DEVELOPING A RISK MANAGEMENT STRATEGY FOR PROFITABLE EXECUTION OF ENERGY STORAGE PROJECTS IN A GLOBAL ENERGY COMPANY

Case study Export EnergyCo

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

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Developing a risk management strategy for profitable execution of energy storage projects in a global energy company: a case study of Export EnergyCo

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Effective risk management is essential for the success of any organization. Due to rapid technological advancements, ever-increasing stakeholder expectations and turbulent global environment, risk management has become increasingly important for companies, with a strong emphasis on linking risk management with a strategy. It is critical for companies to identify potential risks and opportunities during the sales phase and to properly analyse and monitor these risks throughout the project lifecycle in a systematic way to ensure continuous performance.

This thesis aims to examine how a global energy company can improve its risk management process, with a particular focus on managing risks from the early sales stage. The study examines the various phases of the project, from the early sales phase to the project execution and closing phases, while lifecycle assessment is excluded from the scope. It analyses the risk management system in the company and the types of information necessary to support it effectively via continuous improvement.

To achieve this, an exploratory research study was conducted primarily utilizing a qualitative approach, supplemented by quantitative methods whenever applicable and feasible. The study drew on various data sources, including a literature review, interviews, workshops, and surveys to obtain expert insights. The data were analysed using content analysis. The study involved collaboration with the main stakeholders, the resulting framework was built also considering the strategic goals of the company. It should be noted that the company name utilized in this thesis work is purely fictional, referred to as "Export EnergyCo", to uphold confidentiality. The data pertaining to this company was extensively employed as an integral part of the research conducted for the master's program. Consequently, all

confidential information has been either concealed or appropriately disguised to protect its sensitive nature.

The findings of the study highlight the importance of effective risk management in the context of energy storage projects. One of the key findings of this study is the development of a proposed framework that can assist companies to identify potential risks early in the sales phase, enabling them to make informed decisions and minimize the impact of those risks on project success. Furthermore, through iterative improvements the framework also facilitates the evaluation of the effectiveness of the company's risk management process and aids in achieving the identified targets. Overall, this research contributes to the ongoing research, development, and iterative improvement process of a risk management framework within the context of energy storage projects.

Dedicated to

My mom

Her presence has always been with me, guiding and inspiring me to achieve my goals.

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My family and friends have been my pillars of support. Despite of them being far from Finland, their belief in me and encouragement have served as the driving force behind my completion of studies. Their constant presence, even from a distance, has reignited the fire of my dreams and aspirations for education and a future career.

In conclusion, I am indebted to everyone who has played a role in my education and research endeavours. Their belief in me and their contributions gave me the confidence to achieve the goals through my academic career and have shaped me into the person I am today. I am grateful for their being a part of my life.

ABBREVIATIONS

Basic EEQ	Basic engineering, procurement (equipment delivery, logistics)
BDM	Business Development Manager
BESS	Battery Energy Storage
CEM	Customer Experience Management
EEQ	Engineered Equipment Delivery
EMV	Expected Monetary Value
EPC	Engineering, Procurement and Construction
ES&O	Energy Storage and Optimization
Extended EEQ	Detailed engineering, procurement (equipment and material delivery, logistics)
IPI	Internal Process Improvement
NB	New-Build
NPS	Net Promoter Score
OI	Order Intake
PMO	Project Management Office
PMWIS	Project Management Wisdom
PM	Project Management
RACI	Responsible, Accountable, Consultants, Informed
S&OP	Sales and Operations
VP	Vice President

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1 Introduction

This study is being conducted for the Project Management and Sales departments as part of Export EnergyCo's internal improvement and process revamping program, which was introduced on December 1, 2022. One of the program's goals and important aspects is to enhance and foster collaboration in the company and improve the overall awareness on collaborative ways of working by implementing performance and change management. The focus of the program is on establishing end-to-end procedures, adopting, and implementing the Sales and Operations (S&OP) and Performance Management practices.

Project risk management is widely acknowledged as one of the most crucial procedures and competencies in the project management discipline. According to Tadayon and his colleagues, there is a statistically significant correlation between management support for risk management practices and reported project success (Tadayon, et al., 2012). Thus, poor risk management can hinder a project's success. Kermanshachi and his research team state that subject to several hazards, cost overruns and delays pose dangers to the project's success (Kermanshachi, et al., 2020). The implementation of a system capable of identifying such risks in advance may be a crucial step towards quality improvement and finding preventative solutions. This can have a significant impact on the project's execution process from the outset. Moreover, by identifying risks early in the project initiation phase and assessing their importance project managers and other stakeholders will have more time to develop a plan to manage the risks before signing the contract and starting the project execution phase. This can be achieved by aligning best practices and assigning capable individuals to handle any existing risks, which means considering the change in the structure of handling risks and following certain structure. In this instance, developing a risk management framework with predefined assumptions can be a good source to manage risks. The framework would also help to determine how much risk should be considered in a project' cost and managed by stakeholders. Consequently, implementing risk mitigation processes with clearly defined structure early on will lead to proper execution, increased profitability, and strengthen the company's reputation, attracting more clients (Bock, 2013).

The research on the case company' risk management (described in Chapter 4 Case description) reveals that the current approach to risk management is poor and lacks a

systematic way for identifying, evaluating, and managing risks that can be uniformly followed by project team members. Furthermore, the internal process improvement (IPI) program (implemented by the case company) views collaboration as its primary objective to enhance understanding of work processes. In this regard, the framework is perceived as a valuable tool that consolidates team participation within a structured system, enabling the collection of input from sales and management representatives in the initial sales and project signing phases.

The purpose of this study is to develop a risk management process with a framework for profitable execution of battery energy storage projects in a global energy company, Export EnergyCo, through a case study approach. Battery energy storage system (BESS) projects involve substantial investments and inherent risks. The importance of developing a risk management process for such projects lies in the need to carefully consider risks within a wider team and ensure profitability. It is crucial for energy companies to recognize the significance of effectively managing risks in BESS projects, as it directly impacts their financial outcomes. To address this, the study adopts a case study approach, offering practical insights and real-time examples. By examining previous experiences and challenges encountered in similar projects, energy companies can gain valuable knowledge and apply suitable risk management strategies. This approach facilitates informed decision-making and enhances the potential for maximizing financial outcomes in energy company projects.

In the background of the study, the research questions are presented, aiming to delve into some specific aspects of risk management in BESS projects. Recognizing the limitations of the research, the thesis work acknowledges potential limitations and areas for further exploration. The structure of the thesis work ensures a comprehensive analysis of risk management processes in BESS projects.

1.1 Background and the context of the study

The Internal Process Improvement (IPI) program at Export EnergyCo has the goal of enhancing collaboration and implementing effective change management and performance management techniques. To develop a comprehensive understanding of the program's risk

management objectives, it is beneficial to provide a brief introduction to the interconnected streams within the program:

- Stream one - Sales management. One of the components of the stream one involves implementing a risk assessment form with a checklist to optimize sales processes and increase risk awareness. Result: process implementation, systems and templates implementation, continuous improvement.
- Stream two - Project execution. It includes process and templates revamping and governance upgrade, process, and templates implementation. One of the components of stream two involves revamping a risk assessment form from the project management perspective. Result: process and templates implementation, data flow and systems implementation.
- Stream three - Lifecycle services stream, that focuses on developing the processes end-to-end in the project lifecycle phase. Result: process and templates implementation, data flow and systems implementation.
- Stream four – Sales and operations (S&OP) waves, meaning business operation with current tools, blueprinting and proof of concept. Result/aim: implementation of a new integrated system.
- Stream five - Performance management with the focus to improve reporting processes. KPIs (key performance indicators) dashboards, development, and implementation. Result/aim: continuous improvement.
- Stream six - Change management - implementing all the IPI changes into the organization. Main components include target setting, competence development planning, training/onboard planning. Results: competence development implementation.

Overall, in this study, the focus will be on stream one and risk management process, with the aim of explaining the developed risk management framework. The study will also cover the estimation and escalation procedures of relevant risks using a predefined checklist of possible questions and associated examples that has been created for this purpose. The overarching goal is to provide a comprehensive understanding of these processes and the framework that has been developed to aid the process. In addition, the study acknowledges that the developing process covers other streams, such as operations, performance, and change management. These streams are considered integral components of continuous

improvement. By delving into stream one and its risk management process, while also considering the broader context of operations, performance, and change management, the study aims to provide a holistic perspective. This approach ensures a thorough exploration of the developed framework and its applicability in achieving continuous improvement across various aspects of the project.

1.2 Problem statement, objectives of the study and research questions

Risk assessment and risk management have emerged as a well-established scientific discipline, offering valuable contributions to support decision-making in practical contexts. However, Aven states that there are still gaps in the scientific foundation, as it relies on perspectives and principles that have the potential to misguide decision-makers (Aven, 2016). This study aims to address the gap in the existing literature by providing a more comprehensive and structured approach to risk management process in complex projects. Specifically, the study seeks to establish the main checklist of risks associated with EPC (Engineering, Procurement, and Construction (EPC) and EEQ (Engineered Equipment Delivery) types of BESS (Battery Energy Storage) projects, and to develop guidelines for their identification, assessment, evaluation, monitoring, and management. By doing so, the study aims to contribute to the development of a more robust and effective risk management process for battery energy storage projects, which can help global energy companies like Export EnergyCo to execute such projects more profitably and sustainably.

Lihong Zhou and her colleagues stated that there is a significant demand for decision-making tools in risk management such as checklists due to considerable number of risk factors that are raised before the start of the project (Zhou, et al., 2008).

Export EnergyCo, a global leader in constructing energy storage systems worldwide, faces unique challenges when it comes to identifying risks and estimating costs on a project sales phase. The diverse aspects and conditions inherent in each project contribute to the complexity of this task. As costs can vary significantly based on different factors, a standardized approach to risk identification and cost estimation becomes more challenging. Developing a single list of estimated risks during the project sales phase and subsequently modifying it in subsequent steps presents its own set of challenges. The dynamic nature of projects demands continuous adjustments and refinements to accurately capture and address

potential risks. Thus, there is a research gap in developing a connected method for estimating risk costs during the project tailoring phase, that can be applied to complex projects and tailored to specific countries and their unique characteristics.

To address the research problem this study presents the research question and sub-questions for the research and study's development.

The research question for the thesis is:

How can a global energy company revise its risk management processes?

To answer to the main research question support with four sub-questions is conducted:

1. What are the main risks associated with BESS (battery energy storage) projects in global markets and in the company?
2. What is the risk identification and assessment process within the organization and how well is it structured?
3. How should the risk identification and assessment process be approached?
4. How can the improved risk identification and assessment process be implemented into the operational process?

The four sub-research questions support the main question from external business environment and industry to the company empirical studies. The first question focuses on analysing the risks in a global scale. The second involves analysing the risk management process within the company itself. This entails understanding how data, information, and knowledge are utilised to support risk management processes, as well as assessing the effectiveness of the risk evaluation process and its overall structure. The third question aims to examine the data architecture and framework structure that supports risk management process. Lastly, the fourth question explores the practicalities and feedback of implementing a ready-based risk management framework, as well as evaluating the effectiveness of the framework that has been created.

Deliverables: The research proposes a new built risk profile checklist with a developed risk identification, assessment, mitigation, and monitoring techniques in form of a framework, with a set of standards. Also, the research contains the linking process of the data that should be included for iterative improvements and adjustments of the new built risk profile template.

The developed method of operation model in the Sales Management practices is intended to enhance the productivity, risk awareness within Export EnergyCo in ES&O projects (key performance indicators - KPI's: improve risk awareness, quality of offerings leading to better delivery, increase profitability, thus improve the well-being of teams included in a project's sales and execution phases), and assist the sales team in identifying potential threats to the opportunities.

1.3 Theoretical framework

The theoretical framework for this study is constructed based on key concepts of risk management, which is a fundamental component of project management studies. The entire project lifecycle, from its initial stages to the final project delivery, will be examined, encompassing various risk management steps. These steps include planning the approach, identifying, and analysing risks, developing response plans, implementing mitigation strategies for the risks, and their continuous monitoring. The ultimate goal in risk management is to capitalize on or enhance positive risks while minimizing or mitigating negative risks. The theoretical framework is reflected in the literature review section, where essential risk management concepts are explored. Moving forward, these risk management concepts form the basis for empirical studies and investigations in the methodology section. Figure 1 illustrates the sequential steps involved in this research, which are thoroughly explored and refined.

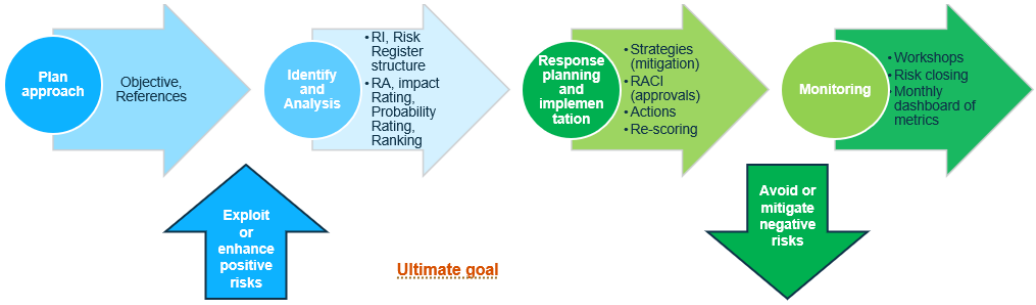

Figure 1. Theoretical framework based on essential studies of risk management in project management discipline

By following this comprehensive approach, the research aims to achieve a comprehensive understanding of risk management, encompassing both theoretical frameworks and empirical studies which are explained in more details under the Chapter 4. This holistic

approach ensures that the research outcomes contribute to the advancement of knowledge and practices in effective risk management strategies.

1.4 Significance and contribution of the study

The study aims to make practical contributions to the field of risk management in the energy storage industry, more precisely provide a customized risk management framework for battery energy storage (BESS) projects in a global energy company based on a case study approach. This framework can be used to develop the company's current risk management processes and enhance the profitability of its energy storage projects through a comprehensive literature and experts' review. Furthermore, the framework intends to enhance the profitability of energy storage projects within the company and promote the adoption of process development in projects through the literature review and secondary data. The research strives to deliver innovative solutions by improving the risk management system in the energy storage industry. By identifying gaps in existing practices and proposing a novel framework, the study aims to contribute to the advancement and evolution of risk management approaches in this sector.

By focusing on practical implications and innovation of energy storage projects, this study seeks to provide valuable insights and guidance for the industry, ultimately contributing to the advancement of risk management practices in the field of energy storage.

1.5 Limitations

Over the years, Export EnergyCo has completed various projects in different energy markets. The company has a total of "n" groups categories in the list of project categories. This thesis will focus only on risk management processes for Group 1 and Group 2 category energy storage projects within the organization, using academic materials, expert review, and company's data for research purposes. The reason for focusing on Group 1 and Group 2 category energy storage projects within the organization is threefold:

- these projects are characterized by a high volume of complexity, requiring intricate risk management processes,

- they make a significant contribution to the company's profitability, making it crucial to effectively manage the associated risks,
- these projects often encounter the most frequent challenges during execution, necessitating a focused examination of risk management strategies.

Category “Group 1” includes all EPC (Engineering, Procurement, and Construction) projects, and category “Group 2” covers demanding and/or large EEQ (Engineering Equipment Delivery) projects. Nuclear, wind and solar projects will not be considered in the research. The New-build (NB) Risk Management profile will enable the identification, evaluation, and accurate analysis of risks in the tailoring phase that are occurring until the project's completion but do not span the lifecycle stage.

The initial version of the template created from the studies is limited geographically and considered core global market target defined by the organization. In further steps, careful analysis will be conducted to separate the focus to the regions as part of continuous improvement. It is important to note that the framework is designed for a global company and does not consider small and medium-sized enterprises (SMEs) using the template, due to the complexity of processes and projects. The direction of the framework is specifically tailored for an energy company but can also be considered for complex projects in other industries.

1.6 Confidentiality

This version of the thesis is intended solely for academic examination purposes within the university. It has been prepared as a requirement for the study program and should be treated as confidential throughout the two-year period. During the two-year confidentiality period, it is important that this thesis and its contents remain strictly confidential. This means that the thesis should not be shared in the university library or with any external parties. The valuable insights and encrypted data presented within should only be accessed by authorized individuals within the university who are involved in the examination and evaluation process.

1.7 Definitions of the key concepts

Risk - the uncertainty regarding the deviation from anticipated earnings or outcomes in the future that is willing to be accepted to achieve a profit from an investment (Mansar, et al., 2009). Positive risks are *opportunities*, while negative risks are *threats*.

Contingency reservation – a value that is budgeted to cover generally risks in projects. In CFU, it is divided to "Contingency Reservation" and "Risk Reservation" due to the reason how sales budgets are being built. However, for sake of clarity they are together considered as total "Contingency Reservation" which is the value in the focus.

Risk reservation percentage – a portion of the project budget that is set aside to cover potential risks or unexpected events. It represents a reserved amount that can be used if risks occur during the project execution phase (Heagney, 2016).

Project group categories – projects have been categorized and grouped according to shared characteristics, such as project type and scope. These projects are then organized into "n" categories, where "n" represents the total number of groups.

Actual quotation – the process of assessing risks during the project sales phase. It involves identifying potential risks and assigning them a probability and monetary value. This evaluation helps in understanding the potential impact of risks on the project's financial aspects.

Monetary risk value – estimated financial impact of a risk event on a project, which is calculated by multiplying the probability of occurrence of a risk event by the potential monetary loss associated with that event. This value is crucial in helping project managers prioritize risks and allocate resources to mitigate them. As noted by the Project Management Institute (PMI), monetary risk value is a critical output of the quantitative risk analysis process and is used in decision-making during risk response planning. Essentially, it is a measure of the amount of money that a company or individual stands to lose due to a particular risk event('A Guide to the PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK® GUIDE) Sixth Edition', 2017 .

Firm offer– "*a binding written offer to buy or sell that cannot be revoked for a stipulated period or for a reasonable time that in no event exceeds three months"* (Merriam-Webster.com Legal Dictionary, 2023). For the case study the company firm offer is valid for one month.

The Net Promoter Score (NPS) – is a metric used to measure customer loyalty and satisfaction. It is determined based on a simple survey question using a scale of 0 to 10, where 0 represents the minimum score and 10 represents the maximum score given by customers.

1.8 Disposition

The master's thesis structure outlines six chapters. The first chapter introduces the background, problem area and the objectives for the thesis. It includes research questions and objectives, limitations, definitions, and the structure of the study. In Chapter 2 theory that is related to the thesis is presented. This information helps the reader learn the basics about the topic and understand the thesis better. Chapter 3 explains the methodology used to achieve results and gain findings. Chapter 4 describes the company, existing risk management process and internal process improvement program established for process improvement. This information gives the overview for the next chapter. Chapter 5 provides a summary of the findings of the research and updates. Chapter 6 provides a discussion, perspective and comparison with the literature review, conclusion and ideas for follow-up research and future investigations.

2 Literature review

The literature review connects to the nature of the research questions, provides a wider insight into the chosen topic, prepares a baseline on process improvement and project concepts, identifies gaps, and contributes to the creation of future research. In this research three subthemes are selected to guide the analysis in the literature review section:

1. Principal challenges in BESS projects
2. Process development in projects
3. Risk management in projects

2.1 Literature review strategy

The study follows a structured review methodology. Providing a clear framework for the conducting a structured review process enables a systematic, comprehensive, and transparent analysis of the literature. The study considers global cases and considers company size limitations, while excluding the research papers from SMEs (small and medium enterprises). Three steps shown in Figure 2 are identified to develop the structured literature review strategy for the single case. In more details, as a first step two general searches are conducted in three reputable research literature databases available to LUT University' students: Scopus, Elsevier ScienceDirect and Emerald. 2018 to 2023 is chosen as the date range. The selection of that time span is motivated by the need to get up-to-date information on procedures that have transpired during the last five years. It is worth noting that the reliance on peer-reviewed literature is emphasized to ensure the credibility and reliability of the sources utilized in this study. The terms for the search are:

1. "epc" AND "project" AND "management" AND "process" AND "improvement" AND "delay"
2. "project" AND "risk" AND "management" AND "template" AND "development"

As an outcome, the literature search concentrates on Emerald and ScienceDirect due to the quantity and relevance of the papers discovered to the subject of the study. Scopus is the database with the lowest number of available hits and mostly not relevant information for

the selected studies. To be precise, the results are very limited, mainly oriented to the medical sciences education and artificial intelligence in environmental sciences. The articles related to risk management in the engineering field are not relevant. Instead, they primarily focus on highly specialized engineering topics. However, in the final step of the literature review strategy, the retained articles are also sourced from this database, as it contains valuable information found in papers.

Figure 2. The steps used at the literature review stage

Following the selection of databases, the term selection procedure is developed, and search terms are specified. To limit the literature findings as much as feasible, an advanced search is conducted:

1. “epc” AND “project” AND “management” AND “process” AND “improvement” AND delay”
2. “risk” AND “project” AND “management” AND “process” NOT “product” AND “improvement” AND “template” AND “development”

Primary filtering criteria for the term selection in Step two:

• the document and article types in the databases are chosen as research papers belonging to the subject area of Engineering,

• articles without keywords in title or abstract are eliminated,

• subject areas other than Engineering and Business, Management are excluded.

In addition, the elimination of non-English articles is undertaken. In the second step 113 articles from the Emerald database and 77 articles from ScienceDirect database are found. In the last step of the elimination procedure, article titles that lacked direct relation to the topic of research are omitted by visual inspection. This involves reading the titles, reviewing the abstracts, and determining that the papers and their content are unrelated to the research topic. For example, the abbreviation EPC (which in the focus of this research imply ‘engineering, procurement, and construction’) has multiple meanings, and it is essential to remove publications that are irrelevant to the meaning of the topic. As a result, only 35

articles retain for the literature review. Furthermore, to enhance the theorical aspects of the study, additional articles beyond the specified date range are also analysed from various sources.

The Project Management Body of Knowledge (PMBOK, 2018) is an additional source that is used as a significant reference in the literature review strategy for risk management in project management. The PMBOK is an officially recognized and widely used resource in the field of project management, serving as a comprehensive guide that outlines best practices, methodologies, and processes for effectively managing projects. Specifically, within the realm of risk management, the PMBOK plays a vital role by providing a standardized framework for identifying, analysing, and responding to risks within a project. Figure 3 displays the summary of the systematic literature review procedure.

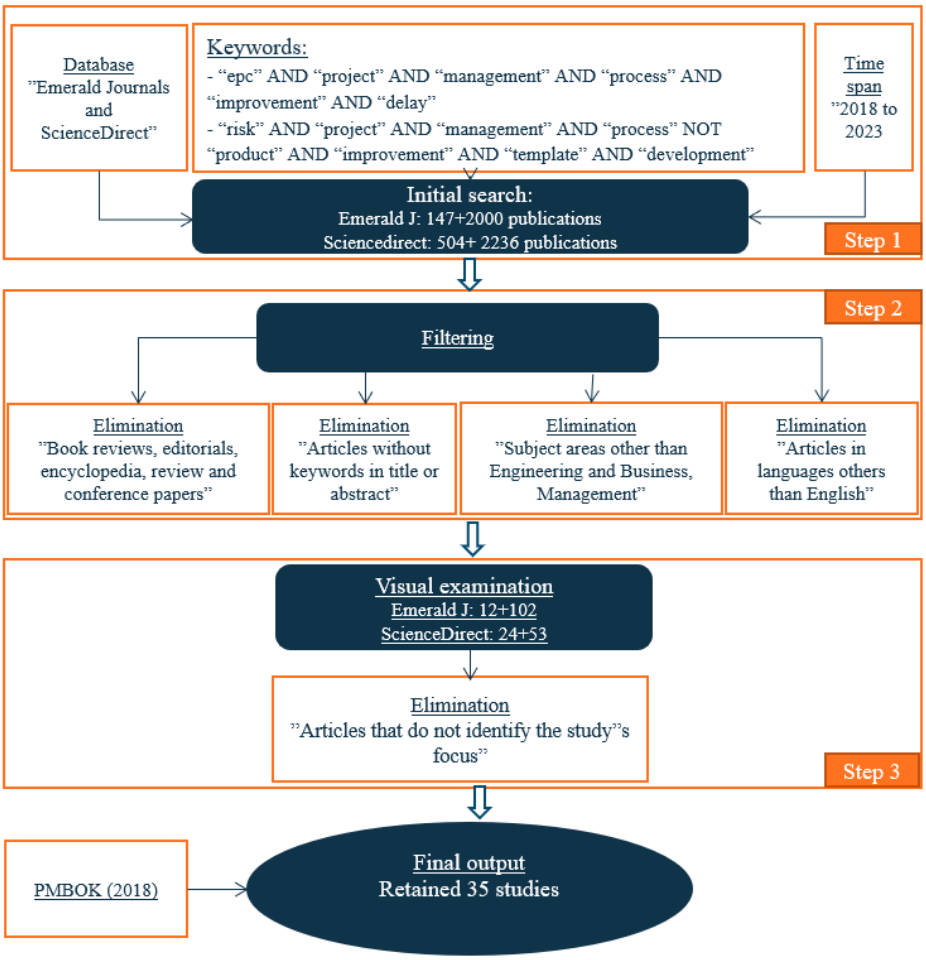

Figure 3. Summary of systematic literature review in three steps

In the following subchapters the literature review of the selected subthemes is presented.

2.2 Principal challenges in BESS projects

The principal challenges in executing Battery Energy Storage System (BESS) projects in a global market include addressing regulatory barriers and navigating complex permitting processes, as well as managing technical and operational considerations such as system integration, grid compatibility, and ensuring long-term project viability. Additionally, market uncertainties, including competition, pricing dynamics, and financing constraints, present further challenges in successfully implementing BESS projects on a global scale.

BESS projects can involve both Engineering, Procurement, and Construction (EPC) aspects as well as Engineering Equipment (EEQ) considerations. EPC projects focus on the overall design, procurement, and construction of the BESS infrastructure, including site selection, equipment sourcing, and installation. EEQ projects, on the other hand, focus specifically on the engineering and equipment aspects of the BESS, such as selecting and integrating the appropriate battery technologies, power conversion systems, and control systems to ensure optimal performance and efficiency.

According to (Yeo and Ning, 2002) the comparatively long time of Oil and Gas EPC projects entails a variety of obstacles that may influence their effectiveness. These obstacles include:

- uncertainty over the timely delivery of long-lead equipment from foreign suppliers,
- the unpredictability of the length of certain operations, such as negotiations and getting permission from authorities,
- incomplete information as a result of phase overlap between engineering, procurement, and construction,
- frequent changes mostly due to external factors,
- significant unpredictability in the planning because of a lack of supplier engagement in the design and planning of long-lead hardware.

The challenges in BESS projects listed above based on the statement of Yeo and Ning, can vary in intensity across different regions due to factors like weather conditions and regulatory frameworks. However, the extensive list of obstacles makes it challenging to

maintain a clear focus when addressing these issues. To ensure successful project execution, it is crucial to define challenge categories that can help identify and tackle these challenges systematically.

Continuing with purchasing, changes in clients may also affect the initial timetable and budget. According to Eden et al. the uncertainty of the duration of procedures like negotiation, cost planning, and management approval causes schedule overruns (Eden, Ackermann and Williams, 2005). Willoughby states that purchasing and shipping play a crucial role in large-scale projects, where good management in this area may dramatically improve cost and schedule performance (Willoughby, 2005). The importance of procurement in the EPC phase is due to the significant proportion of the material and equipment costs to the total cost. Furthermore, Ribeirinho and colleagues state that procurement accounts for 50–70 percent of the entire cost of building projects (Ribeirinho et al., 2020).

According to Kaushik, the Construction Material Supply Chain (CMSC) may be a complicated system consisting of a significant number of stakeholders (owners, contractors, consultants, regulators, suppliers) with varying objectives and participation in another supply network (Kaushik, 2018). Consequently, a higher level of risk inside and across enterprises in supply chain is existed. In the context of CMSC, Cai and his colleagues state that uncertainties might arise from project delays, market volatility, changes in client requirements, projects and procurements, and government restrictions (Cai *et al.*, 2016).

On the one hand, having core competencies that facilitate the reconfiguration of resources is essential for BESS businesses to tackle the issue of project variety. In their paper (Lampel, 2001) stated that in the case of project planning and execution, EPC firms must develop four specific skills and knowledge:

1. technical competencies, which include fundamental knowledge and the ability to design and execute a specific project,
2. entrepreneurial competencies, which include marketing and project opportunity knowledge,
3. relational competencies, which include skills and knowledge for improving and negotiating projects,

4. analytic competencies, which include routines design and implementation. BESS companies must acquire all four competences since each of them solves difficulties inherent to the industry.

On the other hand, according to Kermanshachi and his research team, the success of each project phase may be reviewed from three key standpoints: scheduling, cost, and quality (Kermanshachi *et al.*, 2018). (Cantarelli *et al.*, 2012) state that cost and schedule are always of paramount importance to the top management, and they define the profitability level of the project. In terms of achieving contractual deadlines, (Maués *et al.*, 2017) underline that the construction business performs much worse than other industries, for example the manufacturing industry, particularly in developing nations. Between 2005 and 2015, Maues and colleagues examined 142 projects in the Brazilian Amazon area and discovered that about 80 percent of the works had delays in their initial timelines, equivalent to 116 projects delivered late (Maués *et al.*, 2017). Through semi-structured interviews, (Abd El-Razek, Bassioni and Mobarak, 2008) identified several reasons for project delays and classified them into nine primary categories. These include finances, materials, contractual arrangements, modifications, laws and guidelines, workforce, scheduling and control, hardware, and the environment. Material delay rated first among these factors. According to Gebrehiwet and the colleagues, ineffective material management is the leading cause of project delay and monetary loss (Gebrehiwet et al., 2017). (Wang *et al.*, 2016) conducted a poll that identified the five most significant threats to the BESS projects:

1. inflation
2. government inefficiencies
3. material scarcity in the neighbourhood
4. changing financial market
5. unpredictable political scenario (Wang *et al.*, 2016)

The challenges associated with global energy storage projects can vary significantly depending on the location, and it is crucial to consider factors such as legal regulations, logistical issues, resources, and other details when identifying them. According to Cavanagh

and his research team, the key issues for the Australia region are ultimately related to a lack of real-world Australian experience with each of the technologies across the broad range of potential usage scenarios, or the lag between standards, regulation and the latest technologies now seeing commercial availability (Cavanagh *et al.*, 2015). It can be concluded that by conducting more trials, comprehensive technological studies, and implementing effective standards and regulations, the mass uptake and delivery of whole-of-system benefits promised by energy storage systems can be ensured.

As a result, delays in engineering, procurement, and construction due to various factors are unavoidable and persist in the corporate world, necessitating the introduction of innovative solutions and support systems for complex projects in BESS industry. Overall, achieving the full potential of successfully delivered energy storage projects requires a comprehensive analysis of challenges to develop a process for effective and profitable project execution.

2.3 Process development in projects

Boutros and Cardella describe a 'process' in the following manner:

"*A sequence of linked tasks or activities that, at every stage, consume one or more resources to convert inputs into outputs*" (Boutros and Cardella, 2017).

Processes are crucial for all sorts of businesses in all sectors since they assist organizations in managing their work and identifying various difficulties. Sometimes the process takes too long and requires a great deal of physical labour. Process improvement is not limited to reconstructing whole processes, as is often believed at first. Frequently, it may be as simple as making minor adjustments to existing procedures to meet customer expectations, save costs, and enhance the work environment. A little modification to a process may result in substantial savings over time. At the same time, little modifications can cause a change in a whole system and change the way it works in different directions. Thus, Boutros and Cardella think that it is essential to comprehend the interdependence of the processes in the project and their inherent fragility (Boutros and Cardella, 2017).

To get the greatest possible outcome, it is important for all employees to adhere to the new procedure and work with it, rather than against it. Process improvement enables the

organization to operate and behave in a more structured manner, which may minimize mistakes, costs, injuries, and workload, resulting in increased productivity and decreased expenses. (Boutros and Cardella, 2017) state that over time, the process improvement may also assist the firm in maintaining its market share and expanding into new markets. Finding a suitable framework for a process improvement might take time given the specificity of project types and their metrics, as well as the variety of frameworks and models that have been presented for process development.

There is a contradiction in the improvement idea – the processes should be autonomous enough to not change the main structure of the whole project from one side and connected at the same time in a way that can assist the next operations after them. Therefore, Frandsen and his research team argue that 'autonomous' solutions are never really autonomous in the sense that they can exist as objects on their own; they need a multitude of different mediating instruments to put them into reality and through which they evolve. Frandsen and colleagues contribute to our understanding of how epistemic concepts, guided by tools, facilitate the development of autonomous value-creating solutions (Frandsen, Raja and Neufang, 2022). In addition, this work helps to comprehend an ecosystem as the limit of all related objects and its geographical and temporal evolution.

Overall, understanding and improving processes is essential for businesses to manage their work, identify difficulties, and improve productivity while reducing costs. While finding a suitable framework for process development can take time, making minor adjustments to existing procedures can result in substantial savings over time. However, it is important to comprehend the interdependence and inherent fragility of processes to avoid unintended consequences. Additionally, while the idea of "autonomous" solutions for process improvement is appealing, they always require mediating instruments to put them into reality and evolve. Thus, a structured approach to process development can help organizations maintain their market share, grow into new markets, and create autonomous value-creating solutions.

2.4 Risk management in projects

Project management relies heavily on risk management, which is a crucial process and serves as the fundamental basis for managing a project successfully.

To achieve returns, organizations must be willing to take risks. Therefore, it is not in the best interest of a company to eliminate risk-taking. The concept of risk management entails that the organization is aware of the risks it is undertaking and strives to obtain favourable returns from those risks. According to Karimi Azari and his team, the origin of potential risks consists of various factors such as uncertainties and fluctuations in the company's profit margin, the process of competitive bidding, changes in weather conditions, productivity at jobsites, political circumstances, inflation, contractual agreements, and competition in the market (Karimi Azari et al., 2011). It is also important to recognize that there's a difference between risk and uncertainty. Olsson states that, risk is a quantifiable concept, while uncertainty cannot be measured. In addition to that, he highlights that the empirical findings emphasizing the significance of defining opportunities in risk management, not just focusing on threats (Olsson, 2007).

Regarding project management, the most severe consequences of risks can be consolidated into three categories:

- exceeding the budgetary estimates,
- failing to achieve the desired completion date,
- the inability to satisfy the necessary quality and operational criteria.

Risk management involves the identification and assessment of weaknesses and potential dangers to the information resources employed by an organization to achieve its business goals. It also means figuring out the right measures to mitigate risk to an acceptable level. By engaging in this practice, the probability of success is increased, and the uncertainties associated with achieving the goal are reduced. It is important to note that risk management is an ongoing and dynamic process.

The project risk management procedures encompass the following steps: plan risk management, identify and analyse the risks, plan response and implementation strategy, monitor risks.

In the PMBOK, the risk management plan is defined as "*a component of the project management plan that describes how risk management activities will be structured and performed"*. The project management plan involves:

- Risk strategy – overall approach to managing risks within a project,

- Methodology – specific tools, approaches, and data sources required for effective risk management,
- Roles and responsibilities for involving the right individuals in risk identification and assessment,
- Funding for allocating resources to Project Risk Management and establishing protocols for contingency and management reserves,
- Timing to determine project costs from a resource perspective,
- Risk categories to collect and analyse data by involving responsible parties in risk assessment support,
- Risk probability and impacts – the definition is specific to the project and aligns with organizational and stakeholder risk thresholds. Probability and impact matrices indicate the significance and likelihood of potential actions,
- Reporting formats to specify how the risk management process will be documented, analysed, and communicated through the risk register and reports.
- Tracking to proper recording of risk activities and facilitates risk management audits.

To build a basis for further exploration into quantitative measures and provide crucial information for risk management Iacob suggests that qualitative assessment is crucial (Iacob, 2014). Getting the responses and subjective view from experienced stakeholders within the company gives the evaluation outcomes that determines the quality improvement criteria for further risk management development. Qualitative analysis does not involve precise quantification of risks but involves the people to think about the new risks that can appear in projects, evaluate the risks using subjective view and brainstorming, thus later converting the defining risks into a number. According to Zayed and his colleagues, utilizing a quantitative method to assess risks helps to determine which projects are more susceptible to risk, enables planning for potential risk sources in each project, and facilitates effective management of each source during the execution process (Zayed et al., 2008) .

Risk identification typically relies on the expertise, perspectives, and judgments of subject matter experts. Erfani and Cui introduced predictive risk modelling using historical data and AI techniques, like word embedding models, to detect similar risks with different terminologies. The model gave promising results (Erfani and Cui, 2022). However, the

framework needs testing on pilot projects, especially complex ones, as it was initially designed for small and medium-sized projects with a relatively small sample size.

To effectively manage risks, a comprehensive risk assessment is needed. It involves identifying all potential risks, their likelihood of occurring. They should then be prioritized based on potential impact on the project success and risk management plan should be developed. Hubbard states that risk management (RM) plan outlines strategies for mitigating or avoiding each risk in the project sales stage (Hubbard, 2020). The proposal manager should ensure that the RM plan is communicated effectively to all relevant stakeholders and that the project team is trained on how to implement it. This can help to ensure that all team members are aware of potential risks.

Defining the right risk reservation during project sales is crucial for smooth execution and collaboration between stages. Moreover, involving the project management team in sales phase enhances risk assessment and allows thorough risk review before contract signing. Thompson and Perry state that by identifying risks at an early stage of designing a building project, the project management may be altered to lower the risks and distribute them to the parties best suited to control or absorb them should they materialize (Thompson and Perry, 1992). Studies should be conducted early in a project's lifecycle, far before any choices are made about the project's continuation. Charoensukmongkol and Pandey demonstrate how a flexible management team fosters risk-taking, encouraging functionally flexible salespeople to explore innovative approaches beyond their usual responsibilities and involve project management team, ultimately enhancing sales performance (Charoensukmongkol and Pandey, 2022).

As mentioned by De Marco, in addition to the communication aspect, the proposal manager during the sales stage and subsequently the project manager during the project execution phase plays crucial roles in consistently monitoring the project progress (De Marco, 2011).They should proactively adapt the risk management plan whenever new risks emerge. This proactive approach not only addresses emerging risks but also facilitates schedule adjustments. The project manager assumes the responsibility of ensuring timely delivery of the project within budget constraints while meeting the client's expectations.

2.5 Summary of the literature

Based on the comprehensive literature review conducted in this study, a better understanding of the principal challenges, process development, and risk management in battery energy storage system (BESS) projects is gained. The literature provides valuable insights into these areas and identifies key themes and research directions.

In the subtheme of principal challenges in BESS projects, the literature highlights various obstacles and factors influencing project effectiveness, such as uncertainties in timely delivery, operational duration, incomplete information, frequent changes, and lack of supplier engagement. The literature emphasizes effective management practices in large-scale projects and the need for competency development. Additionally, it emphasizes evaluating project success in terms of scheduling, cost, and quality, and addressing obstacles specific to EPC projects in the gas and oil industry. Regarding the process development in projects, the literature underscores the importance of process improvement in minimizing mistakes, costs, injuries, and workload, resulting in increased productivity and reduced expenses. However, finding suitable frameworks for process improvement poses a challenge due to project-specific metrics. The research can explore the concept of autonomous and connected processes as a potential area of focus. In the subtheme of risk management in projects, the literature provides insights into the origins of potential risks in BESS projects, the need for suitable risk assessment models, and the importance of adopting a holistic view to identify and seize opportunities. The use of quantitative methods and AI (artificial intelligence) techniques for risk assessment and predictive modelling is emphasized, along with the significance of effective communication plans and the role of flexibility in sales teams. However, it is important to consider limitations and the specific applicability of these approaches to different project types.

Overall, the literature review enhances the understanding of the challenges, potential solutions, and areas requiring further research in BESS projects. While it may not provide definitive answers to all research questions, the literature review serves as a reliable source to understand the current situation and gain insights into the research topic.

In conclusion, the literature review provides valuable findings related to the research question, with a focus on sub-questions one (what are the main risks associated with BESS projects in global markets and in the company?) and three (how should the risk identification

and assessment process be approached?) of this study. The literature primarily focuses on (1) principal challenges in BESS projects, (2) process development in projects, and (3) risk management in projects. A summary of the previous research on the topic and research gaps is added as a table in Appendix 1 and provides a summary of the results of the previously stated sources that have been chosen. Emphasis is placed on the main findings as key discoveries and gaps in research.

3 Research methodology

This study aims to offer strategies for identifying the risks and suggesting procedures to develop a risk management in the case company Export EnergyCo. It also highlights a method to continuously generate ideas for applying these risk management techniques. It is important to find effective ways to manage risks in complex projects. Collaboration among multiple participants and using simplified rules can really help with this. It is also worth noting the importance of conducting a literature review and incorporating the resulting conclusions into the process. The research methodology depicted in Figure 4 outlines the main objectives, the approach, and the sequential steps undertaken in this study. It serves as a visual representation of the aim, method and procedural framework employed to conduct the research.

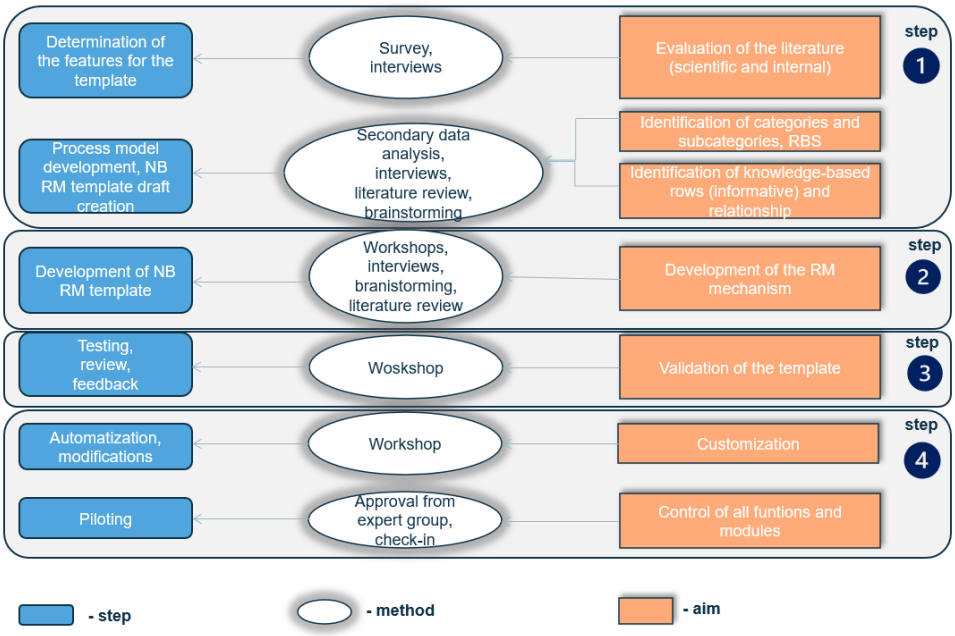

Figure 4. Research methodology and structure

The research methodology involves four main steps. Firstly, a literature review, interviews and survey are conducted to determine the key features for the risk assessment template. The identification process involves analysing internal data, conducting interviews, consulting the literature review, and holding brainstorming sessions with company and university supervisors. The second step focuses on developing a process model and creating a draft version of the risk management template, serving as a framework. Workshops, interviews,

and brainstorming sessions are employed during this step to refine the template into a comprehensive risk management tool. The third step involves validating the risk management template by presenting it to the main expert group of the IPI program, along with participants from Stream 1 and Stream 2. The template undergoes testing, review, and feedback, leading to necessary modifications. The final step focuses on designing and customizing the tool to enhance its user-friendliness and prevent information overload. The first version of the template is piloted and seeks approval from experts before implementation.

3.1 Research approach and design

In this study, the researcher plays a role in coordinating various activities related to the development of risk management processes within the company. Considering the identified research gaps from the literature review, the necessary elements and features for a new template are established for the New-Build (NB) Risk assessment template. Working alongside a supervisor from the company, the researcher forms a review team. This team is also part of the IPI program and is responsible for developing the review predefined milestones and activities, selecting relevant principles for the development process, synthesizing information, and assisting in generating efficient reports on the research outcomes.

During the template development stage, the review team includes additional experts who participate in expert reviews and workshops. The advisory committee, consisting of experts from different departments such as project management, proposal management, program management, quality and safety management, sales, and offer management, is responsible for reviewing the framework, key concepts, and the draft risk assessment template. Given that research in this field also involves experts from various departments, specialists from each relevant category to review the template with the selected advisory team.

The aim of the Risk Management improvement process is to develop the risk identification and risk assessment template before and during the proposal process to a customer. Figure 5 represents the PDCA model, which is incorporated into the risk management process. This model was initially applied by Walter Shewart and his colleagues and as stated by (Moen and Norman, 2006), is evolving iteratively, being used to improve various processes.

According to the PDCA model built for the risk management process development, in the planning phase (Plan), the organization establishes the foundation for effective risk management. The second phase, known as implementation (Do), involves executing the risk management plan or risk treatment. This phase encompasses several key activities, including implementing risk mitigation measures, assigning responsibilities, and ensuring effective communication and training. During the checking phase (Check), the organization assesses the effectiveness of the implemented risk management measures through activities such as monitoring and control, performance measurement, and reporting. In the acting phase (Act), the organization takes necessary actions based on the findings and feedback obtained during the checking phase. This includes analysing results, learning and adaptation, and striving for continuous improvement.

Figure 5. PDCA model to develop the risk identification and assessment process

Overall, the research design focuses on the role of the author of this thesis, who is responsible for the development of risk management processes within the company. By addressing the research gaps identified in the literature review, surveys and interviews, the necessary elements, and features for the New-Build (NB) risk assessment template are established. To ensure a comprehensive and collaborative approach to template development, a review team, who is advisory committee at the same time, and expert from various department are involved. This approach aligns with the risk management improvement process and incorporates the iterative PDCA model.

3.2 Data collection methods, sources, and data analysis

The analysis of studies involves the use of primary and secondary research methods to gather information and data for analysis. Various internal and external documents are utilized, including:

1. Standard Risk Profile document (internal): This document provides a standardized assessment of risks associated with the EPP projects. It helps identify potential challenges and uncertainties that may affect the project's success.
2. Knowledge Area PMWIS (internal & external): This resource focuses on Project Management Work Information System (PMWIS). It provides insights into effective project management practices, tools, and techniques.
3. Customer Experience Management (CEM) document (internal) involves actively managing and improving the interactions and overall experience customers have with a company. CEM data was used to understand customer satisfaction rates and identify weaknesses in sales and project execution processes, with feedback comments being incorporated to identify gaps and enhance service quality.
4. Literature Review (external): This involves reviewing existing research studies and publications related to the project. It helps to gain a broader understanding of the subject matter, explore existing knowledge, and identify gaps or areas requiring further investigation.
5. A survey is conducted with the expert community (internal), comprising managers, specialists, and senior experts from Export EnergyCo, who are based in Europe and overseas and operate globally. The participants hold at least a bachelor's degree, possess five years of work experience, and have knowledge of energy-related risks. In this investigation, a total of 44 questionnaires are distributed, and 27 participants are responded. Data is collected from experts within Export EnergyCo around the globe.
6. Workshop (internal) is conducted and lasted for 75 minutes, focusing on the review and evaluation of the risk assessment form and matrix for IPI. The Delphi technique is used to validate and assess the form, gather inputs, and feedback from participants, and brainstorm the next steps for developing the risk assessment template.

Additionally, time is allocated to explain the assumptions listed in the template, which will be transferred to the checklist during the tailoring stage, and some assumptions that are not considered as risks will be eliminated. The workshop covers the explanation of columns and assessment criteria, and feedback regarding the initial overview, form usage, and defining future steps.

7. Interviews with experts (internal) covers the existing process, gaps, improvement ideas, content that will be useful for the research.

By employing primary research methods, including surveys, workshops, and interviews, original and additional data is directly collected from first-hand sources, consisting of experts within the company. The input obtained from these primary research methods informs the categorization section for different project stages, with the first five documents mentioned in this subchapter serving as key references. Through a combination of insights gained from interviews, workshops, and feedback received, the categories are refined, consolidated, and presented in a simplified form with subcategories.

Secondary research data involves analysing existing information and data from published sources such as books, articles, reports, and case studies. The integration of secondary research with empirical data, along with the analysis of internal and external documents such as the Standard Risk Profile, Knowledge Area PMWIS, and Literature Review, facilitates a comprehensive analysis of the studies. This approach ensures access to relevant and reliable information, thereby supporting the analysis process and enabling meaningful conclusions to be drawn. Therefore, the analysis of data is combined with the research findings from the literature review. The surveys include questions that guide the research and provide clarity on the developmental perspective.

4 Case description

The case description section provides the information about the company, implementation of internal control, description of the current structures within the company, including project management and risk management. It also offers a brief overview of the IPI (internal process improvement) program, highlighting its significance in driving organizational change. Within this section, the development strategies and initiatives from various stakeholders are presented. These initiatives showcase the proactive involvement and contributions of different individuals and teams within the case, such as the case company' clients, Business Development Managers (BDMs), Proposal teams during the sales phase, and Project Management (PM) and execution teams in both sales and execution phases. By examining these strategies and initiatives, the empirical findings shed light on the collaborative efforts and coordinated actions taken by stakeholders to enhance project and risk management practices. This allows a deeper understanding of the company's current state and its commitment to continuous improvement through the IPI program.

4.1 Export EnergyCo case study analysis

Export EnergyCo is created in many decades ago and since then the organization has modified the business model several times. Today, Export EnergyCo is the world leader in energy industry. The way Export EnergyCo net sales are distributed across different regions demonstrates its global presence.

The strategic approach of The Export EnergyCo revolves around three fundamental questions: why, where, and how. The "why" aspect is guided by the company's purpose, which is to drive sustainable societies through technological and service innovation. The "where" aspect pertains to Export EnergyCo's aim to play a pivotal role in shaping the decarbonization of the energy sector, demonstrating the ambitious nature as a company. As for the "how," Export EnergyCo places great importance on three core values: customer success, passion, and performance. These values serve as crucial identifiers for achieving profitable growth and reaching the desired target position (Export EnergyCo, 2023) .

The implementation of internal control in the company rests with the Board of Directors, while the Board of Management is responsible for developing and executing Export EnergyCo's management system. Their primary objectives are to continuously enhance performance, ensure effective global operations, and provide management assurance regarding risk management activities. Export EnergyCo has established control measures at both the entity and process levels, including information system controls. These control activities are necessary to directly address risks at their respective levels. By incorporating controls within their business processes, Export EnergyCo aims to achieve all internal control objectives, particularly those pertaining to operational efficiency, profitability, and reputation protection. Detailed guidelines and manuals describe the various components of Export EnergyCo's internal control system, such as corporate governance, management systems, performance management, and business processes. Monitoring occurs through ongoing assessments and separate evaluations, encompassing internal, external, and quality audits (Export EnergyCo, 2022). Figure 6Figure 6 depicts a visual representation of the main components of internal control in the company.

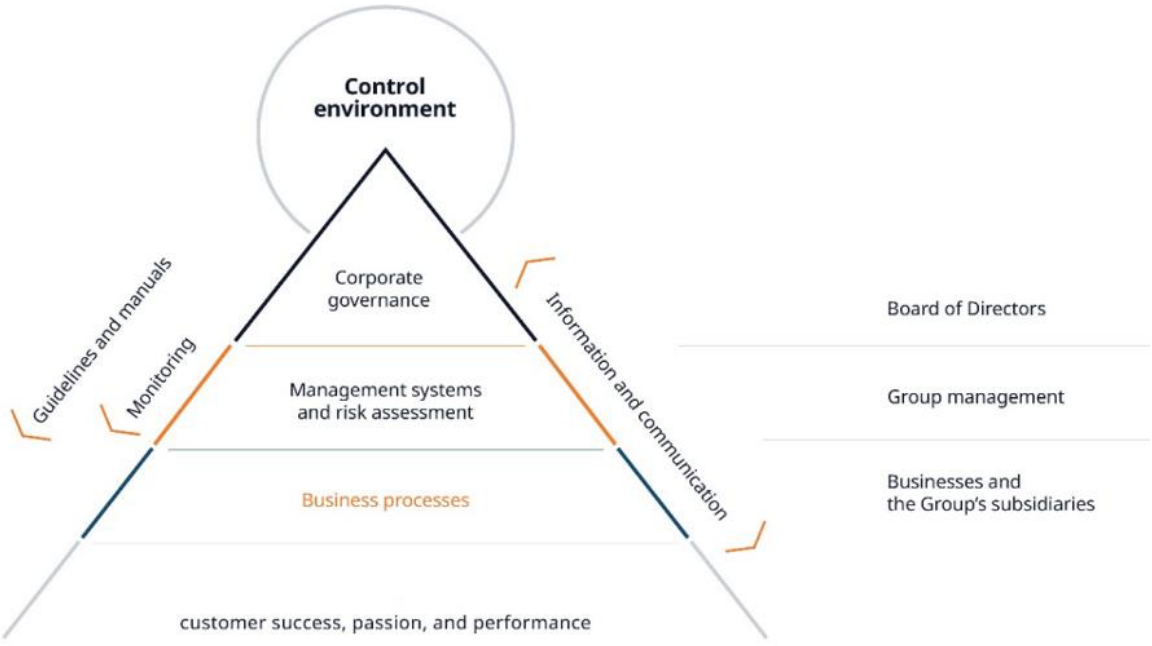

Figure 6. Main components of internal control environment in the case company (Export EnergyCo, 2022)

With the given set of limitations, the research primarily focuses on projects falling under the categories of Group 1 and Group 2. As shown in Figure 7, a visual representation illustrates the distribution of projects in percentage numbers. The data reveals that the highest number of projects is observed in the America (AMER) region, followed closely by the Middle East and Asia (MEA) region, which occupies the second position with a substantial number of executed and ongoing projects. In contrast, the Africa and Europe (AFEU) region ranks last, having only half the number of projects compared to MEA.

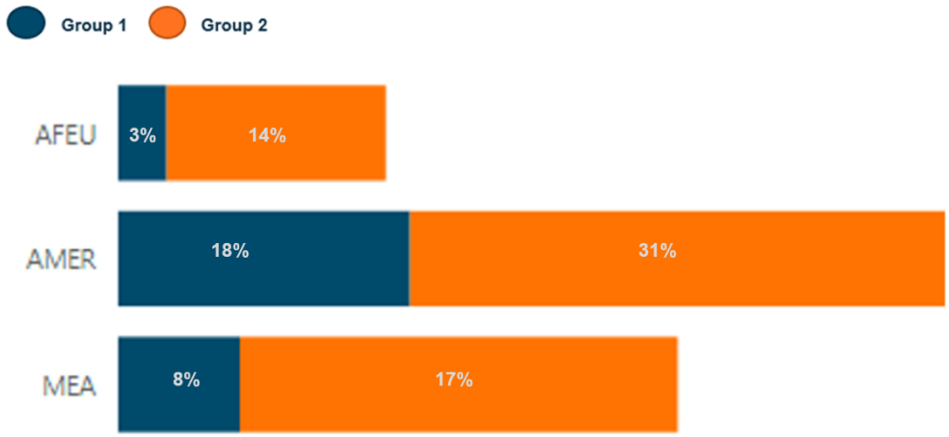

Figure 7. Distribution of project categories Group 1 and Group 2 in percentage numbers at Export EnergyCo (Export EnergyCo, 2023)

Export EnergyCo processes. There are different processes that Export EnergyCo uses for equipment delivery and installation. **Basic EEQ (**Engineered Equipment Delivery), which involves Export EnergyCo providing the main equipment needed for energy storage installation and basic engineering for the customer's own equipment. The customer or customer’s subcontractor without any contractual link to Export EnergyCo is responsible for permits, project management, engineering, installation, construction, and all other support systems. The second process is **Extended EEQ**, where Export EnergyCo delivers the basic equipment along with some smaller support systems. Basic engineering and installation of these systems are included, but the customer or subcontractor is still responsible for permits, project management, engineering, installation, and construction of smaller support systems. The third process is **EPC** (Engineering, Procurement and Construction), which stands for engineering, procurement, and construction. In this process, Export EnergyCo takes care of all site activities and equipment delivery as per the agreed scope. The customer is only responsible for permitting. **EPC** is a turnkey solution

that includes engineering, procurement, and construction services, and varies based on scope, contract, and complexity. The scope of both project types also includes local standards: in the case of EEQ the objective is to understand them, in case of EPC – drive the discussion.

The overview of the contract types and managing responsibilities are clearly shown in Table 1 below. “E” in the table represents the company; “C” in the table represents the customer in the table. Different stages and responsibilities are listed in the top row of the table to show the complexity of the projects and involvement of the stakeholders.

Table 1. Contract types and responsibilities (Export EnergyCo, 2023)

Contract types	Main equipment delivery and basic engineering of supplied equipment	Some smaller auxilaries and support systems delivery	Permitting	PM	Engineering	Installation	Civil works	Building all smaller auxiliaries and support systems
Basic EEQ	E	C	C	C	C	C	C	C
Extended EEQ	E	E	C	C	C	C	C	C
EPC	E	E	E	E	E	E	E	E

E – Export EnergyCo; C – Customer

An extended equipment delivery (extended EEQ) may include switch gears or other components in the delivery and construction, which differentiates it from a basic EEQ. The contract manager works alongside the project manager and the team to understand the contract language and provide additional oversight. Depending on the complexity and size of the contract, some projects may have a contract manager. The contract itself can be extensive, sometimes consisting of over 1000 pages.

In an EEQ project, a similar number of people are involved as in an EPC project, but their role is less critical. In addition to the stakeholders mentioned in Table 1, EPC projects involve logistics, transport, and purchasing managers, among others. The EPC scope can vary greatly depending on the contract and project complexity. These scopes are flexible and vary from one contract to another. All work is accomplished through team effort.

The Figure 8 shows the categorization of Energy Storage projects that are classified into two groups: Group 1 and Group 2. Other groups denoted as “n” are excluded from the picture due to the confidentiality and their variable number.

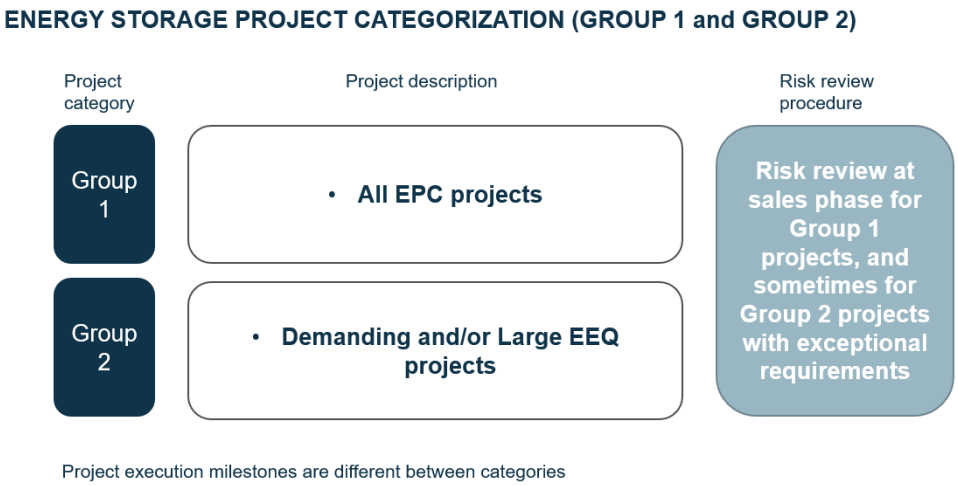

Figure 8. ES&O project Group 1 and Group 2 categorization, project description and risk review procedure (Export EnergyCo, 2023)

Of considered in this work, Group 1 includes all EPC projects with full scope, while Group 2 includes extensive EEQ projects that may involve transferring one or more systems to Export EnergyCo’s scope.

4.2 Project management

The operational development process adheres to the Export EnergyCo Operational Development (OD) Project Model. This model is derived from the overarching Export EnergyCo project model and provides a comprehensive depiction of the project's progression, starting from the Go/No-Go decisions made during the sales stage and continuing through to the delivery stage, encompassing the entire lifecycle. Figure 9 provides well-structured representation of the gates, project phases, and actions involved throughout the entire project lifecycle.

Figure 9. Project phases, gates in ES&O projects in the case company (Export EnergyCo, 2023)

During the planning phase, Export EnergyCo provides a budgetary offering and then tailors the offer for the G1 (gate one) approval for a firm offer, which includes defining the requirements and risks in the form of assumptions. However, the company faces challenges during the tailoring stage, as it has limited time and lacks a list of assumptions to estimate the risk costs accurately. Currently, risks in the tailoring phase are identified based on the project classification (Group 1, Group 2, …, Group n), with a risk reservation percentage assigned to each category without justification, and this approach applies to all projects globally. Only “Group 1” category of projects is additionally reviewed for the risk assessment. The classification defines the complexity of a project and therefore resources required for various types of projects. Furthermore, it should be noted that there is currently no link between the opportunity risk review and the final quotation, underscoring the need for a thorough analysis of projects. This can be accomplished by incorporating additional criteria into the existing project categories.

4.3 Risk management process

Export EnergyCo utilizes the Risk Assessment process during both project sales and project execution phases. The statuses of risks at different stages are outlined in Table 2. Specifically, during the sales phase, risks identified and added to the risk register have two statuses: "Open" and "Closed". The "Open" status indicates that the risk is applicable, while the "Closed" status signifies that the risk is not relevant. Under the "Open" status in the sales phase, mitigation actions are implemented. In the project execution phase, the risk register and statuses are tracked using five categories: "Open", "Work in progress", "Materialized", "Non-materialized", and "Closed". As the project execution phase involves monthly risk monitoring, mitigation actions are planned under the "Work in progress" status. New risks are added with the status "Open". When a risk materializes and becomes an issue, it is

classified under the "Materialized" status. Conversely, if a risk does not occur and/or the mitigation action is successfully implemented, it falls under the "Non materialized" status. It's important to note that a risk categorized as "Non materialized" still has a potential to reoccur. The distinction between the "Non materialized" and "Closed" risk statuses in the project execution phase lies in the fact that, in the "Closed" status, the risk is considered eliminated, reaching a 0% probability of recurrence.

Table 2. Risk statuses in systems during the Sales and Execution project phases (Export EnergyCo, 2023)

	Project phase		Explanation
	Sales	Execution	
Status	Open	Open	The risk is **opened** (reviewed)
		Work in progress	Mitigation **actions** have been planned
		Materialized	The risk is occured and become an **issue**
		Non materialized	Risk mitigation is done, risk is **solved**, can reoccur
	Closed	Closed	Risk is totally **eliminated**, 0%

In Project sales phase all risks that are marked as “Open” are finally included in the risk costs and transferred to the project execution system. In project execution phase, all risks that are marked as "Work in Progress" are included in the risk values.

In the risk categorization section, risk and opportunity factors listed in Table 3 are organized into twenty-five categories. These categories reveal the risks and opportunities that can appear during the contract negotiation phase and move to the project execution phase later in case the status of the risk remains “Open”. In this particular case, the risk category is either manually added or transferred from the sales phase using a risk name, as there are no visible categories present in the risk software application.

Table 3. Risk and opportunity factors/categories

Risk and opportunity factors/categories				
Budget	Commercial	Contract	Engineering	Environmental
External customer	Financial	Installation and commissioning	Internal organization	Legal
Location	Logistics	Manufacturing	Political	Product/ Solution
Project Participants	Purchasing	Quality	Safety and Security	Schedule
Stakeholders	Strategical	Sub-contractors	Supply-chain	Technical

Associated risks/opportunities are linked to the main risk with an impact of X EU/USD but initially have a value of 0 (zero) EU/USD.

Response types in risks and/or opportunities in sales stage and project execution stage are defined in the same way. Thus, in project sales and execution phases, the automated calculation of monetary risk value (in euros) is based on the probability selection and entered risk/opportunity value:

Calculated monetary risk value = Probability % × Max Impact

where Max Impact refers to maximum amount of money that can be claimed as damages if an action occurs. Probability % in this formula indicated the likelihood of the action.

In the project execution phase, following the contract signing, project probabilities are categorized into five levels based on their likelihood of occurrence (Table 4). They are not categorized into the levels in the project sales, tailoring and contract negotiation phases.

Table 4. Risk probability criteria, percentage, and description

Probability	Percentage	Description
Very low	20%	Unlikely to occur
Low	40%	May occur occasionally
Medium	60%	Is as likely as not occur
High	80%	Is likely to occur
Very high	100%	Is almost certain to occur

Analysing the Table 4 and the risk review data it becomes obvious that risk assessment form lacks automation, leading to potential inconsistencies between the assigned probability level and the associated percentage in the project execution phase. For instance, a probability of 45% which is related somewhere between low and medium probability level may be considered as low probability. Additionally, there is no defined percentage range that clearly associates a specific probability level with a range of percentage values. Consequently, it is unclear in the table whether a percentage of 75 should be linked to the medium or high probability level. Another crucial consideration is the inclusion of a "very high" probability level, which is assigned a criteria of 100%. This implies that the defined risk will undoubtedly occur. However, if it is 100% certain, how can it still be considered a risk and not simply an issue?

In addition to the probability level, in project execution phase, after signing the contract, two additional criteria are added to the risk assessment procedure: impact and severity level. Impact is also classified into five levels (as a probability): very low, low, moderate, high, and very high, based on the potential impact on the project. The highest consequence determines the risk item's severity, which is categorized into four levels ranging from R1 to R4. In that matrix, R1 represents the highest risk with the most severe consequences, while R4 signifies the lowest severity. During the monthly report meetings, the Director reviews R1 and R2 risks, except for certain R1 risks that are discussed with the vice president (VP). On the other hand, the project team independently handles R3 and R4 risks.

Risk and Contingency reservation. A risk can be defined as an unpredictable occurrence or situation that, if it were to happen during a project, could have either a favourable or unfavourable impact on the project's objectives, such as its financial outcome. At Export

EnergyCo, risks that have a positive impact are deemed to be opportunities. To account for potential risks that may arise during a project, a contingency reservation is established. This reserve is a predetermined amount of money that is set aside to cover any unforeseen risks that may emerge during the project's execution. The reserve is divided into two categories, namely "Contingency Reservation" and "Risk Reservation," due to the way sales budgets are constructed. Nevertheless, to avoid confusion, these two categories are combined and referred to as the overall "Contingency Reservation", at Export EnergyCo.

Risk and Contingency Management process in energy business. The Risk and Contingency Management Process is initiated during the sales stage. For Group-1-category projects, a Risk and Opportunity workshop is conducted during the sales stage, where an initial risk assessment is carried out. The efficacy of the risk management process is heavily reliant on the extent to which the scope and requirements are clearly defined prior to the workshop made by the sales team. When there are unresolved issues concerning the scope and requirements, the risks are more easily transferred to the project execution phase. It is highly recommended to ensure that all requirements are clarified before the Risk and Opportunity workshop is conducted.

Risks that cannot be mitigated, avoided, or transferred are classified as "accepted" and their respective values are recorded in the sales system by the Business Development Manager (BDM). The project in the project execution phase needs enough Contingency reservations to cover risks as per accounting rules (IFRS Foundation, 2023). The calculation of monetary value is based on three steps: (1) identifying the risk, (2) assigning an impact value to it, and (3) adding the probability of its occurrence. By combining the monetary value of each risk, the total risk exposure for the project can be calculated. This total exposure acts as a "money pool" to cover potential risks. This calculation method is referred to as Expected Monetary Value (EMV) and is important in project risk management. When calculating risk values in a project, it is important to follow certain guidelines for interpreting monetary values. The resulting total risk exposure figure may not necessarily reflect the expected or foreseeable loss in the project. It is crucial to adjust probabilities to align with the project manager's understanding and maintain total Risk Register Value and total Contingency reservations within 20% of the project budget. Project Management Office (PMO) can provide support when considering risks and values if needed. Energy business contingency has a value of 5% and it is fixed, no one can affect it.

Risk reporting and review. Currently, the risks assessed for the tailoring offer and the contract negotiation stages are not linked with the actual quotation (risk reservation percentage), thus numbers might differ and deviate from actual quotation by twice or even more, indicating the need for a more rational knowledge of its risks and a well-defined system. Moreover, quotation and allocated risk percentage in energy storage projects in Export EnergyCo are currently based only on the classification of a project, which means that Group 1, Group 2, …, Group n type of projects and their risk assessment can be neglected when risk reservation percentage is already defined for the categories.

Risk review in project tailoring and contract negotiation phase is continuously updated in collaboration with a customer, negotiating the requirements and policies until the contract signing. In the project execution phase, the risk review is regularly monitored and analysed at least monthly in collaboration with the project delivery team.

4.4 Development strategies

ES&O is currently marketing its products and services in core markets across different regions in 2023. To ensure success in these markets, ES&O is continuously monitoring their development. This monitoring allows ES&O to recognize market moves and take the necessary measures to respond effectively and adapt to changing market conditions.

Order intake is an important metric for assessing a company’s sales performance and forecasting future revenue. It provides insights into customer demand and the level of business activity within a given timeframe. As it is seen in Figure 10, Export EnergyCo applies market segmentation principles of core market to analyse the current year and the year ahead for emerging markets based on order intake (OI) results in 2024. Additionally, the company focuses on evaluating the market in two years with a long-term perspective, considering the initial order intake (OI) in 2025.

Figure 10. Market segmentation principle

The company is planning to revise its OI (order intake) objectives every six months, ensuring they remain up to date. The target level is established by ES&O and reviewed with the regions on a bi-yearly basis. To assess the accuracy of the targets, it is necessary to consider risks, opportunities, and advantages associated with the market. A strong capability and high-quality workforce are developed in alignment with the specified objectives.

The development initiatives in the company are identified in the IPI program through analysis of previous data and project/process results. Table 5 provides an overview of the initiatives to be undertaken by various stakeholders, including clients, the Business Development Manager (BDM), the Proposal team during the sales phase, and the Project Management (PM) and execution teams during both sales and execution phases.

Table 5. Risk management development initiatives in the company

Client	BDM and Proposal team (sales)	PM and team (execution)
Have **enough information** to make decisions as the project should be continued or killed	**Predict profitable project execution**, avoid losses	Better **understand the project plan**
Not waste time and/or money on an initiative that provides more business threat than opportunity	**Confident in their decisions** and recommendations	Confident that **objectives are** aggressive, but **realistic and achievable**
More objectively **focus on the realities of risk-taking** with less finger-pointing; more problem-solving	Improve **communication** with clients	Improve **communication** with clients
	Improve **decision making**	Improve **decision making**
		Manage potential problems instead of management by crisis
		Reduce stress

By utilizing the insights gained from monitoring, aligning with objectives, and implementing strategic initiatives, ES&O (Energy storage and optimisation) organisation is well-positioned to navigate the dynamic market landscape and achieve continued growth and success.

The case study chapter provides insights into the second sub-question of the research, which aims to understand the existing risk assessment process within the organization. Specifically, in relation to the assessment of how well the process is structured, several critical issues are identified during the gathering of information about the company and its risk management process. The following list highlights the research needs identified from the noteworthy issues in Export EnergyCo:

- time constraints in the project tailoring phase and the need for an assumption list to facilitate risk identification,
- establishing a link between opportunity risk review and the final quotation, independent of project category grouping,
- improving the statuses assigned to risks during the risk review process (currently categorized as open and closed),
- streamlining the risk factors/categories to avoid excessive complexity,

- ensuring consistency between assigned probability levels and their corresponding percentage values, with automation implemented for the project execution phase,
- defining clear percentage ranges for specific probability levels,
- examining the role of market segmentation principles in the risk management process,
- assessing the impact of risk management process improvement on decision-making, client communication, and project execution confidence,
- enhancing collaboration among the business development, proposal, and project management departments, and understanding its influence on project quality and delivery.

5 Findings

This chapter presents a structured approach to addressing the question and providing insights into the development of a risk management framework in the energy sector. It outlines a series of sub-questions and provides answers to them using various research techniques in subchapters.

5.1 Main risks associated with BESS projects in global markets and in the case company

The primary focus of this section is to identify and analyse the main risks associated with projects in global markets and within the company and thus answer to the first sub-question of this study. The literature review conducted in this research sheds light on several key risks and their potential impacts on project success.

In addition to conducting a literature review, valuable input is obtained from company representatives and an expert group. Through interviews with company stakeholders, notes are taken to identify gaps and weaknesses in the current risk management practices. The main issues and gaps identified are as follows:

- there is no clear primary categorization criterion during the sales and project execution phases.
- there is no checklist available for identifying risks.
- risk management processes lack defined targets.
- risk identification and assessment procedures are based on subjective views and team analysis, lacking specific criteria to determine high severity risks.
- responsibilities for risk management are not clearly defined, leading to a lack of adherence.
- probability percentages lack specific numerical ranges.
- lessons learned are not effectively utilized during risk reviews.

- the severity risk level needs to be manually added, rendering the data collected for risk review less effective.
- contingency reservation is based on project categories and does not align with the appropriate risk reservation amount. Typically, the contingency reservation amount remains the same by default, regardless of the level of risk.
- there are no training programs in place to continuously improve the risk management processes.

These identified issues highlight significant gaps in the risk management practices within the case company. Addressing these gaps and implementing necessary improvements are important for enhancing the effectiveness and efficiency of the risk management processes.

5.2 Risk identification and assessment: evaluating the structure and effectiveness

The existing risk identification and risk assessment process in the company is discussed in Chapter 4 of these studies, specifically in the section of risk management process (Chapter 4.3). The weaknesses and gaps in the risk management structure are addressed in the response to the first sub-question within the previous subchapter. To address the second sub-question of the research further, a survey is conducted, and CEM (Customer Experience management) data are analysed. Survey is conducted to understand how well the process of risk management is structured in the company. CEM data show the customer satisfaction rate and gives improvement ideas for the customers.

Survey. In the created survey for internal stakeholders, 26 participants out of 44 responded to the survey. This represents about 62 % of the total responses. The gender distribution of the survey participants is as follows: 4 women, 20 men, 2 prefer not to say their gender identity, and 1 participant didn't mention their gender. Regarding the age range of the participants, the survey includes the following distribution: 26-35 years old (6 people), 36-45 years old (10 people), 45-55 years old (6 people), more than 55 years old (2 people), and 2 people preferred not to disclose their age. All participants in the survey hold at least a bachelor's degree, with 13 people having a master's degree and 1 participant holding a PhD degree. Three participants chose not to specify their level of education. Most participants of

the survey are in the energy and related sectors and have over 16 years of job experience. Interestingly, only 6 out of the 27 respondents mentioned having job experience ranging from 6 to 10 years and others have the experience of more than 10 years. This indicates a that the individuals responsible for the risk assessment and involved in the survey possess a high level of experience. In terms of the areas of the projects they work in, most participants, mentioned at least one area: 14 people specified working only in one area, while the rest mentioned working in at least two regions.

From the Table 6, it is evident that the answers to the questions have a predominantly positive tone in some aspects, while leaning towards a neutral response with a touch of negativity in the remaining questions.

Table 6. The survey questions and the corresponding number of responses for each response type

Response	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	The organisation has a documented structure for identifying project risks	The risks are properly identified in early stages of the project sales phase	The assessment of the risks is sorted and evaluated based on different risk categories	The lessons learned are used to identify and assess the risks	The risk management process is standardized for large, highly visible projects	The risk management process is up-to-date and continuously improved	Risks are tracked and controlled adequately	Actions to mitigate risks are verified for their effectiveness
Strongly agree	2	0	0	0	0	0	0	0
Agree	17	8	15	8	14	4	7	5
Neutral	6	8	5	11	7	11	11	12
Disagree	2	10	6	7	6	10	9	8
Strongly disagree	0	1	1	1	0	2	0	2

Among the questions asked, only the first question received a strongly agree response. The remaining questions did not have any strongly agree responses but did have strongly disagreed viewpoints. Regarding the question about “having an up-to-date and continuously improved risk management process” (Q6), there were 4 agree and 10 disagree points. Similarly, the statement about “verifying the effectiveness of actions to mitigate risks” (Q8) received only 5 positive responses, while 10 responses were negative (disagree and strongly disagree). All the responses from strongly disagree (orange colour) to strongly agree (green colour) are depicted in the Figure 11.

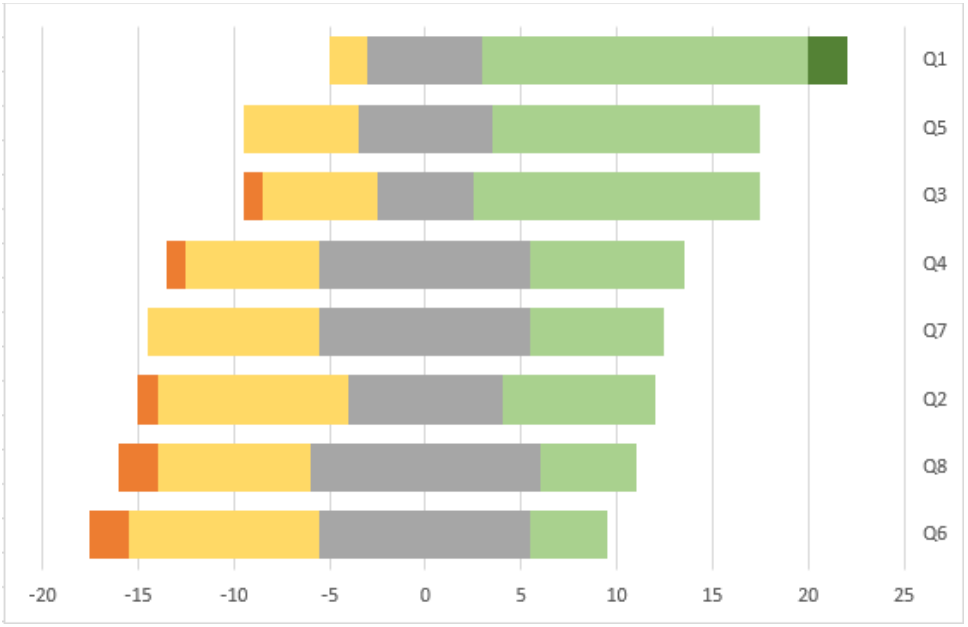

Figure 11. Distribution of survey responses from the "strongly disagree" to the "strongly agree" point

The first question received the most positive responses, with nearly 70% of the audience agreeing or strongly agreeing with the statement "The organization has a documented structure for identifying project risks." This translates to 19 people out of 27, with only 2 individuals disagreeing.

One comment regarding the disagreement with having a documented structure for identifying project risks is from lifecycle and offer management department and as follows: "*...we MAY have a documented structure, and the process MAY be standardized, but from my role, I don't see it, and I know others are not aware. The best thing we can do through this revamped Risk Assessment concept is to communicate and bring awareness!*" This comment emphasizes the importance of communication and awareness in the context of risk assessment.

The second comment is from a system engineer in the delivery project team who faced challenges during the project execution phase due to risks not being defined in a timely manner during the sales stage before signing the contract. He expresses their concern about the "*lack of a systematic approach to risk identification, management, and evaluation*". The current approach relies on individual project teams identifying risks on their own, leading to duplication of effort and the sharing of risks in meetings to inform others. The comment suggests the "*need for a systematic approach to risks and the development of a common*

toolbox of solutions and approaches. Documenting these processes is important, as there appears to be a silo/isolation problem-solving dynamic at play." Communication is once again highlighted as a key factor, along with the need for an automated toolbox that can display criteria such as maximum impact in costs and probability levels, providing a clear understanding of risk severity and impact.

The third comment is from the supplier development and quality management department, which mentions often encountering unjustified expectations that become risks and future challenges in project execution. The comment emphasizes the "*importance of catching these issues early on*", especially regarding the information conveyed by the sales/proposal team to the customer, ensuring that suppliers can accommodate these expectations.

Overall, the comments highlight the significance of communication, awareness, and a systematic approach to risk assessment, as well as the need for documentation and tools to facilitate effective risk management throughout the various stages of the project.

Question 2 has 10 people to disagree with the statement, 8 people to agree and 8 people stand neutral for it. However, in the case studies of the company it can be defined that there is no standardized way of identifying the risks and there are no defined targets for each criterion.

In conclusion, the responses to the questionnaire indicate a mix of positive, neutral, and negative viewpoints regarding risk management. While the first question received the most positive response, the remaining questions lacked strongly agree responses but had strongly disagreed viewpoints. The comments highlight the importance of communication, a systematic approach, and documentation in risk assessment. However, it is evident from empirical studies and comments of the questionnaire that there is a lack of standardized risk identification and defined targets for each criterion within the company. More information about the survey results can be found in the Appendix 2.

CEM Data. The CEM (Customer Experience Management) data for the years 2019 to 2023 reveal the average NPS rate (Net Promoter Score) at the execution and sales solutions phases. Throughout this period, data is selected from 30 projects is randomly, covering both the sales

solution and project execution phases. Questions are asked to customers to evaluate the satisfaction level of the clients with the company.

The customer feedback is divided into three types of responses: detractors (score 0-6), passives (score 7-8), and promoters (score 9-10). Detractors have shown the lowest response rate in both sales solutions and execution phases. Passives are at a medium level, while most responses have been received from the promoters. A more detailed view of the collected feedback is shown in Appendix 3.

One to five respondents from each client participated in a customer satisfaction survey; their job titles include project manager, operations/technical expert, executive, procurement coordinator, department manager, and others. It is evident from the clients' comments that most customers are happy with the service and thus, the comments made to the poll are positive. As a crucial part of development, most of them cite the flexibility of requirements, timely technical pre-sales support, prompt communication as aspects needed to be improved. The CEM data information and results are added in the Table 7.

Table 7. ES&O customer experience management feedback, recommendations to meet or exceed the customers' expectations

Recommendations /Advice	Sales Solutions	Project Execution
Customer Recommendations:	the importance of respecting customer purchasing processes, being more open to customer requests during contract negotiations, and being flexible on commercial and technical conditions.	delivering what was promised, having team competence and expertise, being responsive to client concerns.
Meeting Customer Expectations:	transparency, prompt responses, maintaining high-quality work	focus on improving communication during project management and after sales, managing customer expectations for timing and delivery, delivering systems according to specifications, being responsive to client concerns.
Technical and Commercial Support:	need for technical and commercial support, timely and accurate responses, importance of Export EnergyCo understanding local conditions, adjusting proposals, accordingly, providing support and expertise in storage solutions.	high quality work
Maintaining Communication:	prompt communication, timely technical pre-sales support, constant interaction to understand customer needs	great staff
Reliability and Commitment:	flexibility on requirements	reliability, commitment to target completion dates, high-quality work, and the cooperative nature of the partnership.

Overall, the comments from the survey and the CEM data emphasize the importance of communication and understanding, both internally and externally, to effectively manage risks and meet customer expectations. The findings also underscore the need for a systematic approach to risk assessment, documentation, and tools to support risk management throughout the project lifecycle. Additionally, maintaining transparency, addressing customer needs, and delivering high-quality products and services are vital areas for Export EnergyCo to prioritize in order to exceed customer expectations.

5.3 Development of a risk management framework for BESS projects

During the development of the risk assessment template, various factors such as strategies, goals, policies, and processes are carefully considered. During the research, certain processes are specifically designed as part of the IPI program by the author of this thesis. Figure 12 demonstrates that risks are identified and measured through an established risk management (RM) infrastructure. This involves the utilization of risk analysis, mitigation, and management practices, incorporating strategies and goals from the enterprise risk management level which is the top level in the whole organization and board members. Subsequently, these steps are continuously monitored and checked to ensure alignment by connected the structure to the PDCA model, early mentioned in research methodology chapter. Based on the monitoring results, reports are generated and added to the strategic analysis, facilitating further enhancements in risk management practices.

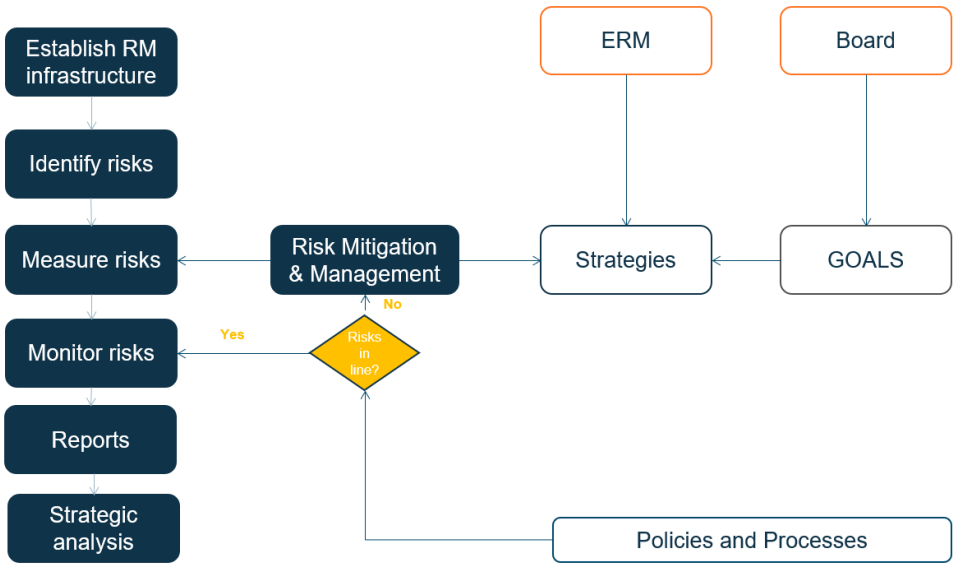

Figure 12. Developed risk assessment form structure

Following the Developed risk assessment form structure, the process of the risk identification and assessment is modified and developed. The Figure 13 represents the results of the development process in the project phases prior to signing the contract for the ES&O projects at Export EnergyCo. Duties are clearly visible early in the sales phase by having clear checklist and objectives from the very beginning. As a result, during the sales planning phase, as mentioned in the figure, Export EnergyCo will already have defined assumptions based on client basic requirements and predefined Export EnergyCo assumption list. During

the contract tailoring phase, a checklist of expanded risks, derived from the assumptions form, aids in identifying risks for a firm offer. Moving to the contract negotiation phase, discussions about deviations from contract terms and conditions lead to the finalization of the sales phase. Overall, the framework ensures, that the risk management checklist remains up to date with and continuously utilized before and during in each phase of the project.

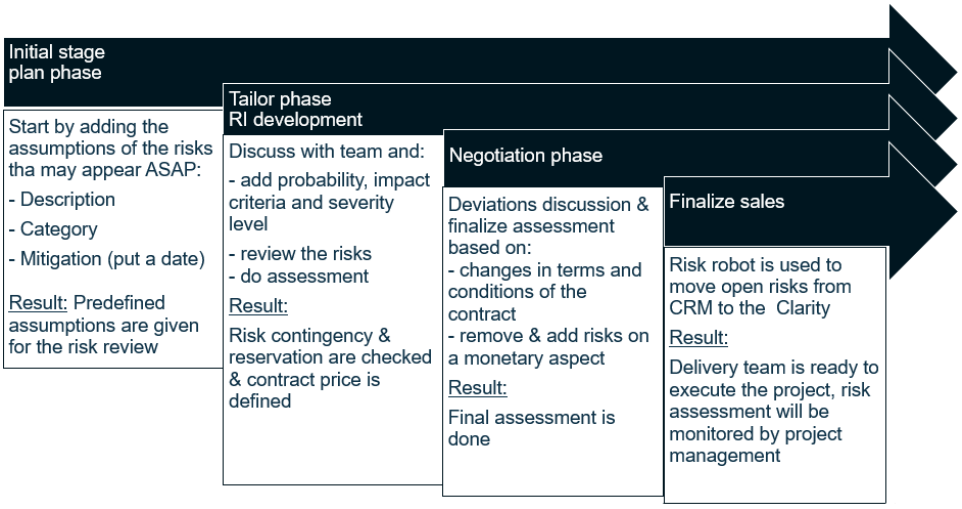

Figure 13. Development of the risk identification and assessment process

The initial version of the template is developed in an Excel file and will be improved in the application in later stages. The file comprises multiple sheets that are segregated but interconnected through formulas in specific areas. This approach aims to maintain simplicity and facilitate comprehension, particularly for complex projects within various phases of the process. The initial stage differs from the tailoring and negotiation phase and placed in two separate sheets. The data necessary for risk assessment is gathered in a third sheet, where all the required parameters are included. This allows for comprehensive collection of relevant information for effective risk assessment. To provide a detailed explanation of how each phase is incorporated into the template, the research results indicate that the establishment of the risk management (RM) infrastructure begins with defining categories in a risk breakdown structure (RBS).

In the initial stage, known as the plan sales phase, an assumptions list is created and stored in a sheet called "Assumptions." This list consists of four main categories:

- Strategic risks
- Operational risks
- Compliance and hazard risks
- Financial risks

For each category, definitions and explanations are included in the notes section of a template, along with examples of assumptions. These categories are derived from the organization's risk management document to ensure alignment and connection with higher-level processes. The primary purpose of these categories is to identify assumptions during the early sales stage and create a checklist for risk assessment. It is important to note that these assumptions may or may not remain valid during the contract tailoring phase, as they are based on limited information available about the customer for the initial review.

During the **project tailoring phase**, the assumption list is converted into a checklist that encompasses eight main categories along with the subcategories. This checklist is in multiple-sheet format. Checklist for the project tailoring phase evaluation named "Categories & Supp info," which stands for categories and supporting information. The purpose of this sheet is to facilitate the review of assumptions and identification of risks. Additionally, the "R&O Register" sheet, which stands for risk and opportunity register, is where the evaluation of identified risks and assumptions begins. This sheet serves as a central location for recording and managing the identified risks and opportunities throughout the project. It is worth mentioning that the project negotiation phase is also reviewed and assessed within the same Excel sheet, similar to the project tailoring phase. The main distinction is that during this stage, assumptions have already been evaluated and/or eliminated, and new risks arising from changes in terms, conditions, and monetary aspects

are added and reassessed. Figure 14 presents the categories of the risk register utilized during the tailoring and contract negotiation phases.

Figure 14. Risk Register categories with subcategories

Each subcategory within the template has number of columns aimed at identifying risks effectively. The primary trigger columns include "Keywords," "Questions," and "Examples of possible risks." These trigger columns serve the purpose of assisting stakeholders who use the template in identifying risks by providing relevant information in those respective columns. Additionally, there is a secondary column called "Standard risk profile," which provides further information and definitions for each subcategory (hidden in the template for improved user interface and accessible when is needed). The "Keywords" column assists in comprehending the meaning of each category and contributes to semantic data collection and analysis. The "Questions" and "Examples" columns prompt the form user to think and gain an understanding of the potential risks that may arise in various scenarios.

The Risk Probability Criteria section has been developed to improve clarity and ensure alignment with the Enterprise Risk Management System. The incorporation of a percentage range helps establish a clear link to the risk probability criteria. This range is determined through discussions with the review team and management group during workshops, where results and feedback on the created framework are collected and evaluated. Additionally, insights from interviews and the perspective of the Business Development Manager (BDM) are carefully considered. Risks exceeding the 75% threshold are treated as costs during the project sales phase, specifically in the contract tailoring and contract negotiation phases.

Figure 15 displays the developed structure of the risk probability criteria, illustrating the percentage ranges and corresponding names.

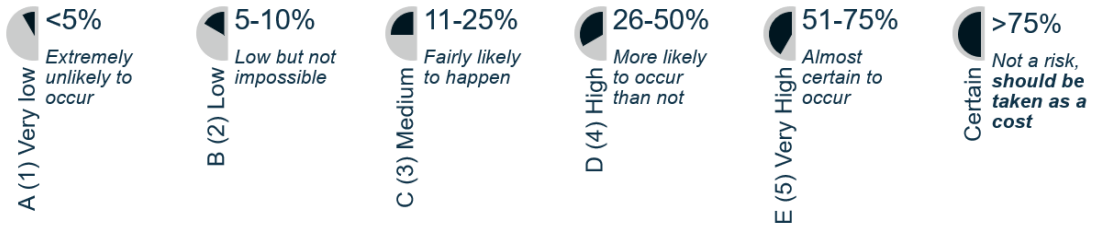

Figure 15. Risk probability criteria, developed version

Previously, the risk ranking matrix was not visible in the risk register system during the sales phase. However, as depicted in Figure 16 the developed risk ranking matrix now calculates the severity level by multiplying the probability level with the impact scales, resulting in a calculated risk severity number. Each cell is assigned a risk rank ranging from 1 to 25, which is used in the Risk Register.

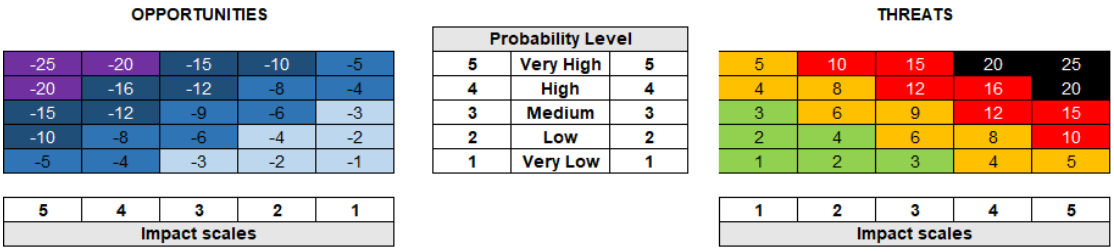

Figure 16. Risk ranking matrix for opportunities and threats (risks)

The risk severity level, ranging from R1 to R4, is connected to the RACI (Responsible, Accountable, Consulted, and Informed) chart. The responsible person is the individual who assumes responsibility for actions during the risk review and mitigation process. The accountable person for each risk severity level is the individual who handles the implementation of mitigation measures, conducts the final risk assessment, and resolves the risk. The consulted individuals are those who provide input to the process, while the informed individuals are those who need to be informed about any changes and actions taken. The severity band of the risk (e.g., red, yellow, green, purple, and blue tones) indicates the level of attention required, as specified in the RACI chart. The development and confirmation of the RACI chart are conducted collaboratively with the quality and safety

department, and the member of the advisory committee. The depiction of the risk ranking level and the associated responsibilities can be observed in Figure 17.

Risk Ranking Level			RACI			
Threat	Opportunity	Severity	Responsible	Accountable	Consulted	Informed
Very High	Very High	R1 - Very Serious	VP/Director	GM/PM	ESO Entity + BOD	BOD
High	High	R2 - Serious	PM	GM	ESO Entity	Wärtsilä BM
Medium	Medium	R3 - Medium	Department Managers	PM	GM	ESO Management Team
Low	Low	R4 - Small	Engineers	Department Managers	PM	GM

Figure 17. Risk ranking level and RACI chart for the risk assessment of the identified risks

Overall, the development of the template incorporates insights obtained from a literature review and interviews with expert reviewers. All sections for the template are carefully considered during the development process, and new columns are added specifically for the project sales phase. These new sections are designed to be customizable and being filled out using formulas. Therefore, in the risk assessment process, when the "Open" risks are transferred to the project execution phase upon contract signing, the system is able to automatically display and track the status of each column necessary for risk analysis and monitoring by the project delivery team. Valuable lessons can be derived from the clean data results generated by the automated risk assessment columns. Moreover, the contingency reservation and its alignment with the risk reservation amount can be further developed and reviewed, based on the ongoing improvements made to the risk assessment form. It is important to emphasize that training programs aimed at promoting awareness and continuous enhancement of the risk management processes should not be overlooked, as they play a vital role in communication and the overall improvement of the risk management process and collaboration.

5.4 Validation of the framework through the expert review

Expert review is used in approving the main categories and subcategories of the risk assessment template. From the several interview sessions, the suggestion of having keywords under each category and subcategory was well received. The feedback of having the keywords was identified as a good step to specify the purpose of each of the sub and categories.

During the interviews it was realized that some categories should be eliminated as they do not make sense or are anyway addressed in the target market definition. Later, in a workshop,

it was approved by the review team with comments to eliminate some content from the subcategories and even some subcategories: geotechnical studies, regulatory issues from the category “Project Country & Location” as they are already in target scope which is defined by the board of members.

Another important point is about the data minimization in the template allowing the simplicity in filling the form and using the template information as triggers to identify and assess risks considered as the essential and sufficient aspect to achieve the company purpose.

The workshop results with an overview, and feedback is collected and documented in Table 8. The column titles on a table display the roles of participants and three exercises conducted during the workshop. Feedback and comments are collected through the validation of a draft version of the template. This exercise takes into consideration the content feedback received, and further enhancements are made in the final version of the template during the subsequent individual workshop with the operational excellence management group. Based on the outcomes of the last exercise, actions are taken to pilot the template. It has been agreed upon to commence the piloting phase with the EEQ project using the updated template.

Table 8. Feedback and results of the project

Title	Overview of assumption list and checklist	Try to use the form, comments	Actions > Test project
Director, Project Management	1. Additional risk assumption examples are added, not relevant assumptions are eliminated 2. *"Generally, the concept is good and categories as appropriate".*	1. "*Some categories in the checklist can be eliminated as they are already has been considered before as company set up market".*	1. Agreed on comments from GM, Global Proposal Management
GM, Project Management	1. Additional risk assumption examples are added	1. *"Move the leftmost columns (K-G) to a more appropriate location as they appear to be procedure-related".* 2. *"For the level gauges, consider using the following criteria:* *Dollar value; Impact on fleet (specific project or entire fleet)* *Future potential issues with significant financial impact* *Potential impact on schedule, quality, or safety".*	1. *"PM should be involved to the process improvement".*
Project Planning and Control Manager	1. Additional risk assumption examples are added	1. *"The definition of risk level in the template is missing. When to choose high / medium / low".*	
Operational Excellence Manager	1. Additional risk assumption examples are added	1. *"The cells are quite long, which makes it hard to scroll around in the document".*	1. Agreed on comments from GM, Global Proposal Management
Director, Sales Management		1. *"Categories shall be same as in assumption list to make it consistent".*	1. Agreed on comments from GM, Global Proposal Management
GM, Global Proposal Management		1. "*Simplify the form"* 2. *"Leave Blank where items to be fill out or highlight recommendation/ suggestion in the template for someone to follow"* 3. *"State the purposes of the Risk Management depending on the phase you are at (i.e. during pre-sales, project execution.) since the risks may vary"*	1. *"Pilot the EEQ project using the template, involve experienced BDM in risk recognition".* 2. *"Gather feedback on form, process, areas of focus, training needs, and ensure proper risk". assessment due diligence".*

Proposal Manager AFEU	1. Additional risk assumption examples are added		
Concept Development Manager	1. Additional risk assumption examples are added 2. "Overall, very fitting assumptions/categories"	1. "*Concept is good, anyhow list to be modified for ES&O. Shorter and simplified list would be more efficient".*	1. Agreed on comments from GM, Global Proposal Management
Senior Program Manager	1. Additional risk assumption examples are added	1. "*We should simplify this matrix and it needs to be aligned with assumption list".* 2. *"Good formatting with proper split of reference/ questions and answers/inputs can do magic".* 3. *"I believe some of the procedures could be taken to a separate sheet for guidance?"*	1. Agreed on comments from GM, Global Proposal Management

Generally, the feedback received from the 'Project Management Director' indicated that the concept is commendable and meets all the necessary requirements. The NB risk assessment form is updated based on the feedback from the workshop session and accepted for the piloting. The 'Proposal Management GM (general manager)' recommended piloting the template and expert review participant were agreed on the next steps. Other feedback mainly focused on the need to develop and align procedures with the sales contract policy, establish training programs, and address specific topics for employee discussions after testing and piloting the template. This approach aims to ensure the sustainable and proper utilization of the template.

5.5 Operational process of a NB risk assessment template

The NB risk assessment template comprises several interconnected Excel sheets. The logic between the sheets is demonstrated using the class diagram shown in Figure 18. The R&O (Risk and Opportunity) Register Excel sheet serves as the final sheet, where all the information regarding the identified risks, including the total cost of the risks, is defined, and calculated.

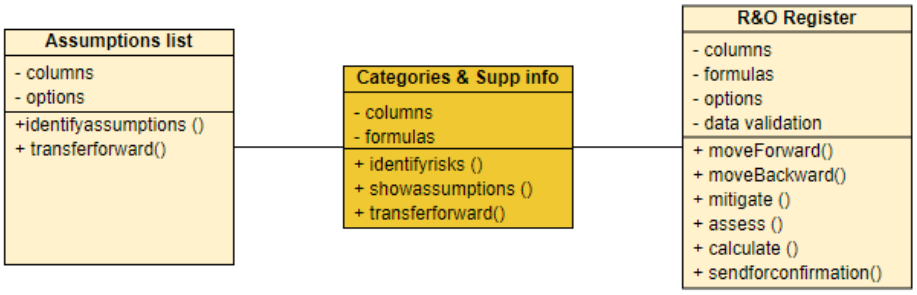

Figure 18. Class diagram shows the connection between the template' sheets

The class diagram provides a simplified overview of the three interconnected sheets of the template, which is explained in detail in the development of the template section of this study (Chapter 5.3).

The sequence diagram, in turn, is used to illustrate the order and sequence of actions that occur in a specific use case. In this research, the chosen use case scenario involves registering risks in different project phases, such as sales planning phase, contract tailoring phase and contract negotiation phase. Starting from the top of the diagram, from left to right, there is an actor named "User", the "assumption list" sheet, the "categories & Supp Info" sheet, the R&O Register sheet, and finally, the Confirmation System. The steps for each project stage are depicted in the Figure 19, including both actions performed by the user and automated customized actions. The Confirmation System represents the final approval team responsible for accepting the cost of the risks. It's worth noting that actions numbers as 2, 5, and 12 in the figure are automated in the template.

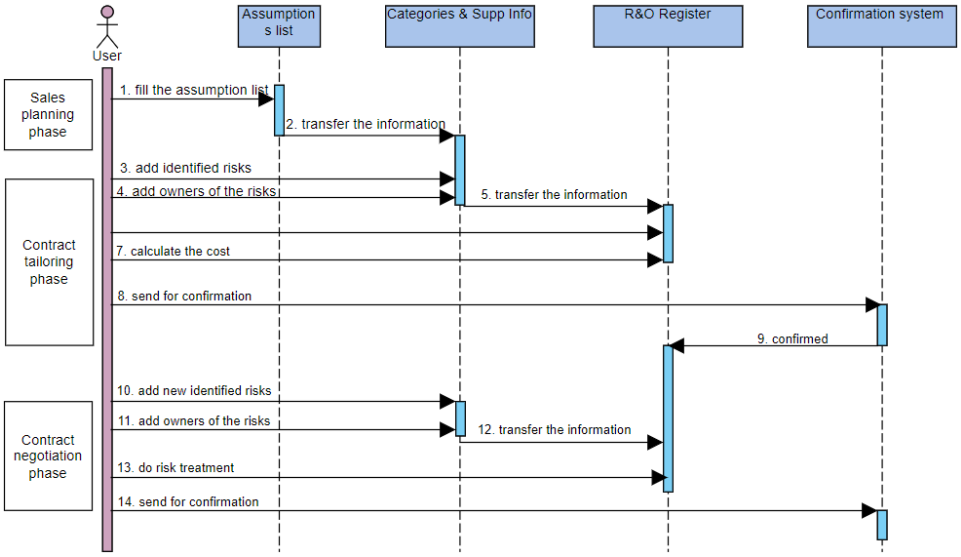

Figure 19. The sequence diagram shows the customized and non-customized actions in the NB risk template

Starting from the sales planning phase, the main purpose is to compile the assumption list and transfer the information using automated formulas to the next sheet, labelled as "Categories & Supp Info." Moving on to the contract tailoring phase, the user includes identified risks and their respective owners. Subsequently, this information is transferred to the "R&O Register" sheet. In total, fourteen steps are defined for the finalizing the procedure. The final step, marked as number 14 in the figure, represents the concluding stage of the sales phase before the contract is signed. At this point, the information is sent for confirmation.

The comprehensive view of the columns on each sheet with their architecture, formulas, and data validation, is presented in Appendix 4. The specific content of each cell is not included due to the confidentiality policy. Access to the template itself is available in the internal files of the company.

The operational process of the research is an ongoing procedure that should be determined after evaluating the software applications available within the company. As an initial development step, the plan is to utilize the NB risk assessment template in its current form and subsequently establish an ecosystem with software integration capabilities for the sales and project delivery teams. This ecosystem will facilitate easy access to all data for both teams. Furthermore, conducting training sessions to ensure proper utilization of the template

and integrating it with other processes is crucial for fostering effective collaboration. Additionally, seeking feedback on the template's usage and continuously making improvements are essential for developing a robust risk management strategy. The template is already prepared and intended for use in ongoing projects that are currently in the project planning phase.

6 Discussion and conclusions

This chapter provides an overview of the conducted study, presents a summary of the findings, and discusses their implications for the global company. Moreover, it highlights the limitations of the study and proposes suggestions for further research in different subsections of the chapter.

6.1 Discussion

This study adopts a case study approach to answer research questions from the company's perspective, with the results presented in Chapter 5. The primary objective of this subchapter is to bridge the identified gaps in the literature review with the main findings. The key points highlighted in the case description chapter are as follows:

- the case company prioritizes customer success and performance for profitable growth and target achievement,
- internal control measures include guidelines, manuals, monitoring, and information and communication processes,
- insights into project complexity are provided from the perspectives of sales, engineering, and management, including contract types and responsibilities,
- the overall project management structure is depicted through project gates, milestones, and phases,
- sales performance is monitored, and market segmentation principles guide market selection.

The gaps in prior literature, such as the need for decision-making tools in risk management and a connected method for estimating risk costs during the tailoring phase, are summarized in subchapter 2.5. This helps to understand which aspects have not been adequately covered in previous studies. The thesis contributes to the literature by offering insights into the company's risk management processes and suggesting improvements. It ensures alignment

between the company's findings and the existing literature while addressing any contradictions that may arise.

One of the identified gaps in the literature is the absence of a decision-making tool in risk management (Zhou, Vasconcelos and Nunes, 2008). To address this, the study introduces a checklist that aids in identifying and managing risks more effectively, along with automated tools for calculating developed criteria and risk costs. Moreover, the investigation uncovers weak points in the organization's risk management processes, particularly in executing complex projects from Group 1 and Group 2 categories. To enhance risk management, a clear structure, working methodology, and defined criteria are established, developed, and evaluated. The focused attention on these two group categories yields a clearer perspective and facilitates the improved iterative development of the risk management process. The systematic identification of assumptions and categorization of risks using different criteria, such as “questions”, “keywords”, and “examples of possible risks”, contributes to the seamless assessment and monitoring of the risk management process. In this study, a connected method for risk identification is introduced by transferring the assumption list to the checklist during the project tailoring and contract negotiation phase. This approach addresses the gap identified in the literature review, effectively bridging the connection between phases, and covering the gap by implementing a coherent link.

The research methodology involves a comprehensive analysis, including customer review data and internal stakeholder surveys from various departments. Customer review data mainly consist of workshops, interviews, and surveys. Additionally, expert reviews from experienced individuals in the energy industry provide valuable insights for process improvement. The sub-questions for this study are systematically addressed, leading to a comprehensive answer to the main research question. The case description chapter reveals essential points about the company's values, internal controls, contract types, and project management structure. The result chapter demonstrates the development of the framework for profitable project execution in Export EnergyCo, addressing weaknesses identified in the literature review, expert review data, and secondary data to propose a better solution for risk management process improvement.

As a result, the risk management framework aims to control cost overruns, prevent delays, and manage risks effectively (Kermanshachi, et al., 2020). It involves a RACI chart and stakeholder involvement from different disciplines to ensure project success and engagement

of the team in achieving successful project execution. The framework for risk management is developed based on challenges in BESS projects, internal information, external factors, and incomplete data. It includes separate categories, such as supply chain management, and emphasizes process development and alignment.

While the study aligns with many gaps identified in the literature review, it also reveals contradictions. For example, the framework may not fully differentiate between risk and uncertainty, particularly in the sales phase. Sometimes it is difficult to measure the risks as they can be seen as uncertainties and should be discussed in qualitative manner (Olsson, 2007), meaning involvement of right people. Moreover, risk management requires flexibility and experience (Frandsen, Raja and Neufang, 2022), making it challenging to follow a strict framework. The research methodology incorporates iterative improvements in the risk management process and is structured using the PDCA model (Moen and Norman, 2006) in different project phases until the contract signing phase for these studies. Metrics are reviewed, modified, and validated to finalize the framework. The study highlights the importance of communication and flexible teams, experience sharing (Charoensukmongkol and Pandey, 2022), and guidance (Willoughby, 2005) to ensure project success. The RACI chart presented in this case paves the way for successful collaboration during the risk management process.

In conclusion, this study offers valuable insights into risk management processes from the company's perspective and aligns them with the existing literature. It also addresses gaps and contradictions while providing a practical framework to enhance risk management in complex projects.

6.2 Summary of the study

The research achieved the objectives through empirical studies and academic research. The study provides a comprehensive overview of the main risks associated with projects in global markets and within the company as an answer to the first sub-question of the research question. The literature review has identified significant challenges and potential solutions, emphasizing the importance of effective management practices, process development, and holistic risk management approaches. This research serves as a valuable resource for project managers and stakeholders seeking to understand and mitigate risks in their projects on time.

The literature review shows that further research is needed to develop practical frameworks and strategies that can be applied in specific project contexts to ensure project success. The area of the study is energy industry and study conducted to develop and model a risk assessment framework and template.

The objectives of the research were successfully achieved through empirical studies and academic research. The study provides a comprehensive overview of the primary risks associated with projects in global markets and within the company, addressing the first sub-question of the research question. The literature review identifies significant challenges and potential solutions, emphasizing the importance of effective management practices, process development, and holistic risk management approaches. This research serves as a valuable resource for project managers and stakeholders aiming to understand and mitigate risks in their projects in a timely manner. The literature review highlights the need for further research to develop practical frameworks and strategies that can be applied in specific project contexts to ensure project success. The focus of the study is the energy industry, and the research is conducted to develop and model a risk assessment framework and template.

Various data sources are utilized to provide a holistic view for strategy development, with the primary goal being the implementation of a novel risk assessment framework for new-build projects, fostering a healthy and innovative ecosystem. The study addresses the second and third research questions by analysing the existing risk management process within the company and developing a new risk management strategy for successful project execution.

Findings include the use of keywords for further semantic analysis of data and the definition of targets and criteria for different variables of the risk assessment template through expert reviews and workshops. Customized actions are implemented using the Plan-Do-Check-Act (PDCA) model as an iterative tool for continuous improvement in the risk management process, resulting in practical contributions. The framework can be used to enhance the company's current risk management processes and improve profitability in ES&O projects based on expert reviews and insights from the literature review.

Operational processes and further steps are addressed in response to the last sub-question of the sub-question of a research topic. Practical considerations, feedback, and adjustments are made, leading to the acceptance of the initial version of the framework. In conclusion, the

developed template and framework have been approved through expert review within the company and are now in the pilot testing phase for new planning projects.

6.3 Conclusions and implications for the global energy company

However, it is important to highlight that the method proposed in this study is not a definitive approach. The initial version of the template will undergo continuous enhancements and modifications to ensure its suitability across different regions and areas within a global company. The template is designed for universal use, and in subsequent stages, it will be tailored to address the specific needs and risks of each region.

One notable strength of the risk management template lies in its flexibility to incorporate cost uncertainty. Furthermore, the implemented risk management strategy can be applied throughout various project phases to effectively handle risks. For instance, it can assess the likelihood of project success during the bidding phase, tailor the project requirements during the project tailoring phase, negotiate contracts during the contract negotiation phase, and even identify, monitor, and assess risks throughout the project execution phase, even after the contract has been signed.

6.4 Limitations of the study

This study has several limitations that should be acknowledged. Firstly, the development of the NB Risk assessment template was part of a seven-month scientific research project. As a result, it was created by experts and through a literature review, rather than by a professional software and design company. This means there may be some shortcomings in terms of the template's interface and architecture and the input of the software architectures may be needed. While the template's functionality has been well-received by experts, there is still room for improvement in these areas. The tool can be customized to cater to the specific needs of companies, particularly for complex projects during the sales phase.

The second limitation pertains to the risk and risk response catalogues. The questions for risk identification and the examples provided in the catalogues are developed based on an extensive literature review, mainly using company data and input from professionals within

the company. Users have the option to modify the content of these sections as needed, and they will continue to be enhanced based on company usage. Moreover, the content of the several sections is hidden from the research due to the confidentiality aspects.

6.5 Suggestions for future research

One suggestion for future research is to analyse the data generated from the new-build (NB) risk assessment template and conduct quantitative research. This research can involve defining coefficients for each category and subcategory of the template, as well as for each region, area, and specific risk situation.

Additionally, conducting a Responsibility Assignment Matrix (RACI chart) for a predetermined list of risks could be beneficial. This approach allows for the customization of the accountable person for each risk by utilizing data obtained from semantic analysis.

Experts have suggested that the effectiveness of the tools could be further enhanced when used in conjunction with other project management tools, such as Clarity and CRM Salesforce. Future studies can explore integrating the NB Risk assessment template with these and other optimal tools. Furthermore, there remains a question of how much time and effort is required to create and implement risk management (RM) templates within an organization. This can pose difficulties in the adoption of such templates by energy business companies. Therefore, future studies should also investigate the feasibility and relevance of deploying such a system, considering both short-term costs and long-term benefits.

Furthermore, employing a business process model to review and identify risks in each phase of different project categories can provide added visibility to the risk management and assessment process. This model can enhance the team's understanding of when and where risks are likely to occur.

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Appendix 1. Summary of the research on the topics, main findings, and research gaps

Subthemes	Authors	Main findings	Remaining research gaps
Principal challenges in BESS projects	(Yeo and Ning, 2002)	Obstacles may influence the effectiveness in projects: uncertainty in timely delivery, unpredictability of length of operations, incomplete information, frequent changes, lack of supplier engagement	The extensive list of obstacles makes it challenging to maintain a clear focus when addressing the issues
Principal challenges in BESS projects	(Eden, Ackermann and Williams, 2005)	The uncertainty of the duration of procedures causes schedule overruns	No research applicable specifically for BESS industry
Principal challenges in BESS projects	(Willoughby, 2005)	good management in large-scale projects may dramatically improve cost and schedule performance, procurement accounts 50-70 percent of the entire cost of building projects	Lack of management practice analysis in EPC projects from procurement perspective
Principal challenges in BESS projects	(Kaushik, 2018)	CMSC is a complicated system consisting of stakeholders and need a high level of a collaboration	Collaboration and coordination techniques between stakeholders in CMSC
Principal challenges in	(Cai *et al.*, 2016)	Uncertainties in CMSC may arise from project	A preliminary analysis for the most required and delayed operations, revealing methods to reduce misconceptions

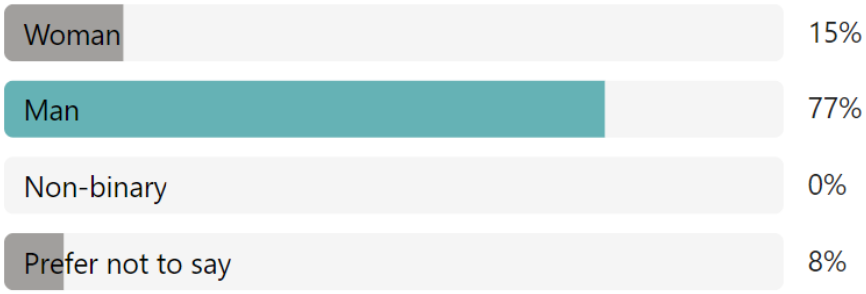
BESS projects		delays, market volatility, changes in requirements, government restrictions	
Principal challenges in BESS projects	(Lampel, 2001)	EPC firms must develop technical, entrepreneurial, relational and analytic competencies	Lack of competency development
Principal challenges in BESS projects	(Kermanshachi *et al.*, 2018)	scheduling, cost, and quality are key points to evaluate success of the project	Cost overruns and delays in BESS projects
Principal challenges in BESS projects	(Cantarelli *et al.*, 2012)	obstacles in EPC projects may influence their effectiveness	In Gas and Oil industry EPC projects needs to find solutions for the obstacles
Principal challenges in BESS projects	(Maués *et al.*, 2017)	Most EPC projects have difficulties meeting contractual timeframes	Delays in initial timelines, late project delivery
Principal challenges in BESS projects	(Abd El-Razek, Bassioni and Mobarak, 2008)	Material management incompetence as the major cause of project delay and financial loss	Before purchase, a preliminary study in the purchasing department for the most required and delayed products
Principal challenges in BESS projects	(Gebrehiwet and Luo, 2017)	Ineffective material management is the leading cause of project delay and monetary loss	General statement: logistics and purchasing varies from place to place
Principal challenges in	(Wang *et al.*, 2016)	Five most significant threats are inflation, government inefficiencies, material	For BESS industry in global market the more detailed list of threats

BESS projects		scarcity, changing financial market, and unpredictable political scenario	
Principal challenges in BESS projects	(Cavanagh et al., 2015)	The key issues for Australia are a lack of Australian experience with the technologies and a lag between standards, regulations, and the latest commercially available technologies	More trials, comprehensive technological studies are needed
Process development in projects	(Boutros and Cardella, 2017)	process improvement can minimize mistakes, costs, injuries and workload, increasing productivity and decrease expenses	Finding a suitable framework for a process improvement might take time given the specificity of project types and their metrics
Process development in projects	(Frandsen, Raja and Neufang, 2022)	epistemic concepts, guided by tools facilitate the development of autonomous value creating solutions	The processes that are autonomous and connected at the same time
Risk management in projects	(Abd El-Razek, Bassioni and Mobarak, 2008)	The origin of potential risks consists of weather conditions, productivity at jobsites, political circumstances, inflation, contractual agreements, and competition in the market	Insufficient attention to select a suitable risk assessment model
Risk management in projects	(Olsson, 2007)	risk management in practical application primarily emphasizes risks rather than opportunities	To effectively identify and seize opportunities, prioritization of holistic view and its development is needed

Risk management in projects	(Zayed, Amer and Pan, 2008)	Utilizing a quantitative method to assess risks helps to determine which projects are more susceptible to risk	Conclusions are limited to the collected data set
Risk management in projects	(Erfani and Cui, 2022)	predictive risk modelling using historical data and AI techniques	The framework was initially designed for small and medium-sized projects with a relatively small sample size and is not considered for complex projects yet
Risk management in projects	(Hubbard, 2020)	Risk management (RM) plan will outline strategies for mitigating or avoiding each risk in the project sales stage	Effective communication plan of risk management has ambiguities
Risk management in projects	(Charoensukmongkol and Pandey, 2022)	Flexibility in sales team enhances better performance and results	The line between high and low level of flexibility

Appendix 2. Survey results

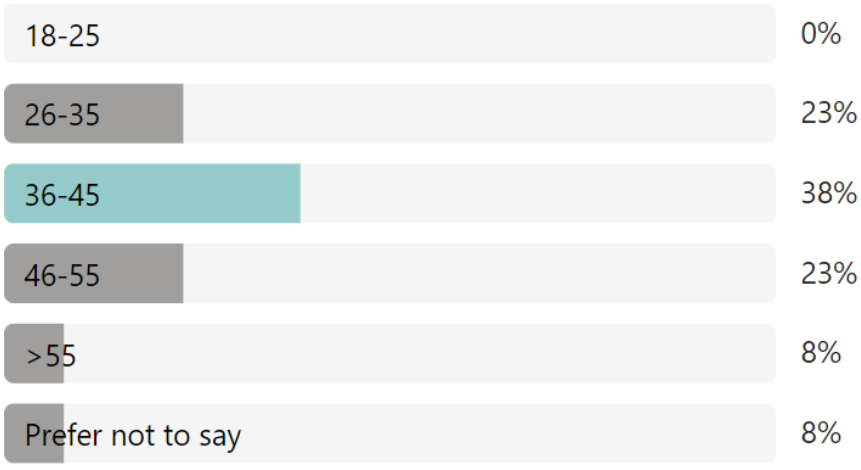
1. What is your gender?



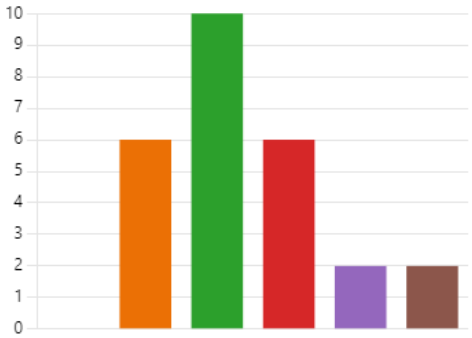
More Details

Woman	4
Man	20
Non-binary	0
Prefer not to say	2

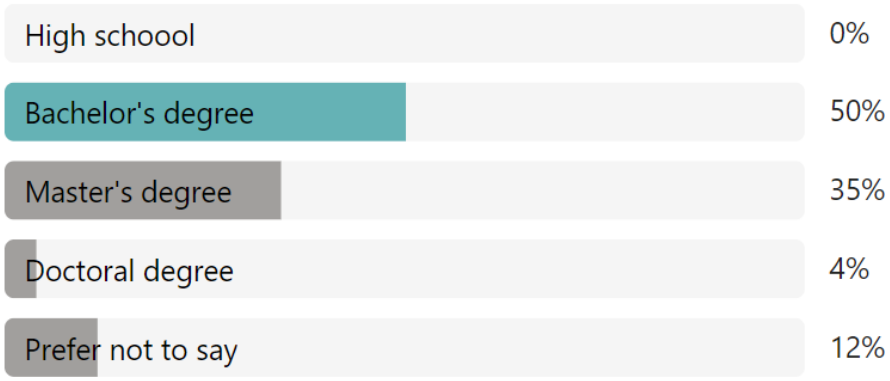
2. How old are you?

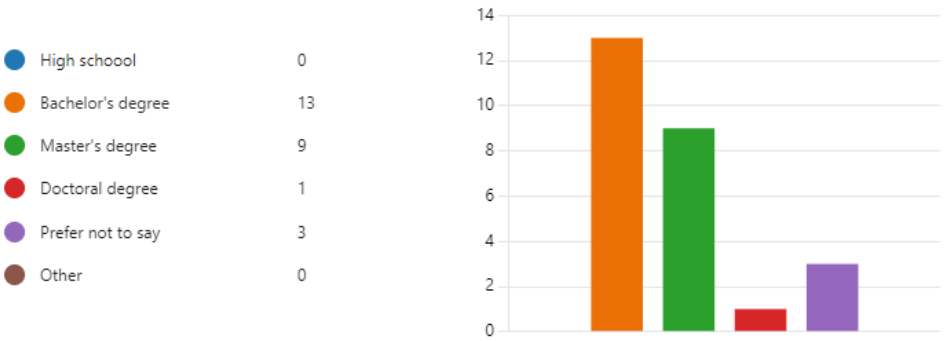


18-25	0
26-35	6
36-45	10
46-55	6
>55	2
Prefer not to say	2

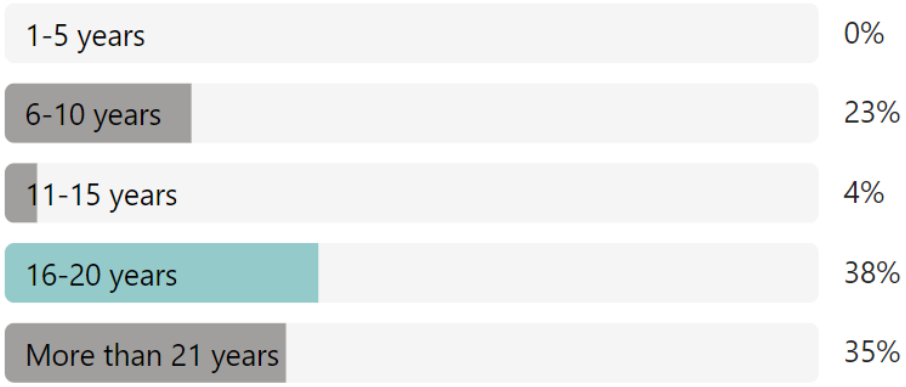


3. What is the highest level of education you've completed?

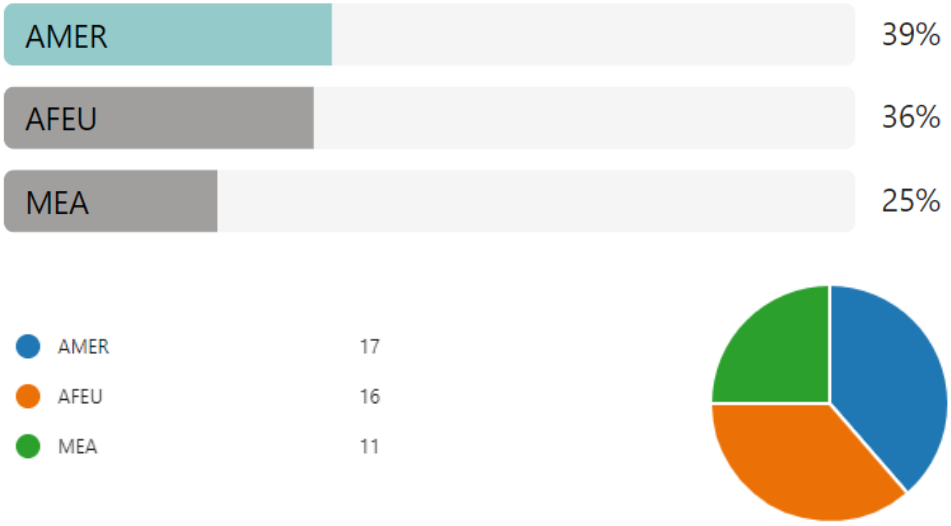




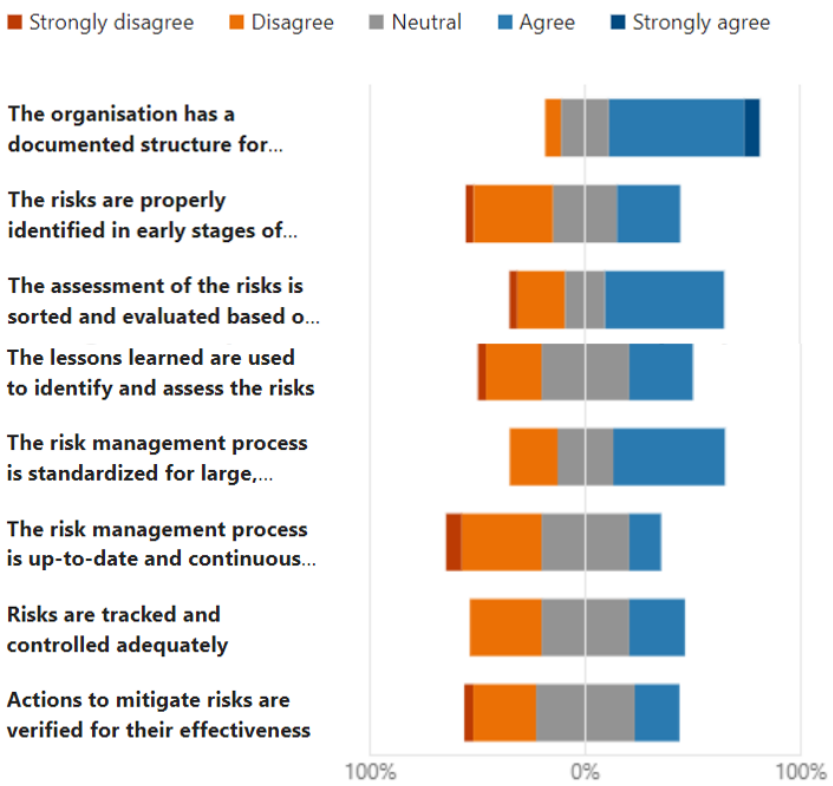
4. Your job background

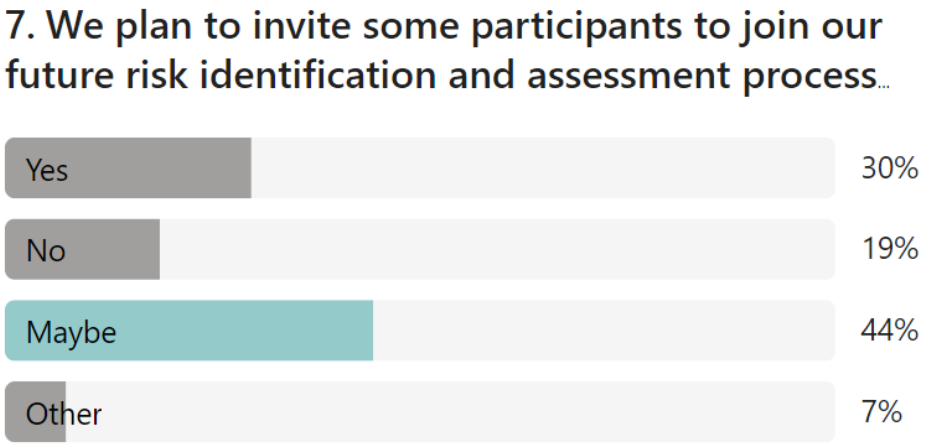


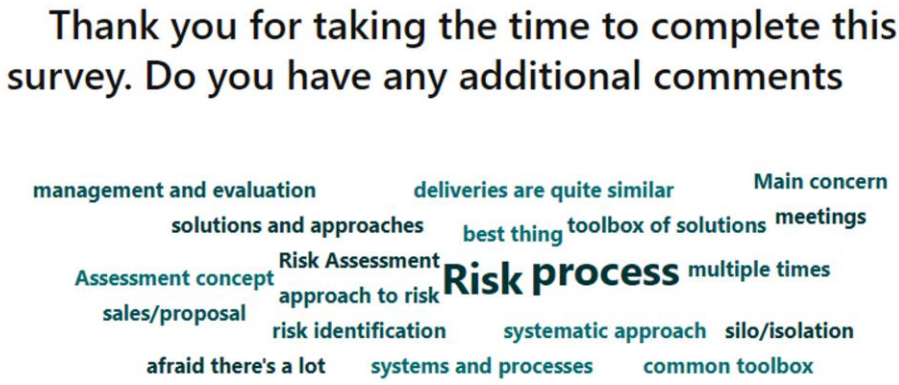
5. For which area projects do you work?



6. How would you rate your experiences with risk management processes within the company?







Comment 1: *"Just to clarify that we MAY have a documented structure, and the process MAY be standardized, but from my role, I don't see it, and I know others are not aware. The best thing we can do through this revamped Risk Assessment concept is to communicate & bring awareness!"*

Comment 2: *"Main concern for me is that I don't see a systematic approach to risk identification, management and evaluation. It's mostly teams looking at their own project and figuring out what to do with it. We're spending time handling the same concerns/risk multiple times. In meetings, the risks are often shared in meetings to inform others. With that said, I'd like to think we could be better in having a systematic approach to risks and having a toolbox in how we tackle them. As our deliveries are quite similar.*

Maybe there are more to all of this, being systematic and developing common toolbox of solutions and approaches. Having these documented is important. I'm afraid there's a lot of silo/isolation problem solving."

Comment 3: *"Good to check. Hope that the things that sales/proposal is telling customer is something our suppliers can accommodate so good to catch these things early on!"*

Comment 4:*" Just to clarify that we MAY have a documented structure, and the process MAY be standardized, but from my role, I don't see it, and I know others are not aware. The best thing we can do through this revamped Risk Assessment concept is to communicate & bring awareness!"*

Appendix 3. Customer experience management responses, feedback, and recommendations to meet the customer expectations

How likely would you recommend Export EnergyCo to your peers? / What is the single most important thing Export EnergyCo can do to meet or exceed your expectations?					
Sales Solutions			Execution		
Detractors (0-6)	Passives (score 7-8)	Promoters (score 9-10)	Detractors (0-6)	Passives (score 7-8)	Promoters (score 9-10)
Respect better the customer and its purchasing process	Be more open to customer requests when negotiating the contract	More friendly contracts/agreement, friendly price, have complete or agreed to easy to understand your system and contracts, we need to spend a lot of time to get the Complete Imagery	Improve communication during project management and after sales.	Deliver what they promised	Team competence and expertise
be more flexible on commercial and technical conditions. align with customer needs.	Manage customer expectations for timing and delivery of product, supporting documentation, and commercials.	Deliver the system according to spec, as contracted and expected.			Responsiveness to client concerns
	To be the most competitive bidder and delivery quality products/services on time	Fulfilling agreements			Fast, cost-effective responses to my enquiries and transparent and optimal solutions
	Flexibility on our requirements	Listen and understand client's requirements Be transparent and fast to respond Provide a product and service of quality			Live up to commitments
	Continued cooperation	Transparency in negotiation and discussion, willingness to evolve with the project			Keep good contact during projects

	Technical and commercial support in the development of storage solutions with public parties. Export EnergyCo needs to improve timelines for drafting and reviewing legal documents.	Always provide timely diligence during contract negotiations.			X North America already recommended Export EnergyCo to X Asia and X Europe (X is the name of the company/new client).
		Improve service and tech. support. There seems to be shortage of experienced persons in this particular field. This may be due to the fact we have mainly been dealing with the sales team only. We expect that further into the project we need only pick up the phone and get help.			Great staff, and that ensures delivery of a very good product
		Export EnergyCo should make themselves familiar with local conditions, economical, technical expertise available, environment and then try to adjust their proposal accordingly.			Reliable and very committed to the target completion date.
		Continue to be a helpful and cooperative business partner			Good communications and high-quality work.
		Great knowledge in my energy storage site during proposal stage. Very prompt and correct feedback from Export EnergyCo Taiwan office.			Continue to have excellent customer communication and focus on delivering high quality products.

		Constant interaction to understand our needs.			Deliver on commitment.
		It has been a great pleasure to be with Export EnergyCo on this journey, worked with a great team that was open for discussion to make it a win-win.			High quality, reliable work and products.
		The most important thing Export EnergyCo can do to meet/exceed my expectations is maintain good levels of prompt communication and timely technical pre-sales support.			
		Timely and accurate technical responses.			

Appendix 4. New-build risk assessment template

“Assumptions list” sheet

"Assumptions list" sheet	Column	Data validation/options
Categories for assumptions	A	Strategic, Operational, Compliance and hazards, Financial risks
Examples	B	
Categories	C	
Subcategories	D	
Assumptions no	E	
Owner	F	

“Categories & Supp info” sheet is used to review the assumptions and identify the risks

“Categories & Supp info” sheet	Column	Formula
Categories	B	
Keywords	C	
Subcategories	D	
Questions	E	
Standard Risk profile (F) hidden	F	
Examples of possible risks (G)	G	
Risks/assumptions identified	H	=Assumptions!$E
Owner	I	=Assumptions!F

The evaluation is shown in “R&O Register” sheet

R&O Register” sheet	Column		Formula	Data validation/options
Categories	A			
Subcategories	B			
Risks/assumptions identified	C		='Categories & Supp info'!H3	

Risk (R) / Opportunity (O) / Cost uncertainty (CU)	D			R, O, CU
Response type	E			Avoid, Transfer, Mitigate, Accept
Responsible Person for action	F			
Mitigation action	G			
MAX impact	H			
Impact level	I		=IF(H2=""; ""; IF(H2<examplevalue1; "1"; IF(AND(H2>=examplevalue1; H2<examplevalue2); "2"; IF(AND(H2>=examplevalue2; H2<examplevalue3); "3"; IF(AND(H2>=examplevalue3; H2<examplevalue4); "4"; IF(AND(H2>=examplevalue4); "5"; ""))))))	
Probability %	J			
Probability Level	K	hidden	=IF(J2=""; ""; IF(J2<5%; "1"; IF(AND(J2>=6%; J2<=10%); "2"; IF(AND(J2>=11%; J2<=25%); "3"; IF(AND(J2>=26%; J2<=50%); "4"; IF(AND(J2>=51%; J2<=75%); "5"; ""))))))	
Risk severity [Number]	L	hidden	=IFERROR(I2*K2; "")	
Risk Severity Level	M	hidden	=IF(OR(L2=1;L2=2;L2=3);"R4";IF(OR(L2=4;L2=5;L2=6;L2=8;L2=9);"R3";IF(OR(L2=10;L2=12;L2=15;L2=16);"R2";IF(OR(L2=20;L2=25);"R1";""))))	
Probability impact [$]	N		=IF(D2="O"; -(J2*H2); J2*H2)	

Status	O			Fully Budgeted, Partially Budgeted, Closed
Owner	P		='Categories & Supp info'!I3	

Note: The keyword "examplevalue" is utilized in the formula row of the "Impact level" section for confidentiality purposes, obscuring the actual numerical values. For instance, "examplevalue1" represents a cost impact and can be designated as 10 euros, while "examplevalue2" represents a cost impact of 1000 euros, and so on.

Appendix 5. Interview and workshop participants, dates

Field	**Title**	**Date**	**Interview length (min)**
Sales	Business Analyst	6.2.2023	30
Sales	Sales Analyst	6.2.2023	30
Sales	Proposal Manager AFEU	9.2.2023	40
Sales	BDM Commercial	7.3.2023	60
Sales	Project Planning and Control Manager	12.4.2023	30
Sales	Proposal Manager AFEU	14.4.2023	30
Sales	Proposal Manager AMER	19.4.2023	50
Sales	Director Sales Management ESS	18.4.2023	50
Project Management	PM Director	7.2.2023	30
Project Management	Project Manager	8.2.2023	70
Project Management	Project Manager	6.4.2023	30
Project Management	PM Development Manager	8.2.2023	30
Project Management	General Manager - PM	16.2.2023	60
Project Management	PM Director	24.4.2023	30
Development	GM, Quality & Safety	7.2.2023	60
Development	General Manager, Quality & Safety	23.2.2023	160
Development	General Manager, Quality & Safety	21.4.2023	80
Development	Concept Development Manager	15.2.2023	35
Development	Operational Excellence Manager	16.2.2023	40

Development	Senior Proposal Engineer	8.3.2023	40
Development	Senior Proposal Engineer (Global Proposal Management)	8.3.2023	40
Development	Operational Excellence Manager	6.4.2023	20
Development	Operational excellence manager	13.3.2023	83
Development	Operational Excellence Manager	5.4.2023	40
Development	Operational Excellence Manager	26.4.2023	60
Development	Concept Development Manager	14.3.2023	58
Development	Concept Development Manager	28.3.2023	34
Development	Concept Development Manager	30.3.2023	50