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Project and Portfolio Management System Design for a Renewables Development Company

Master's Thesis

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Abstract of the master's thesis

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Abstract (ENG)

Atmospheric CO_2 levels have been strongly linked to climate change, and a significant amount of emissions is produced by the energy sector. Thus, decarbonising electric energy production by shifting from fossil-based production to renewable energy sources poses a great potential for emission reductions. This requires the development and installation of a lot of new capacity in renewable energy technologies, including wind power. As a result of EU mandated emission reduction targets, Finland has been experiencing a 'wind power boom' over the past decade or so.

The renewable energy industry's growth has resulted in new challenges in managing and organizing work related to wind farm development projects. This case study investigates from a systems thinking perspective how an organization's project management practices can be improved and made more resilient to strong growth of the organization. The specific context of the project business under investigation is Finnish onshore wind farm development projects. The research is done by familiarising with relevant literature on project management and systems engineering as well as with the case company and its ways in managing an increasingly complex project portfolio.

The study suggests that building a modular and dynamic management system with a user centred focus will benefit rapidly growing companies in managing both their work and growth. Additionally, we observed that such a system improves the flow of information within an organization, aiding strategic decision making and project and portfolio control. A systems engineering solution would also benefit companies experiencing more moderate growth, as it would increase organizational transparency and provide an incentive to identifying and defining workflows and best practices within the organization. We propose that the findings of this case study could be generalised to any small-to-medium size growth company that is managing project-based work.

Keywords:	**Publishing language:**
System design; Systems thinking; Project management; Wind power; Renewables; Case study; Organizational research	English

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Tiivistelmä (FIN)

Ilmakehän hiilidioksidipitoisuudet on yhdistetty vahvasti ilmastonmuutokseen, ja merkittävä osa päästöistä syntyy energiasektorilla. Näin ollen sähköenergian tuotannon hiilidioksidipäästöjen vähentäminen siirtymällä fossiilipohjaisesta tuotannosta uusiutuviin energialähteisiin tarjoaa suuren potentiaalin päästöjen vähentämiseen. Tämä edellyttää uusiutuvien energiateknologioiden, kuten tuulivoiman, kehittämistä ja uuden kapasiteetin asentamista. EU:n asettamien päästövähennystavoitteiden seurauksena Suomessa on viimeisen vuosikymmenen aikana koettu niin sanottu 'tuulivoimabuumi'.

Uusiutuvin energiateknologioiden alan kasvu on tuonut uusia haasteita tuulipuistojen kehittämishankkeisiin liittyvien töiden johtamiseen ja organisointiin. Tässä tapaustutkimuksessa tutkitaan systeemiajattelun näkökulmasta, miten organisaation projektinhallintakäytäntöjä voidaan parantaa ja tehdä niistä joustavampia organisaation voimakkaan kasvun kannalta. Tutkittavan projektiliiketoiminnan spesifinä kontekstina ovat suomalaiset maatuulivoimapuistojen kehittämishankkeet. Tutkimus tehdään perehtymällä relevanttiin projektinhallintaa ja systeemitekniikkaa käsittelevään kirjallisuuteen sekä case-yritykseen ja sen tapoihin hallita yhä monimutkaisempaa projektiportfoliotaan.

Tutkimuksen mukaan modulaarisen ja dynaamisen hallintajärjestelmän rakentaminen käyttäjäkeskeisesti hyödyttää nopeasti kasvavia yrityksiä sekä työn että kasvun hallinnassa. Lisäksi havaitsimme, että tällainen järjestelmä parantaa tiedonkulkua organisaatiossa ja auttaa strategista päätöksentekoa sekä hankkeiden ja portfolion hallintaa. Systeemitekninen ratkaisu hyödyttäisi myös maltillisemman kasvun yrityksiä, sillä se lisäisi organisaation läpinäkyvyyttä ja kannustaisi tunnistamaan ja määrittelemään työnkulkuja ja parhaita käytäntöjä organisaatiossa. Esitämme, että tämän tapaustutkimuksen tulokset olisivat yleistettävissä koskemaan kaikkia pieniä ja keskisuuria kasvuyrityksiä, jotka hallinnoivat projektipohjaista työtä.

Preface

This master’s thesis is an explorative case study of the potential systems engineering opportunities in the project and portfolio management of a medium sized company. It attempts to combine the approaches of project management and systems thinking in a pragmatic manner. The study was conducted between January and June of 2023 by request of the case company, ABO Wind Oy. The identified organizational practices in project and portfolio management were formulated into a functional system prototype that will, hopefully, in the future provide a valuable tool for managing work at the case company.

I would like to thank my instructors, Amanda and Kim, for providing valuable sparring and an outlet for discussion during the research and writing process, my supervisor, Karlos, who gave good constructive critique, thoughts, and ideas when finalizing the report, all my coworkers who demonstrated great empathy and provided a healthy working environment throughout the project, and my family for all the love and support they gave during this half a year period. I thank you all from the bottom of my heart. Because of you, I was able to make this thesis happen.

Much love.

Arttu Kärkkäinen

Contents

Abbreviations

CO_2	Carbon dioxide
EIB	European Investment Bank
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
UX	User Experience
PM	Project Management
PMI	Project Management Institute
PoC	Proof of Concept
PPM	Project Portfolio Management
SaaS	Software as a Service
SFS	Finnish Standards Association
STY	Finnish Wind Power Association
VBA	Visual Basic for Applications
WBS	Work Breakdown Structure
WP	Work Package
WTG	Wind Turbine Generator

List of figures

List of tables

1 Introduction

This is a master's thesis that investigates systems engineering opportunities in the project and portfolio management practices at ABO Wind Oy, a renewables developer company. The thesis is an organizational study that investigates managing project business amongst rapid growth, and how applying systems and design thinking to project and portfolio management theory can be used to improve the management of project business. In this introductory chapter, the background and context for this thesis are described. Then, the case company and the role of the researcher will be introduced. Finally, the research methods for the thesis work are introduced and the research objectives, problems and questions are presented.

1.1 Background and context

Climate change has been strongly linked to atmospheric carbon dioxide (CO_2) levels. Thus, global CO_2 emissions should be drastically reduced as soon as viably possible in order to limit the rise of the global mean surface temperature to 1,5 °C with respect to the pre-industrial baseline of the late 19th century. (IPCC, 2022) Different potential scenarios for the global mean surface temperature's development are presented in figure 1 below. As the figure illustrates, a more rapid reduction in global CO_2 emissions will more likely result in a smaller increase in the global mean surface temperature.

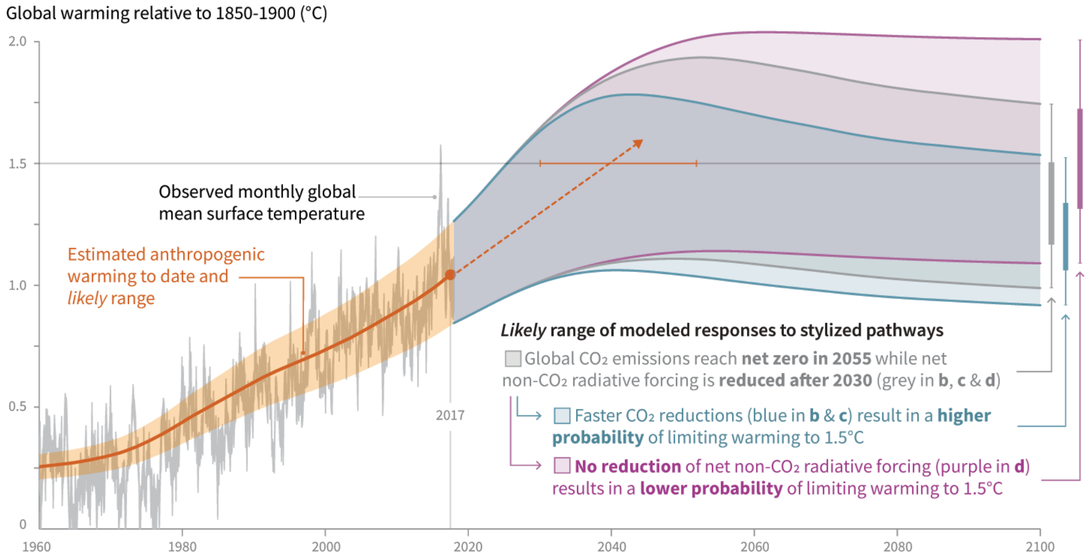

Figure 1. *Observed global temperature change (orange) and modelled responses to stylized anthropogenic emission and forcing pathways (IPCC, 2022).*

Because of this link to climate change, the European Union (EU) has proposed to cut its CO_2 emissions 55% by the year 2030, and the Finnish government as a member state of the EU has pledged to commit to these environmental goals (European Commission, 2020; Huttunen et al., 2022). A great number of global CO_2 emissions are produced by the energy sector: around 15 Gt's in 2021 alone. This is mostly due to the combustion of fossil fuels and other non-renewable energy sources. (IEA, 2022; Ritchie et al., 2020; Tiseo, 2023) Thus, there is great potential for emission reductions within the energy sector. One partial solution can be found in renewable energy production.

As the global community has become increasingly aware of the effects of an upcoming climate crisis, the potential of renewable energy sources has been widely recognized. This includes wind power production, which has grown very rapidly over the last years, both globally and on the EU level. This shift can be also seen in the Finnish energy market, where wind power production has rapidly increased over the last 10 years (STY, 2022; Tilastokeskus, 2023). Figure 2 illustrates this so-called ‘wind power boom’ that Finland is experiencing by the time of writing this thesis.

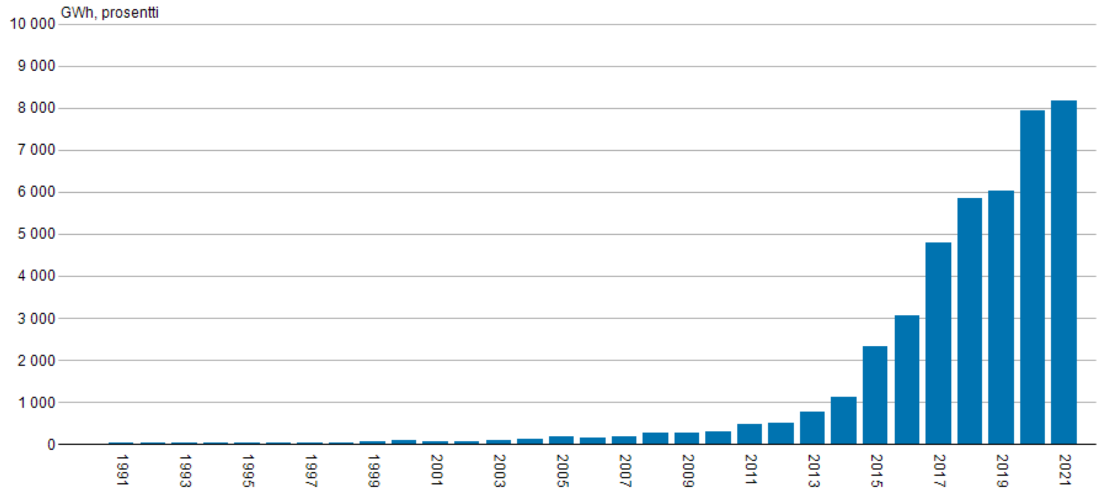

Figure 2. *Annual electricity production (GWh) of wind power in Finland between 1991-2021 (Tilastokeskus, 2023).*

The exponential growth of the wind power industry in Finland has allowed rapid growth for the companies operating in the industry, which are able to initiate more and more development projects each year. Because this growth has happened in a relatively short period of time, it has brought upon some novel challenges to these companies, which must adapt to the increasing number of projects, personnel, and data. As a result of increasing complexity, more efficient project management and project portfolio management are in a key position in gaining competitive advantage in the market, as enhancements in these areas will have a positive impact on the quality and speed of completion of wind farm development projects. Furthermore, this would also speed up the energy transition from fossil-based energy production towards more sustainable renewable alternatives.

1.2 The case company and role of the researcher

The case company of this thesis project is ABO Wind Oy, the Finnish subsidiary of a German based developer for wind and solar farms with 25+ years' experience in the field of renewable energy. At the time of writing this thesis report, the case company is focused on the development of onshore wind farms within Finland and is one of the largest wind farm developers in Finland. There is a notable amount of co-operation between the German parent company and the Finnish subsidiary in the projects, as many of the key departments of project development operate in Germany. The Finnish subsidiary is responsible for the locating, pre-planning, local contacting and construction management of the wind farm projects, while financing, wind turbine generator (WTG) purchases, civil engineering, and land appraisal are located within the German parent company.

The case company has set an objective to develop projects more rapidly and with better quality in the future. Also, the systemization of operations has been set as a strategic key point. Thus, an initiative to develop the company's project management practices was put forward in 2022. The case researcher was hired to the company as a systems specialist trainee to continue this development process as a full-time employee. The research work of this master's thesis was closely related to the preliminary investigation of a new project management system, and this link allowed great immersion into the case research context. In addition to the research, the main organizational responsibilities of the case researcher were investigating the potentials for development in management practices and facilitating the development and implementation phases of a new project and portfolio management system.

1.3 Research questions and setting

This master's thesis is an explorative case study to the potential system engineering solutions for project and portfolio management of renewable energy development projects. The case study has been identified as a research design that can generate knowledge on organizational phenomena and provide insight on an entire industry (Yin, 2009), such as renewable energy development in Finland. The objective of this master's thesis is to investigate project management practices in the context of rapid growth. The case company acts as a representative unit of the Finnish wind power industry, and we suggest that the findings of this case study could be generalised to other medium-to-large scale growth companies in booming markets. The main research question this thesis attempts to answer is:

- How can systems engineering be applied to improve the case company's project management practices and control of growth in a booming market?

The complex environment in which large scale renewable energy projects are developed requires a good understanding of the entire field and its best practices. Thus, a holistic organizational view is necessary to properly interpret and analyse the phenomenon. Therefore, a bottom up approach is utilised in the empirical part of this thesis. Some guiding questions to the empirical work are:

- How is project management and progress tracking currently executed?
- What is good about the current methods?
- What aspects can be improved?
- How would a scalable project management system improve the status quo?
- What are the key requirements for such a system?

The research of this thesis will consist of two main elements, the theoretical part and the empirical part. The theoretical part provides the theoretical framework for the thesis and presents the literature review of relevant publications regarding both project management and systems engineering. The pragmatic approach of this thesis blends these theories together, and the empiricism and analysis are built on this mixed theoretical framework. The empirical part includes the mapping of the initial situation of the case company's project and portfolio management, identifies potentials for development, and explores possible solutions. After the research part of this thesis, the results will be analysed and discussed.

2 Theoretical frameworks

This chapter will provide the theoretical framework for this thesis by presenting the findings of the literature review that was conducted. First, the framework of project work is presented to provide a clear understanding of the case company's business operations, as the company is specialised in project-based wind farm development. Then, the framework for systems engineering will be presented to apply a more holistic approach to the management of project work. These theoretical frameworks are then later used as a basis to investigate the company's project-based work from a systems engineering point of view. Some guiding questions that the literature review attempts to answer include: '*How is project management defined?*' and '*How can systems engineering be applied to improve project work?*'.

2.1 Project work

In this subchapter, the theoretical background of project-based work is provided. A project is a temporary endeavor which attempts to achieve an end goal through a predefined set of objectives within a specific time span (Artto, Martinsuo & Kujala, 2011; Kerzner, 2017; PMI, 2021). By this definition, the case company's main product is a ready-made project solution, i.e., a fully developed onshore wind farm. All the ongoing and potential development projects form together the project portfolio of the company. Thus, it is necessary to understand the framework for project-based work and the simultaneous management of multiple projects, i.e., project portfolio management. Next, the literature review on project management is presented, followed by portfolio management.

2.1.1 Project management

There are various institutions and organizations that provide guidance on project management. For example, the International Standardization Organization (ISO) provides some standards for managing project work (SFS-ISO 21500:2021:en; SFS-ISO

25102:2021:en). Also, the Project Management Institute (PMI), a commercial organization that, according to Sage and Rouse (2009), ”is perhaps the most recognized project management professional society” (Sage & Rouse, 2009), has published its own guide to project work. This guide is called the Project Management Body of Knowledge (PMBOK), and it is a widely recognized publication that provides another international standard for project management (PMI, 2021). These fundamental bodies of knowledge, accompanied by other relevant publications on project management, will provide the framework for project management.

Project management (PM) can be defined as: ‘the application of knowledge, skills, and tools necessary to coordinating activities in directing and controlling the completion of a predefined set of objectives, i.e., a project’ (Artto et al., 2011; Kerzner, 2017; PMI, 2021). The purpose of project management is to monitor and measure performance and progress of a project against a plan formed in the early stages of the project. As the project progresses, the project manager should build on this initial plan, adding detail as the project activities and outputs are further developed and defined. Below are some relevant terms and definitions that are often used in the planning and execution of project management, which include:

- *Critical path*: The sequence of actions that defines the earliest possible completion for a project or a phase.
- *Preventive action*: An action to eliminate any potential risk.
- *Stakeholder*: “A person, group or organization that has interests in, or can affect, be affected, or perceive itself to be affected by, any aspect of a project”.
- *Work breakdown structure (WBS)*: A decomposition of a defined project into progressively smaller units which consist of elements of work.
- *Work package (WP)*: An activity or group of actions that have a defined scope, deliverable, timescale and cost. Smallest unit of a WBS. (SFS-ISO 25102:2021:en)

Project work is very much a human centered activity, as projects are initiated, driven and finalized by the people of a project organization. The key person behind any project’s successful completion is the person responsible for overseeing and coordinating all project activities, who is generally referred to as the project manager. In the context of the case company’s project work, project managers are the ones responsible for project delivery, and they drive the delivery by fulfilling different functions related to their responsible projects (PMI, 2021). Through the projects they manage, project managers provide valuable information to their company‘s upper management, who concern the overall strategic direction of the company (Artto et al., 2011). In the case company, this means the steering group members. Hence, the flow of information between people and departments is utterly necessary, as the effective distribution of information and feedback ensures successful operation by providing a realistic understanding on both internal and external factors throughout the entire company (PMI, 2021). This effective distribution of information is often referred to as organizational transparency.

By adopting commonly used and accepted project management practices, companies are better able to distribute information internally and, thus, develop their project-based operations over a long-time span. Once identified, management practices can be formalised into a project management framework with a standardized and modular set of methods. This kind of a framework can provide direction and guidance to the employees and can reduce the risk of repeating already occurred errors in new projects. (Artto et al., 2011) The facts that support organizational transparency, such as valuable strategic information is spread throughout the whole organization and the nature of project business and communication as human-centric activities, have been recognized by the case company. Thus, project information and best practices are regularly shared between all personnel, for example, in bi-weekly portfolio status update meetings.

In a project organization, such as the case company, internal influences that can affect the governance and management of projects should be taken into consideration. This means accounting for the internal environment that consists of intraorganizational stakeholders, and is influenced by the organization's structure, culture, and processes (SFS-ISO 21500:2021:en). For example, a culture of openness can help bring forward issues that would have gone unnoticed otherwise. Recording and analyzing issues as soon as they surface helps in identifying and prioritizing those issues with the highest impact on the project's objectives that should be dealt with first (SFS-ISO 25102:2021:en).

Project teams define processes that enable completion of tasks and work assignments, i.e., WPs. Project teams may agree to a decomposition process using, for example, a WBS. (PMI, 2021) The WBS may be structured into several distinct phases, which should have a defined start and end. Each phase of the project WBS should have specific milestones that relate to the decisions, key deliverables, outputs or outcomes. Each phase should be preceded by a decision point. These decision points, often referred to as 'gates', are essential aspects of project governance. The criteria to be met to authorize the start of a phase should be defined but can also vary depending on the internal environment and the established project governance. In some cases, phases can overlap. The gates and phases, as illustrated in figure 3 below, should be well defined and can vary depending on the organizational and external environments, funding, risk and other possible constraints. (SFS-ISO 25102:2021:en)

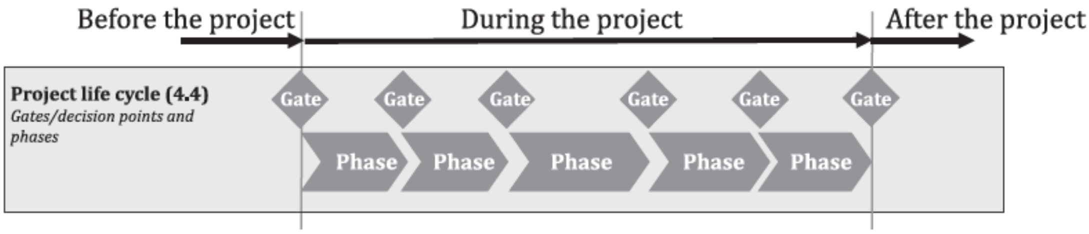

Figure 3. *Illustration of the phase-gate model (adapted from: SFS-ISO 21502:2021:en).*

In a project that follows the above introduced phase gate modelled WBS, the project manager should prepare for starting each phase of the project by preparing or reviewing a plan for the new phase, reviewing the governance and management requirements of the project, and confirming that the project is still justified. Furthermore, the completion of each phase should be confirmed by the project manager by verifying any incomplete actions, recording unresolved issues, releasing resources if no longer required, archiving information and documentation, verifying completed, delivered and accepted outputs and outcomes, and recording lessons learnt. (SFS-ISO 25102:2021:en) The phase gate model reduces ambiguity of projects by providing a structure of simple rules and requirements, which can be used as a tool in project management.

Another useful management tool the phase gate model provides is schedule management, which includes monitoring the status of phases, WPs and other project related activities during the project execution. The purpose of schedule management is to support the on-time completion of work, and to reduce potential schedule slippage to acceptable levels. To achieve this, a realistic, achievable, and controllable schedule should be developed. This is supported by localizing the schedule development, opposed to a schedule imposed from above and out of context. (SFS-ISO 25102:2021:en) The case company already does schedule management based on estimations provided by company experts and/or local consultants in the early stages of a wind farm development project. However, there is room to develop the current schedule development and management into a more systemic form.

The above-mentioned project management practices can be formalized into a methodology. In practice, the implementation of such a methodology can be codified and formalized into a structured project management system. The project organization should consider at least the following factors when considering the implementation of a formal project management system:

- Identified needs for and benefits of formal project management;
- ability to integrate and align other related work with strategic and business objectives;
- capacity to absorb the necessary changes within the organizational governance, structure and culture;
- resource capacity of the organization to incorporate the change;
- potential impacts on stakeholders, both internal and external;
- organizational boundaries and the ability to work across them;
- availability of required competences to implement the system;
- impacts on budgets, identified risks, schedules and requirements of ongoing and planned projects and other work (SFS-ISO 21502:2021:en).

2.1.2 Project portfolio management

Project business is seldom built around singular project-based endeavours, but rather on multiple parallel and strategically aligned efforts. In project business, it is useful if these projects are somewhat similar or related to each other. This enables the grouping of projects into a uniform set, referred to as a project portfolio or, simply, a portfolio. If a project is a part of a portfolio, its objectives and governance should be aligned with the governance of that portfolio (PMI, 2021; SFS-ISO 21502:2021:en). This practice is referred to as project portfolio management (PPM), which is defined by Artto et al. (2011) as: “a process in which projects are evaluated and compared with each other in order to realize the [company] strategy” (Artto et al., 2011). This is the responsibility of a company's steering group, whose role is to monitor the progress of projects from the strategic perspective (Pelin, 2004). Some terms and definitions related to PPM, in the context of this case study, include:

- *Governance*: the principles, policies and frameworks by which something within the project organization is directed and controlled.
- *Governing body*: person, group or other entity responsible for governance.
- *Portfolio*: a collection of portfolio components, i.e., wind farm development projects and such, grouped together to facilitate their strategic management.
- *Portfolio component*: project or other related work, such as a subcomponent of a wind farm development project (overhead line, met mast, etc.).
- *Portfolio manager*: person appointed with the accountability and responsibility for a portfolio's strategic management.
- *Portfolio management*: the coordinated activities of the portfolio manager to evaluate, direct and control the realisation of the project portfolio's identified benefits and deliverables.
- *Strategic alignment*: the result of selecting and adjusting portfolio components so that the strategic objectives of the project organization are accomplished. (SFS-ISO 21500:2021:en; SFS-ISO 21504:2022:en; PMI, 2021)

Although managing an individual project is an important task in project business, this alone does not guarantee the success of the business's entire project portfolio. The project managers must understand the role of their individual projects with respect to other projects and initiatives within the business organization's portfolio. This requires a shift in perspective by adopting a company-level approach to managing projects. (Artto et al., 2011) In other words, there should be enough organizational transparency from the bottom up to ensure a clear big picture view throughout the project organization, including those working on the delivery of individual projects. This also applies to the top down direction, as the practice of PPM should provide enough visibility of the portfolio components' activity and status (SFS-ISO

21504:2022:en), meaning that the company's steering group should have a good enough understanding of what is happening in each individual project to support their decision making and strategic planning on the company level.

PPM is an essential practice for the success of a project company. It can be viewed as the practice of active engagement in decision-making for the coordination of correct procedures and resources towards the most critical projects at the right time. The above description of PPM can be deconstructed and segmented into the following four sections: 1) planning for resource use, 2) evaluating and mitigating risks, 3) coordinating the timing of projects and other related work, and 4) assisting the organization in active and conscious decision making (SFS-ISO 21500:2021:en). All these elements of PPM are central to the company's steering group members' work, who essentially define the broad strategic and operational direction of the company (Artto et al., 2011). By keeping a big-picture focus on the broader effects of any individual project to the whole project portfolio and company, as well as ensuring communication on their decisions, the steering group members are better able to drive the strategic alignment of the project portfolio.

An important task of the portfolio management is to determine whether the work within the portfolio, and also in the wider context of the project organization, can be realistically accomplished. An organization should be able to provide and maintain the capabilities needed to run its current business operations and implement the necessary changes to achieve set strategic objectives (SFS-ISO 21504:2022:en). This is an integral consideration in PPM. Moreover, an organization should be able to forecast its future needs by reflecting the past events and trends, allowing for proactive measures to be taken before the organization is put under unbearable stress by unexpected change. Using both past and current performance, as well as future goals, the organization should identify key objectives as success criteria of the portfolio. These objectives may be set for different time periods and project phases, and should consider potential constraints, such as the risk tolerance of the project organization. (SFS-ISO 21504:2022:en)

Considering the structuring of a project portfolio, a hierarchical order where lower-level portfolio components make up the higher-level portfolio components, which further together form the portfolio, is deemed a well-functioning structure (SFS-ISO 21504:2022:en). In the context of the case company, the higher-level portfolio components refer to the individual projects, and the lower-level portfolio components are essentially the same as the project WBS. In a WBS, the project is broken down to smaller subunits, which can be further divided into the smallest units (WPs), as mentioned in the previous subchapter.

Portfolio management processes and systems should be aligned with the following organizational processes and systems: performance reporting, risk management, financial management, and project management (SFS-ISO 21504:2022:en). A portfolio management system should be well defined and established to improve organizational transparency and provide relevant information to the decision-makers (SFS-ISO 21504:2022:en), i.e., the company’s steering group. Depending on the size of the organization, one or more steering groups are required in PPM to make decisions on project initiation and possible termination (Pelin, 2004). In the case company, a country level steering group has been established and is responsible for the Finnish project portfolio.

The system should provide the status and overview of various elements, such as portfolio components and their alignment with strategic objectives, resource management, and current risk exposure across the entire project portfolio. Hence, a portfolio management system should 1) enable portfolio reporting, 2) align and coordinate with the existing processes and systems of the project organization, and 3) provide visibility of identified portfolio components "The decision by the organization to adopt portfolio management depends on its context and on considerations, such as the impact of introducing portfolio management into the organization, including the capability of the organization to absorb changes in terms of structure, responsibilities and culture, as well as the threats and opportunities associated with the implementation of portfolio management" (SFS-ISO 21504:2022:en). These above-mentioned points also apply when an organization is refining the scope of its current portfolio management measures and metrics. The latter mentioned threats and opportunities will be discussed later in chapter 5.

2.2 Systems engineering

In addition to the theory of project and portfolio management, the other theoretical framework relevant to the work of this master's thesis is that of systems engineering. Systems engineering is defined by Sage & Rouse (2009) as: "management technology to assist and support policy making, planning, decision making, and association resource allocation or action deployment" (Sage & Rouse, 2009). This type of technology can be beneficial to an organization in reinforcing its resourcing, project management practices, and support functions (Artto et al., 2011). Hence, the case company initiated this research work, as the company could benefit from a systems engineering solution to its current challenges in project and portfolio management. Such a systems engineering solution would essentially be an information management and distribution tool. In this context, we can use the following general definition of information: "data that are of value for decision making" (Sage & Rouse, 2009).

In this subchapter, the discipline of systems engineering will be explored with the following three different approaches: the theoretical approach of systems thinking, the more pragmatic approach of system design, and a user centred approach focusing on the practical implementation of a system. Each of these approaches serves a purpose in building an overall holistic approach to understanding the potential systems engineering solution which the case company could benefit from. Next, these approaches will be discussed in more detail in the above-mentioned order.

2.2.1 Systems thinking approach

Systems thinking means adopting a holistic and comprehensive analytical approach to studying a phenomenon of interest. It underlines the interconnectedness and complexity of things by modelling them as systems. Here, a system refers to a set of interacting and interconnected components that together comprise a unified whole (PMI, 2021). The systems thinking approach attempts to account for potential interferences and synergies between system components and can even include analysis of the interplay between these components and various other systems. Adopting this holistic view of systems thinking and blending it with the theory of project and portfolio management can be a helpful tool in modelling and analysing project work as well as in designing a management system to support said work. For example, the interconnected structure of a project portfolio, described in chapter 2.1.2 above, can be thought of as a system of systems (PMI, 2021).

Because systems thinking emphasizes the complexity and interconnectedness of things, it can be a useful tool in the design of a project and portfolio management system. Applying systems thinking to the context in which the system is to be used forces those involved in the design process to critically think about potential interactions and synergies between system components and possibly with other systems too. However, despite the complex nature of interconnected and interacting systems, highly detailed system specifications do not necessarily result in a more effective system (Sull & Eisenhardt, 2015). Instead, a more generalized system with high adaptivity, i.e., a dynamic system, is considered a more viable option. The properties that benefit such a system are its resilience, self-organization, and some sort of built in structural hierarchy. Designing for these properties can help the system function well over a long time period and, thus, be sustainable in the long run.

(Meadows, 2009) This dynamic system design will be further discussed in the following subchapter on system design.

We may even extend the systems thinking approach beyond the *per se* management system that is the main outcome of this thesis' research findings and can use systems thinking in the way we approach project work. The critical evaluation of the project as an entity through the lens of systems thinking may be useful. In this sense, a project can be viewed as a multifaceted entity that exists in a dynamic and complex environment and portrays the characteristics of a system (PMI, 2021). This systems thinking approach to project work is summarised in figure 4 below, and can aid, for example, in the making of a WBS. "Complexity arises whenever a system – – has multiple interdependent parts" (Sull & Eisenhardt, 2015). This is exactly the case with an individual project that has multiple sub elements and interactions among these elements, as well as interactions between other systems and the system environment. Management of this complexity can be demanding due to natural variables, such as human behaviour, system behaviour, and general ambiguity (PMI, 2021). Although the complexity of the project and its environment cannot be controlled, the reactions and handling of said complexity can be managed, for example, with a dynamic project management system.

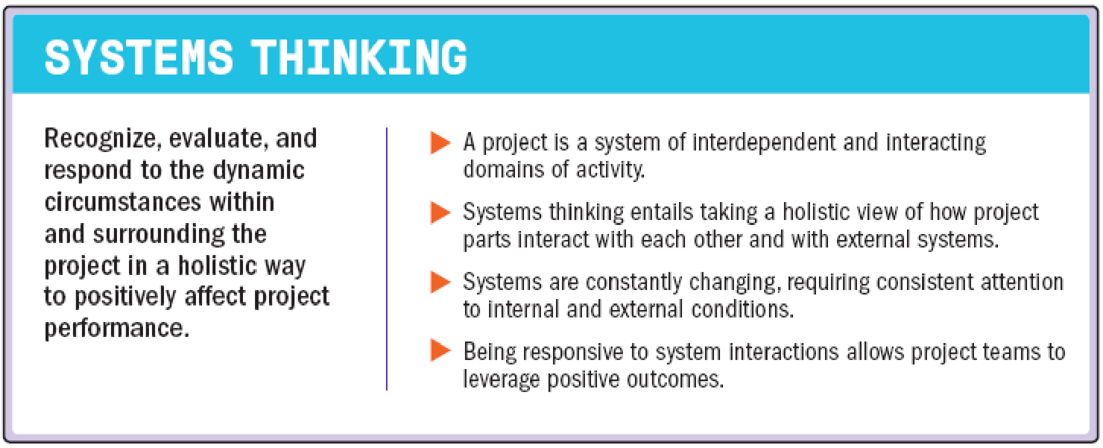

Figure 4. *Project work in the context of systems thinking (PMI, 2021)*.

Furthermore, we can apply the systems thinking approach also on the project portfolio level. We may use a system-of-systems model to describe the interconnected structure of a project portfolio, with projects as its elementary units (PMI, 2021). In this model, individual projects are thought of as subsystems of the project portfolio. If a subsystem's goals override the main system's goals, i.e., a single development project dominates at the expense of the entire portfolio's strategic goals, the resulting behaviour is referred to as suboptimization (Meadows, 2009). Because of this interactivity among systems, those working with this system-of-systems, i.e., the portfolio and its projects, should be aware of the system dynamics (PMI, 2021). Hence, portfolio management plays a crucial role, also from the systems thinking perspective, as effective portfolio management will promote the main system's goals and minimize system suboptimization.

However, it should be noted that too much central control may be just as harmful as system suboptimization. "To be a highly functional system, hierarchy must balance the welfare, freedoms, and responsibilities of the subsystems and total system — there must be enough central control to achieve coordination toward the large system goal, and enough autonomy to keep all subsystems flourishing, functioning, and self-organizing." (Meadows, 2009) Thus, we can derive that a management system should not focus on consolidating the control over specific projects or project elements within the project portfolio but should instead focus on providing useful management tools throughout a project organization. This means increasing organizational transparency and providing a clear view of individual projects and the project portfolio’s situation in a summarized format by providing project management tools for individual project managers.

Systems thinking can also be useful in building a methodology of work. A methodology, or in other words, a common way of working, means a system of practices, techniques, procedures, and rules. An existing methodology can be applied in the way a project is managed. (PMI, 2021) Moreover, the components of a working methodology should fundamentally be simple rules which provide a clear and unambiguous frame of working (Sull & Eisenhardt, 2015), guiding daily decision making and easing the cognitive effort applied to managing projects and the project portfolio. Once established and defined, this methodology can be formalized into a management system. This, of course, requires an effort in the design and implementation of such a system Next, the former mentioned design process is described.

2.2.2 System design

Sage and Rouse (2009) define the concept of design as: “the creative process by which our understanding of logic and science is joined with our understanding of human needs and wants”. It is central to the practice of systems engineering, and systems engineers should understand that design is a creative and iterative decision-making process. (Sage & Rouse, 2009) Including design thinking into the system design process can help in identifying novel solutions to pre-existing issues. This is because design thinking can help in approaching problems with a more creative mindset, which generally leads to better and more successful new solutions (Kelley & Kelley, 2013). As a project organization heavily focused on the practical execution of wind farm development projects, design thinking is not necessarily a daily tool used in the case company. However, the complex development projects do require creative problem-solving, which is a good basis to foster the development of design thinking within the project organization.

Like project management, system design is also a very human centered activity. Afterall, those interacting with a system, commonly referred to as users in literature, including in this thesis, are people with subjective feelings, biases, social connections, and so on. Hence, an empathetic approach is essential in the human centred design process (Kelley & Kelley, 2013), also in systems design. Because of this humane element of system design, the following can be generalized, arguably to any design process: 'The early and continued contact between the (system) designer and the intended user is necessary for good design, as this connection between the parties deepens the understanding of the practical issues and the potential solutions that the designed solution could offer' (Lewis & Rieman, 1993; Kelly & Kelly, 2013). As a result, the research of this case study has included a lot of interaction with and learning from the personnel of the case company.

When several people and/or organizations are working together on a project, such as the development of a wind farm or a new PM/PPM system, the coordination of the collective work effort between various project entities is extremely important to the success of that project. However, a decentralized coordination effort where project work is self-organized and self-managed can be beneficial. In some cases, mixing these two by including elements of self-organization to projects with a more centralized coordination can also be useful. (PMI, 2021) In the case company, self-organization plays an important role in managing project work, as a wind farm development project in the project portfolio is managed and executed mainly by a single responsible project manager, with some external on-demand support functions. This way of how the organization structures its project work should be acknowledged and accounted for in the design of the PM/PPM system.

In system design, it is highly advised to think about the user right from the very start of the design project. This includes the way how the users structure their work as mentioned above, the tasks they will perform using the system, and the context in which the system will be used. (Ritter et al., 2014) Thus, in the early stages of the research and design process, key stakeholder groups should be identified, as was done in the beginning of this thesis project, and an attempt to understand why people belonging to these stakeholder groups work the way they do should be pursued. This approach focused on the present practices can open opportunities to visioning how people might be working in the future (Kelley & Kelley, 2013). The existing ways of working, as well as the existing systems in place, can provide direction in the early stages of the system design process. Also, previous trials and experiences with parallels to the design project may provide valuable user feedback even before the prototyping of a new system has been started. In this thesis, the above described process is referred to as initial situation mapping, which will be further discussed in chapter 3.3 below.

To make the information in a PM/PPM system useful in decision making, the context and environment of the information should be indicated by the system (Sage & Rouse, 2009). This is an integral part of good system design, which makes sure that enough information is made available to the user for proper task and status evaluation. However, there is a cut-off point in presenting too much information and overloading controls to allow users to perform several different actions within the system (Ritter et al., 2014), resulting in cognitive fatigue, confusion, and possibly even frustration. Thus, applying a human centred approach in the system designing is also important to understanding this balance in the number of information. According to Ritter et al. (2014), things that should be considered and understood in the user centred design and implementation phases of a system include the following key attributes:

- how people extract information from the system for decision making;
- the mental models that are used to understand and interact with the system;
- the learning curves of different users and user groups;
- how social factors can affect the use of the system; and
- system behaviour affected by decisions taken outside of the system environment (Ritter et al., 2014).

As Kelley and Kelley (2013) have well stated: ”there is no one-size-fits-all methodology for bringing new ideas to life”. However, a common identified structure for the design process of many successful past design efforts includes the following four general steps: inspiration, synthesis, ideation, and implementation. (Kelley & Kelley, 2013). These general design steps can be well translated into system design – inspiration translates to the need to systematize a process, synthesis to identifying the system boundaries, ideation to defining and structuring the system concept, and implementation to the practical execution. Moreover, the implementation step can be further broken down with the basic waterfall method, commonly used in software design projects. The steps of the waterfall method are requirements analysis, specification, planning, technical design, execution, integration, and maintenance (Lewis & Rieman, 1993).The success of a systems engineering project is often tied to the first two listed steps of the waterfall method: requirements analysis and system specification.

The focus of this master’s thesis project in the design process is directed towards these two above-mentioned initial steps of the system implementation. This is due to the requirements and specifications stemming from the case company’s need to adapt to the changing market environment and are, thus, inherently tied to the management practices of the case company. In the context of system development, “a requirement is a statement that identifies a capability or function needed by a system in order to satisfy a customer need”. It is a definition of what the system should be capable of doing but should not include any demand on how the system is to do it. (Sage & Rouse, 2009) Thus, requirements should indicate direction of the system development process, with space left for the development team to ideate and create the practical system implementation. This implementation should be done based on thorough analysis of the provided requirements, which are transferred into more tangible system specifications. These specifications are then used as a premise in the later steps of planning and technical design of the system.

A common issue in the design and development phase of systems engineering is poor communication between the parties engaged in the development process (Sage & Rouse, 2009). This issue should be recognised by the system development team and enough communication between the development team's members should be ensured. For example, communicating system specifications to the technical development team is crucial to the implementation of the designed system. However, this should not result in the flooding all project member's calendars with unnecessary or inefficient meetings. Instead, communications culture plays a significant role here – the threshold for providing feedback, asking for instructions, and generally communicating any wants and needs should be low enough for information to flow seamlessly between all project parties. A viable approach to successfully collecting all thoughts and ideas is establishing clear channels and instructions for communication from the very beginning of the development process.

In the process of system implementation, different design thinking tools can be useful in driving the system building. One such tool is scenario-based design (SBD), which is a user-centred system design approach. The basic idea of SBD is to concretely describe the future system's use in an early phase of the system development process. This is done with narrated visions of various use cases, or "user interaction scenarios", which are used as a guidelines and targets of the system development process Like other user-centred approaches, SBD shifts the focus of design work from identifying individual system variables and considerations to describing more broadly how people will use the system to accomplish their work in the future, offering a relatively lightweight method for the system development process. (Beaudouin-Lafon & Mackay, 2012b) This is useful, as “people tend to overweigh peripheral variables at the expense of critical ones when they try to take all factors into account” (Sull & Eisenhardt, 2015).

Together, the formulated system specifications and envisioned use cases can be used as a basis for building a system prototype. Because they are concrete representations of ideas, prototypes are an essential tool for interactive and cooperative system design, supporting the communication of a multidisciplinary design team. Prototypes provide a rich medium for exploring the design space and enable more grounded discussion and evaluation of ideas already in the early stages of the design process. They also give stakeholders an early idea of how a new system might look and feel. Additionally, areas that require refinement are well indicated by imprecise or incomplete aspects of the prototype, helping those involved in the design process to focus on, think through and solve design problems related to these blind spots of the design. (Beaudouin-Lafon & Mackay, 2012a)

The term prototype can refer to a wide range of things, ranging from rough sketches to detailed working prototypes (Beaudouin-Lafon & Mackay, 2012a). In fact, this thesis work employed ever more detailed prototypes throughout its lifecycle, starting from a simple system sketch all the way to a fully functional PM/PPM system prototype. Such a functional system prototype allows moving from theorizing to empiricism with the research. Next, this user centred empirical study approach enabled by a well designed and implemented system prototype will be described in more detail in the following subchapter.

2.2.3 User experience

As stated in the previous subchapter, interaction with the user is necessary for any design process to deeply understand the practical issues and the potential solutions that the design could offer (Kelly & Kelly, 2013). Bringing this interaction with the user into the center of the design process is often referred to as the user centered or human centered design approach. However, human centered design has been generally underrepresented in systems design processes, which has resulted in some hard-to-use systems, i.e., systems with poor usability (Sage & Rouse, 2009). To avoid this common pitfall, user experience (UX) should be considered in systems design. Simply put, UX and usability studies quantify how pleasing the use of a system (or any interactive product) is to its user (Ritter et al., 2014). Bringing a focus on UX into the design process means deep diving into the empathetic element of systems design, placing the user into the limelight of the development process.

As a sub-section of systems engineering, UX also attempts to bridge the gap between a science-based technology and the humane user. UX is an aspect of technology beyond the mere functional outcome – it is about the acknowledgement of the situated, complex and dynamic nature of technology, as well as the subjectivity of how that technology is perceived and experienced by its users (Hassenzahl & Tractinsky, 2006). When designing a system, support for the user to effortlessly achieve their goals should be maximised and the need for the user to actively engage in problem solving should be minimised (Ritter et al., 2014). In other words, the system should intuitively support in solving the task at hand, requiring as little cognitive effort from the user as possibly viable. This process can be supported by codifying simple embedded rules into the system that reduce the cognitive strain of the user by simplifying the decision-making process (Sull & Eisenhardt, 2015).

Involving actual system users already in the design phase can be useful, as they can help find the right balance between guidance and discretion, avoiding system behaviour that is overly vague or restrictive (Sull & Eisenhardt, 2015). However, it should be noted that, as an individual experience, UX can even be affected by the user's subjective mental state (predispositions, expectations, needs, motivation, mood, etc.) (Hassenzahl & Tractinsky, 2006). Thus, a skilled design process facilitator should be aware of any personal biases that can affect the feedback of the design and testing phases of a system. Other factors that can influence UX include, for example, the context within which the interaction with the technology occurs and the characteristics of the designed system, such as its usability (Hassenzahl & Tractinsky, 2006). Because of the multifaced nature of usability, there are many indicators that can be used as measurements. These include qualitative and quantitative indicators, usually focused on either performance (quantitative) or process (qualitative) (Ritter et al., 2014), the latter being emphasized in this thesis.

Real world testing is an invaluable source of insight in any design process (Kelley & Kelley, 2013), which ties back to system prototyping previously introduced in chapter 2.2.2. However, the testing phase is among the most resource demanding phases of a systems engineering project. If we take user testing and examine it from this resourcing point-of-view, the testing of a new system requires an input of the company's resources. This is related to the fact that project managers involved in the testing are paid employees of the company with various other responsibilities and tasks, and the system testing will take time off from these other activities. Thus, sizing of the research group is an important factor that should be well considered – the size should be adequate to provide reliable results but not oversized to avoid unnecessary strain on the resources of the company. Figure 5 below illustrates the benefits-to-costs ratio for a typical medium-sized project.

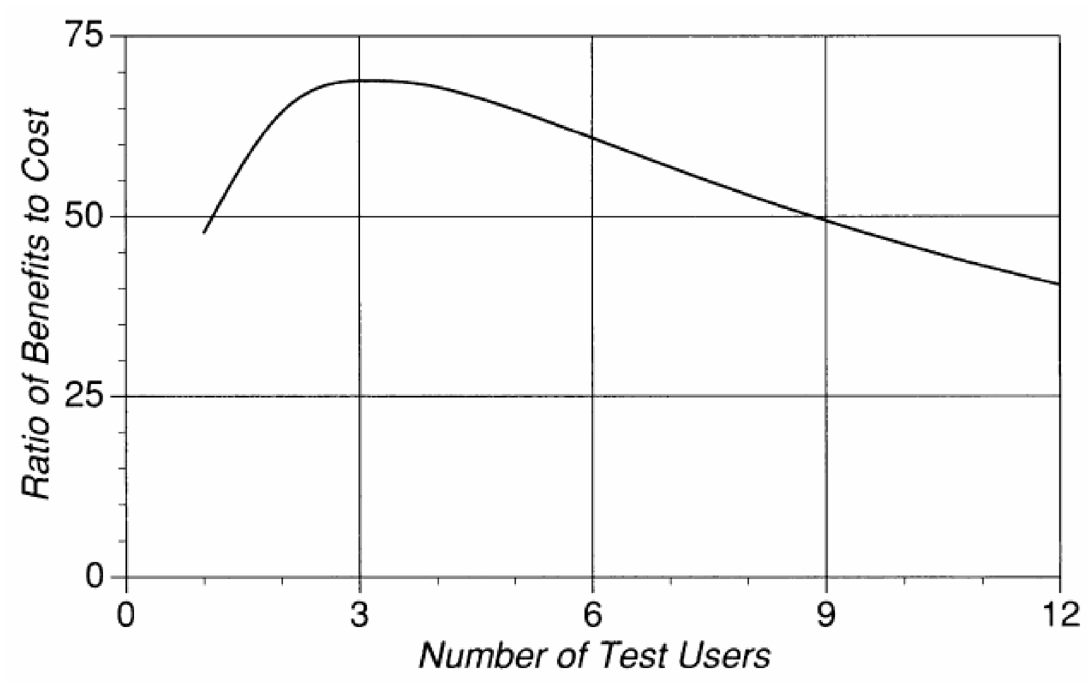

Figure 5. *Benefits to Costs ratio of user testing (Nielsen, 1993)*.

According to Sull & Eisenhardt (2015), it is good to involve a team of four to eight actual system users in the design phase, as developing the rules of a system is more favourable from the bottom up than from the top down (Sull & Eisenhardt, 2015). The above figure also indicates that having four to five project managers to test the system is within reasonable boundaries of benefits to costs. In this case, the actual users are the company's project managers that provide real-life data of their individual wind farm development projects to the system prototype. Having the actual users involved from early on also helps in understanding why people are working the way they do in the now, which, as mentioned before, can open up opportunity to visioning how they might be working in the future (Kelley & Kelley, 2013). Thus, having the project managers use the system prototype is crucial to the design process – it provides the researcher and system designer valuable material to deeply understanding the process under development, and opens the opportunity for user-oriented innovation as the system users become familiar with the new tool.

In usability studies, a group of five to eight people can be expected to produce reliable results. A meta-analysis by Nielsen (1993) suggests that a five-person research group of novice users can be expected to provide results with a probability of 70% and ±21% deviation of the true mean value. (Nielsen, 1993) The different confidence levels of this study are further illustrated in figure 6 below. This confidence interval can be expected to provide acceptable results for qualitative research and the usability testing of a non-critical system prototype, such as the management system under development. Also, the research group sizing at this level of confidence is in line with the formerly mentioned benefits-to-costs ratio and general design process suggestion by Sull and Eisenhardt (2015).

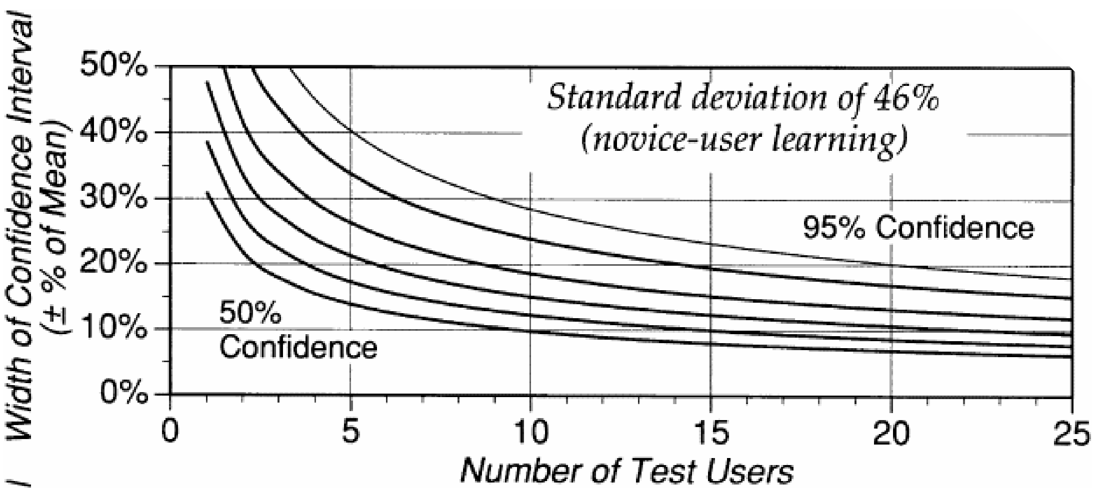

Figure 6. *Confidence intervals of usability testing with a 46% standard deviation of the mean measured value. Bottom curve is the 50% confidence level, followed by curves for 60%, 70%, 80%, 90% and 95%. (Nielsen, 1993)*

There are clear benefits to having the actual project managers test and develop the system. First, active engagement throughout the development process helps users in the testing group detect, collect, and evaluate information, data, and opinions, which can help in creating an aligned and shared understanding of the system’s key attributes (PMI, 2021). Second, being involved in the design and ideation from the beginning of the process allows users to give direct input to codifying their work into the embedded rules of the system. This is highly beneficial, as the test users are experts in their work and, thus, have the best knowledge to build on. (Sull & Eisenhardt, 2015) Also, being included in the testing lowers the threshold of adopting the new system into the daily work routine after development, as familiarization with the system has already happened earlier during research and testing. This increases the probability of successful system rollout, as active participation in the development process makes it more likely for the test users to adopt the tool they have been developing into their daily work (Sull & Eisenhardt, 2015), possibly creating wider system acceptance in the whole organization.

3 Research methods

This chapter describes in more detail the research methods used. This chapter will begin by describing the framework and justifications for conducting a case study. Then, the process of the literature review, followed by the description of the utilised empirical methods will be presented. The empirical methods include mapping the company's current situation and gathering primary data from the project management system's potential stakeholders. The data gathering includes informal talks at the workplace, the surveys and interviews with the key stakeholders (i.e., project managers and the steering group), as well as the workshops and user testing that were carried out to define the project management system.

3.1 A holistic case study

According to Yin (2009): ”A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009). A case should be representative of the research phenomenon it attempts to investigate (Buchanan, 2012). As both the research phenomenon and the context of this thesis are subject to the contemporary Finnish renewable energy market, the case study is a reasonable research design, especially as the unit of analysis is a single company within the larger context.

Typically, case studies are preferred when the research question is framed in a 'how' or 'why' form, when the researcher has limited control over the events of interest, and when the research focus is on real-life events and phenomena. Especially in the case of the latter two, the case study allows to retain the holistic and meaningful characteristics of real-life events, such as organizational and managerial processes. (Yin, 2009) Hence, the case study serves well both the focus on a complex real-life phenomenon, that is, the Finnish renewable energy market, and the rather passive and observational mode of inquiry.

In attempting to answer the research question, this thesis employs a holistic approach that considers both the managerial perspective, focused on project portfolio management, and the employee perspective, focused on project development. The single case holistic study design is advantageous when no logical subunits of the studied phenomenon can be identified and the underlying theory is also of a holistic nature (Yin, 2009). As the company is the smallest logical subunit of the Finnish renewable energy market, and systems engineering is commonly considered a multidisciplinary and holistic science, the use of the single case holistic study design is well justified. However, a typical problem with the holistic design is that the entire study may be conducted at an unduly abstract level, lacking sufficiently clear measures or data (Yin, 2009). Therefore, this must be accounted for in the design, problem framing, and data gathering phases of the research. By rooting the gathering of primary data into tangible practice and framing the abstract theory into a more pragmatic form, this holistic case study aims to narrow the gap between the abstract and practical theory.

In case studies, the interview is considered one of the most important sources of information (Yin, 2009). In addition to the typical interviewer-interviewee query setting, interviews can also be approached as structured guided conversations. Thus, conducting a group interview based on an agenda during an ideation workshop can be a feasible interview method for data gathering. A case study can also include focus interviews as a tool of validation for hypothetic study findings (Yin, 2009), and this type of an interview was utilised in the final interviews with the steering group members. In addition to interviews, other common data gathering methods in case study research are documentation, archival records, direct observations, participant-observation, and physical artefacts (Yin, 2009). However, this listing is not complete (Buchanan, 2012), and case studies can utilise also other methods of data gathering for building the case. The various methods included in the research of this thesis were literature review, internal documentation retrieved from the company's servers, informal talks (i.e., participant-observation), surveys, workshops, and semi-structured interviews with three steering group representatives.

Observation can be used to collect data about meetings and the use of technologies. These observations can be used to add contextual depth to the case. When this observation is done as an active member of the community or organization under investigation, the method is known as participant-observation. (Yin, 2009) In this thesis, participant-observation played a key role in immersing and internalising the context of the research phenomenon and drawing conclusions from that context.

Artefacts were also of interest in this case study. Yin (2009) defines physical artefacts as: ”a technological device, a tool or instrument, a work of art, or some other physical evidence” (Yin, 2009). Although not a physical object, the project management system is, nevertheless, a tool and a technological device that provides value to the company. Hence, it could be considered a digital artefact, and including that artefact into the case can provide valuable context to the analysis phase of this thesis.

As the case study material has been gathered and analysed, research findings can be discovered. Buchanan (2012) has divided the generalizability of the case study findings into the following four non-discrete and potentially overlapping modes:

1) Moderatum generalizations – speculative associations with low-level pattern recognition, usually require from eight to ten cases;
2) Naturalistic generalization – empathetic interpretation and adaptation of findings done by the reader;
3) Analytical refinement – case as an example of the research phenomenon, where experience and observation are reflected upon an existing theory; and

4) Isomorphic learning – deduction from similar emergent phenomena across varying contexts (Buchanan, 2012).

Based on the listing above, this case study can be categorized into the latter two modes: analytical refinement and isomorphic learning, as the empirical findings can be used to analyse and refine the existing theories of project theory and systems engineering, and as the organizational findings of the study can be generalized across other small-to-medium size companies in a similar market situation.

3.2 Literature review

The literature review accumulated sources via various paths. Google Scholar, Aalto Primo and Aaltodoc were the databases searched with relevant keywords. Additionally, literature from various previously taken courses with relevant insights were used. These above-mentioned ways of exploring the literature are summarised in tables 1 and 2 below. Also, in some cases, the references of relevant publications were searched to find further literature on those topics.

Table 1. *Aalto University courses with relevant literature.*

Course	Topic
Aalto University Professional Management (APRO) – PM 1: Projektihallinnan perusteet	Project management
CHEM-E6235 – Circular Economy for Materials Processing	Stakeholder analysis
CS-C3120 – Human-Computer Interaction	Stakeholder analysis, System testing, UX
MUO-E8029 – Systems Thinking	System design

Table 2. *Databases, keywords and filters used in searching literature.*

Database	Keywords	Filters
Google Scholar	[digital tools for project management], [digitalisation in the EU]	-
Aalto Primo	[project management], [wind power industry]	-
Aalto Primo	[methodology of research]	Years 2010-2022; Books; Topics: [Decision making], [Software engineering], [Application software], [Engineering Management], [Management information systems], [User interfaces (Computer systems)], [User Interfaces and Human Computer Interaction]
Aalto Primo	[qualitative research], [interviewing]	Years 2000-2023; Books
Aalto Primo	[ideation]	Books; Topic: Design
Aalto Primo	[case study], [renewables], [growth]	Master's thesis', Doctoral thesis', Articles
Aalto Primo	Organization research	Years 2000-2023; Books
Aaltodoc	[case study], [renewables], [growth]	Master's thesis'

3.3 Empirical study

According to Kvale and Brinkmann (2009), familiarising with a qualitative research phenomenon should not only be done through literature and theoretical studies, but must also involve an empirical study element (Kvale & Brinkmann, 2009). In a case study design, the research phenomenon, the context in which the phenomenon emerges, and the initial research aim are the key factors that should determine what empirical data is to be collected and analysed to gain a comprehensive picture of the case at hand. This can include informal conversations and even biased sources that may reflect stakeholder positions and interpretations, if these biases are accounted for in the final case analysis. (Buchanan, 2012)

Next, the empirical element of this master's thesis case study is described. The two main parts of the empirical study are 1) mapping the initial situation and 2) gathering primary data based on the initial situation. The main method employed in this case study design was participant observation. In participant observation, the study investigator is assumed a functional role within the case context (Yin, 2009). In the organizational context, this role can be, for example, a staff member within the organization. In this case study, the position of the case researcher was a systems specialist trainee, and the role was that of a systemic facilitator in an intraorganizational development project.

3.3.1 Mapping the situation

The systems engineering framework provided by Sage and Rouse (2009) was used to identify potential development paths for the case company's project management in the initial stages of this thesis project. Formally, this framework consists of the following three main steps: 1) issue formulation, 2) analysis, and 3) interpretation. Next, these steps will be briefly described and put into the context of this thesis project.

Issue formulation

The issue formulation was done during the first months of the thesis project. This included getting to know the case company's current project management practices and existing tools for managing projects. This was mainly done by observing the use of project management tools and existing ways of working and by getting to know the wants and needs of various employees working in the project development department. The information was gathered by attending project meetings, browsing the company's internal documentation and gathering reports on past experiences, as well as having informal talks with employees working in the project development department. Later, conversation-like unstructured interviews were also employed. The main objective of this phase was to gain an understanding of the organizational context in which the system development project was to take place.

Issue analysis

Based on the gathered information, a stakeholder analysis was completed in the issue analysis phase. It is considered good practice to complete a stakeholder analysis before the development project is initiated, or latest in the early stages of such a project. Here, stakeholder analysis refers to the process of identifying and understanding what is needed and expected from the development project by the key stakeholders, both within and outside of the project environment. (Smith, 2000) The term stakeholder refers to those individuals, groups, organizations, and institutions that are a part of the same system environment where the development project is carried out in and, thus, directly or indirectly affected by the project. Some stakeholders may also possess the ability to or indirectly influence the project, its performance, or the resulting product. (Artto et al., 2011; PMI, 2021; Sage & Rouse, 2009; Smith, 2000)

Based on the above-mentioned definitions, a stakeholder analysis of a new PM/PPM system was completed. As with the case study, the unit of analysis was the case company, and the different company departments represent the different stakeholder groups in the analysis. The following direct stakeholders of the project management system were identified within the case company: the project development department, the electrical department, and the company steering group. Other identified internal stakeholders that the system indirectly affects were the civil and accounting departments, as well as the operations and management subsidiary. A mind map illustrating these various internal stakeholders, as well as some of the identified potential use cases of the project management system, is presented in figure 7 below.

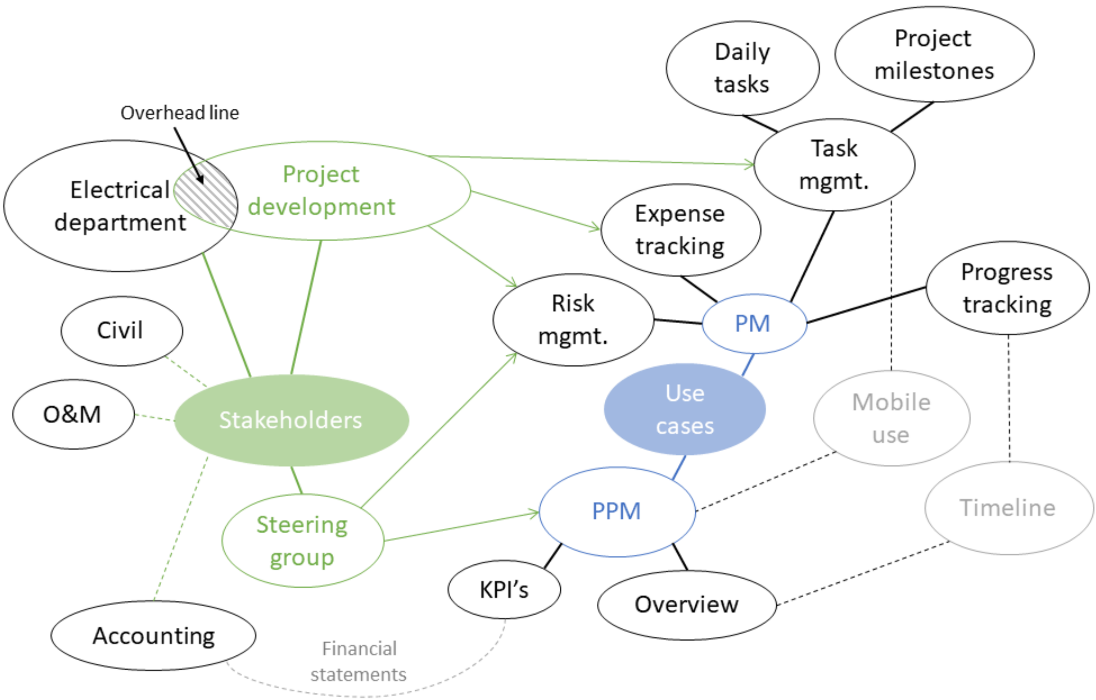

Figure 7. *Mapping of the internal stakeholders and use cases of a project management software (own illustration).*

From the identified direct stakeholders of the project management system, two were identified as key stakeholders, meaning these stakeholders have the highest priority in terms of influence over both the system development and the company's overall performance. These identified key stakeholders for this system development project were the project development department and the company’s steering group. While directly involved in project development, the electrical department already has a distinct project management system in place and operates with a high degree of independency. Thus, it was excluded from the key stakeholders. However, the cross departmental team of overhead line development, involved in both project development and the electrical teams, was included as a key stakeholder.

Issue interpretation

The company had already previously developed a tool for project management to track the progress and to assess risks of development projects. The implementation of this system was built on a set of macro-programmed Excel-files. Although this tool was already in use, it was quite underpowered and static, and frequently resulted in errors. Adapting the management system to fit the needs of an exponentially growing business could have been possible by converting the static Visual Basic for Applications (VBA) code into a more dynamic system. However, this would have required a complete rework of the source code and all existing files and would have not significantly improved the processing power of the system, as VBA is optimised for simple task automation and not for general programming.

Nevertheless, having this tool in place does provide some benefits, as well as challenges, to the implementation of a new PM/PPM system. Taking the elements that are good in the Excel-based tool, such as the WBS and visual layout of the overview, provide a good starting point for the development project of a new PM/PPM system. In addition to the Excel-based system, the case company had previously experimented with an open source project management software, however, with limited success. Although the system was deemed unfitting for the needs of the case company, this former trial, also including user testing, provided valuable data for the issue interpretation in the beginning of this thesis project.

Although the case company's internal stakeholder groups strongly advocate for the development project of a new PM/PPM system, external stakeholders, such as the parent company's management, could deem it redundant. This is because a tool implemented with a more familiar software, i.e., MS Excel, already exists and is in use. Hence, and important task for the project facilitator is to clearly communicate the challenges of the pre-existing management tool and the opportunities offered by a more dynamic and flexible PM/PPM system. Understanding the relationship, interests and interference between the different stakeholders helps in the strategic planning of the project preparation and execution (Smith, 2000), and having a thorough enough contextual understanding of the organization helps in gaining this understanding.

3.3.2 Collecting primary data

After completing the mapping of the situation, the collection of primary data was carried out. To accommodate for the holistic approach adapted in this case study, a bottom up approach was applied to the data collection. In practice, this meant involving the project managers first into the research, design and development of the project management system prototype. This phase took the most time, as "[one] should study the user and their tasks until the risk of not knowing more about them is lower than the other risks to success" (Ritter et al., 2014). After the user research phase, the focus was shifted to the company's steering group members, who provided an alternative viewpoint and valuable feedback on the system prototype.

The collection of primary data was directed by the findings of the initial situation mapping phase. It was done using various data gathering methods, which is a key characteristic of the case study design and helps the researcher in building the case (Yin, 2009; Buchanan, 2012). The data collection focused on gaining a comprehensive overall understanding of the potential development paths of the company's project management. The methods included surveys, workshops, open feedback of the user testing and interviews, and were conducted in the former mentioned order. Next, these different methods and their findings will be described in more detail.

Surveys

A survey is defined by Müller, Sedley and Ferrall-Nunge (2014) as: "a method of gathering information by asking questions to a subset of people, the results of which can be generalized to the wider target population". In the context of systems engineering and design, surveys can provide insights into the subjective traits of the systems' users, such as attitudes, experiences, and intents. Therefore, surveys can be a valuable tool in gaining a broad understanding of how people perceive and interact with the system, and, vice versa, how individuals and groups engaged with the system can be influenced by it. Furthermore, surveys can aid in the development of application and user research strategies. (Müller, Sedley & Ferrall-Nunge, 2014) This can be especially useful in the initial problem framing phase of any systems engineering project. Thus, an initial survey was conducted for the project managers included in the research group.

In early March, before the kick-off workshop of the testing and development of the new project management system prototype, a preliminary survey was sent to the five research group's project managers. As all research group members spoke Finnish, the survey was conducted in Finnish. The translated version of the preliminary survey is provided in appendix 1. The main findings of the survey are presented in table 3 below in a summarized format. A key finding of the survey was that the project managers must handle several broad sets of tasks in their daily job. Another finding of the survey was that the tasks that the project managers found the most laborious were the management of land lease contracts and the progress tracking of individual project elements.

Table 3. *Summary of the preliminary survey's answers.*

Question	Summary of answers (5 total)
Do you deal with complex individual topics in your work?	Yes (5/5)
If you answered yes to the previous question, briefly describe these topics.	Land leases; Environmental impact assessment (EIA) process; Municipal planning process
Are there particularly demanding stages in your work?	Yes (5/5)
If you answered yes to the previous question, briefly describe these stages.	Management of land leases; Progress tracking
Do you track the progress of your projects?	Mostly yes (4/5)
If you answered yes to the previous question, briefly describe your tracking method and/or tools.	Excels (Project-excel, Summary of Land Rights, Risk matrix)
Describe your expectations for the workshop on Friday, March 17th.	Introduction to the software; Clear goals for the implementation project
Describe your expectations for the testing and development work related to the project management tool in the next 4-6 weeks.	Using the software for daily project management; A clear schedule; Bringing up thoughts and ideas throughout the implementation project
If you have any thoughts or expectations related to the project management tool, please describe them here.	Ease of use; Adding and managing your own individual tasks; Structuring project-specific information (e.g. land lease agreements); Monitoring schedules and progress; Risk management

Although surveys are a fast and efficient tool for gathering specific observations from a group of respondents, they lack the possibility to observe the context of the respondents and the opportunity to dig deeper into the responses by asking follow-up questions. However, surveys are great for gathering initial high-level insight that can be probed more deeply by more qualitative research methods following the initial survey. (Müller et al., 2014) This known issue of surveys was accounted for by the following workshops, which the preliminary survey acted as a precursor for. In the workshop, the survey responses were presented in a summarised format and discussed in more detail with the workshop attendees, providing a more in-depth understanding on the preliminary survey responses.

Workshops

One of the methods for gathering data was holding ideating workshops. This was done because the first effort in any multi-stakeholder development project should be some sort of a brainstorming activity with appropriately selected members (Smith, 2000). Those involved in the workshops were the research group's project managers, the process facilitator, i.e., the case researcher, selected steering group members, and the external SaaS providers representative. As was mentioned earlier in chapter 3.1, the workshops can be approached as group interviews due to their structured conversational nature. This type of an interview may reveal information otherwise inaccessible to the case researcher. Two workshops were held in the latter half of March, and the schedules of these workshops are provided in appendix 2.

The purpose of the workshops was to facilitate for early UX innovation and to identify potential areas of improvement in the project managers' everyday work. Afterall, the project managers involved in the research group are experts in their own field of work and have the best understanding of what type of a system would benefit them. The ideation was done based on formative evaluation, a tool of an iterative design process which aims to reveal detailed the pros, cons, and any potential areas of improvement of the early prototype under investigation (Nielsen, 1993). Also, it has been noted that people are more likely to adopt and use systems where they have been a part of the developing process (Sull & Eisenhardt, 2015). Thus, the workshops also served a function in preparing a successful system deployment.

User testing

After the boundaries and requirements for the PM/PPM system were defined and the research group's project managers had provided subjective and objective insight to their daily work, a prototype of the system was built based on these specifications. The implemented core functionalities were selected based on the minimum requirements, as a prototype should provide a reasonably complete understanding of the system's overall performance (Lewis & Rieman, 1993). After creating the functional system prototype, the research group was given training to use it and engaged in a four-week testing period over the course of April.

In usability studies, a group of five to eight people can be expected to produce reliable results (Nielsen, 1993), as mentioned above in chapter 2. The testing group of the new project management system included five project managers, one steering group member, and one support role, as the best test users will be those who are representative of the intended main user group (Lewis & Rieman, 1993). The project managers were selected to the group based on the variety of their user profiles; people with different working styles were identified and recruited to test out the system. The steering group member and support role were onboarded to the testing to provide an alternative viewpoint to the feedback discussions, as a diverse set of skills and knowledge can help foster a culture of shared learning and, hence, aid in the delivery of intended project outcomes (PMI, 2021). The length of the testing period was fitted to four weeks based on the assumption of how long the cognitive process of learning a new system would take.

The group provided valuable feedback and ideas in weekly occurring status meetings, as several design iterations are essential in producing an effective user-system interaction (Lewis & Rieman, 1993). Indeed, the most important data the user testing provided for this case study was in these weekly status meetings. There, the research group project managers shared their experiences with the system along with their expert knowledge on project management in free form conversation. This raw knowledge was curated and compiled into identified best practices, and an attempt to embed this knowledge as the methodology of the system was pursued.

Interviews

One of the most common data gathering methods in qualitative research is interviewing. In fact, just being in the environment where the interviews are to be conducted can provide an introduction to the local language, the daily routines, and the power structures of the organization under investigation. This contextual orientation can aid in planning the interview as it may foreshadow some of the topics that the interviewees will be talking about. (Kvale & Brinkmann, 2009) Especially in case studies, interviews can provide a tool for probing deeper into those topics of interest revealed by some other, more broad data gathering method (Yin, 2009). In the case of this thesis project, the initial situation mapping phase provided the context and direction for the interviews.

The three interviews were conducted after the prototyping and testing of the PM/PPM system and were targeted to the company's steering group. The interviews focused on two main topics: 1) the effects of growth, and 2) the existing project management system. The purpose of the interviews was to validate the findings of the initial mapping phase. Half of the steering group was interviewed, resulting in three individual interviews. The interviewees were selected based on seniority on the assumption that those who have spent the most time with the company have the largest time gradient of organizational change. Another factor that affected the selection was the interviewees organizational role, and those steering group members affiliated with the identified key stakeholder groups were given priority in selection.

The interviews were conducted in mid-May as individual, semi-structured discussions, where follow-up questions were posed by the researcher to gain a more comprehensive understanding of the answers. In accordance to the ethical guidelines of interviewing, the interviewees were informed about the confidentiality and intended consequences of the interview, their right to withdraw at any given time, and the role of the researcher, after which they gave their informed consent to the interview (Kvale & Brinkmann, 2009). The interviews took, on average, 41 minutes to complete. As all the interviewees were native Finnish speakers, the interviews were conducted in Finnish. A translated version of the interview script is provided in appendix 3, and a summary of the findings of the interviews is presented in table 4 below.

Table 4. *Summary of the steering group interview answers.*

Question	Summarized answer
Theme: Effects of growth	
Has the rapid growth of the company significantly affected the nature of your daily work?	The increased number of personnel and projects has directly affected the daily work of all interviewees. Some examples include changes in the chain of command and the increased importance of communication.
Has the rapid growth of the company significantly affected the day-to-day operations of your department?	The increase in the number of personnel has directly affected the overall workload and need of reporting and anticipation in work. The organization has also become more structured.
Has the rapid growth of the company significantly affected the flow of intraorganizational information?	The amount of information has naturally increased as a result of growth, and the chain of command has stretched. Thus, attention has been focused at the communications culture and processes.
Has the rapid growth of the company affected the completion time of projects?	The overall growth of the industry has affected some external processes, such as permitting, appeals, and the work of consultants. However, there has not been notable effects linked to the growth of the case company.
Has the rapid growth of the project portfolio affected the horizontal comparability of projects?	There have not been any notable effects on the horizontal comparability of projects, as there are no established clear metrics for such comparisons (except the general project schedule). The feasibility and financial situation of each project is estimated individually case by case and is heavily context dependent.

(Continues)

Table 4. *Summary of the steering group interview answers. (Continued)*

Theme: Project management system	
Has the rapid growth of the company changed the way you use the project management system?	The explosive growth of the company was the reason the Excel-based system was developed in the first place.
Has the rapid growth of the company changed the way your subjects use the project management system?	The continued growth has not had any significant effects on the overall system use. New employees require a thorough introduction due to usability issues.
What are the most important functionalities the current project management system provides to your work?	Progress tracking (although limited); project forecasting as a tool of resourcing; recognition of patterns (data visualisation); risk management.
What are the most pressing challenges of the current project management system that could be improved?	The usability of the system (loading time and user-caused errors). The tool is too one-dimensional. The overall big picture of the project portfolio could be refined. Adding objectives and milestones.
Why are the risk assessment and progress tracking merged in the current project management system?	The tool was implemented from the angle of operational project development, where risks are associated with different phases of the project.
Could you describe the possible benefits of the merged risk assessment and progress tracking?	Executional assessment of projects; risks as a natural part of project development; essential project information is concentrated into one overview.
Could you describe the possible challenges of the merged risk assessment and progress tracking?	Qualitative assessment, comparisons between different risk categories, mixing up risks with the normal process.
Do you think that a rigid or dynamic project management system would benefit the company?	A dynamic system that can be adapted to the changes in legislation and within the industry to provide a rigid framework for project development.

4 Analysis

In this chapter, an analysis of the case study findings will be presented. The goal of this case study is to expand and derive theories on project management practices via the lens of systems engineering. This is done by analytic generalization from the case, where the gathered material is examined and a generalized theory is derived from the findings (Yin, 2009). The analysis of the empirical findings will be conducted from the viewpoint set by the theoretical framework built in the literature review phase, using a mixed approach of project management and systems engineering. The analysis draws from the primary data gathered in user testing, workshops, and interviews, with contextual understanding built in the initial situation mapping phase. Error analysis and reliability of the results will also be discussed at the end of this chapter.

4.1 Project management system

As mentioned in the introductory chapter of this thesis, more efficient project management can have a positive impact on the productive output of a company. This is due to the development projects' speed of completion being enhanced by the increased efficiency. Applying information technology (IT) to project management can support in enhancing said efficiency (Pelin, 2004). However, the applied IT-systems should be functional and work as intended in order to support the processes of a project organization. By far, the most common pitfall of the case company's current Excel-based project management system, as observed by the case researcher and the interviewed steering group members, was its negative effect on the case company's organizational transparency due to functional unreliability and poor usability. This had resulted in the unwillingness of project managers to voluntarily engage with the tool, leading to outdated and unreliable information in the system with little to none value in decision making. Without exception, these issues surfaced across all organizational levels of the case company and in every step of the data gathering process of this thesis work, including both the initial mapping and gathering of primary data.

Therefore, increasing organizational transparency on project management by implementing a functional and usable PM/PPM system poses a great opportunity for improving the case company's project management practices. The development of such a system would have a positive impact in the individual work of a project manager, as the workshops and user testing suggest. Also, it would help in clarifying the big picture of other departments working in cooperation with the project development department, such as management and accounting, which, according to the steering group interviews, "currently have a limited view into the project development process". The result of increased organizational transparency would be enhanced accuracy of project forecasting and predictability, which would help the portfolio level management by improving decision making and strategic planning, allowing more targeted responses to critically developing projects.

In fact, the case company had set an objective to improve and unify their project management framework by implementing a new PM/PPM system already back in 2022. The case company had defined several objectives for the system to fulfil. Based on the data gathered during the mapping of the situation and the workshops described in chapter 3, these objectives were analysed and formulated into functional requirements for the PM/PPM system, which are presented in table 5 below. In addition to these requirements, the option for mobile use was identified as a potentially beneficial factor to the success of the system deployment. This was due to the improved access to the PM system even in demanding working environments, such as in forests, fields, or any place where the potential WTG construction sites of a wind farm development project are located.

Table 5. *Functional requirements for the project management system.*

Requirement	Functionality
Easy deployment	User-friendly interface
Task management	Check-listing
Schedule management	Gantt view with planned and actualised schedules
Portfolio reporting	Dashboard view with tracking of progress
Risk assessment	Early warning system and flagging project anomalies
Scalability	Dynamic and modular system design

Characteristics that should be considered in the development of any IT-system's architecture are its adaptability and flexibility (Pelin, 2004), as these make the information system more resilient to change and, thus, more sustainable in long term use. One of the key characteristics the company's Excel-based project management system was lacking was, indeed, flexibility. Although logically structured, the system was by design static and rigid. Hence, a new project management system's design should be more dynamic to accommodate for the rapid growth of the project portfolio, which, again according to the steering group interviews, "is estimated to grow even more in the future". This design choice could be implemented with a modular hierarchical PM/PPM system design. The basic unit of such a system architecture is illustrated in figure 8 below, which represents the structure of a single wind farm development project. This prototype draft was based on a pre-existing WBS retrieved from the company's server, which is presented in Finnish in appendix 4.

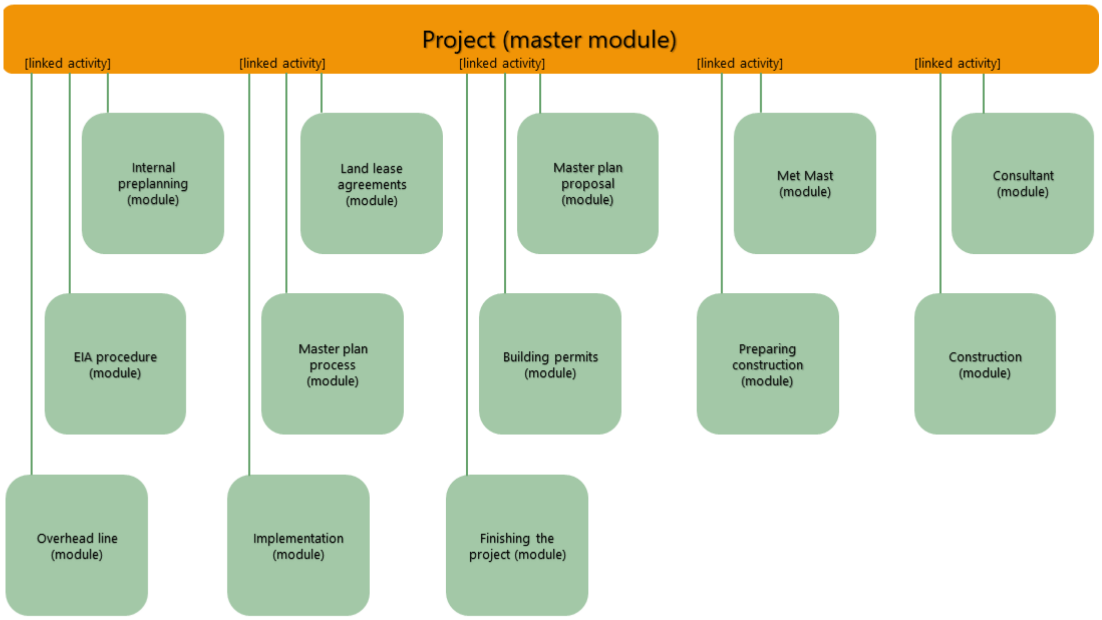

Figure 8. *Draft of the system prototype's modular architecture based on a pre-existing WBS of the wind farm project development process (own illustration).*

In addition to adaptivity and flexibility, another benefit of the modular system architecture is related to the cognitive process of parsing project work. Understanding this mental process that is involved in the evaluation of projects can be used to improve a system design, and the system architecture can be constructed to support project-oriented thinking (Ritter et al., 2014). As was noted in chapter 2.2.2, there should be a balance in the amount of information presented in the system, with enough being available to support decision making while not overloading the user with unnecessary details. By structuring the system around the different phases of the project, as is done in the above illustration, the complex wind farm development project can be deconstructed and sectioned into more tangible working units. These units, also called modules, store all the detailed information required in those phases, and are linked up to the project level. The project level representation then pulls the key information required for project evaluation and management from these modules, while allowing the system user to find more detailed information related to the phases whenever necessary.

The implementation of the above described modular PM/PPM system architecture also provides other benefits. The commonly used practices, which are currently passed on to new project managers in onboarding that takes place during the first months of employment, could be formulated into an agreed set of rules, i.e., a uniform working methodology. This methodology should consist of a set of general rules that the various internal stakeholders can agree to, providing a clear framework for guiding the daily decision making on the project level (Sull & Eisenhardt, 2015). Such a framework would essentially act as a project management handbook that could be embedded into the PM/PPM system. This could enhance the turnaround of projects, as the need for involvement of the steering group into the decision-making process would be decreased, making the process more straight-forward and freeing up managerial resources. These newly freed resources could then be directed to strategic management on the portfolio level as required by the exceptional market situation, allowing more controlled and sustainable growth in the future.

One of the most important benefits that a PM/PPM system offers to a project organization is project monitoring and control. This can be done by progress tracking, comparing predicted and actualized schedules and outcomes, analysing the variances and impacts of variables on different projects, and by making adjustments to the project execution as needed (Kerzner, 2017). Also, recording issues as they occur is an important part of project monitoring and control and helps in accurately capturing the details of said issues for later processing and analysis (SFS-ISO 25102:2021:en). These tools of project monitoring and control are useful to both individual project managers and the steering group. Here, the hierarchical architecture of the information structure again plays a vital role, enabling movement between different scopes of focus. For example, a steering group member is more likely to move between the project and portfolio levels, whereas a project manager is more focused on the project and module levels. However, the workshops suggest that project managers would also benefit from a limited portfolio view focused on specific interest groups, or filtered views, of the project portfolio.

4.2 Digitalisation

Moving from a static on-site project management system to a cloud-based third-party SaaS-solution is closely linked to the digitalization of project business. In the following analysis, we will be focusing on the EU context, as the case company and its parent organization are both located within the EU. According to a study by the European Investment Bank (EIB) including 13 000 companies from the European Union, United Kingdom and United States (2021), European firms view digitalisation as a high-priority endeavour. In a globally connected market economy, experts agree that Europe needs to rapidly utilise the potential of digitalization and firmly address the challenges that change inevitably creates, if the European economies wish to maintain their ability to compete in international markets. (EIB, 2021)

There are several potential benefits that can result from embracing digitalisation. Firms moving ahead with digital transformation are more dynamic than firms that do not invest in digital technologies (Rückert, Veugelers and Weiss, 2020). As has been stated in this thesis, some of the advantages that digitalisation of the project and portfolio management could offer for the case company include increased organizational transparency, more efficient resource allocation, and better-quality development projects, making the company, indeed, more dynamic. Generally, digitalisation is associated with increased productivity, investment and innovation activities, better management practices, faster growth, and greater salaries. These factors support the above mentioned EIB study’s finding that “firms perform better because they are digital, not because of their size”. However, size does affect some aspects of digitalisation, as larger firms with more than 50 employees are more likely to have implemented digital technologies and, thus, have higher median labour productivity than similar sized non-digital firms. (EIB, 2021) As the case company approaches this 50-employee limit, embracing digitalisation becomes increasingly relevant to its operations.

An obstacle in the very beginning of this thesis project was convincing the German based parent company's representatives that the PM/PPM system's digitalisation project was worth the required effort and resources. A possible explanation to the initial opposition could be due to differences in the degree of digitalization in the operating countries – Finnish society is notably ahead in digitalization compared to the German society, as Finland is among the most digitalized societies in the EU and Germany is more closer to the EU average (EIB, 2021; Petrosyan, 2022). Because of the notable difference in digitalisation between Finnish and German societies, illustrated in figure 9 below, the potential of a digital PM/PPM development project might not have been as clear to the German parent company's representatives as it was to the case company's employees.

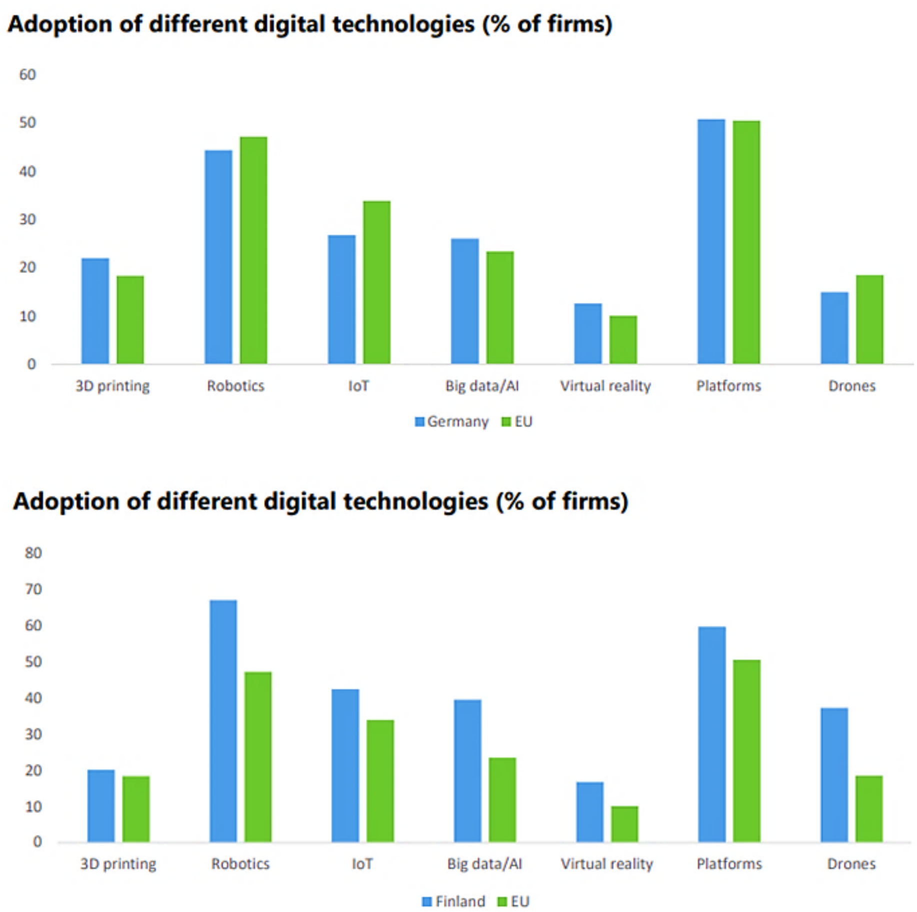

Figure 9. *Comparison of the level of digitalisation measured by various indicators in German (upper) and Finnish (lower) industries (EIB, 2021).*

One factor that affects attitudes and the political will to engage in digitalisation projects on the country level is culture, which, according to one of the three steering group interviews, "is generally quite different in Germany compared to Finland". This should be taken into consideration by multinational companies' corporate management (Rubino et al., 2020), including the parent company's corporate management. With branches in 16 different countries on 4 continents at the time of writing this thesis, cultural contexts, as well as the degree of digitalisation, may and does vary a lot in the different operational locations. The difference in the degree of digitalisation could, and likely did, have an impact on the thinking and approach towards digital tools in the minds of both countries' employees. However, with open discussion and proper justifications, the value of the development project could be communicated across cultural contexts.

4.3 Economic assessment

Like any other project, the development of a PM/PPM system requires justification. As was noted in chapter 2.2.3, it takes an investment of resources to develop and test a management system, and this investment should be justified and aligned with the overall company strategy. This justification should address the need, the benefits and the cost of investment. (SFS-ISO 21504:2022:en) If we examine the market context in which the case company operates in, it becomes evident that a dynamic and scalable management tool is necessary for the sustainable management of the expected continued growth of the project portfolio. As the steering group interviews revealed:

> "*The Excel-based project portfolio management tool we have used so far was built out of necessity to cater for the demands of our growing portfolio and internal communication. It grew organically around the dire need to visualize and communicate the size of our project portfolio to the parent company's upper management.*"
>
> [stylized summary of the interview answers]

The PM/PPM system's primary target should be supporting the work of its users, as this seemingly simple and self-evident functionality helps the case company save money, even in the order of millions of euros (Ritter et al., 2014; Sage & Rouse, 2009). This becomes clear when investigating some selected projects of the case company, where crucial time-of-the-year dependent milestones on the critical path of a wind farm development project have fallen under radar due to human error. This has resulted in the delay of those projects by at least a year. In terms of staff expenses alone, this type of a delay results in an additional cost of a six-figure sum. This simple metric alone is more than tenfold to the implementation costs associated with a commercially available PM software.

To maximize the benefits of a software that the PM/PPM system is built on, the sizing must be appropriate for the context and use case. In practice, this means that the software should be powerful enough and provide the tools necessary for its intended use, but not over-powerful at the expense of user experience, usability, and overall cost. For this company specific case, task management, usability, and adequate PPM tools, such as schedule management and portfolio status indicators, were identified as the most critical attributes of the software. As the potential software tools were screened, it became clear that an off-the-shelf solution to the specific needs of the case company did not exist, and that the implementation of the PM/PPM system with a viable software tool would require the case company's active effort.

The implementation method that was chosen for carrying out the execution of the PM/PPM system was a development project, where employees of the company worked on the configuration and testing of the software. Of course, this takes an input of the company's resources, as does any type of organizational development project. However, this type of a development project should be viewed as an investment into the company's future (Artto et al., 2011), providing monetary benefit over a longer time. If we define value simply as 'the beneficial outcomes of the project deliverable' (PMI, 2021), the implementation project can be expected to create value already in its development phase, as organizational processes are reviewed and improved. Value is also created by the increased efficiency and reduced errors associated with the improved system. Because the development project is limited to a defined time period that only takes a few months to complete, the investment of resources is well justified in comparison to the time and money saved by the finished product, improving the overall economic performance of the case company.

4.4 Validity and reliability

In this subchapter, the validity and reliability of this thesis project will be addressed. The analysis attempts to evaluate the whole research with a critical view, highlighting all identified factors that might have influenced the way the research was carried out or the above introduced analysis' end results. The three main themes this subchapter will focus on are general uncertainties related to a case study, the deviation of the case material, and biases of the user research group's members.

As always, the generalizability of the findings of a single case study can be argued about. Surely, the findings of this research will be strengthened by repeating the research design in other small-to-medium sized project organizations that are responsible for the delivery of a complex and solution-oriented product, such as the readymade wind farm of this case. However, a standalone case study should, and does not, invalidate itself but provides a single, yet complete, datapoint for conducting the above-described meta-analysis on the research phenomenon. Nevertheless, this datapoint does have a specific angle in its approach towards the research phenomenon. This should be accounted for in any follow-up research by employing alternative perspectives, complementing the overall holistic understanding of the research phenomenon.

It should be acknowledged that the case study's material does include data gathered as a part of a commercial company's PM/PPM system's development and implementation project. As a result, the case material is heavily focused on the viewpoint of the management system and might lack in materials addressing more general level organizational practices, such as the general management of the company's growth. This specific focus of the case material also skewed the focus of the research analysis towards the digitalization of project business, away from the initially intended focus on general management of turbulent change. However, this type of a development is not unusual for the case study research design. Sometimes, case researchers face a situation where they must reflect retrospectively on what specific questions the gathered case data allow to be answered, and these questions may or may not have been part of the original set of research questions (Buchanan, 2012).

It has been noted that there are some issues related to the reliability of user testing, due to notable subjective differences between individual test users and the wider real-world user base (Nielsen, 1993). However, this issue was identified already in the data gathering phase, and the recruitment and selection of a diverse research user group was done as an attempt to minimize any potential bias. Also, having some data on the usability of a software to base decisions on can be considered better than no data at all, as an understanding of the way the intended user interacts with and feels about the system aids in guiding the iterative design and development process into the right direction (Nielsen, 1993; Ritter et al., 2014). This understanding, however limited in the end, cannot be achieved in isolation from the user. Nevertheless, acknowledging the individual traits of the research group's users may help in gaining a more general and, thus, useful understanding of the wider user base.

5 Discussion

In the following chapter, the findings of this thesis research will be discussed. First, the research component will be briefly discussed, followed by a corporate angle discussing the managerial implications of the findings. The chapter continues the analytic generalization of the previous chapter throughout the discussion, shifting the focus towards a more pragmatic angle.

5.1 Research contributions

The main research goal of this thesis was to investigate the possible ways of how a project organization manages its work and how this affects organizational processes. The following discussion has been divided into two sections. First, the case study's research will be addressed, followed by a discussion on potential future areas of research. Next, the research path will be addressed in a chronological order.

5.1.1 Addressing the research

This master's thesis project begun in early January of 2023. By then, the case company had already initiated the internal development project on its management practices. This was done as the previous project management system had proven to be too unreliable and static for the demands of the rapidly growing renewables development company. The first months of this thesis project were spent on familiarizing with the company's previous trials with various project management solutions, as well as the then-current situation and practices of project and portfolio management. The familiarization was done via participant observation, as described in chapter 3, by attending to internal meetings, browsing the company's internal documentation and server files, and engaging in informal talks and unstructured interviews with multiple company personnel varying from project managers to project assistants and the managing director. This phase also included gathering and familiarising with the relevant literature for the literature review on the general principles of project management and systems engineering.

After the initial situation mapping, the thesis' research was combined with the development project for a new PM/PPM system, which was initiated in early March. This included forming the research group for user centred system development. The selections for the research group members were done based on the suggestions of the head of project development, who identified five project managers with varying user profiles and potentially high levels of engagement. A suitable SaaS provider for the system prototype's implementation was also screened and selected at this point. A preliminary survey (appendix 1) was conducted in early March, followed by workshops for discussion and ideation on the PM/PPM system prototype a couple weeks later. Based on the input of the research group and the findings of the initial situation mapping, the system architecture and specifications were drafted. These drafts formed the basis for a system prototype, which was later developed together with the SaaS provider. This prototype was then tested, and qualitative user centred data on project management was gathered in a four-week testing period that took place in April.

After the system development and user research phase, analysis of the case material was carried out. In addition, the three steering group interviews were conducted at this time. These were done to validate the initial situation mapping's findings, as well as to provide more insight throughout the entire case company. The various requirements and expectations for the PM/PPM system were used to analyse the interests and needs of the different internal stakeholders within the project organization. After gaining a comprehensive understanding of the way management practices were perceived and practiced throughout the entire case company, the research of this master's thesis was finalized.

5.1.2 Future research

The research of this master's thesis, which investigates the PM/PPM practices of the case company, was conducted on a pragmatic basis from a systems engineering perspective. However, the same research questions could be investigated from multiple other angles as well. In this subchapter, some alternative viable angles to approach the research question are suggested. These suggestions are based on the case researcher's observations from the gathered data. Some alternative approaches were also identified during the research but were ruled out of the scope of this research project.

The first alternative angle that we suggest for future research is that of corporate communications. Project management, as has been previously noted, is a very human centred activity, and, thus, communication naturally plays a significant role in it. According to the findings of this case study, the success of an individual project is often related to communicating the right things to the right stakeholders at the right time. Of course, incorporating this process of communication into the methodology embedded into the PM/PPM system and having the needed information available in a clearly structured format can aid in successful communication. Nevertheless, placing communication into the centre of research would likely result in valuable findings in the field of organizational communication studies.

Another angle that can be adapted to any potential future research is that of general management. Many areas of project management have similarities with general management principles (PMI, 2021). Hence, investigating project organizations from the viewpoint of general management studies may open new perspectives and can enable identifying synergies between the disciplines. Furthermore, it can help in identifying opportunities for the development of the general management practices of companies experiencing notable growth, such as the case company. Future research on the area of this thesis could benefit from a narrower focus within the organization, investigating either the managerial or operational functions of a project organization.

5.2 Managerial implications

Next, the managerial implications of the research findings will be discussed. The main commercial goal of this thesis research was to improve organizational transparency of the case company by reviewing its project management practices from a systems engineering perspective. Next, potential opportunities and threats related to changes in the way an organization manages its projects are discussed. Then, the relationship and role of project management systems to the employees of a project organization will be discussed. Finally, the suggested next steps for the case specific company are presented.

5.2.1 Opportunities and threats

As stated above, the main commercial application of this master's thesis' research was to provide more clarity into decision making, both on the operational and managerial levels and, furthermore, on the local and global levels of the case company. This was to be achieved by improving the organizational transparency of the case company, which in turn was to be achieved by improving the company's project management practices. Practically, this meant developing a new project management system prototype to replace the former system that had been identified to be outdated. This subchapter highlights some of the opportunities and threats related to such a system change.

When selling solutions as projects, the project organization takes responsibility for the project's performance and functionality during both its execution and after sale operation (Artto et al., 2011). With multiple stakeholders and legal obligations included in various points of time throughout the development process of a wind farm project, it is crucial to keep track of all things going on to ensure quality and to reduce schedule slippage. The project managers of the case company, as the experts of their profession, are very competent in driving the complex wind farm development project. However, as the company operations grow, the number of personnel must grow too. Naturally, this creates increasing variance in individual project management practices, as was observed by the workshop attendees and the steering group interviewees. This makes it hard for those outside of the immediate project context to get a grasp of any individual project without thorough investigation. Hence, a standardisation of project management practices via a PM-system poses an opportunity for effectively communicating the status and progress of an individual project, and, thus, the entire project portfolio.

As a company is searching for an area of organizational development, it is suggested to seek for any critical activity where the number of opportunities exceeds the current available resources (Sull & Eisenhardt, 2015). As the company's core business, project development can be classified as such a critical activity with a lot of potential for improvement, posing a great opportunity for wider organizational development. A systems engineering solution to improving the way projects and the project portfolio is managed is the implementation of a functional and scalable PM/PPM system, which has been extensively described in this thesis. This would bring numerous benefits to the case company, such as the above-mentioned standardized practices project management, improved flow of information within and between departments, and analytics to assist in strategic planning and decision making, such as in prioritizing projects within the portfolio and defining their optimal sell-off point.

In the development of onshore wind farm projects, the identification of risks and threats is an integral part of the project portfolio's management. Of course, improving risk management is also an opportunity offered by the continued development of a PM/PPM system. However, as "there may be no provision for risk management – – associated with the use of a system" itself (Sage & Rouse, 2009), the system use should be reviewed, and potential risks be identified by a risk management focus group. This group can consist of selected members of the case company specialised in risk management, as it is not necessary for all stakeholders to be involved in all phases throughout the development project (Smith, 2000). In fact, limiting the number of group members doing the preparatory work for the risk management tool may even make the process more straightforward. This expert group's work could be complemented by discussions with different stakeholders at later points of the project.

However, when considering adding new functionalities to the system, the integration of those functionalities should be well thought out. This is because, over a longer time, large systems may become unsustainable, which generally has been associated with oversized scale and scope (Sage & Rouse, 2009). This issue can be further derived to relate to large systems' capabilities to adapt to change. Nevertheless, implementing a dynamic PM/PPM system as a modular design increases the systems resilience to change because of a higher adaptability, as it makes the modular units of the system easier to manage and maintain. Also, it has been noted that organizational factors and management of complexity often play a more significant role than pure technical implementation in making a system sustainable (Sage & Rouse, 2009).

5.2.2 Human centred systems

In the design process, an empathetic and human centred approach is often applied to achieve better design outcomes (Kelly & Kelly, 2013; Ritter et al., 2014). However, this human centred approach is often underrepresented in systems engineering (Sage & Rouse, 2009), and management studies seem to follow a similar trend focusing on the theoretical abstraction. Yet, as the research of this case study reveals, both of these disciplines include, by nature, a humane element. Purely ontologically speaking, projects and systems are both abstract non-human entities. However, those who create, use and maintain these entities are people with subjective thoughts and feelings, which can be a valuable source of information in the development of organizational processes. By taking this humane element into account, systems engineers are able to build more usable and, thus, sustainable systems, including for project and portfolio management.

Nonetheless, systems engineers seldom engage in system design completely isolated from the context in which the system is to be implemented and used. As was discussed back in chapter 2.2, engagement and interaction with the intended users is necessary for the development of a system that meets the functional requirements set for it. If we accept the user as a valuable and equal contributor to the system development process, a co-design project may be the most effective way to gather all applicable ideas and knowledge to the system design. Moreover, when the users are involved in the design process reflecting on their experience and codifying it into embedded rules of the system, they typically do so to achieve something that is important to them (Sull & Eisenhardt, 2015). Also, having people from within the organization involved in the design process may create desired knock-off effects in the adoption of the new system, as the social notion that the new system is being developed by co-workers could contribute to its wider acceptance.

5.2.3 Next steps

In this subchapter, the suggested next steps for the case company to take after this thesis project are presented. As with any process of change, an outlined detailed plan for the full implementation of the PM/PPM system should be drafted to support individuals, i.e., the system users and partnering organizations, to guide their approach and behaviour towards the desired outcome (SFS-ISO 25102:2021:en). The findings of this thesis can be used in drafting such a plan, and the development and implementation of a new PM/PPM system could be done based on the prototype made for the research and testing purposes of this thesis. If this implementation is to be carried out, a follow up study on the use of the system could be beneficial, as this would provide more insight of how the new project management system has improved the PM/PPM practices. Iterative improvements could also be made based on the feedback from this follow up study. As the duration of the wind farm development projects spans multiple years, the follow up should be done after the system has been in use for at least a year, possibly even longer, to provide useful data over the whole project life cycle.

The current draft of the project management system includes the functionality of progress tracking as a tool for project management. The system could be further developed to include more valuable tools for the case company's project management. Extending the system's functionality to risk management is the next logical step in improving the system, as the project management system has many data that could be used in the analytics of risk assessment. Also, integrating a document management system to support the project management process could potentially improve the system prototype.

After a sufficient piloting period, the project management system could be adopted also by other departments within the case company into their daily workflows. For example, the accounting and electric departments have voiced their interest in such a system before, which should indicate a high probability of commitment of those departments to the development and adoption of the system to their processes. The electric department also has a clear and well-defined task listing, which would support the system's adaptation by providing a good framework of the departments processes for the planning and implementation of the project management system's extension. More departments adopting the new system would provide more data to the analytics tool and, thus, an even more holistic view of the daily operations for the company's steering group. However, some departments of the case company, such as the construction department, already have effective project management systems in use with their customised workflows in place. The functionalities of these different systems and the specific needs of the user groups should always be considered when assessing the potential risks and benefits of migrating an existing solution into a new system.

The parent company's board has also recognised the advanced stage of digitalisation of its sub-branches in various other countries, such as Finland and Spain. The created system prototype could be used as Proof of Concept (PoC) in talks with the parent organization, providing a concrete example of the benefits of digitalization. The Finnish case company's steering group has proposed that various project management software should be tested and piloted in various branches of the corporation. This kind of decentralised form of testing for digital tools could potentially speed up the research and adaptation of said tools, and result in rapidly finding the best suitable project management tool to be adopted on a global level. Nevertheless, it should be noted that such a project endeavour would require at least some top-level coordination from the parent company to be efficient and effective.

6 Conclusion

As wide public recognition towards the need to reduce atmospheric CO_2 emissions to hinder climate change and its effects keeps on gaining momentum, clean technologies can be expected to continue and, potentially, increase their growth. A significant amount of emissions is produced by the energy sector. Thus, decarbonizing electric energy production poses a significant potential for emission reductions. A partial solution is offered by renewable energy sources, such as wind power, which has experienced strong and steady growth in the European context over the past decades, including in the Finnish energy market.

As the companies operating in renewables industry keep experiencing notably strong growth, controlled management of this growth is necessary for maintaining successful operation. Organizational aspects that help in such management are well defined processes and systems that support the organizations' operations. Here, project management links up with systems engineering, a discipline devoted for the design and implementation of these formerly mentioned management systems. Management systems are accomplished by systems engineers via quantitative and qualitative formulation, analysis, and interpretation of the potentials created by their system designs, considering the needs of the client organization (Sage & Rouse, 2009).

This case study is an explorative and descriptive investigation of the case company, ABO Wind Oy, and its PM/PPM practices. The study was set to investigate the way project work is managed within the organization, both on the individual project level and the project portfolio level, and how this has been affected by the industry's past growth. As the research was carried out, the focus grew from the organizational research approach to fully include the systems engineering angle as well. However, this type of a development is not unusual in case study research (Buchanan, 2012).

This mixed approach of management studies and systems engineering provided beneficial synergies to the research. The design research tools employed in the systems engineering part of this thesis well complement the organizational research part. As both project management and systems engineering are essentially human centred disciplines, an empathetic user centred approach in the research and development of a PM/PPM system created a great advantage. This type of an approach opened up paths for the emergence of new opportunities for innovation in the creative problem-solving process (Kelley & Kelley, 2013), that is, the ideation, design and implementation of the PM/PPM system. Also, the pragmatic approach focused on identifying the criteria most crucial for making good decisions minimized the risk of overweighing less significant variables (Sull & Eisenhardt, 2015), both during initial the research and the development of the system prototype.

In the age of an emerging platform economy and rapid digitalization, commercial companies are quick to adopt digital technologies to support their market activities and to gain competitive advantage. As the EIB study (2021) suggested, European companies should be quick to embrace the potential of digital technologies and address their challenges to maintain and strengthen their market position in the global economy (EIB, 2021). The case company has set a strategic objective to systematize its processes and to adopt digital technologies to support business operations amongst the rapid growth it is currently experiencing. These digital technologies can offer more tailored solutions to specific needs than more conventional tools of project business. However, the tailoring process requires effort to facilitate for the controlled development of these solutions.

The findings of this thesis suggest that an empathetic and human centred approach to the development of project management practices results in more sustainable systems. The results of this research project can be utilised as a basis for the planning and implementation of a PM/PPM system. This system would benefit from a modular and dynamic design, as it would make the system more resilient to future change.

Key areas of interest that should be further investigated by the case company include other organizational functions of the PM/PPM system, such as finance and communications. Additionally, a deep probing risk analysis of the wind farm development process should be conducted to strengthen the system's risk assessment abilities and to support more robust quality management of the case company's main product, i.e., a fully developed wind farm.

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Appendices

APPENDIX 1

Preliminary Survey

A short survey for project managers in ABO Wind Oy's project development team.

The purpose of the survey is to assess the current state of progress monitoring and project management from the project managers' perspective. The information gathered from the survey will be used to tailor the project management tool.

The survey is anonymous and takes approximately 3-5 minutes to complete. Required fields are marked with an asterisk (*).

1. Do you deal with complex individual topics in your work? *
    a. Yes
    b. No

2. If you answered yes to the previous question, briefly describe these topics:

3. Are there particularly demanding stages in your work? *
    a. Yes
    b. No

4. If you answered yes to the previous question, briefly describe these stages:

5. Do you track the progress of your projects? *
    a. Yes
    b. No

6. If you answered yes to the previous question, briefly describe your tracking method and/or tools:

7. Describe your expectations for the workshop on Friday, March 17th: *

8. Describe your expectations for the testing and development work related to the project management tool in the next 4-6 weeks: *

9. If you have any thoughts or expectations related to the project management tool, please describe them here:

Agenda, Kick-off Workshop
Friday, 17th March 2023

INTRODUCTIONS

FOREWORD
- Today's agenda
- Motivation
- Project purpose
- Workshop aim

OBJECTIVES
- Short term
- Long term

PROJECT EXECUTION
- Scope
- Role of the case company
- Role of the SaaS provider
- Project Schedule

SOFTWARE DEMO

BREAK

PRELIMINARY SURVEY'S RESULTS
- Project management
- Laborious tasks
- Broad tasks

FREE CONVERSATION

WRAP UP & NEXT STEPS

Agenda, Ideation Workshop
Wednesday, 29th March 2023

FOREWORD
- Recap
- Today's agenda
- Workshop aim

IDEATION WORKSHOP
- Future casting
- Storyboarding

PRIORITATIZING IDEAS
- Minimum requirements
- Must-have / Nice-to-have

INTRODUCING TESTING
- Practicalities
- Communications
- Testing schedule

WRAP UP & NEXT STEPS

Steering group interview

Introduction

This is an interview for the master's thesis of Arttu Kärkkäinen focused on the emergent organizational management phenomena caused by the rapid growth of the case company (ABO Wind). The interview is divided into two focus areas: 1) the effects of growth, and 2) project management system. You are free to withdraw from this interview at any time you wish.

The interview will be recorded and used as primary data in future analysis conducted by the interviewing researcher. Your answers will be used together with other answers to synthesize an interview findings summary. Individual answers will not be published and will be disposed after the summary is done. With consent, your working department and role in the company's steering group can be mentioned in the public written report of the thesis.

- Do you consent to the above-mentioned terms of this interview?
- Could you please state your department and role in the company's steering group?

1) Effects of growth

Over the past ten years, Finland has experienced a "wind power boom" that has resulted in the rapid growth of companies operating in the industry, including ABO Wind. The following questions are about this growth.

- Has the rapid growth of the company significantly affected the nature of your daily work?
- Has the rapid growth of the company significantly affected the day-to-day operations of your department?
- Has the rapid growth of the company significantly affected the flow of intraorganizational information?

- Has the rapid growth of the company affected the completion time of projects?
- Has the rapid growth of the project portfolio affected the horizontal comparability of projects?

2) Project management system

Currently, the company has a project management system implemented as a set of macro programmed Excel-files. The following questions are about this project management system.

- Has the rapid growth of the company changed the way you use the project management system?
- Has the rapid growth of the company changed the way your subjects use the project management system?
- What are the most important functionalities the current project management system provides to your work?
- What are the most pressing challenges of the current project management system that could be improved?
- Why are the risk assessment and progress tracking merged in the current project management system?
- Could you describe the possible benefits of the merged risk assessment and progress tracking?
- Could you describe the possible challenges of the merged risk assessment and progress tracking?
- Do you think that a rigid or dynamic project management system would benefit the company?

Project plan and timeline

PROJECT NAME	PROJECT MANAGER	START DATE	DISPLAY MONTH
		January 01, 2021	0

PROJECT TASKS	RESPONSIBLE	START DATE	END DATE	# of Days
Esiselvitys -Preplanning		**0 01 1900**	**0 01 1900**	**0**
Melumallinnus				0
Välkemallinnus				0
Näkyvyysanalyysi				0
Keskustelu kunnan kanssa				0
Esiselvitys				0
Vuokrasopimukset - Land leasing		**0 01 1900**	**0 01 1900**	**0**
Maanvuokraussuunnitelma				0
Sopimuspohjien laadinta				0
Yhteystiedot, postitukset				0
Infotilaisuus				0
Kriittiset turbiinipaikat vuokrattu				0
Tienkäyttösopimukset				0
Sähköaseman ja mahd. ulkoisen (33kV) kaapelireitin				0
Palkkioiden maksu				0
Summary of land rights päivitys				0
Vuokrasopimusten kirjaaminen				0
Kaavoituksen valmistelu - Master plan preparation				
Kaavoitusaloite		**0 01 1900**	**0 01 1900**	**0**
Yritys- ja hanke-esittely kunnan päättäjille				0
YVA-tarveharkintapyyntö				0
Kaavoitusaloite kunnalle				0
Kaavoitussopimus				0
Konsulttien kilpailutus		**0 01 1900**	**0 01 1900**	**0**
Tarjouspyynnön rajaus ja laadinta				0
Konsulttien kilpailutus				0
Konsultin valinta				0
Mittamasto - Mest Mast		**0 01 1900**	**0 01 1900**	**0**
Mittamaston sijainti				0
Mittamastolupa				0
Mittamaston pystytys				0
YVA menettely - YVA process		**0 01 1900**	**0 01 1900**	**0**
Ennakkoneuvottelu				0
YVA-ohjelma - YVA programm				0
YVA-ohjelman laatiminen				0
YVA-ohjelma nähtäville + Yleisötilaisuus				0
ELY lausunto				0
YVA-selostus - YVA report				0
Arviontiselostuksen laatiminen				0

Erillisselvitykset				0
Arviointiselostus nähtäville + yleisötilaisuus				0
ELY perustellun päätelmän antaminen				0
Kaavoitus - Masten plan process		**0 01 1900**	**0 01 1900**	**0**
Maakuntakaava-asiat				0
Vireilletulovaihe - Participation and assessment scheme				0
OAS:n laatiminen				0
Viranomaisneuvottelu + seurantaryhmä				0
OAS:n nähtävillä olo ja tiedottaminen				0
Kaavaluonnosvaihe - Master plan draft				0
Keskustele sähköosasto, rakennusosaston ja site				0
Osayleiskaavaluonnoksen laatiminen				0
Viranomaisneuvottelu + seurantaryhmä				0
Kaavaluonnos nähtäville + Yleisötilaisuus				0
Vastineet lausuntoihin ja muistutuksiin				0
Kaavaehdotusvaihe - Master plan proposal				0
Keskustele sähköosasto, rakennusosaston ja site				0
Osayleiskaavaehdotuksen laatiminen				0
Viranomaisneuvottelu + seurantaryhmä				0
Kaavaehdotus nähtäville + Yleisötilaisuus				0
Vastineet lausuntoihin ja muistutuksiin				0
Hyväksymisvaihe - Master plan acceptance				0
Kunnanhallitus ja kunnanvaltuusto käsittelee kaavan				0
Valitukset				0
Kaava lainvoimainen				0
Turbiinin valinta ja luvat -Turbine selection and bulding permit application		**0 01 1900**	**0 01 1900**	**0**
Voimalatyypin valinta				0
Sähköaseman rak.lupa				0
Voimaloiden rak.luvat				0
Lainvoimaisuustodistus rakennusluville				0
Other permits		**0 01 1900**	**0 01 1900**	
Ympäristölupa * *Jos vaaditaan*				0
Kaapelin sijoittaminen julkiselle tielle				0
Kaapelin sijoittaminen yksityiselle maalle				0
Tietoimitus				0
Maa-ainesottolupa				0
Toimenpide- tai rakennusluvat				0
Liittymäluvat				0
Ilmoitus vesistön alittamisesta				0
Lentoestelausuntopyyntö + lentoestelupa				0
Liittymissopimus sähköverkkoon				0
Voimajohto - Over headline		**0 01 1900**	**0 01 1900**	**0**
Maankäyttöoikeudet ja -sopimukset				0
YVA menettely				0
Voimajohtoalueen tutkimuslupa				0

Sähkömarkkinalain mukainen hankelupa				0
Voimajohdon johotoalueen lunastuslupa				0
Erikoiskuljetuslupa				0
Vesilainmukainen lupa				0
Luonnonsuojelulainmukainen lupa				0
Lupa kaapleiden ja johtoje sijoittamiseen yleiselle				0
Muinaismuistolain kajoamislupa				0
Lentoestelupa				0
Rahoitus -Financing		**0 01 1900**	**0 01 1900**	**0**
Osallistu aktiivisesti hankkeen due diligence -prosessiin				0
Cost estimate päivitys				0
Rahoitussopimukset saatettava taloushallinto-osaston				0
Rakentaminen - Construction		**0 01 1900**	**0 01 1900**	**0**
Projektin hallinta				0
Maaperätutkimukset				0
Urakoitsijoiden kilpailutus				0
Sisäinen kickoff palaveri				0
Projektipalaverit *(läpi rakentamisen)*				0
Vuokrasopimusten noudattaminen rakentamisessa				0
Rakennus- ja muiden lupien ehtojen noudattaminen				0
Yhteydenotto operaattoreihin				0
Mahdolliset tukisysteemiin/Energiavirastoon liittyvät				0
Puunpoisto - wood clearance				0
Metsänkäyttöilmoitus				0
Maanomistajien tiedottaminen sopimuksen mukaan				0
Infran rakentaminen - Infrastructure building				0
Maanomistajien tiedottaminen sopimuksen mukaan				0
Perustusten rakentaminen - Foundation building				0
Maanomistajien tiedottaminen sopimuksen mukaan				0
Turbiinien pystyttäminen - Turbinr errection				0
Ilmoitus ANS Finlandille				0
Käyttöönotto - Implementation		**0 01 1900**	**0 01 1900**	**0**
Announcements after turbine erection				0
Ilmoita maanomistajille uudet yhteystiedot				0
Ilmoitus ANS Finlandille				0
Avajaiset				0
Vuokrasopimusten noudattaminen toiminnan ajan				0
Projektin päättäminen - Closing project				0
Projektin handover				0
Lessons learned				0