget. And the cost was not thought about it.*
U12	Not managed throughout the life-cycle	8	*I think that is a difficulty. We are improving on that. So, we are more and more trying to incorporate the whole responsibility chain, basically into the process. But if that's not properly done, I think that is a potential reason why the requirements are not ending up in the project in the end.*

It was observed that Advisors and project managers related most to different uncertainties. Figure 5.4 and Figure 5.5, respectively, show how often advisors (out of 7) and project managers (out of 7) mentioned the uncertainties. It is also explained below.

- Advisors' viewpoint

It was observed that among the advisors, U5 (resource limitation) was mentioned most (5/7 interviewees). It was followed by U1(lack of knowledge, training, and necessary skill), U8 (Vagueness in understanding the topic), U10 (lack of clear responsibility identification and distribution), and U12 (not managed throughout the life cycle) (4/7 interviewees). It is summarised in Figure 5.4. This is expected as Advisors mentioned that they could not provide the support needed to translate the goals due to a lack of resources. They further mentioned finding a solution that would also help improve U1 and U8 in the process, as different people in TSO projects would know what TenneT's sustainability ambitions are.

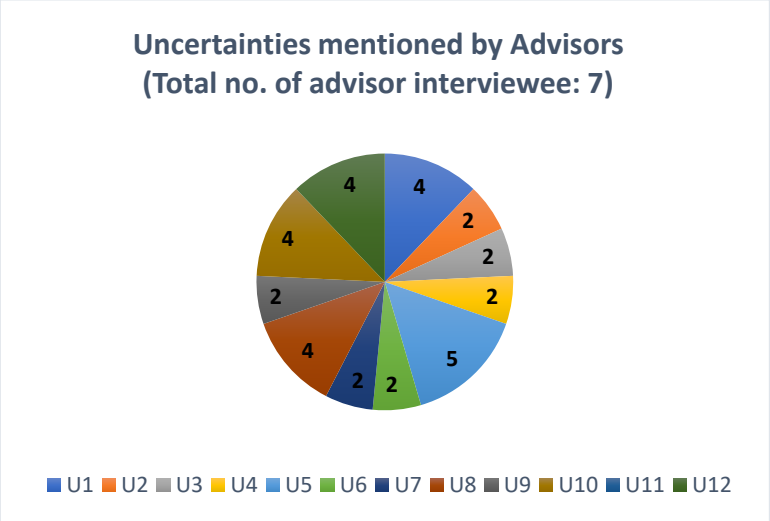

Figure 5.4: Frequency of uncertainties related by Advisors

- Project Managers' viewpoint

It was observed that among the project managers, U1 (lack of knowledge, training, and necessary skill) was mentioned most (5/7 interviewees). This was followed by U3 (low management commitment), U10 (lack of clear responsibility identification and distribution), and U12 (not managed throughout the life-cycle) (4/7 interviewees). It is summarized in Figure 5.3. One interesting observation was that U11(High Cost and lack of funding support) was mentioned only by Project managers and not by any advisors. Advisors named U11 as one of the positive factors that TenneT doesn't have any shortage of funds; Interviewee S1 mentioned, "*our management is willing to invest time and money on that topic.*" The top-down approach from management (U3) seems lacking from the project managers' viewpoint. They mentioned that if the management makes sustainability requirement a hard criterion for TSO projects, it is possible to incorporate sustainability requirements in projects.

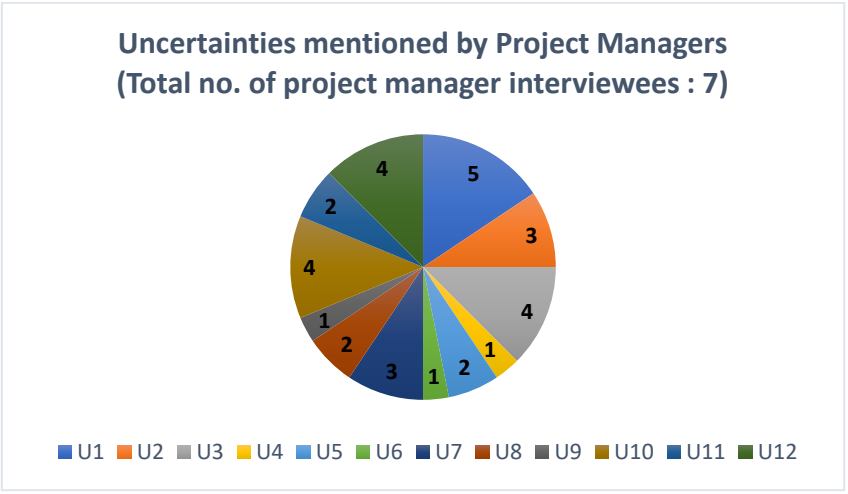

Figure 5.5: Frequency of uncertainties related by project managers

5.4.2 Identifying additional uncertainties associated with sustainability requirements management

The uncertainties associated with sustainability requirements management in TSO projects can be understood as anything that could hinder adopting sustainability requirements in projects. It was identified during the interviews whenever the interviewee mentioned something as a reason for hindering the adoption of sustainability requirements in TSO projects. The quotes from the interviews are translated into uncertainties. The uncertainties identified are in addition to the ones in Table 3.2 (literature study). Table 5.6 shows the additional uncertainties identified.

Table 5.6: Identified Uncertainties to sustainability requirements management in TSO

	Additional Identified Uncertainties to sustainability requirements management in TSO
1	Cost over sustainability
2	Transparency
3	Lack of experience
4	Different views of parties involved
5	Too much responsibility for one person
6	EU procurement law has impact on implementation of SR
7	SR management gets lost in the top-down process
8	Need of clear and strict requirement from management in tenders
9	Lack of tools to measure sustainability in tender
10	Not knowing what the market has to offer
11	Uncertainty on the contractor side
12	Very few pilot projects
13	Mindset

One of the most frequently mentioned uncertainty was that cost is usually considered above sustainability. According to the interviewees, sustainability requirements are seen as an additional cost to the project's budget, and project managers really want to be within the budget. The interviewees also mentioned that people want sustainability in their respective projects but lack the experience and knowledge to do so. There seems to be a lack of communication and transparency within the organisation. These are needed for people to know the resources and goals of the organization. Many respondents also mentioned that managing the sustainability requirements process is not a one-person job, as the responsibility is quite huge. More people need to be involved in the project who take on the responsibility of managing sustainability requirements. Moreover, some of the interviewees mentioned that the requirements related to sustainability often get lost in the top-down management process. This can imply that even though sustainability requirements are considered at the top, it is not prioritized to implement them in the project.

Not having a strict requirement in tenders, lack of tools to measure sustainability, and not knowing what the market has to offer were also some of the uncertainties mentioned in the interviews. Interviewees also mentioned that sometimes the contractors are more uncertain about the sustainability requirements and thus don't make it a priority for the TSO project. Interviewees also expressed their frustration regarding the mindset of the people within the organisation. Many times, people involved in a project do not want to change their way of working. They put the argument that their way of working resulted in many successful projects and thus do not want to change it. This affects the incorporation of sustainability requirements negatively, as there is less possibility of change, adapting to new guidelines, learning new knowledge, and any chance of innovation regarding sustainability in their projects.

5.4.3 Conclusion: Uncertainties associated with sustainability requirements in TSO projects

. Section 5.4.1 described how much actors faced uncertainties identified from literature in practice, and Section 5.4.2 described the additional uncertainties that were identified from the interviewee responses. Both sections let us know the uncertainties associated with sustainability requirements in TSO projects. Several conclusions can be made from Table 5.5 and Table 5.6.

Firstly, uncertainties found in the literature were relatable in practice, with many mentions. For example, 9/14 interviewees related with U1, 8/14 interviewees related with U12, and so on, as seen in Table 5.5. And secondly, multiple other uncertainties were identified from practice, which increased the insights into factors that could potentially hinder adopting sustainability requirements in projects. In addition, uncertainties found from practice (Table 5.6) also overlap with some of the uncertainties from Table 5.5. Uncertainties with similar meanings were combined into one single table. Table 5.7 shows the uncertainties in TSO projects concerning sustainability requirements incorporation and management. The additional uncertainties were further given codes for future reference.

Table 5.7: uncertainties associated with sustainability requirements in TSO projects

Code	Uncertainties
U1	Lack of Knowledge, training, and necessary skill set
U2	No proper framework and document reporting
U3	Low management commitment
U4	Different perceptions of stakeholders and project managers
U5	Resource limitation
U6	Lack of cooperation

U7	Lack of awareness of the changing dynamic environment in practice
U8	Vagueness in understanding about the topic
U9	Poor quality of stakeholder involvement
U10	Lack of clear responsibility identification and distribution
U11	High Cost and lack of funding support
U12	Not managed throughout the life-cycle
U13	Cost over sustainability
U14	Transparency
U15	EU procurement law has impact on implementation of SR
U16	SR management gets lost in the top-down process
U17	Lack of clear and strict requirement from management in tenders
U18	Lack of tools to measure sustainability in tender
U19	Very few pilot projects
U20	Mindset

Table 5.7 resulted from merging Table 5.5 and Table 5.6 and is elaborated below.

- Lack of experience was merged with U1 (Lack of Knowledge, training, and necessary skill set). Experience can be seen as a part of having a necessary skill set that you develop through knowledge and practice.
- Different views of parties involved was merged with U4 (Different perceptions of stakeholders and project managers). Parties here are seen as stakeholders and hence are similar to U4.
- Not knowing what the market has to offer is merged with U7 (Lack of awareness of the changing dynamic environment in practice). Awareness of the changing environment also includes knowing the current market, what is being provided and what is not, and the price. This helps in understanding the market and accordingly estimating whether materials are available, which can contribute towards taking a step in achieving sustainability requirements in TSO projects.
- Uncertainty on the contractor side is merged with U9 (Poor quality of stakeholder involvement). The contractor is one of the stakeholders who is involved in projects. The contractor may be uncertain whether they want to put sustainability requirements in the project because of reasons like extra, high cost, or resource limitations. Then they tend not to be involved or show less interest in conversations regarding sustainability incorporation in projects. Interviewee S6 said, *"people also sometimes play this one. People use it. They just pretend not to understand. If somebody comes to you and says, I really would like to think along on the topic of sustainability. You can stay in your own circle and as you investigate, ask questions, go into the gray area. You stay in your own world, that happens a lot."* Hence it also overlaps the uncertainty of poor involvement of stakeholders.

- Too much responsibility for one person is merged with U10 (Lack of clear responsibility identification and distribution). If one person is only responsible for the sustainability requirements of big TSO projects, then it becomes quite challenging for that person to manage those requirements effectively. Thus, more people need to be involved and share the responsibility. However, it is unclear who should do what and how to distribute the responsibility of managing sustainability requirements.

After merging the points mentioned above, a total of 20 uncertainties are there associated with the sustainability requirement incorporation and management in TSO projects. These 20 uncertainties need to be prioritized to understand which could have the most negative impact on sustainability incorporation in projects and how they could be potentially addressed. It will be discussed in Chapter 6.

CHAPTER 6: FRAMEWORK DEVELOPMENT AND EXPERT EVALUATION

This chapter analyses the results from the semi-structured interviews and proposes recommendations and a framework for managing sustainability requirements in TSO projects. Experts then evaluate the proposed framework, and the reflections on recommendations are discussed. Section 6.1 discusses the prioritization of the uncertainties and proposes measures to cope with those. Once that is addressed, Section 6.2 explains how the framework was developed, followed by Section 6.3, which explains in detail the proposed framework for integrating sustainability requirements in projects. This answers SRQ4.

SRQ4: *How can the existing requirement management process be modified to manage sustainability requirements in TSO projects?*

Section 6.4 discusses the expert evaluation that was done to evaluate the framework. Section 6.5 explains the improvements made and provides the final framework, answering SRQ5.

SRQ5: *How can the developed framework be applied in practice to better impact the implementation of the sustainability requirements in projects?*

6.1 Prioritizing and coping with the uncertainties

6.1.1 Prioritization of the uncertainties

The uncertainties from Table 5.7 are prioritised in this section.

WHY: It is important to prioritize the uncertainties to understand which have a more significant impact on sustainability implementation in TSO projects than the others. The literature and empirical studies resulted in a total of 20 uncertainties. These uncertainties are interrelated, which means there are possibilities that one uncertainty may influence the other. The prioritization of the uncertainties will contribute towards evaluating the impacts it has on sustainability requirements implementation and how those can be reduced.

HOW: They are prioritized based on their occurrence of likelihood and the impact it would have on sustainability requirements implementation. The likelihood is defined as how likely the uncertainty will occur. The uncertainties were given a likelihood based on their occurrence in Atlas.ti, i.e., the number of times interviewees responded related to the code (uncertainty). The likelihood score is divided into four categories: Very High (4), High (3), Moderate (2), and Low(1). If 14 -11 interviewees mentioned uncertainty, the likelihood score of very high (4) is assigned. Similarly, for High (3), the number of

mentions is within 10-7; for moderate (2), the number of mentions is 6-3; and for low (1), it is 2-1 interviewee responses.

After providing the likelihood score, each uncertainty's impact on implementing sustainability requirements is determined, and a score is given. It was done through the interviewees' responses on why and how a particular uncertainty can affect sustainability implementation. The impact score was also based on the overall findings from the interviews. The Impact score is divided into four categories: Very High (4), High (3), Moderate (2), and Low(1). For example, the uncertainty of 'Mindset' is mentioned by 7 out of 14 interviewees. They agreed that the mindset of the actors impacts decisions regarding sustainability. So, sustainability implementation will be hindered whenever the mindset of 'current way works, why change' is there. As a result, this uncertainty is given an impact score of very high (4).

Once both the likelihood and impact scores are given, the priority score is known. (Priority score = Likelihood score * Impact score). For example, the likelihood score of the uncertainty 'Lack of Knowledge, training, and necessary skill set' is very high (4) (as 11 interviewees mentioned), and its impact is based on the interviewees' responses. The impact score of very high(4) is given as interviewees responded that because there is no proper knowledge about sustainability requirements and what needs to be done, it is not implemented in many projects. Thus, the priority score for this uncertainty is 16 (4*4=16). This implies that this uncertainty needs to be prioritized and tackled first. The tackling of the uncertainties is discussed in Section 6.1.2.

Table 6.1 overviews the uncertainties, their occurrence (frequency), likelihood score, impact score, and priority score.

Table 6.1: Prioritization of the uncertainties associated with sustainability requirements integration in TSO projects

Sl No.	Frequency	Uncertainties	Likelihood Score (a)	Impact Responses from Interviewees	Impact score (b)	Priority Score (axb)
1	11	Lack of Knowledge, training, and necessary skill set	4	Not knowing what sustainability requirements are, what is needed and how to do it, will affect its integration	4	16
2	9	No proper framework and document reporting	3	Without proper framework and reporting, people won't be aware of what sustainability aspects are needed in projects and how much it is done in practice.	3	9
3	9	Lack of clear responsibility identification and distribution	3	Unless there is clear understanding and equal responsibility between actors and project members, putting sustainability requirements in projects seems difficult	4	12
4	8	Lack of awareness of the changing dynamic environment in practice	3	Lack of awareness means actors are unknown about the current trends of sustainability as well as of the market affecting its implementation	3	9
5	8	Vagueness in understanding about the topic	3	Not understanding what sustainability requirements means, which affects its implementation negatively	3	9
6	8	Not managed throughout the life-cycle	3	Hinders the long term thought of implementing sustainability requirements in projects	3	9

7	7	Resource limitation	3	Without proper resources, sustainability requirements lose focus	2	6
8	7	Mindset	3	Unless the mindset of "current ways works, why change" is there, sustainability requirements will always take a back seat	4	12
9	6	Low management commitment	2	No drive for making sustainability as a hard criteria for projects	3	6
10	6	Poor quality of stakeholder involvement	2	Focus on sustainability requirements implementation reduces	2	4
11	5	Different perceptions of stakeholders and project managers	2	Different views on sustainability requirements makes it harder for sustainability to be on the table, as the views can be conflicting and contrasting	2	4
12	5	Lack of Transparency	2	Leads to less information and knowledge sharing ultimately hindering implementation of sustainability requirements	4	8
13	4	Very few pilot projects	2	If less projects are piloted with sustainability requirements in them, then other project teams don't have the trust as they think sustainability requirements in projects is still new and are afraid to explore	2	4

14	3	Lack of cooperation	2	Unless actors do not cooperate properly to discuss sustainability in projects, it will negatively affect its implementation	2	4
15	2	High Cost and lack of funding support	1	If integrating sustainability into projects costs more, then it is hard to motivate actors	3	3
16	2	Cost over sustainability	1	Unless sustainability is seen as an additional cost, integrating it in projects will be difficult	4	4
17	2	Sustainability gets lost in the top-down process	1	If sustainability sits low in the priority list of actors, then implementation is difficult	4	4
18	2	Lack of clear and strict requirement from management in tenders	1	If no specific requirements related to sustainability is put in tenders, then it becomes difficult to later incorporate sustainability or to ask the contractors regarding the same, hence sustainability does not get implemented in projects	4	4
19	2	Lack of tools to measure sustainability in tender	1	Hard to measure or evaluate the performance of sustainability requirements in projects	3	3
20	1	EU procurement law has impact on implementation of SR	1	sometimes it is difficult to be flexible with the sustainability requirements	1	1

6.1.2 Coping with the uncertainties

Once the uncertainties have been prioritized, the next step is to provide recommendations to TSO to cope with them. These recommendations are based on the author's understanding from the interviews as well as from literature read when identifying uncertainties (section 3.5, Appendix C.1). This will assist actors in overcoming the challenges faced in the process of translating sustainability ambitions into actions.

1. Lack of Knowledge, training, and necessary skill set (Priority score: 16)

This uncertainty can be tackled by the following:

- *Collaboration* among all the actors involved in the program and project level can help them share knowledge, and groups can be formed that discuss and promotes sustainability.
- *Workshops* for the actors where ideas are shared about sustainability and discussions are done. *E-learning platform* of TenneT, where a mandatory course on sustainability can be added.
- *Knowledge Transfer* between the practitioners and the academic researchers on the topic will help the former understand how sustainability can be implemented.

2. Lack of clear responsibility identification and distribution (Priority score: 12)

This uncertainty can be tackled by the following:

- *Improve ownership* among the actors of different departments regarding sustainability implementation. Ownership means being proactive in work, taking responsibility, and understanding how sustainability contributes to achieving the organization's long-term goals. This can also be done by *raising awareness* through monthly meetings, workshops, and seminars.
- *Push from the senior management* is also essential here. Suppose the senior leadership is committed to this and pushes the project managers in making sustainability a driver in projects. In that case, it will motivate people to take on the responsibility (in the notion that it has come from the top).

3. Mindset (Priority score: 12)

This uncertainty can be tackled by the following:

- *Improving awareness* regarding the importance and benefits of sustainability in the long-term and projects should be done. This can be done through *Workshops and Information campaigns*. These should be done monthly, which promotes sustainability and requires active participation from the actors.

- Awards and recognition can be used as *incentives* to encourage participants to take action toward sustainability. Further, penalties can be set in the form of extra e-learning courses to push actors towards understanding sustainability and its importance in projects.

4. No proper framework and document reporting (Priority Score: 9):

This uncertainty can be tackled by the following:

- *Information campaigns and discussions* should be done on how to make a *standard guideline* for sustainability reporting. This will assist actors in the organisation to be aware of what is happening regarding sustainability requirements if it was implemented in any projects and how it was done. Moreover, this guideline or framework should also present the lessons learned. This way, actors can take references from the guideline and adapt them to their projects.
- *Gradual steps toward the new CSRD* (Corporate Sustainability reporting Directive) should be taken. This will allow the TSO to report the social and environmental impacts of its activities and the associated risks. This will help actors in the organisation know more about how sustainability requirements can impact the organisation.

5. Lack of awareness of the changing dynamic environment in practice (Priority Score: 9)

This uncertainty can be tackled by the following:

- *Improving awareness* among the actors at the project level as well as other stakeholders involved. This can be done through seminars and sustainability meetings before the project starts, where each actor's view on the sustainability topic is understood. The program manager can lead this meeting. It will help the program managers understand where the actors stand and how aware they are regarding sustainability in their projects. Based on that, the program manager can decide what type of workshops and open discussions to have in order to raise awareness.

6. Not managed throughout the lifecycle (Priority Score: 9)

This uncertainty can be tackled by the following:

- *Proper tracking* of the sustainability requirements should be done. This can also be done by asking detailed information from actors in operation phase and having frequent follow-up meetings and discussions. This will help actors follow the

various steps the sustainability requirement went through and know if the requirement has made it through the project's later phases. This will promote discussions within them on how sustainability can be managed throughout the project's life cycle.

7. Vagueness in understanding about the topic (Priority Score: 9)

This uncertainty can be tackled by the following:

- *Raise awareness* about the topic of sustainability. This can be done by having open discussions regarding the topic. Seminars or workshops can be held with other TSOs so that lessons and knowledge can be shared about what sustainability means in a TSO project.
- *Active communication* is also crucial. If someone from the organisation is unclear about what sustainability requirements need to be in the project and how to do it, they should not just shelve the topic. Instead, they should be proactive and motivated to clear the ambiguity regarding the topic by having conversations with experts. A *question form* can also be made available, where actors put in their questions regarding the topic, and the experts can answer them. This will also aid in improving the former's awareness.

8. Lack of Transparency (Priority Score: 8)

This uncertainty can be tackled by the following:

- *Being transparent* about how *project-level actors will be evaluated* regarding sustainability along with *how the project performance evaluation* will be done. This will help actors understand the importance of sustainability and create a sense of trust if they are aware of how sustainability performance is evaluated. This would help them create concrete tasks that needed to be done to implement sustainability in their projects.
- *Being transparent about projects which successfully implemented sustainability* and how that contributed towards the sustainability goals of TenneT. This will also create trust in the actors, and their fear of exploring sustainability requirements will be diminished.

9. Resource limitation (Priority Score: 6)

This uncertainty can be tackled by the following:

- *Market research* should be done to understand where the market stands in the sustainability area. This will help actors decide what sustainability requirements can be considered in their project or if they need to check for any alternatives.
- *Incentivize* the actors based on their active participation in the sustainability topic through workshops and e-learning course certifications. This will also help *raise awareness* among the actors regarding project sustainability implementation.

10. Low management commitment (Priority Score: 6)

This uncertainty can be tackled by the following:

- *Sustainability needs to be seen as an added value*. This can be done by developing a business case focusing on implementing project sustainability requirements. This business case should also focus on being seen as an added value to the project, positively impacting its performance.

11. Poor quality of stakeholder involvement (Priority Score: 4)

This uncertainty can be tackled by the following:

- *Linking sustainability to benefits*. Stakeholders should be aware of the long-term and short-term benefits of project sustainability. The long-term benefits will be the cost advantage, and the short-term benefits will be better project performance and increased reputation in the market (which will be seen as a part of sustainable development).
- Stakeholders should be *involved early* in the topic of sustainability requirements in the project. A questionnaire should be sent, or an initial meeting should be held, where the expectations regarding sustainability are discussed from both sides, i.e., the stakeholders and the TSO. TSO should also show their enthusiasm for this topic and can also be persuasive to the stakeholders (in case the stakeholders are not keen on discussing sustainability) by discussing the first point. Once they are involved, they should be kept involved and updated during the initial phases of the projects. This will make them gain more trust and interest in the topic and will make them feel important. This, over time, will result in proactive involvement from them.

12. Different perceptions of stakeholders and project managers (Priority Score: 4)

This uncertainty can be tackled by the following:

- *It is necessary to align sustainability goals between them* as it will help promote sustainability discussions in meetings. This can be done by having frequent

meetings, discussions, and information campaigns where both parties' active participation is required.

- *Combined workshops* between the stakeholders and the project managers. The workshops can have them work together as a group which will increase their understanding of each other's view on sustainability. The workshops can also have them work separately and then have an open discussion session where views are shared, and further *collaboration* occurs between them. This can be done multiple times on a monthly basis, and the results can be shared with the employees as it will give an overview and help others understand the topic of sustainability.

13. Very few pilot projects (Priority Score: 4)

This uncertainty can be tackled by the following:

- *Market Research* on what is currently being done regarding project sustainability requirements. This can be done by taking examples from other organisations of the same industry to see what sustainability contribution they are making in their projects
- *Developing a business case* for sustainability can be seen as an alternative here. It will help understand how sustainability should be aligned with the strategic objective of the organisation as well as can showcase the benefits sustainability has on cost advantage.

14. Lack of cooperation (Priority Score: 4)

This uncertainty can be tackled by the following:

- There should be *mandatory seminars and discussion session*s in which actors must participate. This will help *create awareness* among them. These sessions should also include experts and program managers so that the actors can have an open learning experience. This will motivate them to participate more in sustainability discussions and decisions for their projects, thus improving their quality of cooperation.

15. Cost over sustainability (Priority Score: 4)

This uncertainty can be tackled by the following:

- *Raise awareness* about the benefits sustainability will give in the long term. This will give an overview of how economic sustainability can be achieved. Further, a business case can be created for sustainability, which will help actors demonstrate sustainability's benefits and long-term cost advantages.

- Having a *sustainability pitch* similar to a safety pitch emphasizes why sustainability needs to be a hard criterion for projects. During review meetings, right after the safety pitch, the sustainability pitch can be given in order to gain people's attention to the topic.

16. Sustainability gets lost in the top-down process (Priority Score: 4)

- *Traceability* of the sustainability requirements should be kept in check. The sustainability requirements need to be documented in each step as it moves from the top -to -the bottom of the TSO organisation. This will aid in identifying where the sustainability requirement is left behind and why.
- It is crucial to see *sustainability as a differentiating factor,* focusing on the market competition. Organisations can differentiate themselves from the market by having sustainable projects. This will also add to their market reputation as a sustainable TSO.

17. Lack of clear and strict requirement from management in tenders (Priority Score: 4)

This uncertainty can be tackled by the following:

- *Concrete KPIs* should be made regarding sustainability ambitions by the management upon discussions. This will help actors translate those into clear requirements that can be put in tenders.
- *Bottom-top approach* can be important, where project-level actors collaborate with the management to determine the clear requirements needed to achieve sustainability goals. The determined requirements can then be put in tenders. This allows flexibility as well as more room for better decisions.

18. High Cost and lack of funding support (Priority Score: 3)

This uncertainty can be tackled by the following:

- *Focused Discussions* should be conducted, where sustainability's long-term benefit is discussed and promoted.
- *Alternative sustainable solutions* should be looked into which are not so expensive.

19. Lack of tools to measure sustainability in tender (Priority Score: 3)

This uncertainty can be tackled by the following:

- *Measurement Tools and checklists* can be used. Moreover, *market research* needs to be done to understand what measurement tools are available and if they apply to the projects. Further *academic research* should be done to develop measurement tools specific to TSO.

20. EU procurement law has impact on implementation of Sustainability (Priority Score: 1)

This uncertainty can be tackled by the following:

- Checking *other alternatives* for implementing sustainability requirements (e.g., social sustainability)

6.2 Developing the sustainability requirements management framework.

As per Section 1.2, the absence of a proper framework was seen as one of the challenges for integrating and managing sustainability requirements in projects (Parsanezhad et al., 2016; Elkhair, 2009; Ann & Shen, 2013). It was observed from Chapter 5 that sustainability requirements are often left behind in the process due to uncertainties like additional cost, low commitment, and poor involvement of actors, to name a few. It was observed from the empirical study that sustainability requirements need to be managed properly through the process, which will eventually lead to its successful implementation in projects. Moreover, it was also identified that uncertainties are present in managing sustainability requirements and need to be coped with. The empirical study also highlighted that the sustainability ambitions of TenneT are more focused on the long term, and actors with more short-term focus find it challenging to operationalize those ambitions into actions. Hence, there is a need to develop a framework that can help tackle these issues mentioned above.

Currently, to manage requirements, the requirements management process shown in Figure 3.3 and described by PMI (2016) is mainly used in organisations. However, from the semi-structured interviews, it was observed that a general approach is taken when planning sustainability requirements for a project. It was observed that the sustainability requirements were mainly the strategic objectives set at the top level and not definitive KPIs. Further, most answers gave the direction that there was no particular sustainability requirements management process that was being followed. It can be interpreted from this that a framework focusing on sustainability requirements management and in line with the PMI's requirements process (Figure 3.3) is needed. As mentioned in Section 3.2, this research focuses mainly on the first three steps of the process (Requirements elicitation, Requirements Analysis, and Solution Evaluation). Hence the framework developed will also be aligned with those three steps, as seen in Figure 6.1. Figure 6.2

presents the framework for sustainability requirements management, and Section 6.3 explains the framework in detail.

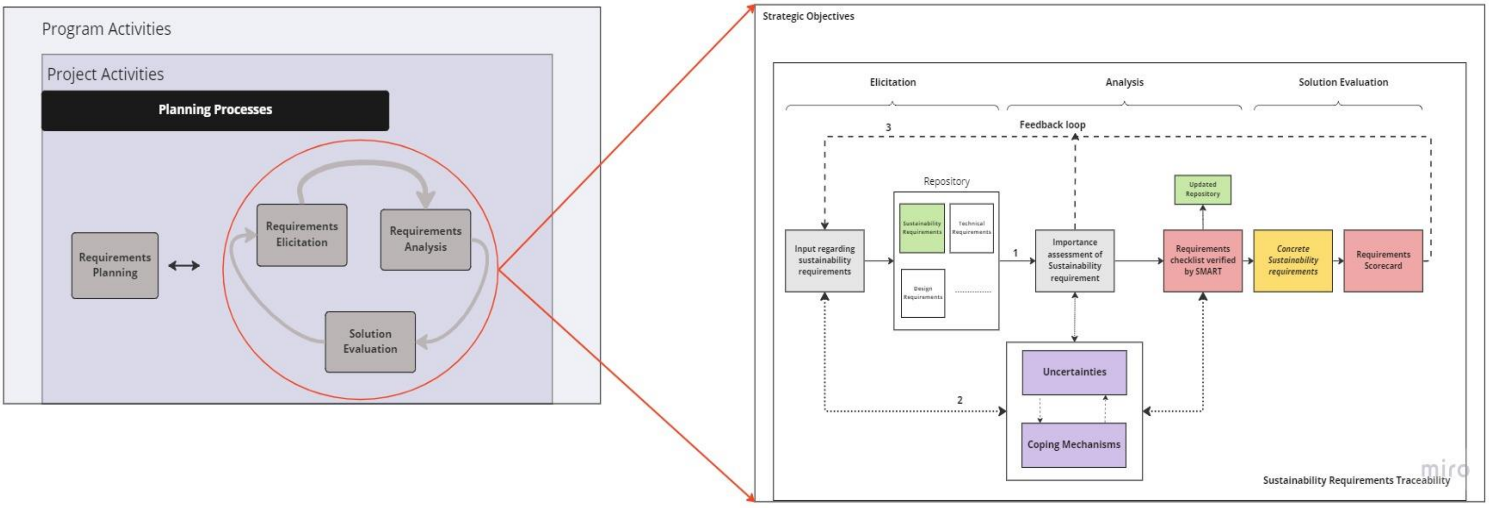

Figure 6.1: Alignment of the framework with the Requirements Management process

6.3 Introducing the proposed framework

The framework describes how managing sustainability requirements is an iterative process. The steps are explained in detail below.

Requirements Elicitation: The first two steps of the framework fall under requirements elicitation. The first step is Input regarding sustainability requirements, where inputs and concrete suggestions will be derived from the actors regarding sustainability requirements in the project. The second step will be to define those requirements and will be done in the Repository section of the framework. These two steps are further explained below.

- Input regarding sustainability requirements

The input takes place at the start of a project. In this step, actors from both the project level and program level should participate. The strategic goals are considered as input, as are contributions from actors regarding the project's sustainability requirements. This can be done via the questionnaire, as shown in Table 6.2. Also, through the questionnaire, it can be known how the actors plan to implement those requirements by defining definitive KPIs/ action plans. This step will provide an overview of what sustainability requirements different actors think could be in that particular type of project. Discussions can take place here between actors on the topic. This step will also help reduce the knowledge gap observed in Section 5.3.3. If any question is put as No in the Response type, then uncertainties related to that will be identified and tackled. Further potential plans to ensure that sustainability requirements are considered for that particular project

will also be known. From the questionnaire, it will also be known if there are overlapping requirements. It then needs to be discussed among the actors, which is to be kept in this step. If a mutual decision is not reached, the requirements will be carried forward to the step of Importance assessment (described below), where the requirement which weighs more will be kept in the project, and the other will be removed.

In the sample questionnaire, the questions are derived based on TenneT's sustainability ambitions. However, questions related to other sustainability requirements used in previous successful projects or derived based on market research can also be included. Table 6.2 shows the sample questionnaire; however, it can be rephrased or restructured according to the project.

Table 6.2: Questionnaire Template

SL NO.	QUESTION	RESPONSE TYPE	POTENTIAL PLAN TO IMPLEMENT THE ACTIONS (if yes)	PLANS TO ENSURE SUSTAINABILITY REQUIREMENT IS CONSIDERED (if no)
1	*Are the following circularity KPIs applicable to the project?*			
1.1	use of 25% less copper	Yes/ No		
1.2	25% less recyclable waste	Yes/ No		
	If no, why so? And what KPI can be considered related to circularity for this project?			
.	.			
.	.			

- Repository

Once input is taken, a list of sustainability requirements is gathered. It is then documented in the repository along with other technical and design requirements. The repository should be kept updated if any changes occur. The repository can be any current online platform that is accessible by the actors of the TSO organisation. If current online platform is not present, then there is the need to create one, however, how to do that is beyond the scope of this research and hence will not be discussed.

Requirements Analysis: The next two steps of the framework fall under requirements analysis. The first step is the importance assessment of the sustainability requirements, defined in the above steps of requirements elicitation. In this step, the requirements are assessed, justified, and prioritized in their importance. It is then verified using the SMAT criteria in the framework's next step, which is the Requirements Checklist. These two steps are explained below.

- Importance assessment of sustainability requirements

Once the requirements are in the repository, the next step is to assess the importance of those sustainability requirements. In this research study, the focus is on qualitatively assessing the importance and thus can be done with the template as shown in Table 6.3.

In this step, actors will participate, as the discussion is a primary part of this step. Column A will provide the importance of a sustainability requirement by understanding its value, the benefit that will be gained, and the impact it will have on the strategic and business goals and the project outcome. If the option of column B is Yes, then Column C will be in use. Column C will provide the uncertainties because which actors think the sustainability requirement is difficult to follow through. Those uncertainties must be coped with, and it is an iterative process. Suppose new uncertainties are identified with respect to the particular project, apart from the ones mentioned in Table 5.7 of section 5.4.3. In that case, it should be added to the list. A brief discussion on either to cope with it or to find an alternative, needs to be done. This step is done to give actors the flexibility to assess the importance of sustainability requirements. This will help focus on which sustainability requirement has more weightage than the other and eliminate any vague guesswork and assumptions.

Table 6.3: Importance Assessment Template

(A) How important is the sustainability requirement	(B) Is it difficult to follow through	(C) If Yes, Why
• **Value**: what value it adds to the project and organisation • **Benefit**: what will be gained from it • **Impact**: impact on the business, strategic goals as well as on the project outcome.	Yes/ No	• Uncertainty 1 • Uncertainty 2 ⋮

- Requirements checklist

Once the importance assessment is done, the sustainability requirements go through the Requirements checklist. In this step, the sustainability requirement will be verified using SMART criteria for the particular project. SMART stands for Specific – all requirements should be clear and accurate. Measurable – all requirements should be measurable to know the achievable limit. Agreed – the project team and the business agree on the project deliverables. Realistic – projects must be possible based on current capabilities within the organization, and Time-bounded – project requirements must have a definite start and stop date (AbdElazim et al., 2020). Uncertainties may also arise in this step; for example, the requirement is not specific. It should then be tackled. This step will produce a set of sustainability requirements for the particular project, with most of the actors being on the same page. The repository will be updated after this step.

Solution Evaluation: The last part of the framework falls under solution evaluation. Concrete sustainability requirements are the results that will go into the scorecard. This step will then lead to the start of the feedback loop

- Concrete Sustainability requirements and Requirements Scorecard

Once the sustainability requirements are verified, then those requirements need to have a measurement, based on which it can be checked later by the project managers if it has been met. These concrete sustainability requirements will then move to the last step, which is the requirements scorecard. Table 6.4 shows the requirements scorecard. This also helps define the task that is needed to implement the sustainability requirement in the project.

Table 6.4: Requirements scorecard

Sustainability Requirements Scorecard	
Sustainability Requirement	
Measurement	
Tasks	

The framework also includes a **feedback loop** to evaluate and improve the process. It is critical because the feedback loop shows how much of the sustainability requirement inputs made it through the process to become concrete requirements for projects. This will help in identifying necessary changes and further improvements as and when required. It is also essential because it will help actors understand what and where uncertainties are faced and how they are tackled. This will help them in future requirements planning. The feedback is also derived from the Importance assessment box so that actors know in their next project which sustainability requirement is highly important, thus making the process efficient.

The framework's steps are linked together by arrows. Arrow 1 serves as the framework's baseline and demonstrates the systematic method's steps. Arrow 2 indicates that uncertainties will be identified and simultaneously coped with. Arrow 3 depicts a feedback loop that can assist in making improvements and capturing lessons learned.

The above steps and the feedback loop are put under the sustainability requirements traceability box. The box tracks the sustainability requirements to ensure that the

requirements approved in the beginning are made into concrete sustainability requirements that can be implemented in the project. The box of strategic objectives covers it. This shows that if the sustainability requirements are correctly managed, then it will result in the achievement of the strategic objectives. This is further explained in Section 6.3.1.

Figure 6.2 shows the proposed framework.

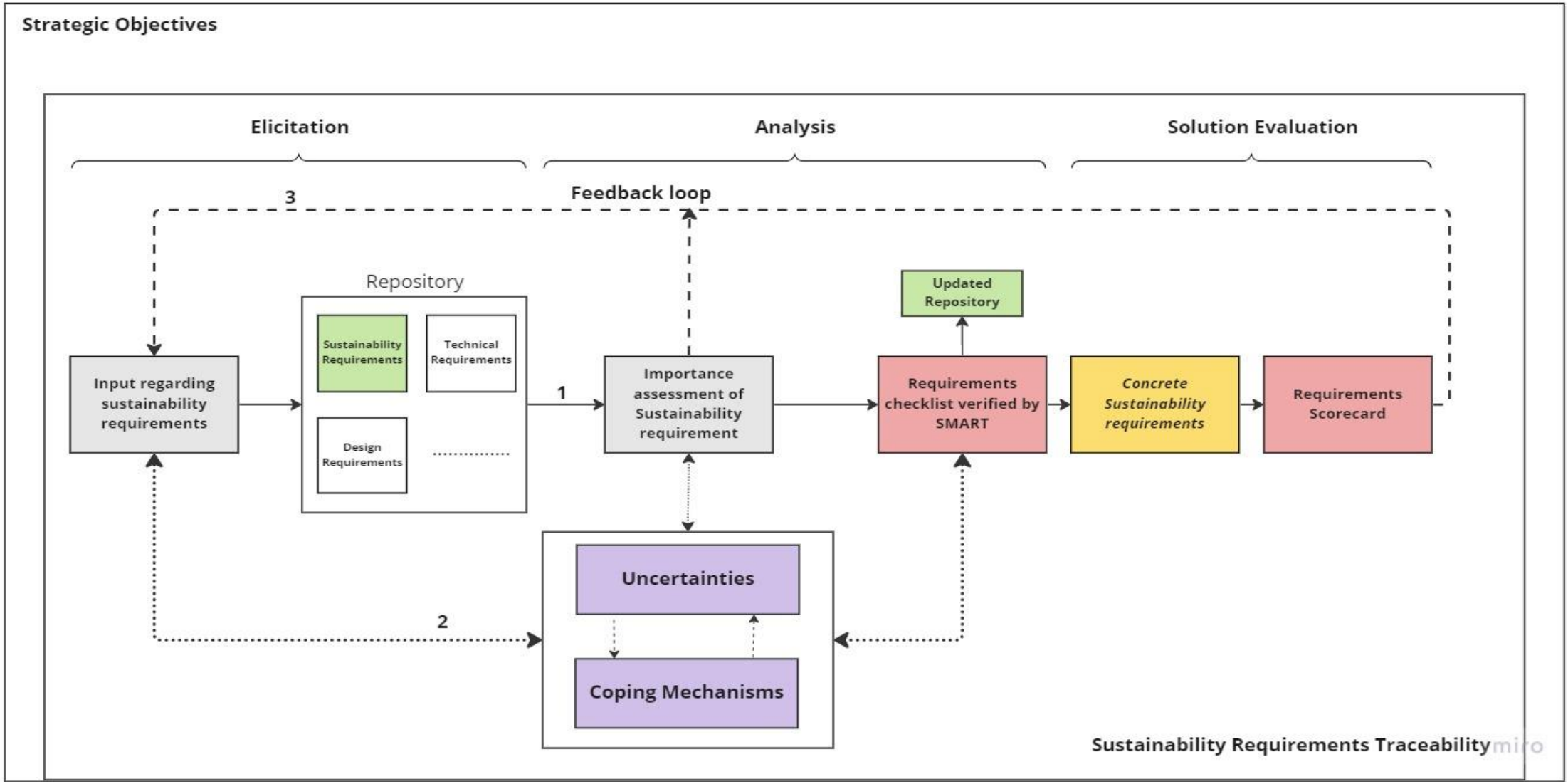

Figure 6.2: Proposed framework for sustainability requirements management

6.3.1 Alignment of the framework with strategic objectives

The framework mentioned above will consider the strategic and long-term objectives (program level) regarding sustainability and assist in providing operationalizable sustainability requirements (project level). Successful realization of sustainability requirements will contribute to a successful project output and further to the strategic benefits. When project outputs contribute to program benefits, it results in processes that deliver value to the organisation. Furthermore, in this way, project activities that support benefits are easily identified, and each project's impact on the program value can be derived (Sopko & Demaria, 2013). In this case, incorporating sustainability requirements in projects, if successfully done, will contribute towards achieving the strategic objectives that the TSO has set. The above-developed framework aims to have a proper project output, which will contribute to the long-term sustainability objective of the TSO and is explained below.

The input is taken from the strategic objectives (sustainability ambitions). In the Input step, the strategic objectives will be discussed and defined per the project. In the Importance assessment step, the sustainability requirements will be weighted and verified to align with the TSO's strategic goals and objectives. The importance assessment template discusses the value and impact the sustainability requirement will have and the benefits it will give. This step will help or prompt actors to think about the long-term benefits contributing to the strategic objectives. Based on that, the sustainability requirements can also be weighed. After going through the rest of the framework's steps, concrete sustainability requirements will be produced, which can be implemented in projects. And through the feedback loop, it again goes to the input. These iterative processes will result in sets of concrete sustainability requirements implemented in different projects.

Once this outcome stage is reached, the intermediate benefits will be known in a few years' time. In this case, the intermediate benefits can be increased market reputation, efficient process-oriented work, increased sustainability discussions within the organisation, increased collaboration with another organisation, and many more. Over time, it will result in end benefits. End benefits mean showcasing measurable improvements that give the business advantages(Sopko & Demaria, 2013). The end benefits can be sustainability on top of the priority list along with TSO's primary purpose of providing electricity, incorporating sustainability in almost every project, increasing market reputation as a sustainable TSO, higher profits, and many more. These end benefits will eventually, as a whole, result in achieving the strategic objectives related to sustainability that the TSO had set. Thus, with multiple uses of this framework in different projects, it will lead to incorporating sustainability requirements in projects, eventually resulting in the organization's strategic benefits. With its different steps, the framework

will help actors align their definitive KPIs with the TSO's strategic objective, thus gradually shifting their short-term focus to more of a long-term one.

6.4 Expert Evaluation

Expert evaluation is done to discuss the proposed framework and its applicability in practice.

6.4.1 Evaluation Approach

The expert evaluation approach chosen was a discussion session. The discussion included providing feedback and suggestions on the proposed coping steps and the framework. The discussion was in person and were experts from Aratis who are involved in TenneT's project. A total of 6 experts were approached, but due to schedule constraints, only 3 were part of the expert evaluation. Table 6.5 depicts the role of the experts and their years of experience. These experts were also chosen based on their involvement in the sustainability implementation topic in TenneT.

Table 6.5: Expert's role and years of experience

No.	Role/ Department	Years of experience
1 (Ex 1)	Sustainability Consultant	17
2 (Ex 2)	Senior Advisor for Tenders	20
3 (Ex 3)	Project Management and System engineering	15

The discussion session started with a brief introduction to the research topic, and the main findings were presented. The main goal for the expert evaluation was explained, which was to evaluate the practicability of the proposed framework. The discussion session provided insights into how the framework can be applied in practice to have a better impact. The following question was put forward for discussion to achieve the goal of the evaluation session:

- Do you think the steps outlined in the proposed framework are practical, and what suggestions do you have for improving the framework?

The expert evaluation also included discussions on the priority score of the uncertainties and the coping steps. However, this is not included in the main body of research. The experts may have faced uncertainties in different situations than the interviewees, and hence it cannot be evaluated by the other. Thus, this part of the discussion is shown as a reflection of experts' views in Appendix E.

6.4.2 Outcome of Expert Evaluation

Feedback on the proposed framework

Experts provided feedback on the proposed framework and suggestions on how to make it practicable. The experts agreed on the steps that were included in the framework as well as on the process. Their suggestions about the practicability of the framework are discussed below.

- Experts agreed to the connection of the different steps of the framework. However, they mentioned that the input step should be checked against something such as ambitions or objectives at the corporate level. This would help actors understand that there is a definitive goal at the corporate level towards which they must take a step.
- According to experts, project-level actors would not be interested in accessing the repository (step two in the framework). It is because when given many choices, project-level actors often tend to focus more on the traditional triple constraints of projects. Expert 2 stated, *"I don't think that you should ask the project leader to check a database. On SharePoint you can also find something about this but also something about leadership, what do you want, and then the project lead says I don't know, my main objective is time and money for the project. You have to give him like; this is it."*
- Experts agreed with the qualitative assessment part of the Importance step, stating that discussions are a crucial factor in decisions regarding project sustainability implementation. Expert 1 also proposed that a SWOT analysis can be done in this step. However, upon mutual discussion between the author and the expert, it was agreed that it could be done as an additional part. However, it would not be indicated in the framework, as the framework follows the steps of PMI's requirements management.
- Experts suggested that the step of the Requirements scorecard can be made more specific by incorporating 5W (what, why, when, where, who) and 2H (how and how much) tools. This will help in assessing the sustainability requirements more concretely.
- Experts also suggested that the main focus of the framework should be on the corporate level. The corporate level can use the resulting concrete KPIs to push the actors at the project level for sustainability implementation. According to the experts, this framework would not be suitable for the project level, as project-level actors would not be interested in it. Also, every time a new project lead comes in, there will be new discussions which would not be feasible. Instead, they suggested that if these discussions and the framework take part at the corporate or program level, it will help them understand that different project types need different KPIs

for sustainability. Experts also expressed their view that the framework can also be like an evolution model, as changes may occur, and importance may vary.

- Lastly, the experts suggested that the diagram for the framework can be more trackable with numbers so that it is self-explanatory. This can be done by making the framework figure more detailed.

The suggestions regarding the practicability of the proposed framework were considered, and section 6.5 presents the updated framework.

6.5 Framework for sustainability requirements management

The framework has been explained in detail in section 6.3 and is depicted in Figure 6.2. However, based on the expert evaluation, the framework has been updated with more specifics, and the depiction is clear. It is explained below and depicted in Figure 6.3.

Few updates have been made to make the framework suitable for the corporate/program level. The box of strategic objectives has been renamed to the Program level, and two additions have been made. The first addition is **box I**, which represents the strategic objectives related to sustainability. These strategic objectives will serve as inputs. This was updated based on the suggestion from experts that the inputs need to be checked against something. In order to implement sustainability, these strategic objectives need to be operationalized. Thus, input from **Box I** will serve as the first step of the process. Eventually, after each step of the process of the framework is completed, the output will be concrete/definitive sustainability KPIs. This definitive sustainability KPI is named box II and is connected with a double-sided arrow with the **box I**. This allows program-level actors to check whether the definitive KPIs produced contribute towards the strategic sustainability objectives. **Box II** can be used by program-level actors as hard criteria for projects and can push project-level actors to implement them. The box program level should also have continuous discussions regarding boxes I and II and the results obtained to make improvements where and when required.

Further, the steps of the framework are marked for easy understanding. The framework consists of 5 steps, starting from A to E, and is explained below briefly. A **detailed explanation of the steps** can be found in **Section 6.3**.

Requirements Elicitation will consist of steps A and B.

A. Input: In this step, the strategic objectives from the box I would be the basis of the questionnaire (Table 6.2). The rest of this step is the same as explained above.

B. Repository: Based on the experts' feedback, the repository can be used as an official documenting platform, where sustainability requirements based on strategic objectives are defined and continuously updated.

Requirements Analysis will consist of steps C and D.

C. Importance Assessment: This step remains the same as explained above. The importance assessment template (Table 6.3) must be used in this step.

D. Requirements checklist: From this step, the repository will be updated, and a feedback arrow will join the feedback loop. This will help make the process more efficient. The requirements will be verified using SMART criteria, as explained in section 6.3.

Solution Evaluation will consist of step E.

E. Requirements Scorecard: This step has been updated based on experts' suggestions to make it more specific. The template of this step has been changed from Table 6.4 to Table 6.6, as shown below. The new template will consider the 5W (what, where, when, why, and who) and the 2H (how and how much). This is done to make the sustainability requirements more specific and know who would be responsible for implementing them.

Table 6.6: Updated sustainability requirements scorecard

Sustainability Requirements Scorecard		
Sustainability Requirements	• WHAT • WHY	
Measurements	• HOW MUCH	
Tasks	• HOW • WHERE • WHEN • WHO	

The solution evaluation also consists of **X. Concrete Sustainability requirements** derived after step D.

Y. Uncertainties and coping mechanisms: as uncertainties are present throughout the process, they must be checked in steps A, C, and D and tackled accordingly.

Lastly, the framework is linked to each other will different **numbered arrows**

Arrow 1: The red arrow depicts the flow of the strategic objective (box I) serving as an input (Step A)

Arrow 2: The plain black arrows serve as the framework's baseline and demonstrate the systematic method's steps.

Arrow 3: The small dotted purple arrows indicate that uncertainties will be identified in the process and simultaneously coped with.

Arrow 4: The large dotted black arrows depict a feedback loop that can assist in making improvements and capturing lessons learned. For this loop, feedback is taken from steps C, D, and E simultaneously as the process keeps happening. It also depicts the lessons learned, which can be captured in the form of reporting

Arrow 5: The double-sided black arrow indicates an ongoing process of checking whether the definitive KPIs produced are contributing to the strategic objectives.

Arrow 6: The green arrow shows that the steps from A to E produces definitive sustainability requirements against the strategic objectives of projects.

The final framework is shown in Figure 6.3.

6.5.1 Practicability of the framework

For **the practical implementation of the framework**, its focus should be at the program level. The program level primarily overviews the projects and their sustainability works. Expert 2 mentioned the use of specialists at the program level. Specialists have great knowledge and experience with a particular way of working or in the field of some materials or components, e.g., specialists for copper use, prefab concrete use, etc. Discussions between specialists and actors at the program level will help understand which projects need what type of sustainability objectives. For example, not all projects can contribute to the circularity ambition as it only points towards a reduction in the use of virgin copper, which does not apply to projects whose work, suppose, is predominated by the use of concrete. The framework will spark discussions and raise questions in each step, contributing to the proactive involvement of actors and knowledge sharing and identifying challenges. The framework aims to translate strategic sustainability ambitions into concrete requirements. These requirements are the definitive KPIs that the program managers can use as hard criteria for projects. Program managers must communicate with project managers on which definitive KPIs apply to their projects. This will lead to actions taken from both the actors' sides to ensure that sustainability requirements are incorporated into practice. This process will eventually show where the TSO stands in achieving its sustainability objectives and the intermediate benefits produced. However, the program-level actors must promote this framework to understand the projects' long-term and short-term value and benefits.

Besides, the results from the framework should often be considered as the sustainability pitch during the monthly meetings. Doing so will motivate other actors of the TSO organisation and different levels to know and understand more about how sustainability requirements come into play and their crucial role in achieving long-term goals and benefits. These will also lead to new ideas or suggestions on how further improvements to the framework can be made and how it can be adapted according to different projects of TSO for sustainability requirements management. The framework will assist program managers in ensuring proper management of sustainability requirements with a focus on benefits. These benefits will also eventually contribute to the TSO's strategic goals regarding sustainability. Thus, through this framework, program managers or advisors can communicate with project managers the strategic benefits taken into account while considering the sustainability requirements.

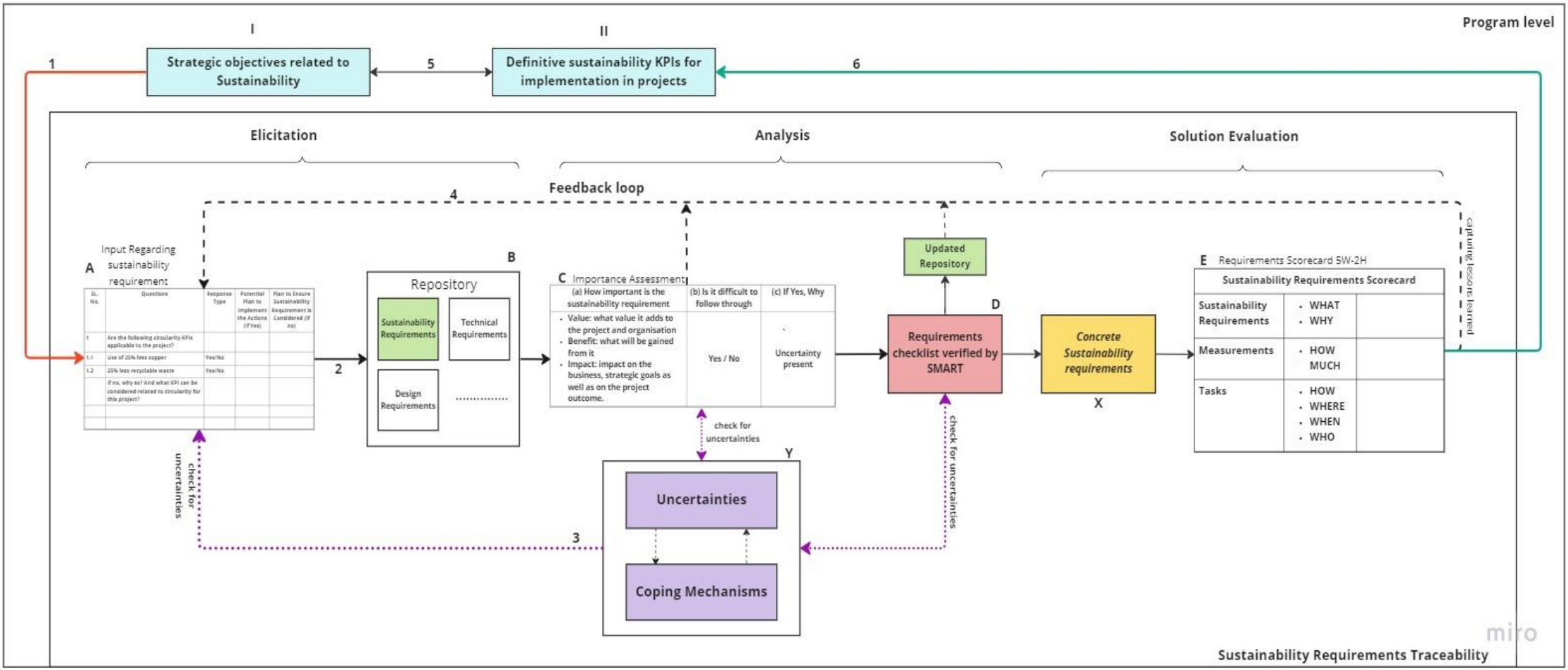

Figure 6.3: Final Sustainability requirements framework

CHAPTER 7: DISCUSSIONS

This chapter discusses the research findings in section 7.1 and the research limitations in section 7.2.

7.1 Results Discussion

Implementing sustainability requirements in projects is of significant importance for organisations in contributing to sustainable development (Silvius et al., 2017). However, implementing long-term sustainability objectives is still challenging (Steward et al., 2016). Organisations find it difficult to translate these high-level sustainability objectives into operationalized requirements (Engert & Baumgartner, 2016). This research is an exploratory study aimed at understanding how sustainability requirements can be managed in TSO (Transmission grid operator) projects so that it leads to the implementation of long-term sustainability objectives. This is achieved by developing a framework based on the qualitative research method. Less literature explores how sustainability requirements can be implemented in TSO projects, thus making this research study beneficial in academia and practice.

The concept of sustainability related to TSO is discussed in the literature study along with requirements management. Sustainability is considered a top requirement for projects in the engineering and operation industry (Ye et al., 2009; Parsanezhad et al., 2016). For this research, sustainability has been considered a requirement for projects. So, a literature study is done on requirements management to understand how requirements are elicited, analysed, monitored, and managed. This requirements management process sets the course of action for achieving project objectives. Literature also mentioned that key elements of organisations' strategic and project goals are improved when requirements are managed effectively (Coventry, 2015). If sustainability requirements are managed well, then it would lead to improvements in achieving organisations' strategic and project goals. The stakeholders would also clearly understand how the organization contributes to sustainable development. However, literature shows that sustainability requirements do not get carried forward to the later phases of projects (Jallow et al., 2010 and Jallow et al., 2008). This means that there is no proper process followed when it comes to managing sustainability requirements in projects. This research meets this need by developing a framework for managing sustainability requirements.

Even though the concept of 3P is about taking in the holistic view of sustainability, the social and environmental aspects receive far less attention as compared to the economic aspect as well as are challenging to incorporate into projects and programs (Silvius & Schipper, 2010; Martens & Carvalho, 2016; Silvius et al., 2017; Hahn et al., 2014). However, this research provided insights that the TSO mainly focused on sustainability's environmental and economic aspects. KPIs were set against those ambitions but lacked

social ambition. Hence it can be said that gradually, the environmental aspect is receiving significant attention for incorporation in projects, but the social aspect of sustainability is still behind in the TSO organisation.

The literature said that sustainability requirements depend on actors' responsibility in projects and programs (Goedknegt & Silvius, 2012). The empirical study findings showed a gap between the program and project levels regarding the importance of sustainability requirements. Actors at the program level were not acquainted with the work that goes into the project level. The findings showed that according to the advisors, the sustainability ambitions set are feasible and can be met, which contradicted the project manager's viewpoint. It was also observed that the triple constraint of cost, time, and quality for project managers still dominates their discussion, and sustainability is nowhere near it. It matches the literature of Silvius & Schipper (2010), who mentions that project managers are still stuck with the traditional ways of working with cost and time. A similarity can be drawn from this between literature and practice. It implies how sustainability is currently not a priority in projects and for project managers and is often overshadowed by cost. Moreover, the literature also mentioned that an organisation's actors must have a responsibility mindset for sustainability incorporation (Silvius & Marnewick, 2022). The empirical study provided a different result. It was observed from the empirical findings that only the advisors (actors at the program level of an organisation) have a responsibility mindset regarding sustainability and not the project managers (actors at the project level of the organisation). The project managers resist changing their traditional way of working and are only focused on the immediate results of the project. Thus, they find it challenging to recognize the value their obligations and projects will add toward fulfilling the organisation's strategic sustainability ambitions. It also negatively affects the implementation of sustainability in projects.

Managing sustainability requirements is challenged by many uncertainties, which may lead to negative project performance. This research identifies uncertainties in the literature and practices focusing on social and environmental aspects. The findings showed that most of the literature's uncertainties were also faced in practice. The uncertainty U1 (Lack of knowledge, training, and necessary skill set) was mentioned the most in literature and practice. The uncertainty U12 (not managed throughout the lifecycle) was the least mentioned one in the literature (see Table 3.2) but the second-most mentioned by interviewees, stating that this is often faced in practice. This observation regarding uncertainty U12 resonates with Økland (2015), where a gap is observed between what is suggested in the literature and how the situation is in practice. The empirical findings also highlighted that actors at the project level see sustainability requirements from an operational viewpoint; however, the strategic goals are relatively long-term and generic. Actors at the program level acknowledged this and mentioned that they must provide more guidance to the project managers in this issue. This

contradicts what is mentioned in the literature by Magano et al. (2021). The literature stated that an organization's crucial actors are still reluctant and lack the commitment to incorporating sustainability requirements in projects. However, this research showed that crucial actors at the program level showed commitment, and actors at the project level gradually showed their interest. This was seen from the findings when project managers pointed out that they were willing to consider sustainability requirements for their projects but that the ambitions of the TSO were not focused on the types of projects they did. It was unclear to them how to develop a new KPI that related to their project and operationalize that. This research further provided recommendations on tackling the uncertainties and developing the framework. Tackling these uncertainties will provide results gradually and not immediately. It should be understood that the goal of tackling these uncertainties and implementing sustainability requirements in projects is to achieve long-term strategic objectives.

One of the findings observed from the empirical study is that for sustainability requirements to be implemented in TSO projects, they must be well managed in the process. Numerous works of literature addressed issues of why sustainability is not getting implemented. But the author did not come across any literature that mentioned the above finding. It can be said that this was something different that this research provided than the literature. Using the above findings, this research develops a framework for managing sustainability requirements by translating strategic ambitions into concrete actions. The sustainability requirements management framework is aligned with PMI (2016)'s requirements management process. Based on the author's understanding of this research's literature and empirical study, sustainability has been seen as an aspect that can be incorporated into projects but not often as a concrete requirement. There is also no such requirements management process mentioned in the project management body of knowledge regarding sustainability. Thus, this research addresses that. The framework for this research is the modified requirements management process focusing primarily on sustainability requirements.

Generally, the requirements management process is project-oriented (Kumar, 2006). But the qualitative framework developed in this research is a goal-oriented process. The practicability of this framework is at the program level. That is because aligning a project's sustainability requirements to strategic sustainability ambitions is critical for overall sustainability performance (Tam, 2010). The program level overviews similar projects and their activities and aims to realize the organization's strategic benefits. The framework of this research is an iterative process and aims to translate ambitions into concrete requirements that can be implemented in projects. It will lead to the gradual achievement of long-term strategic goals and result in strategic benefits. Being a goal-oriented process, this framework will assist program managers in starting with the end benefits in mind. It will help program managers track the project's activities by managing

sustainability requirements. This framework will provide project managers with operationalized ambitions and help them understand how sustainability requirements contribute to the big picture and to daily activities, which according to Tam (2010), is important to understand to include sustainability practices in projects and programs. Thus, the practical application of the sustainability requirements framework at the program level is an interesting result of this research.

7.2 Limitations of the Research

This research provided insight into sustainability requirements management in TSO projects. However, there are a few limitations to this research, which are addressed below:

- The research focused on developing the framework for sustainability requirements management through a qualitative approach. No quantifiable method was considered to understand the implementation of sustainability requirements in projects. Thus, not including a quantitative analysis acts as a limitation of this research.
- The case company TenneT is the client company. The research included understanding the client's perspective on sustainability requirements, and the uncertainties identified were purely based on that. The research did not consider contractors' perspectives as well as the perspective of the supply chain on the topic, which may result in different findings and proposed solutions. This may have changed how the framework is developed and is a research limitation.
- TenneT is geographically located in the Netherlands and Germany. This research focuses on the Netherlands organisation of TenneT for the semi-structured interviews. It does not include the perspective of TenneT's German organisation, which may have resulted in different findings from the interviews and the analysis of the results. Thus, the results of this research can only be considered for TenneT Netherlands and not holistically for both locations. This can act as a limitation to this research.
- The uncertainties identified were only related to social and environmental sustainability and did not include economic sustainability due to comparably lesser literature on the topic. This can also be considered a limitation.
- There was minimal literature discussing sustainability in TSO projects and sustainability requirements management. This led the researcher to depend mainly on semi-structured interviews for the findings. This acts as a limitation to this research.
- There was limited access to TenneT's documents on sustainability; hence the document review presented limited information. With more documents to review, a more in-depth understanding of how requirements related to sustainability are managed could have been gained. This acts as a limitation.

- Due to a schedule conflict of experts for the expert evaluation session, only three experts joined and gave suggestions on the findings and framework instead of the six experts who were approached. Had there been six experts for the evaluation, the outcome of the expert evaluation session would have been different. Different views of different experts could have influenced the final framework development. This acts as a limitation to this research.
- Lastly, data analysis is done qualitatively based on subjective data gathered from interviews. Thus, the findings are influenced by the researcher's view on analysing the data. However, if another person analyses the same data, it may result in different findings.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

This chapter concludes the research to understand how sustainability requirements can be managed in TSO projects. The research questions will be answered in Section 8.1. Section 8.2 provides recommendations for practice and future research.

8.1 Answering Research question

This section focuses on answering the main research question:

How can sustainability requirements be better managed by actors in TSO projects?

The main research question covers the five sub-research questions, and thus, answering the sub-research questions will all together answer the main research question.

SRQ1: What is known about sustainability requirements in projects from the literature?

This sub-question was addressed through literature review of Phase one. The literature review investigated the concept of sustainability related to organisations and projects. For an organisation to move forward in sustainable development, the organisation must have a responsibility approach and not a liability approach. In projects, sustainability requirements can lead to better results. However, translating the long-term sustainability objectives to concrete requirements has been challenging. The lack of a proper framework for sustainability management and uncertainties present in sustainability requirements management is why TSO faces difficulty translating objectives into actions. 12 uncertainties were identified from the literature, namely: Lack of Knowledge, training, and necessary skill set, No proper framework and document reporting, Low management commitment, Different perceptions of stakeholders and project managers, Resource limitation, Lack of cooperation, Lack of awareness of the changing dynamic environment in practice, Vagueness in understanding about the topic, Poor quality of stakeholder involvement, Lack of clear responsibility identification and distribution, High Cost and lack of funding support, and Not managed throughout the life-cycle.

Moreover, to understand why sustainability requirements are often not carried forward beyond the planning phase, the focus is given to the requirements planning process of elicitation, analysis, and evaluation. Stakeholders and actors should be involved early on in the process of sustainability requirements management. Program and project-level actors play a crucial role in sustainability integration practices. However, project managers are still quite reluctant to consider sustainability in their projects. Thus, a gap exists between what is decided at the corporate level and what is done in practice.

SRQ2: How is the current situation of sustainability requirements in TSO's projects?

This sub-question was addressed through the first part of Phase two, which was the empirical research (semi-structured interview). It was observed that sustainability requirements are not considered a hard criterion for projects. Even though the TSO has its sustainability ambitions set, they are generic and not yet concrete requirements for projects. This was observed as the main challenge for not implementing sustainability in their projects. Moreover, the difference in viewpoints was seen between actors at the program and project levels. For instance, advisors suggest that project managers also take responsibility for implementing sustainability in their projects. But project managers were seen to be dependent on the advisors for this and did not have a proactive approach to have sustainability requirements in projects. This shows that there is indeed a gap present between the program (corporate) level and the project level on the topic of sustainability requirements in the TSO organisation.

Moreover, it was also observed that when selecting or formulating sustainability requirements for projects, the requirements process (discussed in the literature) is not followed; instead, a general approach is taken. Most of the time, the sustainability requirements are taken from the KPIs already set; however, those are specific to only a particular type of project.

SRQ3: What uncertainties are faced by actors in managing sustainability requirements in TSO projects?

This sub-question was addressed through the second part of Phase two, which was the empirical research (semi-structured interview). It was observed that most of the uncertainties identified from the literature were also relatable in practice. Advisors and project managers had similar views on the uncertainties identified from the literature. Additionally, another set of 13 uncertainties was identified from the interview responses. Thus, the table of uncertainties found from the literature and the table of additional uncertainties were merged (uncertainty with similar meaning) into one table of 20 uncertainties. These uncertainties were prioritized and are shown in Table 8.1.

Table 8.1: Final list of uncertainties (after prioritization) identified

Sl no.	Uncertainty
1	Lack of Knowledge, training, and necessary skill set (Priority score 16)
2	Lack of clear responsibility identification and distribution (Priority score: 12)
3	Mindset (Priority score: 12)
4	No proper framework and document reporting (Priority score: 9)

5	Lack of awareness of the changing dynamic environment in practice (Priority score: 9)
6	Not managed throughout the life cycle (Priority score: 9)
7	Vagueness in understanding about the topic (Priority score: 9)
8	Lack of Transparency (Priority score: 8)
9	Resource limitation (Priority score: 6)
10	Low management commitment (Priority score: 6)
11	Poor quality of stakeholder involvement (priority score : 6)
12	Different perceptions of stakeholders and project managers (Priority score : 4)
13	Very few pilot projects (Priority score: 4)
14	Lack of cooperation (Priority score: 4)
15	Cost over sustainability (Priority score: 4)
16	Sustainability gets lost in the top-down process (Priority score: 4)
17	Lack of clear and strict requirement from management in tenders (Priority score: 4)
18	High Cost and lack of funding support (Priority Score: 3)
19	Lack of tools to measure sustainability in tender (Priority score : 3)
20	EU procurement law has impact on implementation of SR (Priority score :1)

SRQ4: How can the existing requirement management process be modified to manage sustainability requirements in TSO projects?

This sub-question was answered through Phase three, which is framework development. Firstly, it was observed from the literature and interviews that there is an absence of a proper framework for managing sustainability requirements in TSO projects. Secondly, the interviews also interpreted that translating the long-term goals into actions was difficult for the actors. And thirdly, it was observed that no requirements management process regarding sustainability was followed. As described in the literature, the existing requirements management process was not followed for planning sustainability requirements. Thus, the existing requirements management process is modified into a framework focusing primarily on sustainability requirements. The existing requirements management framework consists of requirements elicitation, analysis, and solution evaluation. The new framework is aligned according to these three steps, but the process is finetuned considering long-term sustainability goals and their translation to concrete requirements. The existing requirements management process is focused on achieving the project's objectives and lacks a goal-oriented approach. The developed framework can be said to have a goal-oriented approach and is an iterative process. The TSO's strategic sustainability ambitions are taken as input to the framework, and they are then defined in the repository, which comes under the step of Requirements elicitation. The defined sustainability requirements are qualitatively assessed and verified using SMART

criteria for the requirements analysis step. This framework step will assess the sustainability requirements based on their value, benefits, and impact. This will also assist actors in aligning the requirements with the organisations' strategic sustainability ambitions. This step will also provide verified sustainability requirements that are concrete and in line with the sustainability ambitions taken as input. Further, these concrete sustainability requirements will go through the requirements scorecard, which will set a measurement and task that needs to be done for the sustainability requirement to be implemented. This will also be put in a feedback loop along with lessons captured to check whether the concrete requirements are fulfilling parts of the strategic goals. Feedback will also be taken from the process to make the following process more efficient and for improvements. The process consists of uncertainties (as gathered from interviews and literature) that must be checked and dealt with. Thus, the modified framework for sustainability requirements management consists of taking strategic goals as input and translating them in the process, with concrete requirements as the output and the feedback loop. Using this framework will result in achieving long-term strategic sustainability goals and gathering intermediate and end benefits in the process. The practical implementation of this framework will be answered in SRQ5.

SRQ5: How can the developed framework be applied in practice to better impact the implementation of the sustainability requirements in TSO projects?

This sub-question was answered through Phase three, which is the expert evaluation. The feedback and suggestions from the experts were taken regarding how the developed framework can be applied in practice so that it has a significant impact on the implementation of sustainability requirements in projects. The practical implementation of the framework should be on the program level. As the framework focuses on translating sustainability ambitions into concrete requirements, it should be done at the program level. It will help actors at the program level track the sustainability requirements in different projects and have an overview of which projects lack sustainability in them. Moreover, using this framework at the program level will help program managers and advisors have concrete sustainability KPIs, which they can set as a hard criterion for projects. In order for the strategic goals and concrete KPIs to be holistic, it is important that, along with program managers and advisors, experts or specialists of different types of projects (onshore, offshore, land station, cables, etc.) are also involved in the framework. The framework will also contribute to having proper reporting and traceability of the sustainability requirements at the program level. It will improve the top-down process of communicating these requirements. It will also help evaluate the project's sustainability performance, how it adds value to the program, and how much of the strategic objectives are being met.

8.2 Recommendations

The following recommendations are made for practice (for the case company) and future research based on the findings of this research.

8.2.1 Recommendations for practice (TSO company)

Following are some recommendations for practice for TenneT (TSO):

- Appropriate training and development of project managers on sustainability competence are essential in transforming them into generalizing specialists. This can be done through project-based rather than discipline-based learning, as the former provides the flexibility for creativity and achieving balanced solutions through participation in actual project-like assignments. Sustainability experts would mentor them. This will make project managers independent enough to have the knowledge to implement sustainability in their projects.
- The program manager should be able to develop competence in understanding various sustainability issues and identifying the impacts of the project options. They should be capable of making a balanced decision with a target to maximize the overall positive sustainability effects of the project. This will assist the program managers in communicating with project managers and helping them with the planning and initial execution of the latter's project's sustainability requirements. These will also allow program managers to guide the project managers in steering the project activities in the desired direction. Project managers should look beyond the immediate life-cycle of the project and, together with the program manager, build a sustainability management plan. This will help the project managers take in the vision of the long-term strategic benefits that their project will contribute to.
- The KPIs against TenneT's sustainability ambitions need to be specific and have a holistic view of the TSO's different types of projects. The proposed framework for this research can be helpful in this step. A proper management framework of sustainability requirements (Figure 6.3) will help program managers reap its benefits. It will also assist project managers in understanding specific KPIs and measuring them later in the project.
- Sustainability should be seen as a separate topic in the organisation and given equal importance as safety. Safety is an unmentioned hard criterion for every project in the TSO, which means actors follow it religiously in their projects. The same should be for sustainability requirements. This step will help project managers prioritise sustainability requirements implementation in their projects.
- The sustainability advisor for TenneT is primarily one person actively working, and this task can be quite pressuring and overwhelming for one person to manage different projects simultaneously. Assigning one or two other people with the sustainability advisors can help ease the advisor's work, thus making their work more

efficient. The assigned people can be experts in the field of sustainability or new trainees whose main area of focus is sustainability. This will also lead to new idea generation regarding how sustainability requirements can be integrated.

- Understanding that a change involving sustainability inside an organisation takes time is crucial. It requires the effort and collaboration of all the actors, including top-level management. Even though organisations are rapidly evolving regarding sustainability, it should be understood that the end goal of implementing sustainability in projects is to achieve long-term benefits. That being said, firm commitment and push are needed from the senior management toward the project managers to make sustainability a top driver of the projects. Project managers must also be proactively involved and take responsibility for communicating with the management regarding the sustainability requirements in their projects and how they will contribute towards the organization's strategic objectives.

8.2.2 Recommendations for future research

The recommendations for future research are as follows:

- This research develops the framework for sustainability requirements management in TSO projects. However, due to time constraints, the framework is not practically tested. Future research can focus on the practical validation of the framework and how it can be improved or adapted according to different industries.
- The research focused on developing a qualitative framework. The next step could be exploring how sustainability requirements can be quantitively assessed and managed. This can be done by developing a quantitative requirements management framework or a tool.
- This research focuses on the problem during the initial phase of a project. It is also important to focus on the execution phase in future research. This can be done by identifying challenges in sustainability requirements management once the project goes into execution.
- Future research can be done to explore what competencies and knowledge are required for project managers at the execution level to implement sustainability in projects.
- Future research can also be done by looking at this research from a contractors'/supply chain perspective.

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Appendices

Appendix A: Requirements Management Process

The requirements management process consists of needs assessment, requirements planning, requirements elicitation, requirements analysis, solution valuation, and requirements monitoring and controlling. These are explained briefly below:

- Needs assessments: To identify and describe a current business opportunity at the corporate level, needs assessments are often undertaken before projects. If external variables impact the project or program during execution, this should be reviewed.
- Requirements planning: The requirements development and management process is laid out in this stage for the project's duration. Throughout the project, the plan is created, examined, and revised. The process of gathering requirements, analysing them, and evaluating solutions result in informational components that are included in the requirements plan.
- Requirements elicitation: In this step, requirements are gathered from the stakeholders and developed into a set of requirements that can be implemented. The requirements are then defined, and this evolves as the project progress.
- Requirements analysis: In this step, requirements are justified as to why there were selected for the projects. The requirements are then prioritized and then verified.
- Solution evaluation: Once the requirements are analysed, it is validated and checked, and improvements are retaken into consideration in the step of requirements elicitation
- Requirements monitoring and controlling: The requirements in the requirement plan are continuously tracked, monitored, and controlled to ensure that the project scope manages the requirements. If any changes occur in the requirements or the requirements plan, it is done only after approval.

Appendix B: Selection process of the relevant literature for uncertainties.

Kordi et al., (2021)'s systematic literature review method of search strategies is adapted in selecting the relevant literature for uncertainties. The method consists of four phase, explained below. This section will explain how the selected 12 pieces of literature were narrowed down from the wide range of results.

Phase 1: Identification

The process of identification entails looking for any equivalent words, phrases, and other variations of the main keywords used in this study, which focuses on the context of requirements management and sustainability. A robust literature search was conducted to combine the existing keywords to develop a search string using three online databases: Google Search, Science Direct and Scopus, and Google search.

The keywords of "sustainability" AND "implementation" AND "challenges" , "sustainability" AND "requirements" AND "challenges", "requirements" AND "uncertainties", "requirements" AND "challenges", "sustainability" AND "requirements" AND "uncertainties were used. It identified articles within titles, abstracts or keywords. The process relied on online search engines, and the keywords were developed based on the keywords that often appear in the initial review study of the articles. The three search engines together provided several results. These results include various sources such as research articles, books, conference proceedings, academic reports, journals, and trade publications.

Phase 2: Screening

The selected articles were screened after phase 1, based on the inclusion criteria. The inclusion criteria consist of journals and conferences produced in English, articles that addressed sustainability, sustainability implementation, and requirements management, and articles that addressed challenges and uncertainties related to the mentioned topics.

The search was undertaken in 2022. The search was limited until 2007 to find recent studies relevant to the topic. Hence, the timeline between 2007 and 2022 was selected. Only articles with data published in journals and conference proceedings were included to ensure the quality of the review, and only articles published in English were added to avoid misunderstandings.

Phase 3: Eligibility

In this phase, the researcher of this report has manually monitored the selected articles to ensure they were in line with the criteria. Titles, abstracts, and summaries were read, and only articles relevant to sustainability requirements and uncertainties were selected. The selected articles were addressed from the context of different industries, namely software, construction, infrastructure, engineering, healthcare, supply chains, manufacturing, textile, agriculture, shipping, SMEs, and MNEs. Among these, most of the articles were addressed from the context of software, construction, infrastructure, engineering, healthcare, manufacturing, and supply chains and were thus selected for the next phase.

Phase 4: Inclusion

In the phase of inclusion, the related studies are reviewed by reading the articles' content. The process included several inclusion and exclusion criteria to narrow down the selection of literature studies. Table B.1 shows the inclusion and exclusion criteria for the literature study in this research.

Table B.1: the inclusion and exclusion criteria for the literature study in this research

Inclusion Criteria	*Exclusion Criteria*
Journals, conferences, reports produced in English.	Articles focusing on sustainability in general
Articles that focused on sustainability implementation and approaches and the uncertainties associated with it	Articles focusing on Requirements Management in general
Articles that focused on Requirements Management and its uncertainties	Articles focussing on other industries except the ones mentioned in the inclusion criteria
Articles with a clear focus on the industries which covered majority of the articles (mentioned in Phase 3)	Books, handbooks, website articles

After full texts were checked, read, and reviewed. A few redundant articles and a few articles which did not focus on the relevant areas were found. Those were then removed, and a final count of 12 articles was selected. These 12 pieces of literature focus on uncertainties associated with sustainability requirements management. The complete list of all the uncertainties present in these 12 literature is shown in Appendix C.

Appendix C: List of all the uncertainties

Appendix C.1: The selected articles and the uncertainties list.

This section provides a list of all the uncertainties (table C.1) present in the 12 literature selected through the procedure mentioned in Appendix B.

Table C.0.1: List of all the uncertainties found in the literature

Sl. no.	Article	Uncertainties	Type of industry/context
1	Khan et al., 2018	• Poor quality of stakeholder involvement • Unwillingness to implement feedback received • Vagueness in understanding each other's role in group • Very low management level and know-how with regard to CSR • Lack of regulation forces to govern labour issues • Operational constraints imposed by law, by resource limitations, by bounded rationality in decision making • Limited resources • Lack of management and supplier commitment • Communication problems • Different perceptions of stakeholders and managers issues • Economic and resource constraints • Changing demands of stakeholders • Stakeholder pressure • Stakeholders' interaction issues	Healthcare industry / UAE
2	Ohene et al., 2019	• Higher Clients' Requirements through the increasing complexity of modern construction projects • Lack of Professional Knowledge on Sustainability • Lack of awareness of benefits • Inadequate Research and development on new construction processes • Lack of awareness of the dynamics and changing environment of practice • In sufficient ICT knowledge and skills on its use to facilitate work processes and search for information • Lack of sustainability measurement tools • Lack of technical ability	Construction Industry/ Ghana
3	de Souza Dutra et al., 2017	• Higher costs • Insufficient or non-existent public policies and government incentives • Inadequate legislation and procedures • Need for training/technical guidance • Ineffective and excessive controls and punishments	Engineering works

		• Slowness in the analysis of licensing procedures • Difficult access to technologies and more sustainable products	
4	Jallow et al., 2014	• Client's requirements were not managed all through-life of buildings • Requirements were not centrally documented and stored • Lack of an integrated and centralized repository. • There is no visibility to the process and auditability is very rare as history of the information is not accurately captured and stored. • Lack of integration and interoperability between those systems.	Construction industry
5	Zhang et al., 2019	• Lack of governmental support • Lack of awareness, knowledge, and information of CSR within the organization • Lack of capacity and expertise • Lack of internal resources • Lack of strategic guidance and support from senior leaders or managers within the organization • The negative attitude within the organization • Lack of measurement of CSR benefits • Incremental time and cost • Lack of appropriate technology • Lack of communication, coordination, and cooperation among stakeholders • Unclear stakeholder role and power • Stakeholder interest conflict • Lack of awareness and knowledge of CSR among customers • Lack of attractiveness of CSR to customers • Consider CSR in a generic sense, not in a specific strategy • Attitudes of society, cultures of the construction industry • Lack of evaluation tools, processes, and frameworks to assess CSR performance • Lack of credibility of the disclosed CSR information	Construction Industry
6	Elkhair, 2009	• very few organizations have a defined requirements management process that is followed across the organization • do not properly distinguish between user or stakeholder requirements and system requirements • the management of requirements more difficult than some other management activities is that it is difficult to monitor progress when requirements are being generated • perennial problem of changes. Requirements management should be the primary focus for change management.	-

7	Ann & Shen, 2013	• Inadequate identification and representation of needs and requirements during the development process • lack of a systematic approach for managing the requirements process • Misunderstanding and misinterpretation of client needs and requirements • Communication gaps between participants in RsM • Insufficient time to work out a good structure for RsM • Inadequate requirements effort throughout the life cycle • Lack of documentation on changes, and feedback for RsM • Lack of end users' participation	Construction industry
8	Stewart et al., 2016	• Difficulty to define relevant sustainability performance metrics / perform reporting • Issues of information filtering / flows / timing to support decision making • Lack of function integration / cooperation • Lack of clear responsibility distribution • Lack of time & human resources • Lack of local empowerment (department, business unit, subsidiary) • Lack of R&D / innovative capabilities • Lack of awareness • Lack of interest / commitment • Lack of involvement and empowerment • Lack of support from management for employees • Difficulties linked to learning process • Lack of skills/knowledge/training • Discomfort / uncertainty about topic	-
9	Khan et al., 2021	• Lack of coordination and collaboration • Conflict of stakeholders' interests • Poor management and leadership support • Resource limitation • Low quality of suppliers' involvement	Supply chain industry
10	Bey et al., 2013	• No extra resources allocated • Specialist knowledge required • Lack of cooperation • No proper tool	Manufacturing industry
11	Suprayoga et al., 2020	• Insufficient funding support • Limited skilled personnel who use tool • Difficulty in obtaining expertise • Lack of users' knowledge and understanding • Difficulty in recognising involvement of stakeholders • Unavailability of specific manuals • Lack of coordination • Low stakeholder commitment to participate • presence of short-term interest • complexity of interaction between departments	Infrastructure / Indonesia

12	Becker et al., 2016	• Lack of success criteria definition • Elicitation of requirements • Lack of proper Stakeholder identification	Software Industry

Appendix C.2: Selecting the 12 uncertainties used in Table 3.3

	Uncertainties	(Khan et al., 2017)	(Ohene et al., 2019)	(de Souza Dutra et al., 2017)	(Jallow et al., 2014)	(Zhang et al., 2019)	(Elkhair, 2009)	(Ann & Shen, 2013)	(Stewart et al., 2016)	(Khan et al., 2021)	(Bey et al., 2013)	(Suprayoga et al., 2020)	(Becker et al., 2016)	TOTAL
U1	Lack of Knowledge, training, and necessary IT skill set	X	X	X	X	X	X	X	X	X	X	X	X	12
U2	No proper framework and document reporting				X	X	X	XX	X		X	X		8
U3	Low management commitment	X				X			XX	X				5
U4	Different perceptions of stakeholders and project managers	XX				X				X		X	X	6
U5	Resource limitation	XX				X			X	X	X			6
U6	Lack of cooperation				X	X			X	X	X	X		6
U7	Lack of awareness of the changing dynamic environment in practice		XX			XX			X					5
U8	Vagueness in understanding about the topic	XX				X	X		X					5
U9	Poor quality of stakeholder involvement	X							X			X		3
U10	Lack of clear responsibility identification and distribution						X	XX	X					4
U11	High Cost and lack of funding support			X		X						X		3
U12	Not managed throughout the life-cycle				X			X						2

Figure C.2: number of occurrence each of the 12 uncertainties

A total of 12 uncertainties were selected based on the number of occurrences. Figure C.2 shows the number of occurrences of each of the 12 uncertainties. (X means the uncertainty occurred once, and XX means there were two uncertainties with the same meaning; hence the occurrence is taken as twice for those).

Appendix D: Interview Questions

As mentioned in Section 5.1.2, the following are the interview questions. The interview questions start with a general part explaining the interview procedure, a self-introduction, followed by the introductory questions. It is then followed by the main questions, which are in 4 stages and end with closing remarks.

Please note: an additional set of questions is made (appendix D.1) in case the answer to the main question 1 was 'No.'

General

- Self-Introduction: Who am I, What is the research, and How will the interview results be used

- Explain the Interview procedure: permission to record the interview, ensuring interviewees' anonymity, and asking for interview transcript acceptance.

Introductory questions

1. What is your role in TenneT?
2. What kind of projects are you involved in?
3. How many years of experience do you have?

Main Interview Questions

Stage 1: *to understand if actors are aware of TenneT's sustainability ambitions and their thoughts on integration of sustainability requirements in TenneT.*

1. Are you aware of TenneT's sustainability objectives that it has set in the Corporate Responsibility plan for 2025? If yes, can you briefly state them? If no, why? (Jump to page 3)
2. Do you think sustainability requirements are successfully integrated throughout the project process in TSO projects ? If yes, can you give an example? If not, why so?
3. In TenneT's Green Financing (2022) report, there has been the mention that TenneT will by 2025 use 25% less virgin copper thus contribute to circularity, what do you think of it? what have you experience related to that in practice?
4. In TenneT's document, the target of the Society goal related to stakeholders is shown as 'to be developed'. Why is it not yet addressed? How in your view that should be done?

Stage 2: *to understand if actors know about how requirements are formulated and how sustainability requirements are selected in TenneT.*

5. How is the existing situation at TenneT regarding formulation and managing requirements?
6. What is the procedure for engaging with the several stakeholders of TenneT in projects and gathering their requirements in projects?
7. How are the requirements relevant to sustainability selected and justified in TSO Projects?

Stage 3: *to understand if actors agree with the Literature statement and how much they relate to the uncertainties (found from literature) in practice.*

8. It is observed from the literature that Sustainability requirements set for project don't get carried forward beyond the planning level towards the execution level due to the uncertainties encountered during the process. What is your view on this and how much is it reflected in practice in TenneT?
9. From the given list of uncertainties (table Y), which ones are being faced in the process in practice in TSO projects and why?
10. Which uncertainties (table Y), according to you, can be considered as the most impactful and the most hindering in the process of achieving the sustainability objectives in projects of TenneT?

Code	Uncertainty
U1	Lack of Knowledge, training, and necessary skill set
U2	No proper framework and document reporting
U3	Low management commitment
U4	Different perceptions of stakeholders and project managers
U5	Resource limitation
U6	Lack of cooperation
U7	Lack of awareness of the changing dynamic environment in practice
U8	Vagueness in understanding about the topic
U9	Poor quality of stakeholder involvement
U10	Lack of clear responsibility identification and distribution
U11	High Cost and lack of funding support

U12	Not managed throughout the life-cycle

Table Y: List of Uncertainties

11. What uncertainties other than the above mentioned are encountered, regarding sustainability requirements? Could you briefly explain your answer?
12. What are some uncertainties you saw in previous projects regarding sustainability requirements management that you would like to avoid in the future?

Stage 4: *to understand how actors cope with the uncertainties and what improvements they think can be made within TenneT's sustainability ambitions.*

13. How does TenneT then cope with these uncertainties ?
14. If given an opportunity, would you have coped with it in a different way? If yes, how? If no, why?
15. Where do you think improvement regarding sustainability requirements can be made within TenneT's ambitions?
16. TenneT's ambitions has people planet and profit? How well do you think it has covered all three aspects in projects or in organizations? Or do you think the focus is more on one than the other?

Closing remarks:

- Would you like to add any other comment regarding the topic?
- Anything about the interview?
- Possibility to follow-up later regarding any doubt?

Appendix D.1: If not aware

1. Why are you not aware of the objectives?
2. Were they not properly formulated and consistently communicated?
3. Is there any particular reason you would like to point out and explain in brief?
4. In TenneT's Green Financing (2022) report, there has been the mention that TenneT will by 2025 use 25% less virgin copper thus contribute to circularity, what do you think of it? what have you experience related to that in practice?
5. In that same document, the target of the Society goal related to stakeholders is shown as 'to be developed'. What is your thought on why is it not yet addressed? Is there something you experienced in practice that can be applied?
6. Are you involved in the process of gathering and formulating sustainability requirements for your projects? If yes, can you explain how it is done? If no, who all are involved?
7. What were some of the sustainability requirements that was present in your current or previous projects? Can you give any examples?

8. What is your thought on implementation of sustainability requirements in TSO projects? Are they successfully implemented? If no, why?

Closing remarks:

- Would you like to add any other comment regarding the topic?
- Are they any recommendations or suggestions for me regarding approaching other interviews and for my research?
- Possibility to follow-up later regarding any doubt?

Appendix E: Expert evaluation reflection

The expert evaluation also included discussions on the priority score of the uncertainties and the coping steps. However, this is not included in the main body of research, as the experts may have faced uncertainties in different situations than the interviewees. Hence, this part is presented just to show the experts views on it. A reflection is provided below.

1. Reflection on Uncertainty prioritization

As mentioned in Section 6.1.1, the impact score was based on the interviewee's responses and the author's assessment of the overall findings. Experts agreed to most of the proposed impact score, except for a few uncertainties. It is explained below

- **Impact score for uncertainty 'Resource limitation' can be changed to 3** (High): Experts stated that this uncertainty would have a higher impact. This will significantly impact the implementation of sustainability requirements in projects. Without proper resources, people often do not regard sustainability as something important. They see it more as an additional task to acquire the resources needed.
- **Impact score for uncertainty ' Low management commitment' can be changed to 4** (Very High): Experts agreed that there needs to be a push from the management to make sustainability a hard criterion in projects. Expert 1 mentioned that unless actors in the project do not see sustainability as a bare minimum in projects from the management's side, implementing it will be challenging.
- **Impact score for uncertainty ' Poor quality of stakeholder involvement' can be changed to 3** (High): It was stated by the experts that one of the main stakeholders for TSO projects is the supply chain, and their involvement is critical for the sustainability implementation of projects. They must be actively involved in sustainability as they provide the resources for projects. If not, it will have a high impact on project sustainability implementation. Expert 2 also added that recently there had been growth in the involvement of stakeholders when it comes to the discussion of sustainability.
- **Contradicting views regarding the impact score of ' No proper framework and document reporting'**: Experts had different views regarding the impact score of this uncertainty. According to expert 1, the impact score needs to be moderate (2) as the main problem is not the lack of proper framework and reporting. Expert 1 further mentions that it is more of the process of not knowing what steps to take in sustainability implementation that is the problem. If people know this, sustainability implementation can be improved even without a proper framework. However, according to expert 2 the impact score needs to be very high (4). Expert 2 stated that a proper framework and document would help guide people to take action regarding sustainability. Expert 3 agreed with the current

impact score. Based on the observed discussion, the uncertainty impact score kept unchanged, as lack of proper framework was found to be one of the crucial challenges regarding sustainability implementation from the literature, but at the same time, less crucial than some others from the interviews.

2. Additional mitigation steps on coping uncertainties

There were additional measures mentioned and are explained below.

- Supply chain knowledge also needs to be there (uncertainty: Lack of knowledge, training, and necessary skill set): According to the experts, it is also essential to consider the supply chain and understand their knowledge regarding sustainability implementation.
- Tracking of the fulfillment of the sustainability requirements (uncertainty: not managed throughout the life-cycle): Experts mentioned it is important to track the fulfillment of sustainability requirements in projects after it is executed. This will ensure that the requirements are being managed throughout the life cycle.
- Mutual goals and managing expectations(uncertainty: lack of transparency): Experts suggested that to be more transparent, in-depth discussions should be done to understand the mutual goals and the parties' expectations and how they can be managed.
- Connect with supply chain (uncertainty: Resource limitation): Experts suggested that early collaboration with the supply chain will help actors regarding the availability of resources.