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Recommendations to Improve the Monitoring of Product Projects at the Case Company

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Preface

This thesis is the culmination of an interesting journey. Doing this study was an interesting challenge and offered many opportunities for growth and learning. The task of improving the monitoring of product projects in a global company required, in addition to technical and analytical skills, an understanding of organizational dynamics and stakeholder cooperation.

During this whole process, I have learned valuable lessons about the development of processes and methods, as well as productive cooperation with different stakeholders. These experiences have had an important impact on my personal and professional development.

I am grateful to the case company for giving me the opportunity to complete this study. Special thanks to my colleagues and my supervisor, whose insights and cooperation made it possible to create recommendations. Their expertise and willingness to participate in interviews and workshops were crucial to the success of this study.

I also want to express my gratitude to the Metropolia Industrial Management lecturers for an interesting and educational journey. Especially, I want to thank my thesis instructor, Dr. James Collins, for his guidance and support with this thesis and M.A. Sonja Holappa for her help with language and writing.

Finally, I would like to thank my family and friends for their support. Thank you for believing in me and providing the necessary balance to see this project through.

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Abstract

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The objective of this study was to create recommendations for improving the monitoring of product projects at the case company. The goal was to enhance the effectiveness of this monitoring, which had not sufficiently supported decision-making due to inadequate data available. Additionally, as the organization and its units operated globally, it was crucial to ensure uniform monitoring of product projects across all locations. Achieving this uniformity would enhance understanding of development and innovation opportunities and improve product portfolio management.

Applied Action Research with qualitative methods was used, focusing on solving a specific business problem within the organization through a four-stage process: current state analysis (CSA), literature review with conceptual framework (CF), recommendations creation, and recommendations validation. The CSA identified strengths and weaknesses in current practices, with key weaknesses related to data management, visualization, project evaluation, and target setting. The literature review provided best practices and tools for addressing these weaknesses, forming a conceptual framework for the initial recommendations.

In the recommendation creation stage, initial recommendations were co-created with the stakeholders during workshops and interviews. These were refined and validated with top management, resulting in final recommendations categorized into improving data management and visualization, and enhancing project evaluation and target setting. The recommendations offer a comprehensive set of actions to streamline project monitoring, improve data management, and enhance decision-making for new projects. Implementing these changes will provide better visibility and usability of project data, improving the company's ability to manage and understand product project success factors.

Keywords: Product projects, monitoring, data management, process improvement

Abbreviations

AHP	Analytical hierarchy process
BSC	Balanced scorecard
CF	Conceptual framework
CRM	Customer relationship management
CSA	Current state analysis
CSF	Critical success factors
DMS	Document management system
ERP	Enterprise resource planning
KPI	Key performance indicator
NPI	New product idea
NPV	Net present value
PBI	Microsoft Power BI
PDM	Product data management
ROI	Return of investment
SOP	Standard operating procedure
TRM	Traceability matrix

Contents

1 Introduction

In the changing and forward-looking environment of product development and product management, monitoring and analyzing the success or failure of products is essential for sustainable business growth. The journey from idea to market and customer implementation is full of challenges, which is why it is necessary to implement clear methods for monitoring product projects.

Effective product project monitoring includes continuous monitoring of key performance indicators (KPI) throughout the product's life cycle. From initial customer engagement to post-launch feedback, this process provides valuable insight into user preferences, market trends, and the competitive landscape. Analyzing these metrics not only measures the product's impact on users, but also reveals opportunities for development and innovation.

Understanding the factors that influence success or failure is essential for decision making. This requires reviewing sales data, customer feedback and market trends to identify trends and various connections. Findings and ideas from such analysis allow companies to iterate on product features, improve marketing strategies, and address potential pain points.

In rapidly developing markets, the ability to adapt and innovate based on real-time feedback is a competitive advantage. Successful product project monitoring and analysis ensure product longevity and help organizations stay ahead of changes in the industry, which promotes a culture of continuous improvement and flexibility in changing market situations.

1.1 Business Context

The Case Company, a Finnish biotechnology company, is a global leader in developing and manufacturing critical raw materials for global diagnostic industry manufacturers. The key products of the case company are monoclonal antibodies, antigens, and biological products, which play crucial roles in the development and functionality of diagnostic tests. These materials are used e.g., in hospital analyzers and in rapid tests used by healthcare or consumers, including tests for COVID-19 and pregnancy.

The company currently employs around 300 people at its locations in Europe, the United States and China. In recent years, the company has significantly expanded its product range, strengthened its scientific expertise and its local presence through acquisitions. These acquired companies operate in the same industry, offering products to a large extent to the same customer base as the case company.

Following the acquisitions, product development, manufacturing and product management have been carried out in various locations and under several managers. In connection with the organizational changes, functions have been condensed and now both product development and product management are managed globally. Each location has its own product development teams and the company's product range is distributed to product managers in different locations.

1.2 Business Challenge, Objective, and Outcome

With company acquisitions, there has been a pressing need to unify operating methods, processes and start using the same systems. Due to all the changes after the acquisitions that have taken place, many operating methods and processes have already been rethought and systems aligned, but many topics are still in the planning stage, such as monitoring of product projects. In different locations, teams, and stages of the process, several methods are currently used for project monitoring.

However, the monitoring has not been effective enough to support decision-making with proper analyses. It has also been noted that creating reports and analyses is time-consuming, either due to difficulties in locating information or because the necessary data is not recorded accurately. Additionally, as the organization and its units operate globally, uniform monitoring of product projects across all locations is crucial. This uniformity would enhance understanding of development and innovation opportunities and improve product portfolio management.

The objective of this study is to create recommendations for improving the monitoring of product projects at the case company, resulting in recommendations to improve monitoring of product project monitoring as an outcome. The case company can implement all or only some of the recommendations, recommendations can be applied to all or only some of the teams or products, and they can be implemented immediately or gradually.

1.3 Scope and Outline of the Thesis

This thesis contains seven sections. Section 1 introduces the business challenge, the objective of the study, and the planned outcome of the thesis. Section 2 describes the research approach and design and explains the data used to carry out the study.

Section 3 describes the current practices in product project monitoring in the case company. Monitoring practices in different product development stages are described, and strengths and weaknesses are analyzed. At the end of this section the findings are discussed, and key findings are selected for further development. Section 4 examines the definitions and practices, concepts, and tools for monitoring product projects from the literature focusing on the selected key findings. Different options are discussed, and the conceptual framework of the study is created and visualized.

Initial recommendations to improve monitoring of product projects are created in section 5. The recommendations are based on ideas of the model presented in the conceptual framework and the findings from the analysis of the current practices. In section 6 the feedback for the initial recommendation created in section 5 is received and reviewed. The final proposal for the recommendations for product portfolio management is created. The final section, section 7, contains the summary, recommendations for next steps and provides an evaluation of this thesis.

The next section, section 2, describes the selected research approach and research design and introduces the data used in this study.

2 Project Plan

This section describes the selected research approach and design and explains the data used to carry out the study. The business context, challenge, objective, and outcome were presented in the first section.

2.1 Research Approach

It is essential for a successful thesis project to choose a suitable research method for the study. Saunders (Saunders, et al., 2016) presents two main research methods, which are basic research and applied research. The choice of method is influenced by the purpose and context of the research. Basic research is described as research that aims to expand existing knowledge and better understand business or management processes. Such research is typically conducted in universities as well as in the academic community. Applied research, on the other hand, focuses on investigating a particular issue and different methods to solve it. Applied research is usually particularly relevant to the case organization and may be less relevant in the academic research sense. (Saunders, et al., 2016) There are several different ways to apply research, such as: case study, action research, or design research (Saunders, et al., 2016).

In his book, Kananen (Kananen, 2013) describes action research as process-like, in which operations are continuously improved through successive cycles.

In his book, he also discusses design research, which he also calls Applied Action research. Applied Action research aims to improve the function of an organization and the purpose is to produce practical and functional solutions for the use of the organization by combining development and research. It is typical for Applied Action research to focus on an organization’s business problem, involving stakeholders in problem identification and resolution, and for research to be conducted within a tight schedule. (Kananen, 2013)

Applied Action research using qualitative methods was chosen as the research method for this study. Applied Action research was chosen as the most appropriate research method after consideration because the research focuses on a specific business problem within the organization and aims to develop operations by recommending improvements to a specific process. The objective and outcome of this study do not include the implementation or evaluation of the impact of the recommendations on the process. Therefore, instead of a quantitative approach, a qualitative data collection method is chosen.

2.2 Research Design

After the objective of the thesis was defined, the research design was planned. This study includes four stages describing the process the study was conducted. The study was designed to proceed in logical successive stages with the data collection plans and the stage outcomes to achieve the objective of this study. The outcome of the previous stage provides information for the next stage. The research design of this thesis is shown in Figure 1 below.

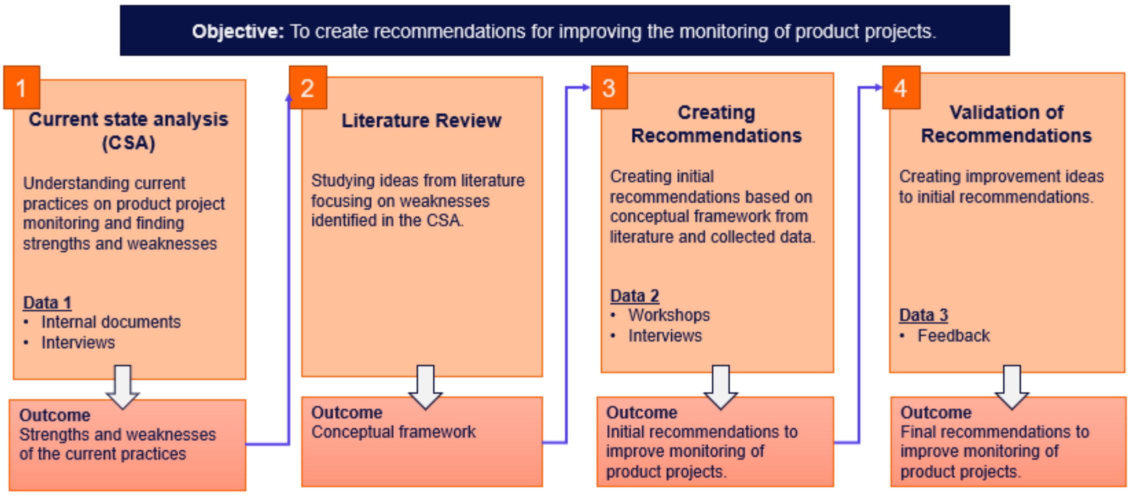

Figure 1. Research design of this thesis.

As seen in Figure 1, the first stage after determining the objective of this study is the current state analysis (CSA). The current state analysis was conducted by reviewing the case company's documentation, the current product project data and by interviewing relevant stakeholders. Based on the data collected, current practices were analyzed, and strengths and weaknesses identified. The outcome from this stage was the key findings which were used together with the outcome from the literature review in the stage 2 in creating the initial recommendations for product project monitoring in the stage 3.

In the stage two, the best practices and tools were searched in the literature, focusing on the weaknesses identified during the current state analysis in the previous stage. Utilizing the key findings from the literature review, a conceptual framework was developed to assess the business case and address the weaknesses identified in the case company.

The initial recommendations were created in the stage 3 based on the conceptual framework and the key findings from previous stages. The key stakeholders were used to create recommendations through workshops and interviews. The outcome from this stage was the initial recommendations for product project monitoring.

In the fourth and final stage, the recommendations were validated with the top management, and based on the feedback obtained, the final recommendations were created. The final recommendations to improve the monitoring of product projects form the outcome of this thesis.

2.3 Data Plan

Data from several different data sources are used in this study and data have been collected at different stages of the study. Data collection methods include case company's documentation as well as interviews with key stakeholders and internal workshops and discussions. A summary of the different data collection steps and methods is presented in Table 1.

Table 1. Data collection summary

Data	Content	Source	Informant	Timing	Outcome
Data 1 Current state analysis (CSA)	Current practices and data available Identify strengths and weaknesses	• Product data and documents in the systems • Stakeholder interviews • Meeting observations	• Product Managers • R&D Project Portfolio Manager • VP of R&D • Product Management Director	Jan-Feb 2024	Summary of strengths and weaknesses
Data 2 Creating initial recommendations	Creation of Initial recommendations	• Stakeholder interviews • Stakeholder workshop	• Product Managers • R&D Project Portfolio Manager • Product Management Director	April 2024	Initial recommendations for monitoring product projects
Data 3 Feedback, Validation	Adjustments to initial recommendation	• Feedback from key stakeholder	• Top Management: BU Decision maker	May 2024	Final recommendations for monitoring product projects

As seen in Table 1, Data 1 was collected for the current state analysis to review and analyze the case company's current practices monitoring product projects. Data 1 collection includes reviewing the case company's documentation and product data, relevant stakeholders' interviews, and meeting observations.

Data 2 was collected by discussing with the stakeholders in workshops and interviewing the stakeholders individually. The conceptual framework created combining information from key findings from the CSA and literature were presented in the workshops and in the interviews. The data from the workshops and interviews was used to create the initial recommendations.

Data 3 was collected through a discussion with a representative of top management, who provided feedback on the initial recommendations. Based on the feedback, the final recommendations were created.

2.3.1 Data 1 Collection and Analysis

Data 1 collection includes reviewing the case company’s documentation and product data, relevant stakeholders’ interviews, and meeting observations. Table 2 describes the internal documents and product data, and Table 3 the interviews and meeting observations used in the CSA stage. Documentation was collected and interviews were conducted between January and February in 2024.

Table 2. Data 1: Internal documents used in the current state analysis.

DATA 1 - Current state analysis (CSA): documents					
#	**Source**	**Data Type**	**Topic**	**Time**	**Documented**
1	New product idea process SOP in DMS	Document (PDF)	NPI process information	Accessed 4.1.2024	New Product Idea Process v5.0
2	Product development process SOP in DMS	Document (PDF)	R&D process information, Product success rate evaluation	Accessed 4.1.2024	Product development process v6.0
3	Management of R&D stage product stock and feedback SOP in DMS	Document (PDF)	R&D stage product feedback and reporting practices	Accessed 4.1.2024	R&D product stock and feedback v7.0
4	New product ideas in shared folder	Document (Excel)	List of new product ideas and idea evaluations	Accessed 4.1.2024	New product ideas
5	Product idea second evaluation template in DMS	Document (Excel)	Information used for decision-making to start a new product development project	Accessed 4.1.2024	Template - Second evaluation
6	Product idea evaluation template in DMS	Document (Word)	Information used for decision-making to start a new product development project	Accessed 4.1.2024	Template - Product idea
7	Project evaluation template in DMS	Document (Word)	Information collected after R&D project	Accessed 4.1.2024	Template - Project evaluation
8	New product idea Annual report 2022 in DMS	Document (PPT)	Monitoring parameters of new product ideas	Accessed 4.1.2024	NPI report 2022
9	R&D Product review report 2022 in DMS	Document (PPT)	Monitoring R&D KPI's	Accessed 4.1.2024	Annual report R&D 2022
10	R&D Product review report 2023 in DMS	Document (PPT)	Monitoring parameters of new product ideas	Accessed 30.1.2024	Annual report R&D 2023
11	Product Management Product review report 2023 in DMS	Document (PPT)	Monitoring product feedback and evaluations	Accessed 30.1.2024	Product feedback 2023
12	Project documentation report in shared folder	Document (PPT)	Deficiencies previously found in project monitoring	Accessed 4.1.2024	High impact project report 2022
13	Product evaluation template used at Site B	Document (Excel)	Information used for decision-making to start a new product development project at Site B	Accessed 1.2.2024	Template - Product evaluation Site B

Standard operating procedures (SOP), process descriptions, reports and used templates were collected from the company's document management system (DMS) and shared folders, which were related to the different stages of product project processes and their analysis and monitoring. One document was received from one of the interviews by email after the interview. With the help of all these above listed documents, it was possible to get a more accurate and comprehensive process description of product projects and an understanding of the methods and tools used in analysis and monitoring.

Table 3. Data 1: Interviews, discussions, and meeting observations used in the current state analysis.

DATA 1 – Current state analysis (CSA): interviews, discussions, and observations					
#	**Source**	**Data Type**	**Topic**	**Time**	**Documented**
14	Product Management Director	Interview and discussion (face-to-face)	Whole process, KPI's	8.1.2024, 30 min 23.1.2024, 60 min	Field notes
15	Vice President	Discussion (face-to-face)	Reporting, monitoring and data management	8.1.2024, 20 min	Field notes
16	R&D Project Portfolio Manager	Interview (Teams meeting)	Whole process	24.1.2024, 75 min	Field notes
17	Product Manager 1	Interview (Teams meeting)	Whole process	1.2.2024, 60 min	Field notes
18	Product Manager 2	Interview (face-to-face)	Whole process	31.1.2024, 60 min	Field notes
19	Product Manager 3	Interview (Teams meeting)	NPI process at Site B	1.2.2024, 60 min	Field notes
20	PM and R&D meetings	Observation	Process operation	Jan - Feb 2024	Field notes

In the CSA stage, people who are dealing with product projects and/or their monitoring were selected to be interviewed. A comprehensive list of the interviews and discussion performed is presented in Table 3, where the title of the interviewee, the main topic, the time and how the interview was documented are stated. The interviewees were chosen from both manager and director levels, different teams, and locations of the company, in order to enable a comprehensive picture of strengths and weaknesses and also to be able to identify different ways of working.

Observations were also made by participating in meetings related to the product projects, in order to get a better understanding of the actual working methods mentioned in the interviews and instructions, and thus also have an opportunity to observe the strengths and weaknesses mentioned in the interviews in practice.

A total of 20 data sources were used as Data 1 for the current state analysis, of which 13 were documentation and 7 were interviews, discussions, and observations.

2.3.2 Data 2 Collection and Analysis

Data 2 collection includes workshops and relevant stakeholders' interviews. Table 4 describes the workshops and interviews used in the initial recommendation creation stage. The workshops and interviews were conducted in April 2024.

Table 4. Data 2: Interviews, discussions, and meeting observations used in the initial recommendation stage.

DATA 2 – Creating initial recommendations: workshops and interviews					
#	**Source**	**Data Type**	**Topic**	**Time**	**Documented**
1	Product Management Director, R&D Project Portfolio Manager	Workshop 1 (face-to-face)	Initial recommendations	8.4.2024, 90 min	Field notes
3	Product Management Director, R&D Project Portfolio Manager	Workshop 2 (face-to-face)	Initial recommendations	10.4.2024, 60 min	Field notes
4	Product Manager 2, Product Manager 3	Workshop 3 (Teams meeting)	Initial recommendations	10.4.2024, 60 min	Field notes
5	Product Manager 1	Interview (Teams meeting)	Initial recommendations	11.4.2024, 60 min	Field notes

A comprehensive list of the workshops and interviews is presented in **Table 5**, where the title of the interviewee, the main topic, the time and how the interview was documented are stated. The interviewees were selected from both manager and director levels across various teams and company locations to capture as comprehensive a range of stakeholder suggestions as possible. The same stakeholders participated in the creation of the recommendation as in the CSA stage (Data 1) interviews.

A total of five data sources were used as Data 2 for creating initial recommendations. These included three workshops and one interview.

2.3.3 Data 3 Collection and Analysis

Data 3 collection includes top management interview. Table 5 presents the information from the interview used in the validation of the initial recommendation stage. The interview was conducted in May 2024.

Table 5. Data 3: Interview used in the validation stage.

DATA 3 – Validating recommendations: interview					
#	**Source**	**Data Type**	**Topic**	**Time**	**Documented**
1	Vice President	Interview (face-to-face)	Validation	5.5.2024 90 min	Field notes

As can be seen from Table 5, top management was interviewed in the validation stage. One of the Vice Presidents from the leadership team was chosen as a key stakeholder and Data 3 source to ensure a credible assessment of the initial recommendations derived from Data 2.

This completes the project plan section. The next section of this study presents the results of the first data collection step, including observations of the current state analysis of the product project monitoring of the case company.

3 Current State Analysis of Monitoring Product Projects

This section describes the current state analysis (CSA) of the case company's product project monitoring practices and related processes and tools. It also discusses the key findings categorized as strengths and weaknesses. The previous section presented the data collection methods together with the research approach and design.

This section contains four parts. The first part of this section describes the overview of the CSA stage. The second part is a description of the current practices followed by the analysis of key findings and categorization of strengths and weaknesses in the third part. And the last, the fourth part, is a summary of key findings to elaborate.

3.1 Overview of the Current State Analysis

Since the objective of this study was to create recommendations for improving the monitoring of product projects, the CSA began by gathering information about the company's current monitoring practices by examining the process itself, as well as related tools, available data, and reporting practices. After analyzing the documents, a series of interviews of key stakeholders were organized, in addition to which observations were made in meetings related to the product projects.

The collection of data for the CSA is initiated by reviewing the documents in the company's document management system (DMS) and common shared folders. General operating procedures (SOP's), templates used, and reports related to product projects of both product development and product management were chosen as data sources. The detailed list of used documentation is presented in Table 2 in section 2.3.1.

Based on the documentation, the first version of the monitoring practices of product projects was created. The final version of the current monitoring practices was created based on the information obtained from the interviews and discussions, supplementing the information in the first version. These monitoring practices are described in more detail in the next subsection 3.2.

As stated in the data plan in section 2.3, the key informants selected for the interviews and discussions were Product Management Director, One of the Vice Presidents, R&D Project Portfolio Manager, and three Product Managers. These key informants all work closely in the process that is the subject of the study, either by producing data for it, using the data, or observing it. Therefore, they could be expected to have the best understanding of the current state of product project process and its monitoring practices as well as the associated strengths and weaknesses.

The interviews focused on obtaining a more complete picture of the stages of product projects than the documentation provided, focusing on the stages where data is produced and monitored, in order to identify improvement opportunities. The interviews were conducted either face-to-face or via Microsoft Teams calls. Interviews with Finnish people were conducted in Finnish and people outside Finland, in English.

The organized interviews were semi-structured, and a set of general questions had been prepared in advance, but the interviewees were encouraged to share their own experiences and thoughts about the current state of the process. The observations made in the interviews were recorded in field notes during the interviews and summaries in English were written immediately after that. The interview questions prepared in advance are presented in Appendix 1.

Informal, unplanned discussions were held with a few key stakeholders in order to obtain the necessary additional information and clarifications on the topics revealed in the interviews. Observations were also made by participating in meetings related to the product projects, in order to gain a better understanding of the actual working methods mentioned in the interviews and instructions, and thus also have an opportunity to observe the strengths and weaknesses mentioned in the interviews in practice.

After analyzing Data 1, which included reviewing documentation and analyzing interview results, the current state of monitoring product projects was described. The strengths and weaknesses observed were detailed using three process steps: Product Idea, Product Development, and Commercialization. These are presented in Sections 3.2.1, 3.2.2, and 3.2.3, respectively. A summary of the strengths and weaknesses related to the monitoring of product projects was created and it is described in section 3.3.

The most relevant findings were categorized under three topics, one of which was strengths and two of which were selected as key findings to elaborate.

3.2 Description and Analysis of Current Practices

The analysis of the current state began by collecting and analyzing the company's documentation. From the standard operating procedures (SOP’s) related to the process or monitoring of product projects, it turned out that there is no separate guideline or process for monitoring product projects, but in many of the guidelines used as data sources, remarks were found of analyzing or monitoring parts of the processes. The product project has been divided into three subprocesses to describe the current state of product project monitoring in the case company. The steps of the subprocesses and their monitoring practices described in the subsections were created based on the documentation and interviews. Figure 2 describes the company's product development process.

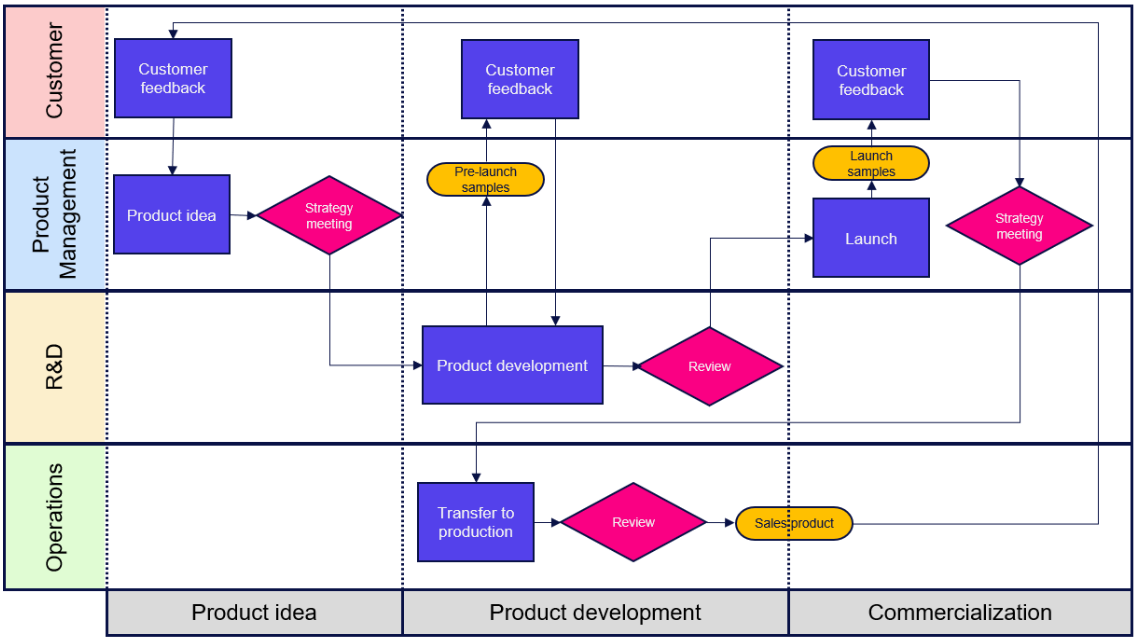

Figure 2. Product development process of the case company

As shown in Figure 2, the product development process is divided into three subprocesses: **Product idea, Product development** and **Commercialization.** The product development process begins with the collection of suitable product ideas and ends when products have been developed, launched to the market, and transferred to production.

The information collected and monitored in these three different subprocesses is presented in more detail in the following subsections.

3.2.1 Strengths and Weaknesses of Product Idea Stage

The company's new product idea (NPI) process has been unified globally and product management is responsible for handling new product ideas. Product ideas are processed with a two-stage evaluation, and the approved ideas are taken to the company's product strategy group for decision making. The process and the data produced in its various stages, as well as the current monitoring practices are described in Figure 3.

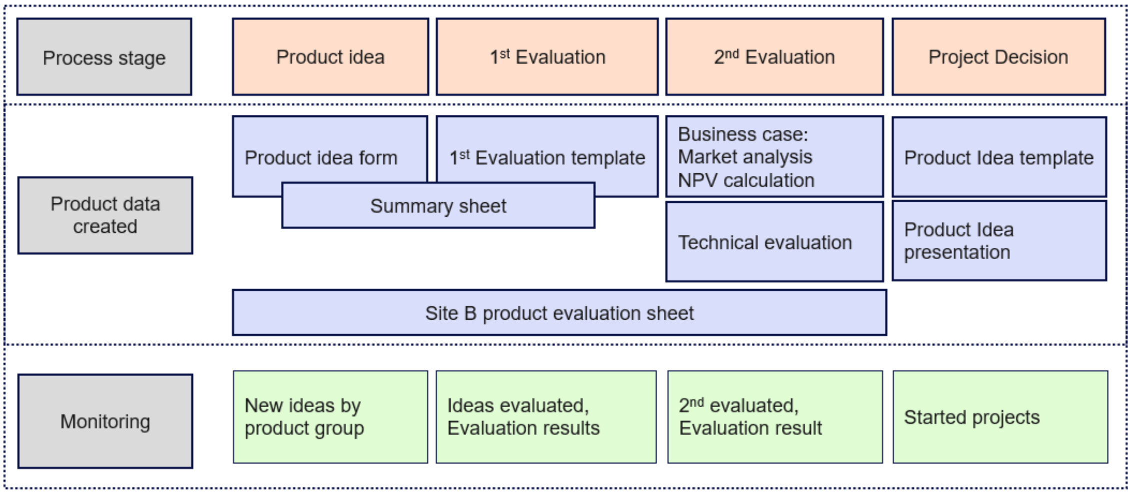

Figure 3. The company's product idea processing process and the data produced in its various stages, as well as the current monitoring practices.

As shown in Figure 3, the product idea process includes several stages. At the first stage all the product ideas are collected in the same table with the help of a questionnaire, and the product manager responsible for each product area handles the initial evaluation of the product using the evaluation form created for that purpose. The questionnaire and the information on the form used to evaluate the idea can be found in Appendices 2 and 3. The data is stored on a shared folder to which a limited group of users has access. Both the questionnaire data and the initial assessment data are together in the same Excel file, on their own sheets.

After the initial evaluation, the products selected for the next stage are subjected to a more detailed analysis, in which representatives of product development participate in addition to product management. The business case template and the product idea form used in this second stage can be found in Appendices 4 and 5. The product ideas selected for the next stage from this second stage are presented to the product strategy group for the decision to start the project. A PowerPoint presentation is created for the meeting using a specific product idea presentation template.

Current monitoring practices of this product idea process were not described in any of the company's current instructions but reports in the DMS used as Data 1 source shows that reports had been created annually. Information presented in those reports includes:

- new product ideas by product group
- evaluated and not evaluated ideas
- evaluated ideas by their result
- product projects started

The parameters presented in the annual reports had been compared with the results of previous years, but according to the documentation and the interviews, there have been no defined targets for them. Results have been considered good if they have been better than the previous year's results.

In the interviews, several interviewees stated that it was good that the new product idea process was implemented. They found the use of the new template clear, as it combines information into a single table, making it easier to access and monitor the progress of ideas. However, the interviews also revealed that making product evaluations is time-consuming. This is due to the need to collect large amounts of necessary information from different sources and add it into several different templates at different stages of the evaluation process. And it is also very difficult to find the information needed for evaluation and calculations.

In particular, the interviewees mentioned the net present value (NPV) calculation as part of the business case as a challenging and vague point. It is used in project decision-making and prioritization, however, the realization of the estimates made in it is not monitored systematically after the product is launched on the market. Several interviewees mentioned this as a significant shortcoming in project monitoring. One interviewee particularly mentioned that monitoring this would probably help in making more accurate and truthful calculations in the future. At the same time, however, it was noted that both the information used in general evaluations and in NPV calculations, and thus the information obtained from them, may be outdated by the time the project is completed. This is due to the fact that developing products from the initial idea can take several years. Consequently, it has not been customary to update these evaluations or calculations.

One interviewee mentioned that it would sometimes be meaningful to later track the source data used in the evaluation of product ideas. However, this has been challenging because the information about the sources of the ideas has not been previously recorded in all locations. The same interviewee mentioned that some of the evaluators add links to information sources in the templates they fill out, which is really useful and could be implemented in practice.

Prioritizing product ideas was also perceived as difficult, as product managers may favor ideas from their own product areas. Product managers should be able to rank the product ideas within their own areas and also compare ideas across different product areas. Prioritization has been done both based on NPV and by evaluating different properties of the product ideas in joint product management meetings. The opinion of product development has also been asked and used in decision making. A prioritization tool was considered for the second stage evaluation, but it has not been created and therefore has not been implemented in the new process.

New product ideas are collected using the Forms questionnaire, which outputs the information from the product form to an Excel table. Product managers transfer ideas to evaluation tabs according to product groups. Summary tables are maintained on one tab, from which the number of new ideas and the status of processed and unprocessed product ideas can be monitored. The summary table has proven to be an effective tool for monitoring various aspects, such as which clinical areas or product groups receive the most ideas and the number of unprocessed product ideas. This information helps guide the time spent on processing these product ideas. The disadvantage of the summary table has been its unreliability because the formulas in Excel only work correctly if the output data on the other tabs is correct. Formulas are therefore vulnerable to typos or edits made by users, as well as missing data.

With the new product idea process, personal targets have been set for the product management persons who make evaluations, both for the number of product ideas to be evaluated and the number of product ideas that have been accepted as a new product project. However, these goals do not appear in the summary table, i.e. the product managers monitor their own goals themselves, each in their own way.

All the interviewees who did the evaluations themselves mentioned that it takes a great deal of time to process product ideas, but no one had more detailed information on how long the processing time in different stages, or as a whole, is in practice. During the introduction of the new product idea process, it had been stated that the registered product ideas should be processed as quickly as possible, but the target time has not been defined.

In addition to the uniform product idea process of global product management, a separate product idea list is collected at the company's Site B. The team at Site B evaluates the product ideas of its own market area with its own evaluation template, which differs from the templates used by the global team. The table in question also has a prioritization tool, in which points are given for different properties according to pre-agreed instructions, and with which the order of importance of the products can be monitored. The new product idea evaluation and prioritization monitoring is done in one table. The summary of the evaluations made by the team at Site B is recorded in the evaluation template used by the global process.

3.2.2 Strengths and Weaknesses of Product Development Stage

When a decision has been made for the product idea to start the project, the actual product development project stage begins. The process and the data produced in its various stages, as well as the current monitoring practices are described in Figure 4.

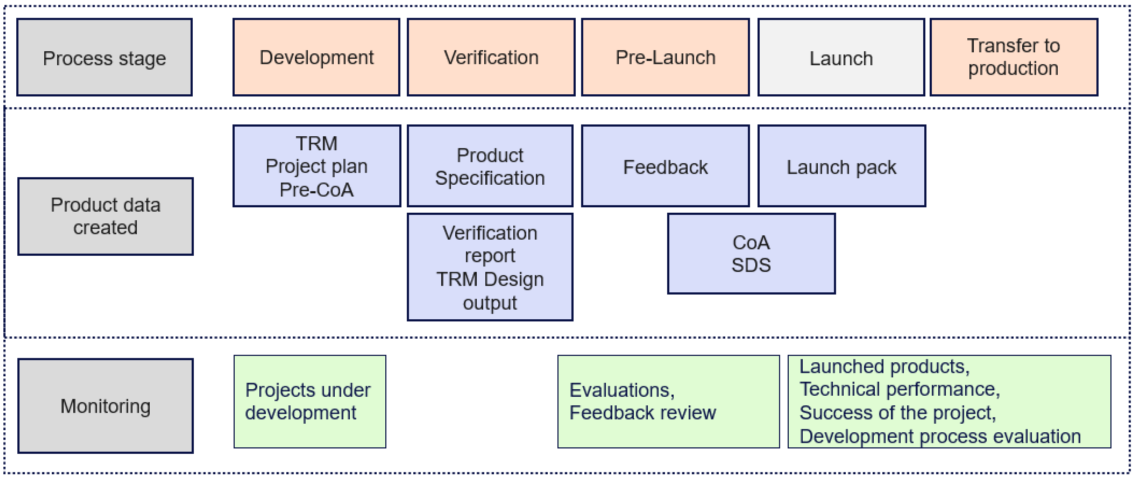

Figure 4. The company's product development process stages and the data produced in its various stages, as well as the current monitoring practices.

As shown in Figure 4, in addition to the actual development stage, the stages of the product development project include verification, pre-launch, product launch, and transfer to production.

In the first stage of the product development project, customer requirements, design contributions and requirements for verification are documented in the traceability matrix (TRM) model together by product management and R&D. During product development, the R&D team is responsible for developing the product into a final form that meets the design input requirements recorded in TRM. This TRM document is new to the process, and there is no experience with its use yet; therefore, no information on monitoring practices or feedback on the TRM was received from the interviewees.

In the final stage of the product development project, before the final completion of the product, pre-launch samples of the product can be sent to selected customers for testing. Product management monitors the sent samples and collects customer feedback to share with the product development team. When product development completes the product, product management prepares the product launch. After the launch, product management monitors product sales and feedback.

At the end of product development projects, a project evaluation meeting is held, where e.g., duration of different project stages, costs, customer feedback and general comments from product development and product management are monitored. However, observations from the meeting revealed that this data is not compared to any targets; therefore, the meeting does not assess whether the actual numbers are satisfactory.

Based on the interviews, the new product idea process with new templates has been found to be good. However, for effective real-time monitoring of projects, better tools are needed to prioritize them. Currently, product managers are asked to prioritize projects and product development provides their own proposal to support decision-making. But there are no rules and guidelines defined for prioritization, which makes it challenging.

Information during product development is mainly stored in the company's document management system or in location-specific shared folders. The product development teams have access to their own local data, and in some cases also to other teams’ data, but in general there is no global visibility for the R&D data in different locations. The information is also mainly stored in each country's own language, which means different teams cannot smoothly read or understand each other's documentation. Also, product management only has partial access to product development data, and thus monitoring projects is not always possible for the individuals themselves but require assistance from local team members.

The interviews also revealed that especially Finnish R&D people have had challenges in finding product information if the information is stored elsewhere than in the document management system they mainly use. Product idea data is stored in a shared Teams folder, where they have access, but sales data is viewed in a separate reporting tool, where product development people generally have not had access. If the product development team wanted to monitor product sales, they would request sales figures from product management. Both the earlier documentation and the interviews made it clear that in both product management and product development, it is unclear how the different time points in the project are determined. For example, it is unclear how the dates are determined for the start of the project and the product launch. This leads to inconsistencies in the reports produced by different teams, as the same terms are used even though the calculation methods and date specifications vary across teams.

3.2.3 Strengths and Weaknesses of Commercialization Stage

The commercialization stage already starts with the launch of the product. The process and the data produced in its various stages, as well as the current monitoring practices are described in Figure 5.

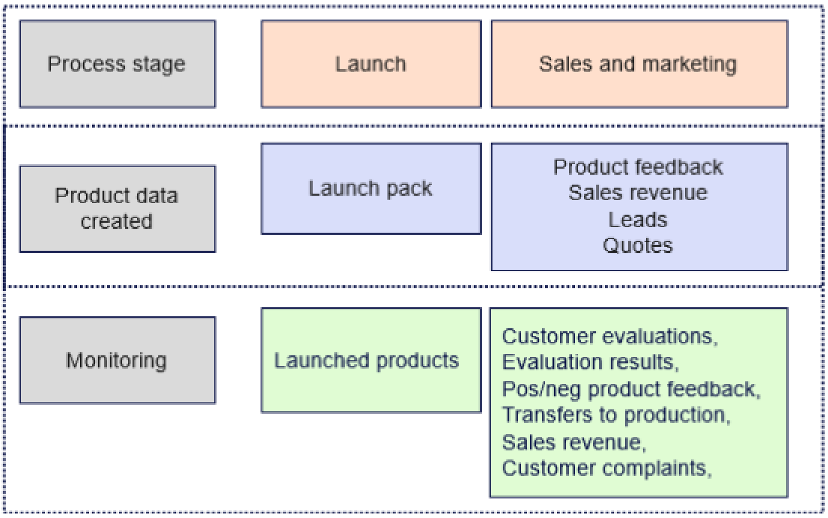

Figure 5. The company's commercialization process stages and the data produced in its various stages, as well as the current monitoring practices.

As shown in Figure 5, the commercialization process steps include the product launch as well as the sales and marketing of the launched product.

Product management launches new products on the market and monitors the number of launches each year. Samples of the products are sent to customers and sales quotes are made, and with these measures, the number of sample shipments and the feedback received from them, as well as sales, are monitored. The general quality policy of the company also includes the monitoring of complaints, product changes and product deviations. Basic product information and sales data are maintained in the company's Enterprise resource planning (ERP) system.

A new customer relationship management (CRM) system was introduced in the company last year. The CRM system is used in the company in the commercialization stage, e.g., for making sales quotes, recording evaluations and product feedback. Due to the short operating time of the new system, the information that can be obtained directly from the system is limited, resulting in monitoring evaluations and product feedback being currently still challenging. However, it is believed and hoped that the necessary information will increase and be enriched in CRM already during the current year, as the development of the software continues, the sales teams' ability to use the software increases and the reporting possibilities supported by the CRM are developed.

At Site B, evaluations and product feedback are recorded in a separate table and shared with the global team every other month. One of the interviewees is responsible for processing and monitoring feedback and has experienced it laborious and time consuming, because the data must be combined from both old and new CRM systems and from a separate table provided by the Site B team, where the data is described in a slightly different way than in the new CRM system.

The new sample process, which has been created in cooperation between product management and sales, is just about to be completed and taken into use. The goal of this new process is to increase the number of samples sent to customers, leading to higher numbers of products selected for validations and hence increased sales revenue. The metrics and monitoring of this process will be agreed upon when the new process is implemented. But the goal is to be able to track the sent product samples, i.e. product evaluations and the product feedback received from them. And since this process was not yet in use, no feedback was received from the interviewees on the process and its monitoring, but the interviewees were of the opinion that the monitoring of the sample process has not been effective so far and it was nevertheless considered an important part of the product project monitoring. The interviewees were also satisfied with the creation of the new process and the use of the new CRM system to track sample shipments. However, it was also noted that due to the system's recent implementation and the new sampling process, only a limited amount of evaluation information and product feedback is currently available.

The sales of the product are monitored using Power BI reports, which were found to be user-friendly according to the interviewed members of the product management team. However, the interview revealed that sales reports have not been distributed to product development personnel, preventing them from monitoring sales as they might wish. In general, the product development team would like to see more information sharing, such as sales data and sample quantities of new products, to enable independent monitoring of product projects. Although these metrics are reviewed twice a year in the joint product review meetings between product development and product management, there is a desire for more frequent information sharing. Communication about high sales or successes of product projects was perceived as one of the motivational factors for the product development teams.

The interviews also revealed that it is unclear when a product project can be defined as successful, since actual targets for metrics such as sales have not been established, except in the NPV calculations. This results in sales being monitored only at a general level. Several of the interviewees stated that since a considerable amount of information is analyzed and recorded before and during the product projects, it would be interesting and important to monitor their implementation after the projects are finished and when the products have been on the market for some time. In other words, the interviewees also believed that the monitoring of product projects needs improvement.

The interviewees found current meetings related to the product project and general product related practices to be useful in sharing information and monitoring product performance. The largest of the meetings is the annual product review, where different teams present information related to the products from their respective perspectives. These meetings cover topics such as sales of products, product ideas, product development projects, and new and discontinued products, even if at a general level. Additionally, a joint product meeting between product management and product development is held every six months, focusing on customer interest and feedback regarding the products. Project meetings also occur during the product development phase. Additionally, products are discussed, and reports are generated in a wide variety of meetings, sometimes with very short notice. This can be challenging, as the necessary product information is not always readily available.

3.3 Summary of Findings

In the previous subsections, the CSA was divided into product development stages to simplify discussions with the interviewees. However, similar findings related to the same topics were made in different stages of the product development process. Therefore, these findings have been consolidated, and the division according to the process stages is no longer applied in the further analysis of the findings. The summary of the findings of the current state analysis, divided into strengths and weaknesses, is presented in Table 6. The strengths are highlighted with a green plus sign, and the weaknesses with a red minus sign. The sources of the findings are listed in the last column of the table.

Table 6. Summary of the findings of the CSA divided into strengths and weaknesses.

No#	+/-	Strength or weakness	Sources
1	+	Teams and company management have a common interest in improving processes.	Interviews, documentation
2	+	Product idea evaluation summary sheet makes easy to monitor ideas and their progress.	Interviews
3	+	The new sample process is created.	Interviews, documentation, meeting observations
4	+	Current meeting practices are a good way to share information and monitor performance of the products.	Interviews, documentation, meeting observations
5	+	The new CRM system is in use with track sample shipments and feedback monitoring function.	Interviews, meeting observations
6	+	Power BI reports and dashboards are useful for sales monitoring.	Interviews
7	-	Product idea evaluation is time-consuming.	Interviews, meeting observations
8	-	Information needed for NPV calculation is hard to obtain.	Interviews
9	-	Prioritization parameters and tools have not been defined.	Interviews, documentation, meeting observations
10	-	Relevant project or product data is not available to all stakeholders.	Interviews, documentation, meeting observations
11	-	Product and project information may be inconsistent across sites.	Interviews, documentation
12	-	The use of Excel in analysis and data source is sensitive to user errors.	Interviews, meeting observations
13	-	Creating reports is time consuming.	Interviews, discussions
14	-	Same or similar information added to several documents.	Interviews
15	-	Project success factors are unclear.	Interviews, documentation
16	-	Only few targets or KPI's set.	Interviews
17	-	Final properties or sales of the product not compared to initial information or estimates.	Interviews, documentation
18	-	Accuracy of the initial evaluation data is not re-evaluated as the project progresses.	Interviews
19	-	Lack of information in the new CRM for product evaluation and feedback monitoring function.	Interviews
20	-	Product feedback reporting is inconsistent across sites.	Interviews, meeting observations

As shown in Table 6 a total of 20 findings were listed, of which 6 were strengths and 14 were weaknesses. Most of the strengths were related to the general improvement of the processes, systems and operating methods used, as well as proven meeting practices. Regarding weaknesses, the findings were related to undefined, unused, or missing product or project parameters and targets as well as finding or storing product or project information.

3.4 Key Findings to Elaborate

The aim of the current state analysis was to clarify the methods and tools related to the monitoring of the company's product projects at different stages of the process and to determine the weaknesses and strengths to be able to create recommendations for better monitoring practices. Table 7 shows the CSA findings divided into three main categories as a summary of key findings to elaborate.

Table 7. CSA findings summarized into key findings to elaborate.

Category	No#	Findings
Strengths	1	Teams and company management have a common interest in improving processes.
	2	Product idea evaluation summary sheet makes it easy to monitor ideas and their progress.
	3	The new sample process is created.
	4	Current meeting practices are a good way to share information and monitor performance of the products.
	5	The new CRM system is in use with track sample shipments and feedback monitoring function.
	6	Power BI reports and dashboards are useful for sales monitoring
Improvement of data management and visualization	8	Information needed for NPV calculation is hard to obtain
	10	Relevant project or product data is not available to all stakeholders
	11	Product and project information may be inconsistent across sites.
	12	The use of Excel in analysis and data source is sensitive to user errors.
	13	Creating reports is time consuming.
	14	Same or similar information added to several documents.
	19	Lack of information in the new CRM for product evaluation and feedback monitoring function.
	20	Product feedback reporting is inconsistent across sites.
Improvement of project evaluation and target setting	7	Product idea evaluation is time-consuming.
	9	Prioritization parameters and tools have not been defined.
	15	Project success factors are unclear.
	16	Only few targets or KPI's set.
	17	Final properties or sales of the product not compared to initial information or estimates.
	18	Accuracy of the initial evaluation data is not re-evaluated as the project progresses.

As shown in Table 7, several weaknesses were found related to data management and tools used to store or present data. Another group of weaknesses were found to relate to practices used in product ideas and project evaluation. Also, weaknesses linked to target setting and in general monitoring performance of various stages and the whole project. The key findings to elaborate in this study include the ones marked in red in Table 7: improvement of data management and visualization as well as improvement of project evaluation and target setting.

In this section, an analysis of the current state and the key findings on strengths and weaknesses was presented. The following Section 4 presents the improvement ideas found in the literature for the selected weaknesses presented in this section.

4 Improvement Ideas for Product Project Monitoring from Literature

In the previous section, an analysis of the current state of monitoring product projects and the most important findings on strengths and weaknesses were presented. In this section, the best practices and tools were searched from the literature, focusing on the weaknesses identified during the current state analysis in the previous stage. Utilizing the key findings of the literature review, a conceptual framework was developed to assess the business case and address the weaknesses identified in the product project monitoring in the case company.

As a result of the CSA, the improvement of data management, visualization, project evaluation and target setting were selected as key findings to elaborate. Based on literature, these themes have been discussed in the subsections below, and the last subsection presents a conceptual framework compiled from this literature review, which is used together with the CSA findings to create the initial recommendations for monitoring new project projects in section 5.

4.1 How to Improve Product Data Management and Visualization

This section and its subsections focus on enhanced data management focusing on unified data, data management systems, and visualizations.

4.1.1 Unified Data

Product Data Management (PDM) plays an important role in the success of product projects, and it can be considered a strategic company asset. It involves the effective management of product data throughout the entire life cycle of a product, starting from the initial idea gathering and evaluation stage until the product is launched and customers start using it. Product information must also be easily available there where it is needed and by whoever needs it. (Peltonen, 2000; Stark, 2022)

During the idea gathering and evaluation stage, product data management helps in organizing and storing all the relevant information related to the product idea. This includes data such as market research findings, customer feedback, and competitor analysis. During the development stage, product data management helps in creating and maintaining the product's specifications, drawings, and models. It also facilitates collaboration and communication among different teams involved in the development process, such as engineering, manufacturing, and marketing and sales. Throughout the development process, product data management ensures that all changes and modifications made to the product are properly documented and tracked (Kropsu-Vehkaperä, 2012). As the development process continues, product data management ensures that relevant marketing information, production data, and knowledge and experience are analyzed and utilized to evolve potential design solutions, determine the desired functionality of the product, estimate expenses, and adhere to any necessary restrictions. This helps in maintaining the integrity and consistency of the product data, ensuring that all stakeholders have access to necessary product information, facilitating efficient decision-making and reducing the risk of miscommunication or errors.

The literature (Stark, 2022; Cooper, et al., 2001; Silvola, et al., 2019; Kropsu-Vehkaperä, 2012) presents several challenges found in the management of product information and therefore also provides guidelines for improved data governance including data integrity, availability, security, and alignment with company strategy.

Paying attention to data integrity is one key thing in data management. It is important to ensure that product data remains accurate, consistent, and reliable throughout its life cycle. Attention should be paid to cleaning data and harmonizing data between different units. Silvola et al. (2019) highlights the importance of master data as essential information needed in the organization’s various business applications and processes for achieving strategic business goals including better decision-making. Master data refers to a process that is independent of specific applications and is responsible for defining, owning, and managing essential business data sets. Company-wide master data typically includes key business entities such as customer, product, employee, supplier, and asset information, and is critical to ensuring consistency and accuracy of decision-making across the processes. Product master data should ideally be created once and utilized throughout the product life cycle. And by implementing robust data governance practices involving various stakeholders; data accuracy, completeness, and consistency can be ensured (Kropsu-Vehkaperä, 2012).

Data availability can be a challenge since data is typically stored in different sources. Therefore, the correctness of the received data must be ensured, and the inefficiency caused by data transfers between data locations must be reduced. With the help of system integrations, IT systems and their data can be combined, thus ensuring the correctness of data, and enabling a seamless data flow between e.g., CRM, ERP and PDM systems (Silvola, et al., 2019). System integration also enables the real-time monitoring of data quality and integrity as well as timely use of product information, which is essential for enabling efficient operations and decision-making processes (Kropsu-Vehkaperä, 2012). Also, with system integrations data security can be improved by managing user access and rights as it is relevant to protect sensitive product data from unauthorized use or manipulation. For different stakeholders, different data can and should be available. By creating user-specific views or a dashboard within the systems used, stakeholders can review and analyze the specific information they need.

Silvola et al. (2019) emphasize in their research the alignment of product master data with company strategy. Product data should directly support these objectives, whether they are related to market expansion, customer satisfaction, innovation, or operational efficiency. Therefore, it is important to ensure that the collected and maintained product information remains relevant and meets strategic needs. This may include re-examining what data is collected, how it is structured and how often it is updated. By analyzing data definitions and their linkages to business drivers together with management, helps in supporting categorization and ensuring that product data requirements are defined clearly from a business perspective, especially during product development.

4.1.2 Data Management Systems

The amount of product information produced during the life cycle is growing rapidly and many companies have challenges in managing it. There are many kinds of product information, and it is often maintained and managed in various systems, including ERP, CRM, and PDM. Product Data Management (PDM) systems can either manage all information related to a product throughout its life cycle or focus specifically on managing technical information that arises from the product development process.

These PDM systems focusing on product development data are primarily concerned with the technical aspects of products, often leaving out operational manufacturing data, sales, delivery processes, and costs and prices. With the help of a comprehensive PDM system, product information can be managed throughout the product's life cycle and the information is available to users at the right time, from one place (Stark, 2022, p. 11). PDM systems provide secure storage for documents and other objects, ensuring controlled access to manage data efficiently. This secure environment helps in maintaining the integrity of the data and preventing unauthorized access. These systems are equipped to manage data across different sizes, types, formats, and media, which increases flexibility and applicability in different operating environments (Stark, 2022).

The PDM systems enable objects to be associated with a variety of attributes, which can be used to describe the properties of documents and other objects. Attributes can be then used e.g., for searching and classifying objects. PDM systems can handle the evolution of an object through successive versions. This version control feature is crucial in environments where users modify existing models frequently and different versions need to be accessed later.

With the help of PDM systems, it is also possible to manage different variations of the object, which contain different versions of products or documents as well as facilitate the change management.

Much of the product data has been handled in ERP but additionally also by using Excel as a handling tool for product data. Since there is a huge amount of product-related data to manage, companies increasingly integrate product data into ERP systems, which aim to handle almost all company data comprehensively. Although ERP systems have begun to include PDM functions, often as add-on modules, their capabilities in this area are still limited. Thus, ERP systems cannot yet completely replace PDM systems. Despite this, there is significant overlap between PDM and ERP systems and a growing need for interoperability and data sharing to improve efficiency and data consistency across the company's various functions (Peltonen, 2000). PDM systems are designed to work in conjunction with other enterprise applications such as ERP and CRM systems, providing a unified environment for product data management (Stark, 2022).

Project management systems also play a key role in product development projects, as they provide the tools and framework needed for effective planning, implementation and monitoring of all phases of product development. These help organizations align project goals with business goals, manage resources effectively, and ensure timely delivery of projects. They facilitate communication and collaboration between different teams, which enables real-time updates and changes to project plans. In addition, project management software often includes features such as task scheduling, risk assessment, budget management, and performance monitoring that are necessary to manage the complex workflows and multiple dependencies typical of product development projects. (PMI, 2021)

Product data is created and processed by many people during the product's life cycle, which is why it is particularly important that these people understand the importance of the information they create and process. To ensure the integrity and correctness of the data, an investment must be made in training for the use of the systems, and people must be committed to correct and continuous use of the systems.

4.1.3 Visualizations

Effective data management involves not only organizing and storing data but also making it accessible and understandable to stakeholders. Visualization of product data serves this purpose by presenting complex information in a visual format that is easier to interpret and analyze. It allows users to gain insights, make informed decisions, and collaborate more effectively throughout the product life cycle. Visualization improves the usability and value of product data by providing intuitive ways to explore and interact with it, therefore visualization is an important aspect when considering how to manage and leverage product data effectively, especially to support decision-making.

Kropsu-Vehkaperä and Haapasalo (2011) highlight the importance of building separate views tailored to different stakeholder groups for effectively utilizing product data. These distinct views allow stakeholders to access relevant information based on their specific needs and roles. By doing so, organizations can enhance collaboration, decision-making, and overall efficiency in managing product data. And respectively Geraldi and Arlt (2015) emphasize the power and importance of visuals in problem analysis and decision-making processes within project and portfolio management. Their study examines the impact of visuals in project portfolio decision-making and emphasizes that well-designed visuals can help cognition by facilitating different perspectives, processing large data sets efficiently, expanding short-term memory, influencing negotiations, storing, and sharing information, and inspiring commitment.

Visualizations should be designed to specific needs and align them with the objectives of the decision-making process or different stakeholders. This includes focusing on the type of information that is most relevant to each group, ensuring that the visualization delivers the intended message clearly and effectively (Kropsu-Vehkaperä & Haapasalo, 2011). And by choosing the most relevant and informative visuals, it can be ensured that each visual element has a meaningful impact on the decision-making process (Geraldi & Arlt, 2015). By adding interactive features such as drop-down options, tooltips, and filters to visuals, users can process data, explore different perspectives, and gain deeper insights.

The design of visuals should be done also with the end-user in mind, considering their preferences and abilities to use the visualization tool, and familiarity with visual formats, and avoid unnecessary complexity. In this way, it can be ensured that the visuals are intuitive, easy to use and tailored to meet the specific needs of different user groups. A detailed explanation of the visual, support for its use, and iteration of user feedback and visual design increase usability and efficiency in supporting decision-making processes (Geraldi & Arlt, 2015). The goal is to make the data easy to understand at a glance, which requires using descriptive headings, avoiding complexity, and choosing the right types of charts and graphs that best represent the underlying data. Gathering feedback from users and continuously iterating on the design based on this feedback is vital. This feedback process helps in refining the visualizations to better meet the needs of the stakeholders over time (Kropsu-Vehkaperä & Haapasalo, 2011).

These principles help ensure that visualizations are functional and effective in displaying the desired information to different stakeholders. In addition to the principles related to visual design, the literature presents visual methods and tools in use. Various data visualization techniques can be used to improve project management and decision-making processes by providing clear, actionable information about project performance, risks, resource allocation and strategic alignment.

Joana Geraldi and Mario Arlt (Geraldi & Arlt, 2015) provide a selection of data visualization techniques commonly used in project management and decision-making processes. Some of the key visualization techniques and tools presented in their book are dashboards, Gantt charts, mind maps and bar and bubble charts.

Dashboards are visuals that show essential information at a glance. They can provide a view of project statuses, KPIs, or other critical data. They help managers and stakeholders quickly assess project details and make informed decisions. Dashboards typically show real-time data and specific, defined metrics that are critical to a success of the topic visualized on the dashboard. In project management, dashboards can show task progress, budget status, resource allocation, risk levels, and more. They allow managers and stakeholders to monitor project status and make decisions quickly without detailed reports. To create a powerful and interactive dashboard, tools such as Microsoft Power BI or Tableau can be used.

Gantt Chart is a classic project management tool used scheduling activities over time, showing start and end dates, the sequence of tasks, and dependencies between tasks. They are invaluable for planning and tracking project timelines. It is a type of bar chart that illustrates a project schedule. It represents the duration of tasks against the progression of time. Each bar on the chart indicates when a particular task or set of tasks starts and ends. Instead of a Gantt chart, although less often used, a visual tool for monitoring the various stages of the status of projects is a portfolio funnel, where the projects are displayed according to the stages in the project portfolio funnel. Basic systems such as Microsoft Project and Trello can be used to create Gantt Charts and track project schedules.

Mind Maps are useful in the ideation stage of project management. They can be used to visually organize information, promote creative thinking, and structure ideas, making it easier to see the relationships between different aspects of the project or breaking down complex problems into actionable parts. Mind maps are diagrams used to visually organize information, typically centered around a single concept. From a central idea, branches are drawn out to represent connected thoughts, tasks, or data points. MindManager and XMind are examples of tools specialized for creating mind maps.

Bar charts and bubble charts are commonly used chart models for all kind of data visualization. Basic bar charts are among the simplest and yet the most effective tool for visualization. They are primarily used to compare quantities across different categories, and they can visually summarize large data sets in an intuitive format that is easy to understand and communicate to stakeholders. Compared to basic bar charts, bubble charts are a type of chart that extends features by adding a third dimension, represented by the size of the bubbles. These are particularly useful for displaying data involving multiple variables. In project management, bubble charts can be used to visualize a more complex data set, where each bubble represents a project or project stage with several variables, such as costs, size, or risks. This allows stakeholders to assess relationships between projects or variables at a glance. Charts can be created using a variety of tools, from simple spreadsheet software to more advanced data visualization platforms. Tools such as Microsoft Excel, Google Sheets, Tableau and Microsoft Power BI are commonly used for creating charts.

Consistent use of colors, styles, and layouts across visualizations helps strengthen visualization understanding and facilitate comparison. This also requires guidelines intended for the authors of the visualization and their compliance in order to maintain a uniform appearance and functionality (Kropsu-Vehkaperä & Haapasalo, 2011).

However, it is important to note that visuals can also be misleading if not used or designed consciously (Geraldi & Arlt, 2015). As mentioned in the beginning of this section, choice of visualization must align with the specific needs of the data and the information requirements of the stakeholders. It is also easy to overemphasize strong visuals and neglect other communication and decision-making tools. It is therefore essential to understand that visualizations are only one part of a comprehensive decision-making toolkit and that it should be used wisely alongside other methods. At the same time, it is also important to remember that better chances of success in managing and visualizing product and project information require gathering feedback from stakeholders and continuous improvement of used practices.

4.2 How to Improve Project Evaluation and Target Setting

This section and its subsections focus on literature defining key parameters, setting targets and KPI’s as well as prioritization.

4.2.1 Defining Key Parameters

Monitoring the success or failure of product projects requires a comprehensive approach that considers various parameters across different stages, from ideation to development and finally to launch. It is essential to define key parameters that serve as indicators of progress and performance throughout the project's life cycle. (Cooper, et al., 2001). These parameters should be carefully chosen based on the specific goals and objectives of the project, as well as the industry and market conditions (Stark, 2022). In his book, Kerzner (2017) differentiates metrics and KPIs and explains that metrics tell us where we stand today, while KPIs guide us toward where we want to be tomorrow. Both provide valuable information but KPI’s provide more strategic meaning for decision making.

Key parameters, also called key metrics, are specific variables or factors that can significantly affect the outcome of the project or the performance of the product. Cooper et al. (2001) provides one sample list of key metrics of project divided in four categories: General, Resources, Scores and Ranking, and Financial and Probabilities. All these categories include several metrics, over 30 in total, covering parameters such as project name, project identification, priority, project type, market segment, source of idea, resource allocated, costs, time to completion, ratings, NPV, probability to adjusted NPV. The total list of provided metrics is presented in Appendix 2. When defining the metrics, it is crucial to understand the purpose and use of them, as metrics must provide clear and truthful representations of project status to support informed decision-making (Kerzner, 2017).

Metrics should be chosen based on their ability to provide valuable insights into project performance, including aspects such as cost, time, quality, and stakeholder satisfaction (Kerzner, 2017). It is also important to select metrics that are specifically relevant and useful for the project at hand (Kerzner, 2017) but in a larger picture, it is beneficial to consider the common parameters for an entire product or project portfolio collectively, thus enabling effective monitoring across the portfolio. To avoid the need to search for essential information at the end of the project, it is crucial to establish key parameters at the start of the project (Cooper, et al., 2001).

To ensure that metrics can provide valuable insights into project performance, they must be selected based on the project's targets. Each goal must have its own metric, which can be used to clearly measure performance in relation to the target in question. This can ensure that the key metrics are practical and functional and closely linked to the project's targets, which provides a clear way to also evaluate and improve performance in alignment with strategic goals (Stark, 2022). Once these parameters are defined, various lists, charts, and graphs can be created to effectively monitor and present the data (Cooper, et al., 2001).

4.2.2 Setting Targets and KPI’s

Setting clear targets and defining key performance indicators (KPI’s) is important for the success of product projects. Project targets are a set of specific, quantifiable, and time related goals that a project aims to achieve within the project timeline and KPI’s are used to measure the effectiveness and efficiency of ongoing projects toward achieving key business objectives. (Stark, 2022)

Well-defined targets and KPI’s are aligned with an organization’s goals and vision, ensuring that efforts are directed toward meaningful outcomes. Furthermore, targets provide a clear direction for the project team and stakeholders, enabling them to focus their efforts on specific outcomes. Properly defined targets and KPI’s enable measurement and control, allowing organizations to track progress, identify areas for improvement, and make informed decisions. (Kerzner, 2017)

The literature presents (Cooper, et al., 2001; Parmenter, 2015; Stark, 2022; Kerzner, 2017) many very similar descriptions of the best features of KPIs. These characteristics ensure that KPIs are effective tools for project management, providing meaningful insights into project performance and guiding strategic decisions. These features include:

- **Measurable:** KPI’s should be measurable, providing a clear framework to assess project progress and success.
- **Relevance and alignment with goals:** KPI’s should be closely aligned with and directly relevant to the organization’s overall goals.
- **Focus and direction:** KPI’s should show direction to project teams and stakeholders focusing on specific outcomes thus helping teams prioritize tasks and activities.
- **Simple and clear:** KPI’s should be simple, clear and understandable to all stakeholders.
- **Timeliness:** KPI’s should be reported in a timely manner to be effective.
- **Actionability**: KPIs should be actionable, guiding decision-making and lead to actions.

KPI’s may include parameters such as the number of new products launched, time to market, customer response time as it influences satisfaction, and the return on R&D spend. When selecting KPI’s, it is essential to consider several factors to ensure they align with project and company goals and provide meaningful insights into performance.

In addition to defining targets, David Parmenter (2015) emphasizes in his book the practical aspects of implementing KPI methodology and importance of preparation when selecting KPI’s and he introduces the six-stage process for successful KPI implementation:

- **Preparation:** This is 50% of success as half of the success lies in groundwork.
- **Design**: Identifying critical success factors (CSFs) that drive performance and choosing KPI’s that are operationally relevant and align with CSFs. Developing clear formulas for each KPI.
- **Data collection**: Determining where data will come from, how often it will be collected and who is responsible for data collection.
- **Data reporting**: Creating user-friendly dashboards, using charts, graphs, and visual aids, and ensuring timely reporting.
- **Action:** Regularly reviewing and interpreting KPI’s and creating actionable insights that can be used to make informed decisions. Based on KPI performance course corrections should be made by adjusting strategies.
- **Sustainment**: Refining KPI’s by continuous improvement. Educate stakeholders by training and communication and embed KPI’s into the organization’s culture.

When there is an understanding of what is wanted to achieve, the most relevant KPI’s can be identified and implemented.

4.2.3 Prioritization

Scoring and ranking methods offer a tool to analyze, score, and rank projects based on their expected performance, allowing for the prioritization of both products and projects. Topics related to the company's objectives, such as portfolio balance, competitive advantage, and profitability can be used in the ranking classification. A scorecard, the analytical hierarchy process (AHP), and forced ranking are methods used to help define scoring criteria and prioritize product projects.

In the scorecard method a list of criteria is developed, and the project are evaluated on each criterion on a scale such as 1-5 or 0-10. These grades can be multiplied by weighting and added together to get the total score, i.e., the attraction score for each project. It is worth paying attention to the selection of criteria and choosing topics that can distinguish successful and profitable projects from failed and unproductive projects. The balanced scorecard (BSC) method for ranking projects is a strategic management tool that evaluates projects based on four perspectives: financial, customer, internal processes, and learning and growth. By considering these perspectives, the BSC method ensures a holistic assessment of projects' impact on both short-term and long-term organizational goals. It provides a balanced view of project performance, enabling decision-makers to prioritize projects that contribute most effectively to overall strategic objectives. (Kaplan & Norton, 1992)

The analytical hierarchy process (AHP) is a structured decision-making technique that helps in prioritizing and selecting among multiple alternatives based on a set of criteria. First, criteria relevant to project evaluation are identified, such as cost, time, feasibility, and market potential. These criteria are organized hierarchically, with the main goal at the top, criteria in the middle, and project alternatives at the bottom. Decision-makers then conduct pairwise comparisons between criteria and alternatives, assigning numerical values to represent their relative importance or performance. This involves using a scale, typically ranging from 1 to 9. Weights are calculated for each criterion and performance scores are determined for each alternative. A consistency check is performed to ensure the reliability of judgments made during comparisons. The weighted scores are aggregated to calculate an overall score for each alternative, which is then used to rank the projects. Sensitivity analysis may be conducted to assess the impact of changes in criteria or scores on the rankings. Ultimately, decision-makers use the AHP results to make informed decisions about project selection, prioritizing those that best align with organizational goals and objectives. (Vargas, 2010)

In The Forced Ranking method projects are ranked against each other and only few major criteria are used. Typical criteria used in this method are strategic fit, product advantage, technical success probability, market attractiveness and profitability based on NPV. Cooper et al. (2001) recommends this method for project prioritization, because unlike many other methods, it forces separate projects both at the top and bottom end of the scale, while in other methods projects easily fall into the middle stages of the scale. In his book, he presents an example of this method, where the projects are ranked from best to worst according to each criterion. Finally, a table is created in which all the ranked projects are listed in their own rows and the evaluated criteria are listed in the columns. For each project, the combined average of the rankings of the different criteria is calculated, according to which the projects are then prioritized. The project with the highest number has the highest priority, and the one with the lowest number has the lowest priority.

When evaluating and prioritizing product projects, it is essential to consider a possible combination of methods to achieve a comprehensive and balanced evaluation. Although financial methods provide valuable information on potential returns and resource use, they should be supplemented with scoring, ranking, and mapping methods to ensure a more holistic assessment. The combination of these methods not only facilitates a more thorough evaluation of product projects, but also mitigates the limitations associated with purely financial criteria. By utilizing different evaluation methods, decision-makers can prioritize projects that offer potential financial returns but are also in line with overall strategic goals and promote innovation in the organization.

Each parameter must be carefully monitored using appropriate project management and data collection tools and regular updates and reports should be made to ensure that all stakeholders are informed of progress. Parameters should be revisited and adjusted as necessary throughout the product project's life cycle to respond to new information and changing market conditions.

4.3 Conceptual Framework

A visual presentation of the conceptual framework compiled from relevant literature is presented in Figure 6. This conceptual framework combines the key ideas and states the key authors from the literature in visually compact format.

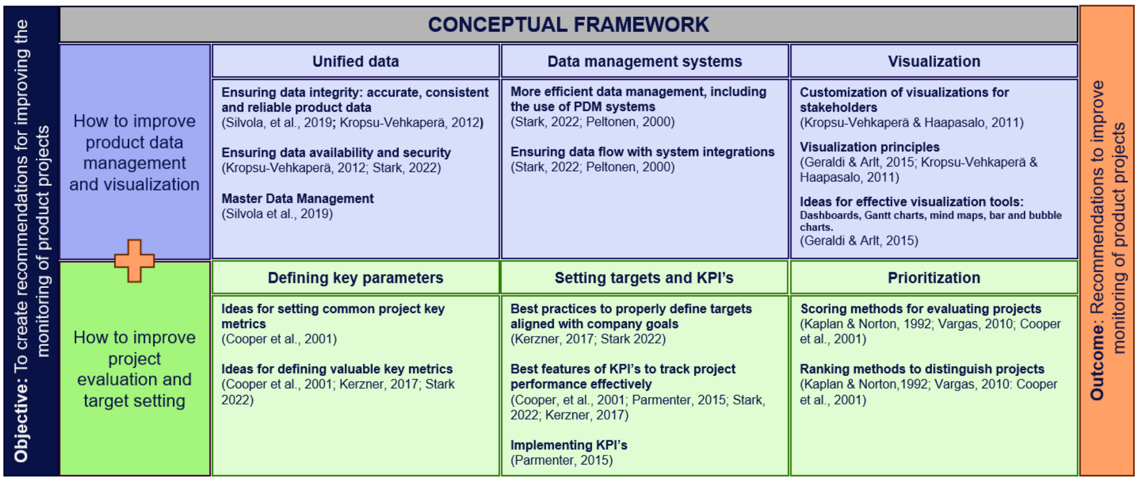

Figure 6. Conceptual framework for monitoring product projects

In the conceptual framework, the literature review is divided into two main questions according to the categories formed for the selected key weaknesses in the CSA stage as can be seen from Figure 6. The first part focuses on literature topics answering the question “How to improve product data management and visualization” and the second part “How to improve project evaluation and target setting”.

The first part called “How to improve product data management and visualization” combines topics related to unified data, data management systems and visualization into a comprehensive approach to managing and utilizing product data. Unified data section contains practices related to data governance, including ideas for ensuring data accuracy, consistency, and reliability (Silvola, et al., 2019; Kropsu-Vehkaperä, 2012) as well as ideas for ensuring data availability and security (Kropsu-Vehkaperä, 2012; Stark, 2022). This section also includes ideas for master data management from Silvola et al.’s (2019). The second section covers strategies from Peltonen (2000) and Stark (2022) for integrating and managing data across systems, proposing more efficient product data management (PDM) systems, providing a more reliable and efficient way to handle product data. The third part contains best practices and tools used for project and product data visualization with ideas from Geraldi & Arlt (2015) and Kropsu-Vehkaperä & Haapasalo (2011). This combination of three topics ensures that data is not only managed well, but also used effectively to support project monitoring and thus help decision-making and operational efficiency.

The second part called “How to improve project evaluation and target setting” consolidates the topics of defining key parameters, prioritization as well as setting targets and KPIs. The first section focuses on project key metrics presented by Cooper et al. (2001) and defining valuable key metrics for the projects (Cooper, et al., 2001; Kerzner, 2017; Stark, 2022). The second section describes best practices from Stark (2022) and Kerzner (2017) to define targets aligned with the company goals as well as best features for KPI’s from several authors (Cooper, et al., 2001; Parmenter, 2015; Stark, 2022; Kerzner, 2017) to effectively track project performance. In this second section also best practices from Parmenter (2015) for KPI implementation is presented. The third section handles scoring and ranking methods used to effectively prioritize projects to enhance the project management and decision making (Kaplan & Norton, 1992; Vargas, 2010; Cooper, et al., 2001).

In this section, the literature review was described, and a conceptual framework was created. In the next section, the conceptual framework is used together with the CSA findings to build the initial improvement proposal for the case company.

5 Creation of Recommendations to Improve Monitoring of Product Projects

In this section, an initial proposal to improve the monitoring of product projects is created by combining the conceptual framework of the previous section with the findings of the current state analysis. This section contains a general overview of the creation stage, a description of the recommendation creation process divided into categories according to the CSA findings and CF, and finally a summary of the initial recommendations.

5.1 Overview of Recommendation Creation Stage

The objective of this study was to create recommendations for improving the monitoring of product projects, resulting in recommendations to improve monitoring of product project monitoring as an outcome. In the recommendation creation stage, initial recommendations were co-created with the stakeholders. Data was collected by discussing with the stakeholders in workshops and interviewing the stakeholders individually. The conceptual framework created combining information from key findings from the current state analysis and literature were presented in the workshops and in the interviews. The Data 2 of this thesis from the workshops and interviews was used to create the initial recommendations and is presented in more detail in Table 4 in section 2.3.2 of this thesis.

The workshops were started by presenting the findings made in the CSA stage about both weaknesses and strengths in monitoring product projects, after which the CF created was presented. The purpose of the workshops was to co-create, together with the participants, an initial improvement proposal for monitoring product projects in the case company, dealing with the weaknesses and strengths found in the CSA stage. People who had also participated in the first data collection stage when creating the CSA were selected for the workshops. Each workshop focused on a certain theme or part of the product development process and participants were selected based on those themes or subprocesses. In addition to the workshops, individual interviews were held. In the first and the second workshop, the focus was mainly on product idea evaluations in the early stages of the process and as well as challenges related to the product development process, and in the third workshop on product and evaluation feedback and their follow-up.

The participants in workshops and interviews were free to comment and share their own opinions on topics under discussion. During the sessions, the participants were active and open, and they conveyed a strong motivation to improve current practices. There were good discussions about the topics and the improvement ideas were agreed upon quite easily. The observations and decisions made in the workshops and interviews were recorded in the field notes and summaries in English were written after each session.

Data 2 contains ideas and suggestions from the participants of the workshops and interviews. Based on the information gathered from these sessions, the improvement ideas were divided using the same themes that were used in categorization of key findings during the CSA and creating the CF.

5.2 Initial Recommendations to Improve Data Management and Visualization

Weaknesses related to data management and visualization were found in several different stages of the product development process, therefore these topics were discussed in each of the workshops and interviews.

5.2.1 Initial Recommendations for Unified Data

Since several weaknesses related to unified data were identified in the CSA stage, this topic also caused the most discussion in the organized sessions. The summary of findings from Data 2 related to unified data is presented in Table 8 and described in more detail after that.

Table 8. Summary of suggestions related to unified data.

<table>
<tr><th colspan="2">How to improve product data management and visualization</th></tr>
<tr><td>CSA:
Weaknesses related to unified data</td><td>CF: Unified data
• Ensuring data integrity: accurate, consistent, and reliable product data
• Ensuring data availability and security
• Master Data Management</td></tr>
<tr><td>8 Information needed for NPV calculation is hard to obtain.</td><td rowspan="6">DATA 2: Suggestions from stakeholders for unified data
• Values used in NPV calculations need to be updated with latest estimates and instructions for data sources and calculations as well as decision justifications need to be created. R&D needs to determine cost estimates for different project types. Updating the template and creating clear instructions for use. ROI estimate will be added to business case addition to NPV.
• Summary file of all business cases need to be created to be able to compare different project metrics estimations. And this same file will be used as a data source to monitor project success.
• Documents and systems that contain product and project master data need to be defined and access added to persons who need the data.
• R&D project code provided by ERP will be used instead of manually written project name as an identifier to monitor projects.
• R&D project code will be added as an attribute to each product in ERP to be able to monitor projects instead of individual products.
• Project time point names need to be defined and aligned.
• Evaluation document information needs (both headings and content) need to be harmonized to ease up information transform (allowing copy-paste) from one document to another to save time.
• The use of one system (CRM) for recording product feedback is suggested and more training needs to be provided to the CRM users.
• Attributes used for feedback reporting need to be harmonized.</td></tr>
<tr><td>10 Relevant project or product data not available to all stakeholders.</td></tr>
<tr><td>11 Product and project information may be inconsistent across sites.</td></tr>
<tr><td>14 Same or similar information added to several documents.</td></tr>
<tr><td>19 Lack of information in the new CRM for product evaluation and feedback monitoring function.</td></tr>
<tr><td>20 Product feedback reporting is inconsistent across sites.</td></tr>
</table>

As shown in Table 8, the initial proposal related to unified data is built focusing on ensuring data integrity, availability and security as well as defining the master data and sources.

In the workshops, there was a discussion about standardizing terms and definitions to ensure everyone would use the same language. At the same time, it was stated that the introduction of new naming practices can be challenging, but with the systematic use of names, they can be established for use. One such term is the launch date, which was suggested to be considered as a commercial term instead of R&D readiness and the date should be defined and recorded to ERP by the product manager responsible for the product. However, it became clear in the discussions that more detailed definitions of the launch date are still needed for certain special product groups in order to ensure that the launch date for the product is defined in the same way after each project. Similarly, the names of other time points of the projects were recommended to be defined in the same way in different systems and documentation.

As one idea to improve project monitoring, it was suggested to add a project code to all data that was considered to include in project monitoring. The project code was proposed to be added to the product idea evaluation sheet, the summary table of product development and the ERP system for the product, making it easier to combine information from different data sources based on the systematic project code instead of manually written names that are different in every source.

A great deal of discussion was sparked by the documentation used in the product evaluation, the time spent on it, and the consistency of the document headings and the content needed under each heading in each document. It was agreed that current system is not optimal, but each currently used document was felt to have its own importance in the process, and thus the number of documents was not wanted to be reduced, nor the documents to be combined. However, it was suggested that certain documents be defined as master data and to other documents, the information from these master data can be directly copied, which saves time from editing the information and the same information can be found in different documents in a similar way. To make this possible, the headings and data contents of the used templates must be unified and taken in the use.

Actions were also proposed regarding the correctness of the data used in the market analyses, especially in NPV calculations, and how to update it. The numbers of NPV calculations were agreed to be relevant specifically for monitoring the success of projects, and for that reason more attention should be paid to the accuracy of the calculations. Although NPV calculations use estimates and are difficult to do over the long term, it was found that more precision could be gained in determining internal costs and sales estimates. Product development team was already working on the cost calculation and harmonization of project cost calculation for different projects and different offices, and it was agreed that R&D would provide average costs for different project types to support the calculations as soon as numbers are available. It was agreed that more market information is needed for evaluating the market and forecasting sales volumes, and for this it was suggested to evaluate and acquire fresh market analyses targeted at the company's industry. As soon as more precise internal cost calculations are available and market analyses gained, the template used for NPV calculations was suggested to update. More detailed instructions on how to make calculations, which data to use, how to record decision justifications and the data source used were also recommended to be added to the template to facilitate the NPV calculations.

To be able to monitor the estimated business case data, a summary file containing values from the NPV calculations were suggested to create. This would help in comparing different projects as well as used as a data source in reporting and monitoring project success. It was also discussed if this data could be added to the project in the ERP system.

Product feedback is collected in both Excel and the CRM system; therefore, the forms used in both systems were reviewed with the Site B team, who uses the Excel sheet. It was suggested that harmonization of the feedback attributes be implemented. In the discussions, it was stated that a few feedback response options need to be added to the Excel form and the spelling needs to be harmonized with the response options used in the CRM system. Also, two response options were suggested to be added to the CRM feedback template to align with options used at Site B. This harmonization would allow more efficient integration of data, even if there are two systems in use.

5.2.2 Initial Recommendations for Data Management Systems

Another topic related to Data management weaknesses in the CSA stage was data management systems. The summary of findings from Data 2 related to data management systems is presented in Table 9 and described in more detail after that.

Table 9. Summary of suggestions related to data management systems.

<table>
<tr><th colspan="2">How to improve product data management and visualization</th></tr>
<tr><td>CSA:
Weaknesses related to data management systems</td><td>CF: Data management systems
• More efficient data management, incl. the use of PDM systems
• Ensuring data flow with system Integrations</td></tr>
<tr><td>10 Relevant project or product data not available to all stakeholders.</td><td rowspan="5">DATA 2: Suggestions from stakeholders for data management systems

• The ERP is integrated with other systems; therefore, new product attributes should be added to the ERP system to enable its use as master data for reporting and monitoring in other systems, such as CRM and PBI.
• Project and product management systems will be evaluated but possibilities provided by current systems (document handling system and ERP) will be explored first to avoid new additional systems.
• Shared folders and Teams channel access need to be revisited to ensure visibility to relevant documentation to all stakeholders.
• All sites should use the same CRM and in the same way to ensure validity of the product feedback.
• Excel is considered a good tool despite the user's sensitivity to errors. More attention should be paid to it, that information is checked regularly before processing meetings, and if errors are noticed, users are further trained.</td></tr>
<tr><td>11 Product and project information may be inconsistent across sites.</td></tr>
<tr><td>12 The use of Excel in analysis and data source is sensitive to user errors.</td></tr>
<tr><td>14 Same or similar information added to several documents.</td></tr>
<tr><td>20 Product feedback reporting is inconsistent across sites.</td></tr>
</table>

As shown in Table 9, the initial proposal for data management systems focused on improvement ideas for systems where information can be best stored and made available to stakeholders.

In the company, product and project information is stored in different systems, and various Microsoft Office programs such as Word, Excel and PowerPoint are used as tools. Participants find using these programs useful and they offer many opportunities to record and store information. And while the weaknesses found in the CSA stage included the challenges associated with using Excel sheets in analysis and data source in terms of sensitivity to user errors, Excel was anyway considered the best tool for collecting and evaluating product ideas by the stakeholders. It was agreed during the workshop that before the monthly evaluation meeting the document needs to be reviewed by the product management responsible and confirm that that no errors are in the data and that the charts are updated in the summary file. And in case user errors are noticed, all users will be notified and re-trained to use the file correctly.

It was also discussed and suggested that all sites should use the same systems for storing the similar data. The company is introducing a global document management system, and its future use for managing and developing common, globally used product documents was discussed and recommended. It was also recommended that the CRM system implemented the previous year should be implemented in all parts in all sites, allowing information on product feedback and evaluations to be found in the same place and recorded in the same way. Thus, enabling efficient and up-to-date monitoring and analysis of all available data.

It was also recommended to pay attention to data storage locations (e.g. Excel sheet) in case one wanted to use the information in them for monitoring and reporting ensuring that the information can be connected directly to e.g. Power BI reports. Also, as ERP is integrated with many of other systems in use, it was suggested that new product and project attributes should be created to the ERP system to be able use it as a master data in reporting and monitoring in other systems such as in CRM and Power BI.

It was also discussed that in the past some PDM systems and recently some project management tools have been reviewed, but no decisions have been made to acquire a PDM system, as several other system deployments have been made in recent years. It was found that the implementation of the new system also would require budgeting and plenty of human resources, as well as integration into the current systems. It was decided to continue evaluation of the systems, but as a first step it was suggested to evaluate the add-ons offered by the current systems, such as ERP, in use, with which both the management of product data and the management of projects could be made more efficient.

5.2.3 Initial Recommendations for Visualization

Another weakness revealed by the analysis of the current state was related to data visualization. The summary of findings from Data 2 related to visualization is presented in Table 10 and described in more detail after that.

Table 10. Summary of suggestions related to visualization.

<table>
<tr><th colspan="2">How to improve product data management and visualization</th></tr>
<tr><td>CSA:
Weaknesses related to visualization</td><td>CF: Visualization
• Customization of visualizations for stakeholders
• Visualization principles
• Effective visualization tools</td></tr>
<tr><td>10 Relevant project or product data not available to all stakeholders.</td><td rowspan="3">DATA 2: Suggestions from stakeholders for visualization

• A new project monitoring dashboard in Power BI will be created for R&D to ensure easy access to relevant product and project data.
• For post-launch monitoring, a new project monitoring dashboard will be created in PBI, which will enable essential information to be found in one place.
• Charts and graphs should be created for continuous monitoring instead of static reporting to save time and allow on-time monitoring.
• Funnel chart will be created for product idea stages to help monitor progress and identify bottlenecks.
• Gantt Chart would help in monitoring project stages, task management and tracking schedules.
• Feedback must be collected from stakeholders to enable continuous improvement of the created visualizations.</td></tr>
<tr><td>11 Product and project information may be inconsistent across sites.</td></tr>
<tr><td>13 Creating reports is time consuming.</td></tr>
</table>

As shown in Table 10, the initial proposal related to visualization focused on improvement ideas for consistent and customized availability of product and project information in a visualized form.

In the case company, Excel graphs, PowerPoint presentations, CRM dashboards and Power BI graphs are used to visualize project and product information. In most cases, visualizations are created for individual meetings or reports. In the discussions it became clear that it takes a great deal of time to create these visualizations and they are often not aligned. In the workshops and interviews, it was wished that ready-made, constantly up-to-date reports with visual charts and graphs would be available to all. In particular, product development would like to receive up-to-date information about the sales and customers of new projects. Customized dashboard was suggested to be created for different teams separately to make sure that only relevant information is included and to avoid unnecessary complexity in visualization. Power BI was suggested as a tool for sales revenue visualization because with it is possible to combine data from several different data sources, such as Excel and ERP. Separate visualizations for individual projects and for summary of all projects were suggested to be created.

It was suggested to add a funnel diagram to the tracking of product ideas in Excel, in order to gain a better understanding of the ideas that went through the different stages and their quantities. As well as better monitoring of possible bottlenecks.

Gantt Chart was discussed to be a classic tool for project management, that would help in monitoring project stages, task management and tracking schedules. This kind of visualization had already been tried for product development projects and found to be necessary, but it was agreed that implementation of such a tool still requires finding a suitable tool or system.

For all visualizations, model views were first suggested to be made, after which feedback from users is collected and changes are made according to improvement suggestions. Feedback from stakeholders should be collected even after implementation to continuously improve the created visualizations.

5.3 Initial Recommendations to Improve Project Evaluation and Target Setting

Weaknesses related to project evaluation and target setting were also found in several different stages of the product development process, therefore these topics were discussed in each of the workshops and interviews.

5.3.1 Initial Recommendations for Defining Key Parameters

The defining of key parameters was found to be one weakness in the CSA stage. The summary of findings from Data 2 related to defining key parameters is presented in Table 11 and described in more detail after that.

Table 11. Summary of suggestions related to defining key parameters.

How to improve product project evaluation and target setting	
CSA: **Weaknesses related to defining key parameters**	**CF: Defining key parameters** • Setting common project key metrics • Defining valuable key metrics
7 Product idea evaluation is time-consuming.	**DATA 2: Suggestions from stakeholders for defining key parameters** • Time used for evaluation is not needed to measure but more attention will be paid to guidance and tools to ensure a smooth process. • Project time points, such as launch date, and time used between each point and from start to finish will be defined and R&D project time points can be recorded in the R&D summary file. • In case a project's outcome is several products, the success of individual products is no longer monitored separately, but monitoring is done for the entire project. • Estimated values in the business case will be re-evaluated at least once a year. Re-evaluation values will be used as key metrics. • Key parameters for product feedback need to be aligned with two sites using different systems. • Launch date was suggested to be a key parameter that determines the initiation of post-launch monitoring.
17 Final properties or sales of the product not compared to initial information or estimates.	
18 Accuracy of the initial evaluation data is not re-evaluated as the project progresses.	
20 Product feedback reporting is inconsistent across sites. (This is categorized also under Data management.)	
11 Product and project information may be inconsistent across sites. (This is categorized also under Data management.)	

As shown in Table 11, the initial proposal for defining key parameters focused on establishing common key metrics and suggesting harmonized use and nomenclature of used parameters.

In the workshops and discussions, parameters used and obtained in different stages of the process were reviewed. In particular, the first workshop discussed the significance of different time points. Measuring the time spent on the different stages of the product development process was suggested as a task. It was noted that not all product projects align on the same timelines. However, documenting the information available for each project is useful, since this data can later be used to assess how time is allocated across various project stages.

On the other hand, measuring the time spent on evaluating product ideas was not considered significant. It was agreed that more focus would be placed on the guidance and tools used during the evaluation process to ensure it is smooth and efficient. With the product ideas, the details of the original idea were considered as potentially valuable parameters in understanding the significance of the sources of project ideas in the success of the project. And assessing and comparing the total number of ideas at various stages of the idea evaluation process was deemed necessary to determine how many ideas must be filtered to initiate new projects.

The values used in the business case and especially in the NPV calculation were considered important parameters and it was suggested that they be used as reference values for the figures realized in the evaluation of the project's success. At the same time, it was also proposed to update the NPV calculations at least once a year in connection with longer product development projects. It was also suggested that an estimation of the return of investment (ROI) would be added to the business case and that it would be used in post-launch monitoring.

The launch date, which was also discussed from the point of view of data harmonization, was agreed to be a key parameter that determines the initiation of post-launch monitoring.

5.3.2 Initial Recommendations for Setting Targets and KPI’s

The current state analysis revealed that setting targets and KPI's was one of the weaknesses in product project monitoring. The summary of findings from Data 2 related to setting targets and KPI’s is presented in Table 12 and described in more detail after that.

Table 12. Summary of suggestions related to setting targets and KPI's.

<table>
<tr><th colspan="2">How to improve product project evaluation and target setting</th></tr>
<tr><td>CSA: Weaknesses related to setting targets and KPI’s</td><td>CF: Setting targets and KPI’s
• Properly defined targets aligned with company goals
• Best features of KPI’s to track project performance effectively
• Implementing KPI’s</td></tr>
<tr><td>15 Project success factors are unclear.</td><td rowspan="2">DATA 2: Suggestions from stakeholders for setting targets and KPI’s

• Personal targets for evaluation quantities have been set for Product Managers, and those can be monitored alongside the evaluation parameters on the idea summary sheet.
• Product idea evaluation process targets and KPI’s can be prepared for next year after more data have been collected from the current process to support KPI decision making.
• Clear targets for recording product feedback should be set for the sales team to ensure more feedback is captured in the system.
• Target for overall feedback should be set for next year after the current process is properly in use. Need to make sure that the sales team understands the importance of collecting feedback and how it can benefit them directly.
• Initial product idea parameters, such as idea source, from product idea document can be used in post-launch monitoring to evaluate their impact on project success.
• Estimated values from business cases should be compared annually with actual results for five years post-launch to effectively assess the success of the projects.
• When the new strategy of the company for the coming 5 years has been determined, new targets and KPI’s can be planned and defined accordingly at the end of the year.
• List of suggestions for target setting and monitoring collected from the documents and discussions is presented in Appendix 3.</td></tr>
<tr><td>16 Only few targets or KPI's set.</td></tr>
</table>

As shown in Table 12, the initial proposal for setting targets and KPI’s focused on defining project success factors and suggesting examples for target setting and monitoring practices.

During the sessions, it was discussed that due to organizational changes and new processes, setting targets and KPI’s had been challenging. The focus for the upcoming year would be to concentrate more on this task. The primary goal for the current year had been to collect data on new processes to facilitate the setting of numerical targets and KPIs for the following years. Personal targets have also been set, for example, product managers have annual targets for the number of product idea evaluations. It was suggested that these targets, along with the evaluation parameters, should be followed up on the idea summary sheet. Stakeholders proposed that targets and KPI’s for the product idea evaluation process be evaluated for the next year after gathering more data from the current process to support KPI decision-making.

The use of the new CRM system began in the previous year, and therefore KPI’s have only been set for the some of the functions in the system. However, the stakeholders suggested that both team and personal KPI’s, such as recording product feedback, should be set for the following year, when the system’s use become more standardized across the sales teams.

Stakeholders also recommended that estimated values from NPV calculations should be compared annually to actuals for five years post-launch to evaluate project success. Additionally, it was proposed that using initial product idea parameters, such as the idea source from the product idea evaluation document, in the post-launch monitoring could help understand their impact on project success and enhance the quality and accuracy of evaluations.

More detailed suggestions for target setting and monitoring collected from the documents and discussions are presented in Appendix 3.

5.3.3 Initial Recommendations for Prioritization

The topic related to the weaknesses in project evaluation in the CSA was prioritization. The summary of findings from Data 2 related to prioritization is presented in Table 13 and described in more detail after that.

Table 13. Summary of suggestions related to prioritizations.

<table>
<tr><th colspan="2">How to improve product project evaluation and target setting</th></tr>
<tr><td>CSA:
Weaknesses related to prioritization</td><td>CF: Prioritization
• Scoring methods helping in evaluating projects
• Ranking methods for distinguish projects</td></tr>
<tr><td>9 Prioritization parameters and tools have not been defined.</td><td>DATA 2: Suggestions from stakeholders for prioritization

• Information and parameters already gathered in the evaluation document can be used as parameters for prioritization.
• Prioritization using the scorecard and/or forced ranking methods should be created for the idea and project prioritization together with the stakeholders.
• Before choosing a prioritization tools, different methods should be tested in use by stakeholders to ensure usability.</td></tr>
</table>

As shown in Table 13, the initial prioritization proposal suggested using current parameters and developing and testing scorecard and forced ranking methods for scoring and ranking product evaluations and projects.

Prioritization was discussed with the stakeholders and both scorecards and the forced ranking method were considered as possible alternatives for prioritizing projects. In the business case, it was found that there are several parameters that could be given numerical evaluations and used in ranking and scoring, but the determination of the evaluation scale was nevertheless considered a challenge.

The NPV was agreed to be an important prioritization criterion, but at the same time noting that more attention must be paid to its calculation, which means that the comparable values are calculated in the most systematic and credible way possible. The discussions emphasized that the use of prioritization tools should be straightforward and not too time-consuming. It was also suggested that a workshop be organized later in the year to test different methods and select the prioritization tool that best serves the decision-makers.

The discussions also stated that the use of prioritization tools should be simple and should not take too much time. It was also suggested that later this year a workshop with stakeholders would be organized, focusing on testing different methods, and choosing the prioritization tool that best serves the decision makers.

5.4 Summary of the Initial Recommendations

The object of this study was to create recommendations for improving the monitoring of product projects in the case company. The initial proposal of recommendations, created together with the stakeholders, is summarized in Table 14 and Table 15. For clarity and logic, the initial recommendations were divided into two main categories and six subcategories in the same way as in the CSA and CF. The strengths that were identified in the CSA stage have been embedded into the stakeholder proposals. Strengths are marked in green in the text.

Table 14. Summary of initial recommendations for product project monitoring related to data management and visualization.

Initial recommendations to improve the monitoring of product projects - Data management and visualization
Unified data
• **Evaluation data updates**: Create instructions for NPV data sources and calculations to clarify how data can be obtained. Update NPV calculations with the latest estimates and add ROI to the business case. Align documentation and evaluation templates to ensure consistency and ease of use in processing evaluation data. • **Master data and use of ERP**: Define documents and systems containing essential master data to enhance consistency in monitoring. Define also access rights. Add R&D project codes to each product in the ERP for unified project monitoring. • **Centralized and aligned project data**: Create a summary file of all business cases to facilitate comparisons and serve as a centralized source. Define and align all project time point names. • **Product feedback**: One system, CRM, should be used for recording product feedback to allow monitoring in the system. If two systems (CRM and Excel) are used, the attributes must be harmonized to ensure smooth monitoring with consistent data.
Data management systems
• **ERP enhancements:** Enhance the ERP system by adding new product attributes to improve master data usage in reporting and monitoring with CRM and PBI systems to improve consistency**.** Power BI reports are considered useful for monitoring sales, reflecting the usefulness and effectiveness of system integrations. • **System Evaluation**: Prioritize the capabilities of existing systems such as the document handling system and ERP to minimize the need for new PDM or project management systems. • **CRM standardization:** Standardize CRM usage across all sites to ensure consistent and valid product feedback. The new CRM system includes functions for product evaluation and feedback monitoring, enhancing data integrity. This aligns with the new sample process with sales, highlighting ongoing improvements and commitment to process development. • **Access Revisions:** Review and update access to shared folders and Teams channels to ensure all relevant stakeholders have necessary visibility to data. • **Excel Management:** Excel remains an essential tool for data handling. Focus on regular checks and user training for Excel to mitigate errors and improve data handling efficiency.
Visualization
• **Customized dashboards:** Create new PBI dashboards for R&D and post-launch monitoring, directly addressing stakeholder needs, enhancing data availability and avoiding inconsistency in product and project data. The product idea evaluation summary sheet aids in monitoring ideas and their progress efficiently. Feedback must be collected from stakeholders to enable continuous improvement of the created visualizations. • **Continuous monitoring:** Charts and graphs should be designed for continuous monitoring rather than static reporting, enabling more efficient and time-saving monitoring. • **Funnel and Gantt charts:** Create a funnel chart to monitor product idea evaluation stages and identify possible bottlenecks in the process. A Gantt chart can be utilized for detailed tracking of project stages, task management, and schedule tracking. These tools would improve the relevant project data availability to all stakeholders.

As shown in Table 14, several initial recommendations related to data management and visualization were created together with the stakeholders for product project monitoring in the case company. The initial proposal of recommendations related to project evaluation and target setting is presented in Table 15.

Table 15. Summary of initial recommendations for product project monitoring related to project evaluation and target setting.

Initial recommendations to improve the monitoring of product projects - Project evaluation and target setting
Defining key parameters
• **Project time points:** Define relevant key project time points such as launch dates, and the calculated time used between each project stage and from start to finish. These metrics should be recorded in the R&D summary file to ensure data availability and parameter consistency across projects. Defining the launch date as a key parameter that triggers post-launch monitoring, highlights its importance in the overall project timeline. • **Project monitoring:** Rather than monitoring the success of individual products within a project separately, track the overall project performance to align monitoring. Use project codes created in ERP. • **Business cases:** Key metrics will include values from business cases, which should be re-evaluated at least annually to ensure they remain relevant and reflective of current market situations. • **Product feedback parameters:** Align key parameters for product feedback across two sites to ensure consistent and valuable metrics.
Setting targets and KPI's
• **Personal targets for PM's:** Monitor personal evaluation quantity targets using the idea summary sheet. • **Feedback collection targets:** Establish clear targets for the sales team to record product feedback, highlighting the direct benefits to them and the overall company goals. • **Post-launch monitoring:** Compare estimated values from business cases annually with actual results for five years post-launch to effectively measure project success. Initial product idea parameters should be used in post-launch monitoring to evaluate their impact on project success. • **KPI development and integration with strategy:** Prepare subprocess targets and KPIs for the next year after collecting sufficient data from the current processes to support informed KPI decision-making. Plan and define new targets and KPIs at the year's end once the company's strategy for the coming five years is established. This is supported by the common interest to improve target setting and monitoring in the company. • **Documentation of target setting:** More detailed list of suggestions for target setting and monitoring is presented in Appendix 3.
Prioritization
• **Use of existing information:** Utilize the information and parameters already collected in the evaluation documents to create the prioritization process using scoring methods. • **Scorecard method**: Implement a scorecard system as a scoring method to systematically evaluate and prioritize projects and product ideas based on predefined criteria. • **Forced ranking method:** Adopt forced ranking method to distinguish and prioritize projects. • **Decision-making:** Before choosing a prioritization tools, different methods should be tested in use by stakeholders to ensure their usability, which reflects the engagement of teams in process improvements.

As can be seen from Table 15, several initial recommendations related to project evaluation and target setting were created together with the stakeholders for product project monitoring in the case company.

In this section, the initial recommendations were created and in the next section, these initial recommendations are validated, and final recommendations will be created.

6 Validation of the Recommendations

In this section, the initial product project monitoring recommendations created in the previous section are validated. This section provides an overview of the validation stage, explains the feedback obtained, and presents final recommendations to improve the monitoring of product projects as an outcome of this study.

6.1 Overview of Validation Stage

In the validation stage, initial recommendations to improve the monitoring of product projects were presented to company top management to obtain feedback and to create final recommendations based on that feedback. One of the Vice Presidents from the leadership team was chosen as a key stakeholder to validate the initial recommendations. Data 3 of this thesis from the meeting with key stakeholders was used to create the final recommendations and is presented in more detail in Table 5 in section 2.3.3 of this thesis.

The meeting started by first presenting the thesis objective, findings made in the CSA stage and the CF created. After that the initial recommendations for product project monitoring were presented and discussed with the participant. At the meeting, the participant was free to comment and share her opinions about the initial proposals. The participant was very active and very motivated to improve current monitoring practices. There was a good discussion about the topics and only minor adjustments were made to the initial recommendations. Feedback obtained in the meeting was recorded in field notes and a summary in English was written immediately after the meeting.

Data 3 contains feedback obtained in the validation stage. Based on Data 3, adjustments were made to the initial recommendations and final recommendations to improve the monitoring of product projects were created.

6.2 Feedback and Adjustments to the Initial Recommendations

The key stakeholder generally provided very positive feedback on the initial recommendations. The list of initial recommendations was considered to contain good elements for project monitoring, and the work was recognized as addressing an important and meaningful issue for the case company.

When discussing unified data, the significance of NPV calculations in decision-making was acknowledged, emphasizing the need for more precise estimates and the importance of updating these estimates even after a project decision has been made. And aligning the evaluation documents and templates to ensure data consistency and reliability was also considered valuable and timesaving. The key stakeholder generally considered all time-saving measures to be relevant improvements. Adding project codes to both product information in the ERP system and project documents was seen as a good enabler of project monitoring. The summary tables of NPV calculations and product projects, which would be visible to all stakeholders, also received positive feedback.

The introduction of new systems for product data management or project management was considered possible, but it was found a particularly good idea to evaluate the possibilities offered by the current systems in order to avoid any additional systems. This would also enable better data visibility for a wider group of users who already use the existing systems. For the R&D team, the product feedback received from the customer is critical both in the development of new products and in the improvement of old products. For this reason, standardizing the use of CRM for all sites and effectively recording feedback in the system was felt to be very important, and it was concluded that the practical problems in the feedback recording and monitoring may not have been properly understood by the top management.

Creating new dashboards for monitoring product projects was considered a very positive improvement, especially since the R&D team has found it challenging to access sales data. The tracking and monitoring of product ideas was found to be handled well with a separate Excel.

Project time points were considered well managed on the R&D summary file, and it was agreed that the launch date is defined by product management and recorded in the ERP system as master data. It was considered reasonable to monitor projects instead of individual products. However, it should be clarified how the monitoring process will account for differences between projects that produce many products and those that produce only one. How, for example, are estimated target values compared in multi-product projects, when in the evaluation stage it is not possible to know how many products will be launched in the final stage of the project. A reassessment of the NPV calculations at least annually was seen as possibly necessary, but it was wanted to emphasize that it should be done with the minimum amount of work possible to avoid excess workload. It was discussed that if the evaluation targets for product managers are monitored, then the product development team should also establish and monitor corresponding goals. This approach would likely ensure that the desired evaluation objectives are achieved through shared goals. It was also noted that new processes must be monitored and evaluated this year to establish proper and strategic goals for next year. Additionally, setting targets and KPI’s will require a decision regarding the strategy for the coming years. The list of suggestions for target setting and monitoring in Appendix 3 was reviewed, and a few topics were slightly adjusted.

During the discussion on prioritization, the key stakeholder agreed that already existing parameters should be utilized in project evaluation instead of creating new parameters. However, the proposal was to avoid complex scoring methods, as their use has been laborious according to previous experiences. It was suggested that if scorecard or forced ranking methods are introduced, they must be designed to be as simple and user-friendly as possible. Ideally, it would be possible to prioritize multiple projects simultaneously by comparing them to each other.

Adjustments made to the initial recommendations based on the feedback obtained in the validation stage are presented in Table 16.

Table 16. Adjustments made to the initial recommendations.

Adjustments to the initial recommendations	
Initial recommendations	**Adjusted recommendations**
Defining key parameters	
Project monitoring: Rather than monitoring the success of individual products within a project separately, track the overall project performance to align monitoring. Use project codes created in ERP.	**Project monitoring:** Rather than monitoring the success of individual products within a project separately, track the overall project performance to align monitoring, considering multi-product projects vs. projects that only produce one product. Use project codes created in ERP.
Setting targets and KPI's	
Personal targets for PM's: Monitor personal evaluation quantity targets using the idea summary sheet. **Documentation of target setting:** More detailed list of suggestions for target setting and monitoring is presented in Appendix 3.	**Targets for idea evaluations:** Set evaluation quantity targets for Product Managers **and R&D team**, monitor targets using the idea summary sheet. **Documentation of target setting:** More detailed list of suggestions for target setting and monitoring is presented in Appendix 3. Appendix updated.
Prioritization	
Scorecard method: Implement a scorecard system as a scoring method to systematically evaluate and prioritize projects and product ideas based on predefined criteria.	**Scorecard method**: Implement a simple and easy-to-use scorecard system as a scoring method to systematically evaluate and prioritize projects and product ideas based on predefined criteria.

Table 16 shows that only minor adjustments were made, with a total of 4 initial recommendations adjusted based on Data 3. All initial recommendations were presented in Table 14 and Table 15 in section 5.4 and the final recommendations are presented in the next subsection.

As shown in Table 16, the first adjustment is related to unified project monitoring instead of product monitoring, noting that multi-product projects versus projects that produce only one product should be taken into account in monitoring practices. Another adjustment to the initial recommendations was to also add targets for the R&D team to evaluate product ideas, since their input is needed to finalize the evaluations. The third adjustment concerned the suggestions for product project monitoring reports in Appendix 3, to which a few additions were made. The final adjustment to the recommendations included an enhancement to the scorecard features, specifying that the method must be simple and easy to use, thereby ensuring that its use does not require excessive time.

6.3 Final Recommendations

Based on Data 3, adjustments were made to the initial recommendations, leading to the final recommendations for product project monitoring. The final recommendations for the product project monitoring in the case company are presented in Table 17.

Table 17. Final recommendations for product project monitoring.

<table>
<tr><th colspan="2">Recommendations to improve the monitoring of product projects</th></tr>
<tr><th>Data management and visualization</th><th>Project evaluation and target setting</th></tr>
<tr><td>Unified data</td><td>Defining key parameters</td></tr>
<tr><td>• Evaluation data updates: Create instructions for NPV data sources and calculations to clarify how data can be obtained. Update NPV calculations with the latest estimates and add ROI to the business case. Align documentation and evaluation templates to ensure consistency and ease of use in processing evaluation data.
• Master data and use of ERP: Define documents and systems containing essential master data to enhance consistency in monitoring. Define also access rights. Add R&D project codes to each product in the ERP for unified project monitoring.
• Centralized and aligned project data: Create a summary file of all business cases to facilitate comparisons and serve as a centralized source. Define and align all project time point names.
• Product feedback: One system, CRM, should be used for recording product feedback to allow monitoring in the system. If two systems (CRM and Excel) are used, the attributes must be harmonized to ensure smooth monitoring with consistent data.</td><td>• Project time points: Define relevant key project time points such as launch dates, and the calculates time used between each project stage and from start to finish. These metrics should be recorded in the R&D summary file to ensure data availability and parameter consistency across projects. Defining the launch date as a key parameter that triggers post-launch monitoring, highlights its importance in the overall project timeline.
• Project monitoring: Rather than monitoring the success of individual products within a project separately, track the overall project performance to align monitoring, considering multi-product projects vs. projects that only produce one product. Use project codes created in ERP.
• Business cases: Key metrics will include values from business cases, which should be re-evaluated at least annually to ensure they remain relevant and reflective of current market situations.
• Product feedback parameters: Align key parameters for product feedback across two sites to ensure consistent and valuable metrics.</td></tr>
<tr><td>Data management systems</td><td>Setting targets and KPI’s</td></tr>
<tr><td>• ERP enhancements: Enhance the ERP system by adding new product attributes to improve master data usage in reporting and monitoring with CRM and PBI systems to improve consistency. Power BI reports are considered useful for monitoring sales, reflecting the usefulness and effectiveness of system integrations.
• System Evaluation: Prioritize the capabilities of existing systems such as the document handling system and ERP to minimize the need for new PDM or project management systems.
• CRM standardization: Standardize CRM usage across all sites to ensure consistent and valid product feedback. The new CRM system includes functions for product evaluation and feedback monitoring, enhancing data integrity. This aligns with the new sample process with sales, highlighting ongoing improvements and commitment to process refinement.
• Access Revisions: Review and update access to shared folders and Teams channels to ensure all relevant stakeholders have necessary visibility to data.
• Excel Management: Excel remains an essential tool for data handling. Focus on regular checks and user training for Excel to mitigate errors and improve data handling efficiency.</td><td>• Targets for idea evaluations: Set evaluation quantity targets for Product Managers and R&D team, monitor targets using the idea summary sheet.
• Feedback collection targets: Establish clear targets for the sales team to record product feedback, highlighting the direct benefits to them and the overall company goals.
• Post-launch monitoring: Compare estimated values from business cases annually with actual results for five years post-launch to effectively measure project success. Initial product idea parameters should be used in post-launch monitoring to evaluate their impact on project success.
• KPI development and integration with strategy: Prepare subprocess targets and KPIs for the next year after collecting sufficient data from the current processes to support informed KPI decision-making. Plan and define new targets and KPIs at the year's end once the company's strategy for the coming five years is established. This is supported by the common interest to improve target setting and monitoring in the company.
• Documentation of target setting: More detailed list of suggestions for target setting and monitoring is presented in Appendix 3.</td></tr>
<tr><td>Visualization</td><td>Prioritization</td></tr>
<tr><td>• Customized dashboards: Create new PBI dashboards for R&D and post-launch monitoring, directly addressing stakeholder needs, enhancing data availability and avoiding inconsistency in product and project data. The product idea evaluation summary sheet aids in monitoring ideas and their progress efficiently. Feedback must be collected from stakeholders to enable continuous improvement of the created visualizations.
• Continuous monitoring: Charts and graphs should be designed for continuous monitoring rather than static reporting, enabling more efficient and time-saving monitoring.
• Funnel and Gantt charts: Create a funnel chart to monitor product idea evaluation stages and identify possible bottlenecks in the process. A Gantt chart can be utilized for detailed tracking of project stages, task management, and schedule tracking. These tools would improve the relevant project data availability to all stakeholders.</td><td>• Use of existing information: Utilize the information and parameters already collected in the evaluation documents to create the prioritization process using scoring methods.
• Scorecard method: Implement a simple and easy-to-use scorecard system as a scoring method to systematically evaluate and prioritize projects and product ideas based on predefined criteria.
• Forced ranking method: Adopt forced ranking method to distinguish and prioritize projects.
• Decision-making: Before choosing a prioritization tool, different methods should be tested in use by stakeholders to ensure their usability, which reflects the engagement of teams in process improvements.</td></tr>
</table>

As shown in Table 17, the final recommendations are organized into six subcategories within two main categories, following the same logic used in earlier steps from CSA to CF, and then to the initial recommendations.

In this section the validation of initial recommendations was carried out and the final recommendations for product project monitoring as an outcome of this study was created. The next and the final section of the study summarizes the study, presents recommendations for the next steps, and contains self-evaluation of the study.

7 Discussion & Conclusions

In this final section, the thesis is summarized and practical recommendations for the next steps are presented. This section ends with a self-evaluation of the thesis and the closing words.

7.1 Executive Summary

The objective of this study was to create recommendations for improving the monitoring of product projects at the case company. The goal was to enhance the effectiveness of this monitoring, which had not sufficiently supported decision-making due to inadequate analyses. Additionally, as the organization and its units operated globally, it was crucial to ensure uniform monitoring of product projects across all locations. Achieving this uniformity would enhance understanding of development and innovation opportunities and improve product portfolio management.

Applied Action research using qualitative methods was chosen as the most suitable research method because it focuses on a specific business problem within the organization and aims to develop operations by recommending improvements to a specific process. The research design outlined a four-stage process, and the study was designed to proceed in logical successive stages with the data collection plans and the stage outcomes to achieve the objective of this study. The outcome of the previous stage provided information for the next stage. The research design of this thesis is shown in Figure 1 in section 2.2. The research design includes four stages: current state analysis (CSA), literature review with conceptual framework (CF), recommendations creation and recommendations validation. Data for the study was collected at different stages of the study from various sources, such as company documentation, stakeholder interviews and workshops, which supported the creation of recommendations for monitoring of product projects. A summary of the different data collection steps and methods is presented in Table 1 in section 2.3.

In the stage one, the current state analysis was conducted by reviewing the case company's documentation, the current product project data and by interviewing relevant stakeholders. Based on the data collected, current practices were analyzed, and strengths and weaknesses identified. The aim of the current state analysis was to clarify the methods and tools related to the monitoring of the company's product projects at different stages of the process and to determine the weaknesses and strengths to be able to make recommendations for better monitoring practices. Stakeholders who were dealing with product projects and/or their monitoring were selected to be interviewed. The interviewees were chosen from both manager and director levels, different teams, and locations of the company, in order to enable a comprehensive picture of strengths and weaknesses and also to be able to identify different ways of working. Observations were also made by participating in meetings related to the product projects, in order to get a better understanding of the actual working methods. A total of 20 data sources were used as Data 1 for the current state analysis, of which 13 were documentation and 7 were interviews, discussions, and observations. After analyzing the Data 1, a total of 20 findings were listed, of which 6 were strengths and 14 were weaknesses. After analyzing the findings, several weaknesses were found to be related to data management and tools used to store or present data. Another group of weaknesses were found to relate to practices used in product ideas and project evaluation. Also, weaknesses linked to target setting and in general monitoring performance of various stages and the whole product project. The key findings to elaborate in this study were selected and categorized in two main groups: improvement of data management and visualization as well as improvement of project evaluation and target setting.

In the stage two, the best practices and tools were searched in the literature, focusing on the weaknesses identified during the current state analysis in the previous stage. The first part of the literature view focused on topics related to improving product data management and visualization. The literature was searched for improvement ideas and tools for uniform data, data management systems and visualization. The second part focused on finding information on how to improve the evaluation of projects and setting goals. The literature was searched for improvement ideas and tools for defining key parameters, setting targets and KPI's and prioritization. Utilizing the key findings from the literature review, a conceptual framework was developed to assess the business case and address the weaknesses identified in the case company. A visual presentation of the conceptual framework compiled from relevant literature is presented in Figure 6 in section 4.3. The conceptual framework created was used together with the CSA findings to build the initial improvement proposal for the case company.

In the stage three, recommendation creation stage, initial recommendations to improve the monitoring of product projects were co-created with the stakeholders through workshops and individual interviews. The workshops began by presenting the strengths and weaknesses identified in the CSA as well as the CF. The goal was to co-create initial recommendations addressing the identified issues. Participants for the workshops and interviews were chosen based on their involvement in the initial CSA data collection and their expertise related to specific themes. Participants were encouraged to openly discuss and share their opinions, leading to active sessions. The collected ideas and from the sessions were recorded in field notes, and summaries were written in English after each session. Data 2 contains ideas and suggestions from the participants of the workshops and interviews. Based on the data obtained from these sessions, the initial recommendations for product project monitoring were created. The initial proposal of recommendations was embedded with the strengths and summarized in Table 14 and Table 15 in section 5.4.

In the fourth and final stage, the recommendations were validated with the top management, and based on the feedback obtained, the final recommendations were created. The final recommendations to improve monitoring of product project monitoring in the case company are presented in Table 17 in section 6.3 and it forms the outcome of this thesis.

Several recommendations for monitoring product projects were made based on the findings from the CSA stage. The final recommendations were divided into two main categories, similar to what was done in previous stages: Improvement of data management and visualization as well as Improvement of project evaluation and target setting.

These created recommendations provide a comprehensive set of actions that can enhance and streamline the project monitoring at the case company. By implementing these recommendations, the management and consistency of product and project data will significantly improve, enhancing visibility and usability for all relevant stakeholders. And by implementing the recommended changes to monitoring practices, the case company can better understand the factors influencing the success or failure of product projects, thereby enhancing its decision-making for new projects.

7.2 Recommendations for Next Steps

As a result of this study, recommendations were created to improve the monitoring of product projects, including a comprehensive set of actions. To improve monitoring based on these recommendations, the proposed actions need to be implemented.

As a first step, it is recommended to ensure that all data used in the monitoring of product projects is consistent, as it is the basis for combining information from different sources and thus a basic condition for effective monitoring. The recommended first steps are:

- Update, refine and align business case and NPV calculations as well as the documents and templates used for product idea evaluation.
- Add project codes to products in the ERP system and to all project-related documentation containing data used for monitoring.
- Define relevant key project time points and align in all systems and documentation.

- Align product feedback parameters in Excel and CRM system.
- For the product idea Excel file, focus on regular checks and user training to mitigate errors in data.
- When data is consistent and recorded either in documentation or systems, it is crucial to make sure that it is available to all relevant stakeholders. To ensure availability:
- Check and update access settings for documents and systems.
- Create a summary file for business cases.
- Design updated charts for product idea monitoring into the product idea summary sheet.
- Create customized dashboards in PBI and CRM using the ideas in the Appendix 3.
- Utilize a Gantt chart for tracking of project stages.

Once the company's strategy for the coming years has been determined and the data is consistent and available, it is possible to use this information to make decisions about future targets and set KPI’s. Few specific project monitoring target settings were recommended in the final recommendations table and more suggestions are presented in the Appendix 3.

- Setting evaluation quantity targets for Product Managers and R&D team.
- Establish targets for the sales team to record product feedback, highlighting the direct benefits to them.

As a final step, further improvements to processes, tools, and systems should be made. Recommendations for these final steps include:

- Arranging a workshop to create and test prioritization methods for product ideas and projects.
- Creating a process for business case re-evaluation.
- Evaluate the capabilities of existing systems for enhanced product data and project management.
- Discuss with the CRM owner how to standardize the use of CRM across sites. This may also require the commitment of top management.

- Monitoring the quality of the feedback recorded in the CRM and giving feedback to the user if any deficiencies are detected.
- Training on CRM functionalities, where deficiencies are seen, (such as recording product feedback) need to be provided by the CRM owner.

By following the steps listed in this subsection, significant improvements can be made to the monitoring of product projects. It is important to remember that this is not a one-time change, but monitoring must be continuously developed. The best way to enhance monitoring is by regularly collecting feedback from stakeholders and refining processes and tools accordingly. This approach ensures that the monitoring tools and methods remain relevant and effective throughout the project life cycle.

7.3 Thesis Evaluation

The thesis, like all research, results and conclusions should be credible and reliable and this should be evaluated (Kananen, 2013). In research methodology, various criteria are used to evaluate the quality of research, with reliability, credibility, logic, and relevance being the commonly used. And researchers can mitigate the inherent biases of studies that depend on a single method, observer, or theory by integrating multiple observers, theories, methods, and data sources (Denzin, 1970).

The business challenge of the case company was the lack of uniform monitoring practices for product projects, in order to improve the selection of projects, product development and to better understand the issues affecting the results of projects. As an outcome of this thesis, recommendations were created to improve product project monitoring based on the findings in monitoring practices in the case company linked with relevant existing literature. The outcome provided practical tools and a framework that the case company can implement. By implementing these recommendations, the case company can standardize its methods for monitoring product projects and enhance its insight into the factors influencing project outcomes. Thus, the outcome of this thesis is relevant for the case company in addressing its business challenge. The relevance is also confirmed by the relevant stakeholders who were involved in several stages of the study, from whom data was collected and who were involved in creating the recommendations.

The research was carried out in a structured way in four successive stages. After introducing the business challenge, the methods and documentation related to the current state of the monitoring of product projects were analyzed in the first stage of this thesis. In the second stage, ideas for monitoring-related challenges found in the case company were explored from the literature. In the third stage, initial recommendations to improve monitoring of product project monitoring were created together with stakeholders. And in the fourth stage, the recommendations created were validated. This logical flow supports the argumentation of the thesis. The findings from the data were logically analyzed to identify the strengths and weaknesses of the company's product project monitoring processes. The study combined these findings with a literature review and used them as the basis for proposed recommendations. Thus, this study was conducted logically, following a systematic sequence of stages where information gathered in one step informed the subsequent step.

The use of versatile and appropriate methods increases the reliability of the results and triangulation method can be used to improve the validity and credibility of the results and mitigate the occurrence of research biases in the thesis. In triangulation, multiple datasets, methods, and theories are used to answer the research question. This thesis dealt with a systematic approach to research, including data collection from multiple sources (such as documentation, interviews, workshops, meeting observations) and applying action research methodology appropriate to the business context. Data collection from direct company sources confirms that the findings were based on evidence related to the case company. Data was collected in three different stages of the study and there were people from different teams, different levels and different locations. In this study multiple perspectives, data sources and methods were used to increase the reliability and credibility.

As a critique, involving more stakeholders from various levels in interviews and workshops could have provided a broader perspective on the challenges and yielded additional ideas for monitoring recommendations. This limitation was partly due to the lack of personnel resources at the case company, which influenced the selection of final participants for the various stages of the study. With more time and resources, additional efforts could have been dedicated to refining the initial recommendations and developing more comprehensive and detailed final recommendations than those accomplished in this study.

7.4 Closing Words

Monitoring product projects is an important part of the product life cycle management as well as product development. Project monitoring is not a one-time event but must be done continuously in different stages of the project. With the help of an effective monitoring plan, it is possible for the company to better understand the issues affecting the success or failure of the project. At the same time, however, attention must be paid to the defined metrics ensuring that they serve the company's strategy and goals in project monitoring.

This study has taken a step forward towards effective monitoring of product projects in the case company. By implementing the recommended changes to monitoring practices, the case company can better understand the factors influencing the success or failure of product projects, thereby enhancing its decision-making for new projects.

References

Cooper, G. R., Edgett, J. S. & Kleinschmidt, J. E., 2001. *Portfolio Management for New Products.* s.l.:Basic Books.

Denzin, N. K., 1970. *The research act: A theoretical introduction to sociological methods..* Chicago, IL: Aldine.

Geraldi, J. & Arlt, M., 2015. *Visuals Matter! Designing and Using Effective Visual Representations to Support Project and Portfolio Decisions.* s.l.:Project Management Institute.

Kananen, J., 2013. *Design Research (Applied Action Research) as Thesis Research: A Practical Guide for Thesis Research.* Jyväskylä: Publications of JAMK University of Applied Sciences.

Kaplan, R. S. & Norton, D. P., 1992. The Balanced Scorecard—Measures that Drive Performance. *Harvard Business Review.*

Kerzner, H., 2017. *Project Management Metrics, KPIs, and Dashboards : A Guide to Measuring and Monitoring Project Performance.* 3rd ed. Hoboken, New Jersey: John Wiley & Sons, Inc..

Kropsu-Vehkaperä, H., 2012. *Enhancing understanding of company-wide product data management in ICT companies.* s.l.:University of Oulu.

Kropsu-Vehkaperä, H. & Haapasalo, H., 2011. Defining Product Data Views for Different Stakeholders. *The Journal of Computer Information Systems,* 52(2).

Parmenter, D., 2015. *Key performance indicators: developing, implementing, and using winning KPIs / David Parmenter, 3rd edition.* 3rd ed. Hoboken, New Jersey: John Wiley & Sons, Inc..

Peltonen, H., 2000. *Concepts and an Implementation for Product Data Management.* s.l.:The Finnish Academies of Technology.

PMI, 2021. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition and The Standard for Project Management.* s.l.:Project Management Institute (PMI).

Saunders, M., Lewis, P. & Thornhill, A., 2016. *Research Methods for Business Students.* s.l.:Harlow: Pearson Education.

Silvola, R. et al., 2019. Defining One Product Data for a Product. *Int. J. Business Information Systems,* 30(4), pp. 489-520.

Stark, J., 2022. *Product Lifecycle Management (Volume 1): 21st Century Paradigm for Product Realisation.* 5th ed. s.l.:Springer International Publishing.

Tolonen, A., Shahmarichatghieh, M., Harkonen, J. & Haapasalo, H., 2015. Product portfolio management – Targets and key performance indicators for product portfolio renewal over life cycle. *International Journal of Production Economics,* Volume 170, Part B, pp. 468-477.

Vargas, R., 2010. *Using the Analytic Hierarchy Process (AHP) to Select and Prioritize Projects in a Portfolio.* Washington DC, PMI Global Congress 2010 – North America.

Appendices

Appendix 1

Interview Questions

1. What information is collected during the NPI process? At which stage?

2. Where is that information stored?

3. How is the information used? Do you use the information yourself?

4. What works well in the NPI process and its monitoring?

5. What should be improved in the NPI process and its monitoring?

6. On which basis you make decisions on new product projects?

Appendix 2

List of Key Metrics and Characteristics of Projects presented by Cooper et al. (2001)

General:

- Project name
- Project identification
- Status: Active, On Hold, Other
- Priority level of project
- Project leader
- Stage in Stage-Gate model
- Next gate and date
- Project type (e.g., platform, new product, improvement, maintenance, etc.)
- Project type: defensive, offensive, breakthrough
- Fit with business or corporate strategy (low, medium, high)
- Inventive merit and strategic importance to the business (low, medium, high)
- Durability of the competitive advantage (short-, medium-, long-term)
- Competitive impact of technologies (base, key, pacing, and embryonic technologies)
- Market or segment
- Product line
- Project size (minor, medium, major)
- Source of idea

Resources:

- Resources allocated ($)
- Resources allocated: FTEs
- Annualized resources ($)
- Annualized FTEs
- Total cost of project (now till launch) in $ or FTEs
- Time to completion (months)

Scores and Rankings:

- Ratings (0-10, most current) on key gate criteria
- Rankings (1-N) on key ranking criteria
- Project Attractiveness Score (based on ratings)
- Project Attractiveness Score (based on rankings)

Financials and probabilities:

- Projected NPV
- Probability of technical success
- Probability of commercial success
- Probability adjusted NPV
- ECV
- IRR %
- Payoff (a qualitatively scaled measure 0-10, modest to excellent)

Appendix 3

Suggestions for target setting and monitoring collected from the documents and discussions.

Topic	Monitoring topic
Product idea	Number of product ideas collected. -by product type, CA, territory, source
Product idea evaluation	Number of product ideas evaluated, % of product ideas. - by product type, CA, PM
Product idea evaluation	Number of 1st stage evaluated product ideas by result and %. - by product type, CA, PM
Product idea evaluation	Number of 2nd stage evaluated product ideas by result and %. - by product type, CA, PM
Product idea evaluation	Number of approved project decisions, % of ideas. - by product type, CA, PM
Product idea evaluation	Number of projects started, % of ideas. - by product type, CA, PM
Product idea evaluation	Duration of the product idea evaluation and its stages. - Idea received, 1st evaluation, 2nd evaluation, project started
Product idea evaluation	Market analysis NPV's and x year sales estimates for started projects. - by product type, by estimated launch year
R&D project	Duration of the project and its stages. - by product type, site
R&D project	Project costs (needed for NPV). - by product type, site
R&D project	Project stages
R&D project	Project priorities
Evaluations, samples	Number of pre-launch samples sent. - by project, customer
Evaluations, samples	Number of new evaluations, or samples sent. - by product, territory
Evaluations, samples	Revenue estimate for the sample evaluations. - by product type, analyte, territory
Evaluations, samples	Number or won sample evaluations. - by product type, analyte, territory Compared to total number of sample evaluations to get win rate.
Feedback	Number of feedbacks received. - by product, by feedback result
Feedback	Products chosen for production by customers. - by product, customer, date
Sales	Product sales, average price, number or customers. - by CA, analyte, product type, product, territory, PM
New products	Sales of products launched during last x years. - by product type, in-house/resale, analyte, product, product idea source, territory, site developed Compared against estimated targets from NPV calculations.
Profit	Product profit against estimated targets.
Project follow up post-launch	Project specific dashboard.