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Applying user centric design to develop portfolio prioritization concept for digital initiatives

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Aim of the thesis was to develop a portfolio management solution for a technology company working with digital initiatives. We applied User Centric Design (UCD) as an iterative approach to understand the needs of users and engage with them throughout the project. The qualitative research to collect empirical data included semi-standardized interviews and multiple user surveys.

Scope of the project consisted of how initiatives are collected, assessed, planned, prioritized, and finally committed for execution. The execution phase of the portfolio was not part of the scope. Related research chapter is structured according to the portfolio management frameworks studied. It covers the generic portfolio management knowledge and implementations of project portfolio and lean portfolio management methodologies. Specific interest is put on how to combine both worlds in a single concept and apply a consistent portfolio prioritization approach.

The developed portfolio management solution is described as part of empirical studies. The chapter follows the steps of the UCD driven development approach that are discover, design, and deliver. The main deliverables were the portfolio management process, the categorization and criterions used for early phase evaluation, prioritization method for digital initiatives and a computer-based decision support system. The tool introduced is utilising the standard Microsoft M365 productivity platform. The designed modular structure covers the database, user-interface, prioritization model and on-line portfolio reports.

The key outcome of the thesis project was the three-dimensional prioritization model for early evaluation and selection of digital initiatives. The model applies qualitative criterions with pre-defined subjective values to choose from. The dimensions are strategic-fit, complexity and value. The developed dynamic portfolio management reports had a significant role in how users perceived the proposed concept. Improving visibility was one of the key requirements. It turned out the automated portfolio roadmap was the most valued.

To conclude, the thesis project revealed it is possible to combine traditional project portfolio and agile development portfolio approaches into a single portfolio management concept. The introduced minimum viable portfolio governance with simple prioritization method could be interesting for anyone wanting to prioritize digital development ideas and take full advantage of an existing collaboration platform.

Keywords	
Portfolio Management, Project Prioritization, User-Centred Design	

Contents

Abbreviations

AHP	Analytic Hierarchy Process
AI	Artificial Intelligence
BT Standard	Business Technology Standard
CBA	Cost-Benefit Analysis
CD3	Prioritization technique: Cost of Delay Divided by Duration
CoD	Cost of Delay
DevOps	Practice that combines Development and Operations
DSS	Decision Support System
ERP	Enterprise Resource Planning
HCI	Human-Computer Interaction
ITIL	Information Technology Infrastructure Library
KPI	Key Performance Indicator
LPM	Lean Portfolio Management
MCDM	Multi-Criteria Decision-Making
MPT	Modern Portfolio Theory
MVG	Minimum Viable Governance
MVP	Minimum Viable Product
NLP	Natural Language Processing
NPV	Net Present Value
PBP	PayBack Period
PMI	Program Management Institute
PMO	Program Management Office
PPM	Project Portfolio Management
PPMO	Project Portfolio Management Office
QDA	Qualitative Data Analysis
RAID analysis	Analysis of risks, assumptions, issues, and dependencies
ROI	Return on Investment
RPA	Robotic Process Automation
SAFe	Scaled Agile Framework
UCD	User-Centred Design
UI	User Interface
WIP	Work In Progress
WSJF	Weighted Shortest Job First

1 Introduction

This thesis will study needs of the commissioning organization to manage a portfolio of emerging digital initiatives. Specific focus is put in how to prioritize and select projects and build the portfolio visibility. The artefact developed during the thesis include a lean concept for portfolio prioritization and implementation of the proposed concept.

It is expected that with high-level portfolio management execution of strategic priorities can be accelerated, use of modern technologies advanced for value creation and employee engagement made easier with improved visibility and a collaborative planning approach.

User Centric Design (UCD) method is applied throughout the project to get user insights and ensure outcome of the work will meet the needs (Lowdermilk, 2013, pp. 5–13; Still and Crane, 2017, pp. 1–17). Implementation takes place fully virtually due to the outbreak of Coronavirus COVID-19. Modern cloud technologies like Microsoft M365 are utilized extensively to engage with users, collect data and to develop a solution for collaborative virtual portfolio management.

As background information, major cloud transformation was recently completed in the commissioning organization, a technology company. All business processes are run cloud-only. Purpose of this transformation was to reduce cost, increase agility and enable use of modern cloud-based technologies. The business processes and related digital technologies are managed by dedicated teams, hereinafter referred as organization, responsible of development, maintenance, and business support of the processes.

After cloud transformation the first implementations of artificial intelligence, machine learning and robotic process automation have raised the need for improved portfolio level prioritization and visibility. Digital projects are done hand in hand with business many times involving several processes, teams, and end to end workflows.

The demand for such digital projects is increasing rapidly as the organization becomes aware of the possibilities and benefits of modern technologies. To capture the opportunities and keep the momentum an easy, fast, and flexible high-level portfolio management approach is required to collect, prioritize, and select the right initiatives.

The thesis project will help organizations having multiple development teams and project methodologies in use by giving example of a common minimum practice how to constantly align the digital initiatives. As the target organization is small in this case the practice to be introduced will focus on the minimum required steps having the highest potential to add

value without increasing need for dedicated portfolio management resources or to establish a project portfolio management office (PPMO).

The Objective chapter will start with describing the project backgrounds in more detail and the expected practical outcomes for the development project as agreed with the commissioning organization. Next the process and reasoning of selecting the research questions will be discusses. In short, the first research question will focus on finding the specific needs for improving portfolio management and the second question is about how the implemented improvements were perceived. As portfolio management is large knowledge area, specific focus will be set to discuss project scoping and what is left out of scope per se. At elevated level the scope will strictly focus on improving selected phases of portfolio level management and the implementation, i.e., project management is not in the scope of the thesis. This chapter is concluded with describing the thesis writer's role in the project.

The methodology chapter explains how qualitative research and User-Centred Design (UCD) approaches were applied to carry out collection and analysis of empirical data and to guide the development work by involving users in the project. The focus groups, sample sizes and questions used in data collection are included. The chapter will also describe the tools used to engage with users, collect data, develop the artefact, and receive feedback.

Related Research is investigating the current knowledge and research around portfolio management frameworks. The chapter will start with description of the context where the project is implemented. After introducing common development frameworks including portfolio management practices, specific focus is put in discussing portfolio scoring, prioritization, and selection practices. The choices and reasoning for the theoretical framework are explained and supports grounding the portfolio management concept developed in the implementation phase to the theory.

The research process and outcomes are described in the Empirical Studies chapter. The section is organized according to the utilized methodologies. Overview of focus groups and user profiles are included. The steps described comprises semi-standardized interview (Flick, 2009, pp. 156–157) to get overall understanding and priority of the improvement needs, an affinity diagram (Lowdermilk, 2013, p. 68; Still and Crane, 2017, pp. 86–88) to get user insight to relevance of portfolio data, virtual dialog to validate the proposed portfolio management concept, and collection of final input through facilitated workshop complemented by a feedback form. Each step includes description of how the research was carried out in practice and the outcomes.

Implementation and results chapter starts with describing the research data collected and the analysis conducted during the research process. Next the chapter provides the answers to the two research questions based on the empirical studies and the related research. The first answer includes the focus areas for the portfolio management concept to be developed. Answer to second research question is description of the proposed practical implementation of a portfolio prioritization concept. The results include the details of how the technical solution was constructed to support implementation of the portfolio management as well as how the solution was introduced to the organization.

Discussion chapter will elaborate the portfolio management development measures implemented and how they were experienced by the organization and what were the challenges. Chapter will be concluded by discussing the reliability and validity of the research conducted.

The final Conclusions chapter is a short evaluation of the outcomes of the project and benefits of establishing a dynamic portfolio management concept for the organization. The chapter includes discussion how the original objectives were met by comparing the user input from early-stage interviews to the final feedback received. Last, recommendations are provided for further portfolio management development measures in the given context based on the findings and theory.

2 Objectives

In recent organizational survey the teams working with development initiatives indicated need for improved visibility and prioritization of work efforts across the teams. In the past teams have been able to manage the projects and resources within their own domain and governance from key business stakeholders. Fast moving digital initiatives involving many teams and stakeholders are changing the ways of working. Shared visibility and collaborative planning across the organization has become essential.

The objective agreed with commissioning organization was to develop and introduce a portfolio management concept addressing the issues raised by the teams. As portfolio management is a wide knowledge area that can be implemented in multiple diverse ways it was agreed that the project would start with a study to understand the needs for visibility and prioritization in more detail.

The project engages with users throughout the effort. Thesis writer is member of the organization and will have an observer role in the data collection phase. During development thesis writer create the artefact and has active role in communicating the concept and seeking feedback from users.

The thesis project includes studying the theory, collecting data from the users, developing the concept, technical implementation of the portfolio, validation of the artefacts and communicating with the organization.

2.1 Expected outcomes

First practical outcome is an analysis of the most important things collected from users to address with portfolio management in the target organization. The analysis shall be based on user interviews and include clear recommendation and reasoning for detailed scoping the actual development effort. It may also provide ideas for further improvement projects.

Next a portfolio management concept will be developed based on the findings from the analysis phase. It shall include the process and description of data needed in each step. Recommendation for a portfolio prioritization method is an important expected outcome as part of the concept. The proposed concept shall be grounded to theory. When ready, the concept will be introduced to users and initial feedback is collected for fine-tuning the suggested approach.

Final and most tangible development outcome is establishment of the shared portfolio with the support of virtual modern cloud-based collaboration tools. The tools shall guide the

process and provide shared visibility for the organization. Increased visibility and capability to prioritize business needs will be a key success criterion for the projects.

2.2 Research questions

The need to develop portfolio management had raised from within the users of the commissioning organization, hence the research questions focus on understanding and fulfilling that need.

The research aims to learn the user's expectations and priorities for successful management of a digital portfolio. Digital transformation, portfolio management theory and new ways of working are studied in order address the recognized improvement opportunities. Selected first improvements are implemented and learnings discussed as part of the thesis work.

The two research questions are:

(**RQ1**) What are the main challenges experienced by users managing a portfolio of digital initiatives?

(**RQ2**) How does users perceive the implemented portfolio management concept?

For the first research question it will be important to understand broadly the way the teams operates and what are the specific pain points of each user group to address. Based on the received input a common view will be formed as requirements for the concept to be developed.

The second research question focus on how users perceive the concept and the practical implementation of the supporting tool. Ideas for further development will be captured.

2.3 Scope

Portfolio Management is a wide knowledge area. It can be applied in many various contexts and there is substantial number of different approaches and methods available. Therefore, it is extremely important to carefully understand the situation and user needs when doing practical implementation and not jump directly in applying a specific theory or method. (Harder, 2002)

The scope will strictly focus on improving selected phases of portfolio management and practical implementation of those to the target organization. The phases in scope includes

how new initiatives are collected, how they are assessed, planned, prioritized, and finally committed for execution.

The execution phase, i.e., project management and portfolio level reporting and benefit tracking during the execution will not be part of the project scope. The focus and effort have been agreed to be put specifically to the early steps of portfolio management prior execution that is the area having the biggest potential for improvement. The practices to execute projects are mature and there is a good record of accomplishment of successful project execution in the organization.

It is already known that essential for the scope is the collection of new initiatives. It will be a pre-requisite for doing further assessment and planning of an effort. Out of scope is however detailed requirement management that is happening in the projects or as a continuous practice in agile teams. At portfolio level the organization needs visibility to the strategic objectives and the drivers behind the proposed initiatives to be invested in.

Portfolio shall provide view of high-level resource utilization and potential conflicts in the plans. This means the initial cost, required competences and dependencies for carrying out an effort. Detailed project level cost and resource planning are out of scope and are part of the project management domain. Also, budgeting and investment calculations are based on standard company practices and are not part of the scope. Outcome of these processes are noted at the time project is committed in the portfolio to be executed.

Portfolio prioritization is essential part of the scope. The proposed method needs to incorporate the strategic dimension that is important when driving digitalization. The prioritized initiatives may vary materially in size. Main purpose of prioritization is to increase dialog and alignment among the delivery organization and the stakeholders. The prioritization and overall visibility shall be supported by visual portfolio reports.

Finally, aim is not to do a full implementation of any existing framework like e.g., Lean Portfolio Management (Scaled Agile Inc., 2021c) but take the influences from the parts of known standards relevant to the organization. The designed concept should be agnostic to project methodologies. Each project has freedom to select the best development approach for its need. Both traditional waterfall methodology, agile development models and combinations of these both are in use. Many of the projects are delivered with help of external companies having specific technical skills and fit for purpose implementation methodologies. There is no need to change this but empower the teams who knows best the work they do and the way they are setup to decide the methodology for project delivery. Improved portfolio visibility shall help to plan and select efficient delivery method.

3 Research Methodology

In this study we applied qualitative research method as optimal way to learn about the research subject and provide focus for the artifact to be constructed. We also applied the user centred design approach to involve the end-users with the researchers throughout the project to "influence how a design takes shape". (Abras, C., Maloney-Krichmar, D., Preece, 2004, p. 1)

3.1 Qualitative research

Qualitative research is a multimethod approach that can included several types of empirical studies to make sense or interpret real-life phenomena. A study about what is qualitative research came into the conclusion that qualitative research is an "iterative process in which improved understanding to the scientific community is achieved by making new significant distinctions resulting from getting closer to the phenomenon studied." (Aspers and Corte, 2019, p. 139;142).

Flick describes qualitative research as an umbrella covering "various research approaches" and further distinguish those to the ones focusing on (1) studying subjective meanings, (2) everyday life routines or (3) cultural framing of perceptions. (Flick, 2009, p. 57)

The "five features of qualitative research" further support selection of qualitative research method for the research outlined in previous chapter. In this context the five features could be summarized as following: (1) The essence of the study is to understand under real-world conditions what are the areas of portfolio management in most need for improvement. (2) The research results represent the views and perspectives of the users and (3) cover the contextual conditions in each team that may vary. (4) The research conducted will provide insights to existing or emerging portfolio management practices that may help to construct the new concept. (5) Evidence will be collected from multiple sources and summarized to present the real-world setting. (Yin, 2011, pp. 7–9)

3.1.1 Qualitative interviews

According to Yin interviews as data collection methods can be considered at high-level to fall either under structured interviews or qualitative interviews. Structured interviews are formal and carefully scripted while qualitative interviews allow the questions to be open ended and the dialog to be adapted during the interviews based on the findings and interest of the participants. The interview mode in qualitative interview is conversational hence the social relationship formed in each interview will vary. (Yin, 2011, pp. 133–134)

In this study we applied qualitative interviews with open ended questions allowing follow-up questions when required to gather more information. The interviews were conducted individually. Saturation point was considered to have been achieved when no more new data was found during the interviews. Collection of data could stop. (Flick, 2009, p. 138)

Flick suggest semi-standardized interviews goes a bit further with the intention to get insight to the vast knowledge the interviewee may have around the subject by preparing more specific but still open questions around selected themes. Aim is to get instant and spontaneous answers. This method helped to provide structure for the statements arising from the interviews (Flick, 2009, pp. 156–158)

The unit of data collection was interviewee (Yin, 2011, p. 82). The number of interviews needed to reach saturation point cannot be fixed in advance. According Ojasalo et al. a good amount to start with is 4-6 interviews (Ojasalo, Moilanen and Ritalahti, 2014, p. 108). For the study representative sample included 6 interviewees that was enough to reach the saturation point. Beside the sample size another important aspect is the composition (Yin, 2011, p. 92). The interviewees represented each team in the organization, i.e., focus group, and had in-depth knowledge of how current development portfolio is managed in their area. An interview protocol was prepared for the topics to be covered (Yin, 2011, p. 139). (Appendix 1)

Due to COVID-19 The interviews were conducted as qualitative online research. This approach required the researcher to be familiar with the different tools used. (Flick, 2009, p. 265;269) In this study we utilized Microsoft M365 cloud platform and the Teams meeting functionality for the interviews. The interviews were recorded with the permission of the participants. The MP4 files created by Teams were transcribed with M365 Word Online with the help of the new transcribe feature applying Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies. (Wiggers, 2020) The ready transcripts were stored as pdf files for the analysis phase. The Figure 1 shows the steps and tools used to support the qualitative research process.
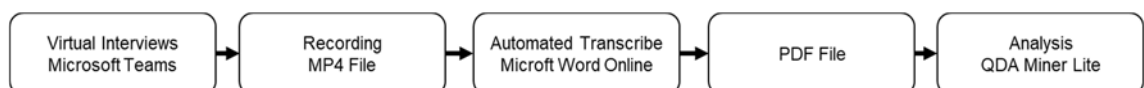

Figure 1 The tools used for collecting and analysing interview data

After the interviews and analysing the results a survey with one close-end question and one open-end question was sent to a wider focus group of 19 people to get broader insight to the research subject. (Appendix 2) The questions were based on the findings

from the qualitative interviews. With the help of the data an affinity diagram was prepared to further prioritize user requirements. Still & Crane suggest affinity diagramming is useful tool for big groups with variating interest as it helps to form a common view. (Still and Crane, 2017, pp. 87–88)

This approach of applying both qualitative and quantitative methods in a pragmatic way is called mixed methodologies. (Flick, 2009, p. 471) For getting continuous user feedback during the concept design phase Microsoft M365 Yammer discussion group was used (Appendix 3). At final stage of the solution design the researcher had more an observer role being part of the organization that is using the solution developed. (Flick, 2009, p. 472) Observation was complemented with a survey (Appendix 4).

3.1.2   Qualitative content analysis

Qualitative content analysis was applied for interpreting the data collected from interviews. The three main phases were preparation, organizing and reporting. The process can be inductive or deductive. We were applying the inductive process where organizing data included open coding, creating categories and abstractions. With getting insight to the data and representation of the facts the content analysis guided selecting the right areas of portfolio management to be improved withing the organization. (Elo and Kyngäs, 2008, pp. 107–111)

Analysing qualitative data collected was done with the help of Qualitative Data Analysis (QDA) software (Figure 2). The data was first imported and coded with ad-hoc codes, notes were then added and attached to text segments, followed by comparison done between segments, and finally codes were integrated and combined to core categories. (Flick, 2009, pp. 359–371) The software used in the study was QDA Miner Lite. (Provalis Research, 2021)
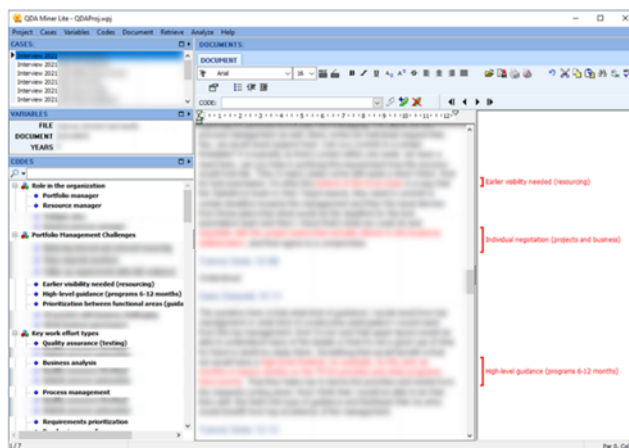

Figure 2 QDA Miner Lite was used for analysing the interviews

Frequency analysis of the codes helped to discover the broader themes arising from interviews but was not alone the strategy for reassembling. The three procedures followed during reassembling are meant to help avoid bias in analysis and they were (1) constant comparisons, (2) watching for negative cases, and (3) engaging in rival thinking. (Yin, 2011, p. 196)

3.2   User Centred Design (UCD)

User-Centred Design (UCD) methodology was used in this study to ensure that the portfolio management concept and solution created is meeting the needs of the users. Data collected from users had a vital role when applying UCD and when taking decisions during the design process. Engaging early with users in the design process help to avoid mistakes and save time. UCD is influenced by multiple disciplines like Human-Computer Interaction (HCI) that is subset of usability focusing on human interaction in computing products. (Lowdermilk, 2013, p. 6;13)

Important aspect of UCD is the continuous and iterative nature of the process. The main phases followed are outlined in Figure 3. They are (1) Discover, (2) Design and (3) Deliver.
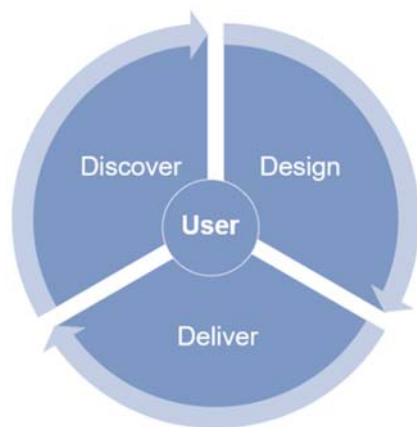

Figure 3 The UCD process (Still and Crane, 2017, p. 61)

In discovery the essence is to understand what is required to make the product usable for users. This included e.g., learning to know users and their needs, understanding existing solutions and how the product could be further improved. Discovery should never stop. It feeds the design phase that may start with making a prototype, in our case the concept. After delivery of the concept user feedback guided the further design and ultimately when solution is ready it leads to a product that will fulfil user needs. The user was in the centre of the process. (Still and Crane, 2017, p. 61)

Several methods can be used to research users during user centred design. The goal was not only to understand what user needs but to capture their knowledge of the use environment, motivation to use specific solutions, what is enabling efficient use or what are the issues users may face when managing digital portfolios. The user research methods may include e.g., analysing existing data, observation, assessing emotions, self-reporting, designer analysis or user and use diagrams. (Still and Crane, 2017, pp. 67–103)

Self-reporting means users "answer questions based on their experience". In this study we do self-reporting in form of user interviews (Appendix 1), mixed-method surveys (Appendix 2, Appendix 4) and qualitative survey (Appendix 3). With the final survey (Appendix 4) we gain input how users are perceiving the proposed portfolio management concept (RQ2) and the delivered solution. (Still and Crane, 2017, p. 80;84) Lowdermilk emphasize the need for detailed questioning and documenting the findings. At this stage "we have to open ourselves to criticism that may be difficult to hear." (Lowdermilk, 2013, p. 77).

The Figure 4 summarizes how iterative user-centered design principles were applied in the project and what were the research methods to interact with users in each phase. Future improvements are not part of the project scope, but they are included in the picture to emphasize the continuous improvement and engagement with users will continue.
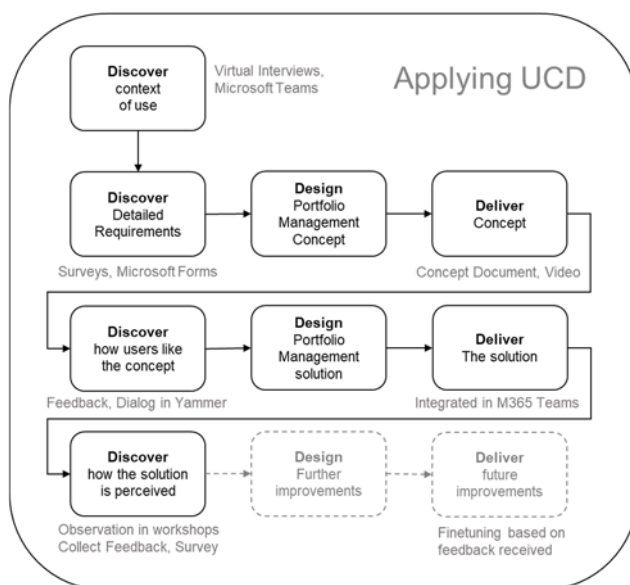
Figure 4 Interaction with users during UCD oriented thesis project, adapted from (Still and Crane, 2017, p. 61)

3.3 Development tools

In this project we used extensively Microsoft M365 cloud platform to implement the defined portfolio management concept (Table 1). The out-of-the-box services have matured and offers today advanced capabilities. Many companies like Accenture have implemented M365 to support its digital worker vision with integrated and seamless offerings aiming to "increase productivity and enable employees to work from anywhere, anytime, and do it sustainably." (*Accenture's Journey to Microsoft 365*, 2020)

Table 1 Tools used for implementing the portfolio management solution

Tool	Purpose
Microsoft Teams	Portfolio management solution is consolidated under a dedicated "Portfolio Management" channel.
Microsoft SharePoint	Portfolio data is structured and made available as a SharePoint list.
Microsoft Power BI	Portfolio is visualized with automated reports created with Power BI.
Adwise RoadMap	Custom visual for creating portfolio roadmap. (Adwise s.r.o., 2021)
xViz Bubble Chart	Advance visual used for creating portfolio prioritization matrix. (XViz LLC, 2021)
Microsoft Power Automate	Portfolio scoring model and calculation implemented with Microsoft Robotic Process Automation (RPA) platform.
Microsoft Forms	Survey tool used for receiving user input and feedback.
Microsoft Yammer	Tool for user dialog and engaging with users.

4 Related Research

The thesis project was implemented to support building management and prioritization practice for internal digital development initiatives of a technology company. Such initiatives include gaining efficiency through automating business processes, providing insight to business data, and engaging with employees and customers with modern digital solutions. Initiatives supporting creation of future growth are having strategic importance. Likewise, important is to guarantee business continuity. The projects typically consist of process improvement work followed by development of digital platforms.

The size of development teams is compact. They consist of key internal roles strengthen by external team members. The compact size enables lean ways of working. Traditional waterfall projects are used time to time to implement a change. Teams are empowered to select and use the development method that best match the need. This however requires alignment, improved visibility and effective prioritization of development initiatives and resources across the teams.

First, we will investigate the role and importance of portfolio management during digital transformation. Next the Standard for Portfolio Management (PMI, 2017) is researched to understand the generic competences, disciplines and terminology related to portfolio management. This is followed by studies of how portfolio management can be implemented for project-oriented portfolios (Romano, 2017) and lean portfolios (Scaled Agile Inc., 2021c). As the commissioning organization may use both traditional and lean methods for development the research will cover how these two different worlds could be executed under one portfolio (Business Technology Forum, 2019). Finally, options for common portfolio prioritization method and approach for tool support is studied. The research is scoped to provide relevant portfolio management knowledge for designing and delivering a fit for purpose portfolio management and prioritisation solution with the User Centred Design (UCD) process followed in the thesis project. Build of the theoretical framework is explained in Figure 5.

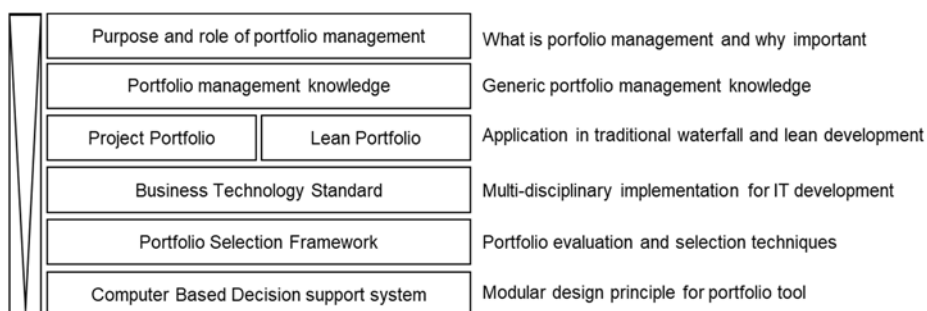| Purpose and role of portfolio management | What is porfolio management and why important |
Portfolio management knowledge	Generic portfolio management knowledge
Project Portfolio	Lean Portfolio	Application in traditional waterfall and lean development
Business Technology Standard	Multi-disciplinary implementation for IT development
Portfolio Selection Framework	Portfolio evaluation and selection techniques
Computer Based Decision support system	Modular design principle for portfolio tool

Figure 5 Building the theoretical framework

4.1 Role of portfolio management

Portfolio management is not a new practice to manage programs and projects to implement changes. Project portfolio management (PPM) originates from modern portfolio theory (MPT) applied as investment framework where the essence is in constructing a portfolio with items that will maximize return of investment and minimize risk. The theory was defined in late 1950s by the economist Harry Markowitz who was awarded in 1990 Nobel prize in economics. (Harder, 2002; Mangram, 2013; Bolster, 2021)

Identified challenges during 4th industrial transformation highlights the need for systematic and efficient portfolio management. Technologies like Artificial Intelligence (AI) and Robotic Process Automation (RPA) are in the heart of digital transformation touching almost any industries. Companies that are forward looking and adopt strategies to embrace the change are estimated to outperform their peers. At high-level the supporting management mechanisms includes 1) being purpose-led, 2) pursuing possibilities and 3) adopting adaptive strategic planning. (Stephen, 2021)

Project Management Institute recent 2021 pulse survey reported the three biggest changes organizations are currently going through are related to digital transformation (68%), changes to business strategy (64%) and increased organizational adaptability (61%). These changes are common across all the industries but especially high in finance and IT sectors. The survey also revealed that enterprises that have adopted new ways of working have much higher organizational agility (48% vs 27%). However only 32% of the companies have fully adapted new ways of working, 38% are somewhere between old and new ways of working and 30% are still relaying on traditional ways of working. (Project Management Institute, 2021)

During digital transformation, the change has become constant, fast, and more complex. Continuous focus is required to ensure companies are working on the right priorities and to be able to scale with speed to capture the digital opportunities. Capgemini Consulting recommends "Think portfolio!". When implemented as dynamic and effective continuous process, rather than static roadmaps, it can be used to facilitate the change (Bonnet, 2016, p. 7). This will result to increased business agility and organizational resilience.

The change is realized by directing investments, prioritization and scheduling projects, allocating limited resources, and communicating the benefits. According Satoglu visual roadmap is a key tool for anyone in the company to understand the planned changes (Satoglu *et al.*, 2018, pp. 95–98)

KPMG IT advisory 2020 compass report outlines the three core competences organizations need to build to survive digital transformation. They are business agility, scalability, and focus (Figure 6). These competences are enabled by processes managing the changes, especially portfolio management. (Hofland, Hattink and Ginkel, 2020)

Figure 6 "Orchestrating change through three core competencies" (Hofland, Hattink and Ginkel, 2020)

When looking for growth in the business, organizations are continuously balancing between how much effort is put on ensuring business continuity by protecting the existing revenue generating business and how much effort is dedicated to further optimizing or exploring fully new digital value streams. Portfolio management provides a good framework for organizational dialog to ensure initiatives are aligned with the strategy and they are maximizing the value created. Without having such alignment, the distinct types of efforts may be in worst-case counterproductive rather than supporting each other's. Different efforts will also require different implementation strategies. (Humble, Molesky and O'reilly, 2015, p. 26; Gartner, 2017)

To summarize, an agile portfolio driven by company strategy, aiming to capture the potential of modern technologies, and supporting making good decisions is an essential capability during the digital transformation journey. Next, we will study the portfolio management knowledge that sets the scene for specific applications.

4.2   Portfolio management standard

The Standard for Portfolio Management (PMI, 2017) published by Program Management Institute (PMI) is a widely recognized set of "principles and performance management

domains" supporting management of project investments. It is more a reference manual than a methodology but has a key role in defining common terminology and best practices for portfolio management. The standard is generic by nature enabling applications across many types of portfolios and business domains. The environment where the standard is applied and frameworks that are in use in the organization are important parameters when designing implementation of portfolio management. (PMI, 2017, p. 1; Business Technology Forum, 2019, p. 102)

An organization can have many portfolios for different purposes. Typically, they include programs, project or operations organized according to the strategic goals they are aiming to achieve. Therefore, portfolio has a vital role in aligning the execution activities with the vision and strategy of the organization (Figure 7). Up-to date and professionally managed portfolio can be considered as a window providing a snapshot to the "intent, direction and progress" of the organization, helping to optimize and prioritize the use of organizations resources. (PMI, 2017, pp. 3–10)

Figure 7 Portfolio and strategic planning (PMI, 2017, p. 8; Romano, 2017)

To summarize portfolio management is having organizational scope to plan, co-ordinate and monitor the activities undertaken to reach the strategic objectives. It helps to balance an allocate use of organizational resources. This organizational focus distinct portfolio from projects or on-going operations that are the implementation arms of the portfolio strategy. Management of detailed requirements, risks and constraints like resource availability or allocated budget happens in programs and projects. Program is a collection of linked projects managed under same umbrella. Project focus on creating or improving a service or a product. Key characteristic of a project is the temporary nature. It has always a start and end. (PMI, 2017, pp. 6–13)

4.2.1 Portfolio life cycle

The lifecycle of portfolio is continuous and according to PMI consist of four stages as illustrated in Figure 8. These four stages are supported by monitoring and control process that is responsible for executing, documenting, and communicating the "decisions and resulting actions" from each stage (PMI, 2017, p. 26).
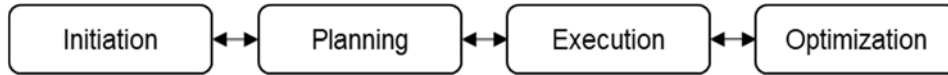
Initiation ↔ Planning ↔ Execution ↔ Optimization

Figure 8 Portfolio Life Cycle (PMI, 2017, p. 23)

Initiation is the most important stage as it includes identification of the portfolio scope and the included items, setup of governance practices and prioritization criteria. Also, communication plan, high-level risk management and performance monitoring are defined during initiation. Output of the initiation phase is a portfolio governance plan and charter. (PMI, 2017, p. 24)

Periodical strategic **planning** ensures the portfolio with agreed scope stays in constant alignment with strategy. This is supported by proper high-level budgeting and resourcing of planned activities. Portfolio level risks, issues and dependencies are critical to understand during planning stage. Important part of the planning is to define how the success looks like. This should cover financial and non-financial benefits to be measured and the governance body responsible of benefits realization. Prioritization of initiatives happen during this stage resulting to optimized portfolio. (PMI, 2017, pp. 24–45)

During **execution** portfolio is actively facilitated and managed to ensure any issues and risks raising from portfolio level dependencies are getting resolved. Monitoring and reporting of statuses and realized benefits are essential part of portfolio execution. Reprioritization of initiatives or adding new initiatives to portfolio can be done during execution phase based on critical unplanned needs, e.g., capturing a new opportunity. (PMI, 2017, p. 25)

Portfolio **optimization** can be a regular scheduled event but according to PMI, it is normally triggered after projects have been completed or new projects added. This step will assure organizations resources are used in a best way to maximize the impact of remaining portfolio items. Stakeholders are important to involve in the optimization dialog to secure realization of the remaining planned benefits. (PMI, 2017, p. 25)

4.2.2 Performance domains

The portfolio life cycle is supported by six performance domains (Figure 9) that consist of "good practices" (PMI, 2017, p. 10). The first domain, portfolio strategic management, is the most fundamental as it set the purpose and expectations for portfolio management.
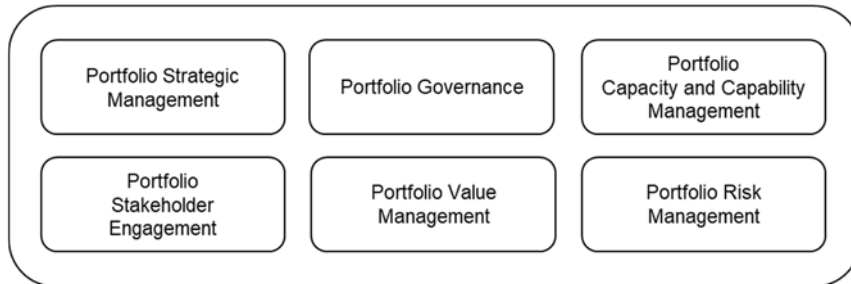

Figure 9 Portfolio Management Performance domains (PMI, 2017, p. 10)

Essence of **Portfolio Strategic Management** is to make sure the right things are done and that the value of planned initiatives is in balance with the risks. The evaluation, optimization and selection of initiatives requires thorough understanding of the context and alignment of the portfolio initiatives with the vision and strategy. This is supported by defining strategic goals and objectives for the portfolio. Goals are more generic and links the portfolio to the mission of the organization. Increasing efficiency or market share could be examples of such generic goals. Objectives are the more specific short-term actions (1 to 2 years) describing what needs to be achieved and how (at elevated level). Example of more specific objective could be to decrease lead time of customer deliveries by 15% within Europe compared to 2020 figures by the end of year 2021. (PMI, 2017, pp. 29–34)

For evaluating portfolio items PMI propose to consider three factors. Realization factor is about cost, duration, resource capacity, expected results, complexity etc. Objectives related factors are evaluated to understand how an initiative is contributing to reaching organization's strategic objectives, is it easy to measure and when will the results realize. Finally, the external factors are evaluated, e.g., how an initiative impact company image and the wider society. (PMI, 2017, p. 37)

Output of portfolio strategic planning activities is documented in a portfolio charter that "authorizes and specifies the portfolio structure and links the portfolio to an organization's strategic objectives" (PMI, 2017, p. 117). Portfolio roadmap is the visual presentation of how the items are contributing to the strategic goals and it is updated whenever changes to portfolio are done. (PMI, 2017, p. 35)

Organizational governance and senior leadership set the expectations for **Portfolio Governance**. It focuses on "decision making, oversight, control, and integration" of the portfolio components (PMI, 2017, p. 44). These functions can be repeated at all levels of the portfolio. The governance framework consists of controls, processes and relationships required to reach the business goals. It should not be mixed with management activities that take care of executing the directions set by portfolio governance. Such management activities are e.g., escalation of issues and risks, making change requests and providing visibility to performance. Many companies have established portfolio governance boards that are responsible for the governance practices and execution of those. Governance board may assign audits for the portfolio items, e.g., the projects in the portfolio, to review finance, management practices, risks, quality, documentation, and strategic alignment. The leading principle of portfolio governance is to ensure "transparency, responsibility, accountability, sustainability, and fairness" of the portfolio. (PMI, 2017, pp. 43–50)

Portfolio Capacity and Capability Management performance domain is critical for the overall success of portfolio execution. The principles under this domain will ensure the resource needs are known and that potential conflicts or gaps in the portfolio are managed. Resources might be e.g., financial, human capital or technology related. Target is to maximize the outcome and align the use of resources with capacity. For successful alignment it is important to understand the interdependencies within the portfolio. In digital projects this could specifically mean access to certain technology competencies or readiness of linked digital platforms. Any interdependencies, whether they are related to resources, competences, technology, or budget, often increase the overall complexity and risk of the execution. (PMI, 2017, pp. 51–61)

PMI suggest the "portfolio should be understood as a complex adaptive system" (PMI, 2017, p. 53). This means any decision made when selecting projects, or when managing changes, risks and results will have impact on organizational resources. Roadmaps are key source of information for optimizing the portfolio capacity with demand. In parallel with the day-to-day demand and supply balancing, it is crucial to assess and build new organizational capabilities required to execute upcoming plans. This will bring competitive advantages and increase the organizational resilience. (PMI, 2017, pp. 51–61)

Central function of **Portfolio Stakeholder Engagement** is portfolio communication. At portfolio level the focus is on communicating the portfolio execution strategies and use of organization resources to deliver the strategic objectives. Programs are managing communication of program benefits and projects focus on communicating the progress in delivering the set scope with agreed cost and quality. (PMI, 2017, pp. 63–73)

Anyone being impacted by execution of the portfolio is a stakeholder. Impact may occur through portfolio decisions, planned actions and deliverables. This means, especially considering the objectives of this thesis project, that resource managers and individual resources contributing to portfolio deliverables are one of the main stakeholder groups. Beside development teams and individuals, major stakeholders are also the internal customers of the deliverables who owns the demand and naturally executives and managers of the company. (PMI, 2017, pp. 63–64)

They key activities to manage stakeholder engagement is to 1) identify the different stakeholders and analyse their role, interest, and expectations for engagement. With this the portfolio communication can focus the messages with right context addressing the specific concerns stakeholders might have. 2) plan the engagement, i.e., the process and activities how to engage with stakeholders. 3) the engagement activities that may include assessment of portfolio items prioritization and selection, execution status and potential risk and issues. Assessing portfolio prioritization will be one of the main interest for the stakeholders in the commissioning organization of the thesis. (PMI, 2017, pp. 64–70)

Portfolio Value Management is driven by organizations' strategy and the expected value to be created by the strategic investments. Portfolio manager negotiates the value portfolio is expected to deliver and the desired risk appetite. Here portfolio manager has a vital role to align the expectations and ensure delivery with strategy owners and individual portfolio components. (PMI, 2017, p. 75;77)

Metrics are essential to have in place so that the value can be recognized. Tangible value like increase in sales can be measured directly. Also improving productivity, when a value can be attached to the metrics, is a tangible value. Intangible values are more difficult to measure directly. Brand awareness is example of intangible value, where setting a measurement for value is not straightforward but can be achieved through defining proxy measures. (PMI, 2017, pp. 76–77)

PMI defined value as "an indicator of the effect an entity or offering can deliver". When portfolio components report the forecast and value created to portfolio governance, using the defined measurements, it will allow portfolio level optimization of value and risk. Reasons for any deviations are also captured. Known issue is that reporting value might not be fully objective and can been seen political. (PMI, 2017, p. 76;84)

As indicated earlier portfolio is an adaptive system (PMI, 2017, p. 53) like the strategy of the company that is continuously evolving. For digital initiatives this is especially true when the environment is constantly changing, and new opportunities may arise. Hofland

et al. suggest failing, when done fast, can be as important as succeeding. This is enable by effective portfolio management making information and choices available for timely decision making (Hofland, Hattink and Ginkel, 2020). Therefore value management need to be continuous effort to assure and maximize realization of the value while balancing the risks involved (PMI, 2017, p. 75).

Portfolio Risk Management is also a continuous process that that provides leadership and portfolio management visibility to potential risks, mitigation actions and scenarios for decision making when all facts are not known. Usually, programs and projects are responsible for the mitigation actions delegated by portfolio steering. Portfolio risk management consist of risk planning where the risk tolerance and process for risk management is defined, risk identification where the risks and owners are captured, risk assessment of the risks including e.g., probabilities and impact, and finally the risk response that is following the overall portfolio risks status and balancing the portfolio and investment decisions according to the set risk appetite. (PMI, 2017, pp. 89–95)

4.2.3   Conclusions and challenges (Portfolio management standard)

The Standard for Portfolio Management (PMI, 2017) offers a good overall view what disciplines and competencies are required to establish and execute portfolio management. It links company strategy to execution and help organizations to reach objectives in an adaptive environment. Selecting the right initiatives and making changes during execution is supported by continuous portfolio lifecycle and cross-discipline performance domains with the required knowledge.

For digital fast-moving initiatives and small organization, it would be a burned to implement the full PMI standard. The optimal approach should however include the core elements so that the existing portfolio management knowledge can be utilized, and the approach extended when desired. While the standard is excellent as handbook practical implementation requires further research. Next, we will build on the portfolio management fundaments and investigate Project Portfolio Management (PPM) that is applicable for larger investments executed in project mode.

4.3   Project portfolio management

Project Portfolio Management (PPM) builds on the portfolio management knowledge. It focuses on projects as mechanism to contribute to organization success and delivery of the strategy. PPM is a practical way to connect the high-level strategy planning process

with operative project management. Building this connection will ensure the link to strategy remains through planning, execution, and realization of the benefits. (Romano, 2017)

Aalto et al. (Artto, Martinsuo and Aalto, 2001, p. 24) defines the project portfolio as "collection of projects that are carried out in the same business unit sharing the same strategic objectives and the same resource pool." This practical definition is also accurate giving the context of our thesis project where use of limited resources needs to be prioritized together under same leadership.

The prioritization task is not however easy. Among the biggest challenge for project-oriented organizations is to align the projects and resources with strategy. Artto et al. stated already in 2001 that more research is needed on how project portfolio management is applied in business context. (Artto, Martinsuo and Aalto, 2001, p. 23)

The thesis project is aiming for practical implementation of a portfolio with capability to prioritize digital initiatives. For this we need to understand next application of portfolio management in project driven delivery.

4.3.1 Project portfolio management process

The project portfolio management process covers the entire lifecycle from manging the demand for new projects to measuring and reporting the achieved benefits. Starting point for the portfolio is the vision and strategy of the company that is guiding the objective setting. The strategic objectives are set as part of the strategy process and are more concreate than vision. Objectives must be measurable and quantifiable and have a specific timeline, usually within short or mid-term. (Romano, 2017)

Portfolio management process will ensure organization is addressing the objectives with right actions. Success of the portfolio is determined by how well the objectives are met. Given the thesis scope specific interest is put on how the digital initiatives are collected, assessed, prioritized, and selected. (Romano, 2017)

Implementation and benefit tracking are essential steps following selection of a proposed initiative. However, these steps will be covered only shortly as they are not in the core of this thesis focusing on prioritization of digital initiatives. The commissioning organization is having solid implementation and reporting practices in place. A well-established portfolio will support tracking and connecting achieved benefits of individual initiatives to strategic objectives.

The detailed process linking organizations strategy to projects is outlined in Figure 10. (Romano, 2017)
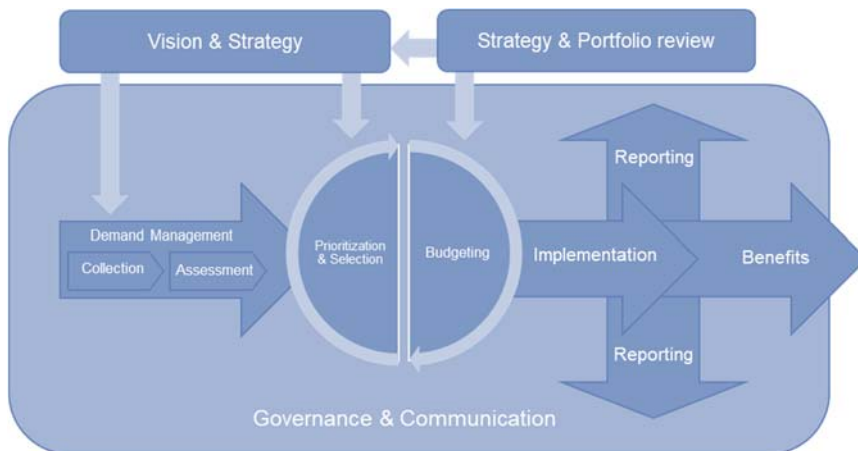

Figure 10 The portfolio management process (Romano, 2016)

As illustrated in Figure 10 **Demand Management** of new initiatives should be a natural consequence of the strategy definition work. Collection does not only focus on innovative ideas but also looking at any ongoing projects or projects not yet selected to be implemented. All these initiatives together form the portfolio to be prioritized. This is important finding that we will use later when establishing the portfolio. The assessment step focus on understanding the benefits but also things like alignment with strategy, cost, schedule, risks, feasibility, and potential dependencies are investigated. In the thesis project purpose is to create a lean approach to make it easy to capture and run fast simulations of digital ideas. The information seen as useful for managing portfolio is studied as part of the user centric design. As the go decisions are made based on the collected information the project teams need to know exactly what is expected for the prioritization. According Romano the depth of the business case preparation depends also on the organization's maturity. (Romano, 2017)

Budgeting is a portfolio level activity. Project Portfolio Management (PPM) process and the go decisions needs to be coordinated with organization's budgeting cycle and the expectations and constraints set by the business strategy. Prior a go decision can be done for individual initiative the resources required to implement as well as the overall budget availability must be known. The initiatives creating biggest long term strategic value are in specific interest. Other factors, like risk and complexity must also be considered when doing final prioritization and selection. Depending on the organizations budgeting and finance processes, techniques like e.g., Net Present Value (NPV), Payback Period or Break-Even Analysis may be used for evaluating the value. (Romano, 2017)

The challenge during digital transformation is that experimental initiatives must be included to portfolio without knowing how they will play out. According to O'Reilly et. al a digital modern portfolio should have good balance of explore and exploit initiatives (Humble, Molesky and O'reilly, 2015, pp. 21–36). In comparable manner Romano suggest classifying the portfolio into initiatives that will change the status-quo and initiatives that will drive value from what already exist. (Romano, 2017) To ensure this some level of portfolio categorization is required. Otherwise, good innovative ideas with unknown future potential might never been tried out. Some share of budget should therefore be reserved for experimental projects. Some may fail but some might turn out to show immense potential for future value creation and would be good candidates for incremental funding.

How to **prioritize and select** initiatives is one of the key things to consider when implementing project portfolio management. Organization needs to develop a method how to effectively evaluate and rank the potential initiatives. Especially on their alignment with strategy, feasibility for implementation and risks involved. The company strategy process should provide the high-level guidance and constraints supporting ranking of initiatives. However, in many cases according to a study done in 2016 by Romano the sponsorship from top management might be weak or the strategy is not planned and cascaded to a level useful for managing portfolios. The study concluded that taking a bottom-up approach to establish a portfolio can help the organization to create and mature their strategic planning process. (Romano, 2016)

This finding is encouraging for the thesis project as the commissioning organization has a high-level strategy but the need for establishing a joint portfolio has been raised bottom-up by the implementation teams that are self-organizing. The steps proposed by Romano to conduct bottom-up prioritization and selection of initiatives are outlined in table 2.

Table 2 The steps followed for bottom-up prioritization and selection of portfolio items (Romano, 2016)

1. Breakdown strategy
The first step is to breakdown the company strategy and map the current or proposed new initiatives to interrelated strategy elements. This was found in the study to immediately capture leadership interest and ensure participation to portfolio dialog.
2. Establish priority
Initiatives are given relative importance based on selected criteria's such like significance for reaching strategic objectives, preferences, and likelihood.
3. Produce ranking
Ranking is done by looking into the strategic benefits that each initiative will produce.
4. Evaluate initiatives
Evaluation is based on how likely it is for an initiative to be successful. Factors like risk, cost and feasibility were studied to understand the success potential.
5. Find highest scoring initiatives
All the criterions from steps 2-4 are used to calculate a score for each initiative and find the initiatives with the highest overall score. Most common scoring models used according to the study were Analytic Hierarchy Process (AHP) and Pairwise Comparison. We will look more detailed into the scoring models in chapter 4.6.
6. Develop reports
Professional looking reports are produced as outcome of the prioritization and selection phase for portfolio decision making and engaging with the leadership.

The described bottom-up method to prioritize and select initiatives is straightforward. Output of the process can help the organization to understand the current portfolio from strategic perspective. As the process is simple it allows feedback loop and planning of different scenarios together with leadership. Use of the bottom-up method can speed up the implementation of project portfolio management (Romano, 2016).

To fill in and collect too many data-points is slowing down the process and not being practical when evaluating fully new digital ideas. The more ideas the better. Therefore, when implementing the thesis project, the criterions to be build need to allow high-level evaluation and prioritization of new initiatives without yet knowing all the details. Final

investment approvals are usually subject to detailed business case validation, but it makes no sense to prepare detailed business case for all the demands before initial prioritization.

Portfolio Implementation phase is realizing the selected initiatives that are first planned in detailed. This is applicable both for initiatives done as projects or under operations management. Things like detailed scope, deliverables, tasks, schedule, and resourcing needs to be fixed. Portfolio Management Office or similar function overseeing the portfolio is responsible of establishing the monitoring and controlling loop. This included follow-up of implementation status and realization of the anticipated benefits. Romano highlights that the managers responsible of execution needs to be fully aware of the strategic expectations so that they can make the right decision during implementation and the process how to agree changes impacting targeted benefits. (PMI, 2017, p. 28; Romano, 2017)

Follow-up is done through centralized **Portfolio Reporting.** More than following progress of individual initiatives the focus is on following how the strategic objectives are met at portfolio level. Bottom-up reports from initiatives are aggregated to form the portfolio view. Any deviations that may impact portfolio benefit realization are important to include in reporting. Portfolio manager duty is to resolve issues related to interdependencies between the initiatives. Such interdependencies could be e.g., related to resource availabilities. (Romano, 2017)

A word of warning. Given the modern organization theories around effective self-organizing teams to add more control from outside is not recommended. The portfolio monitoring and control mechanism implemented should therefore focus on supporting the work and autonomy of implementation teams rather than giving and extra burden of control. Support in e.g. ensuring adequate resourcing for the team to deliver the commitments would be seen as value adding activity. (Martela, 2020, pp. 22–23)

More formal **Strategy & Portfolio Review** is usually conducted once a quarter. The meeting should investigate the current portfolio and consider is this still the best combination of initiatives to support strategy execution. There might have emerged new initiatives with better potential than current ones. Or the market situation has changed impacting the strategic priorities. (Romano, 2017) During digital transformation constant and critical portfolio review is essential to capture opportunities during each development cycle. Technologies are emerging rapidly enabling new business models. The companies

who can timely capture those opportunities will be awarded. (Humble, Molesky and O'reilly, 2015, pp. 21–36)

In the final **Benefit Realization** phase the value delivered by portfolio initiatives is verified. The expected benefits should have been listed for each item when capturing the demand. Good practice is to as early as possible agree the exact measurements for each initiative and who is responsible for measuring. Collection of realized benefits should begin as soon benefits starts to accumulate and continue during the whole lifecycle of value generation. Cumulative value generation during implementation and over time is illustrated in Figure 11. (PMI, 2017, pp. 80–83; Romano, 2017)
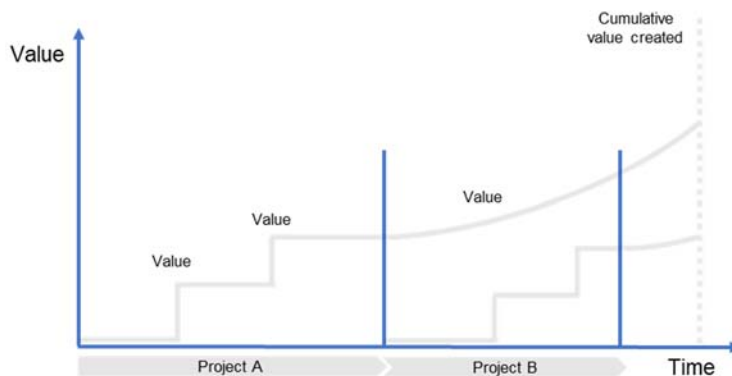
Figure 11 Portfolio benefit realization over time (Romano, 2017)

4.3.2   Conclusions and challenges (PPM)

For successful implementation of project portfolio management, it is must to be able to establish the link between strategy and the initiatives. Romano suggested based on his study the bottom-up approach to build portfolio and create the link to strategy. This will help the whole organization to view the portfolio as strategic tool and increase planning maturity. (Romano, 2017)

Second key finding is that it is essential to define a robust method to prioritize and categorize the initiatives. The best ones are selected to be implemented. Thirdly, it was stated that a portfolio will benefit highly of some type of tool support that enables collection and prioritization of initiatives and help to maintain the dialog within the organization. It is noted for future development that benefit tracking is important part of the portfolio lifecycle. Effectively managed portfolio should follow value created. (Romano, 2017)

However, Forrester Research has highlighted the traditional tunnel planning approach does not support digital initiatives in an optimal way. Projects have become fast, agile and

in many cases transformative due to digital disruption. Continuous delivery cycle with inbuild customer feedback loop and constant portfolio review capability is essential. (Visitacion, 2018, pp. 13–18)

New lean applications of project portfolio management are required. We need next to look for some more agile portfolio approaches in addition to project based portfolios. The commissioning organization for the thesis project has development done both in project and agile mode.

4.4 Lean portfolio management

Biggest issue with traditional gate-based portfolio management model is that it can lead to long lead times and missed opportunities. Humble et. al highlights in the book Lean Enterprise the importance of exploiting innovative ideas and failing fast. Continuous delivery model with short cycle times is proposed to be used helping to manage the risks. In the lean thinking deployment teams should be given autonomy to decide what is the best ways of working to deliver the expected outcomes. Autonomy requires however constant alignment that the portfolio can facilitate. Alignment is created by sharing the intent and purpose of the things to be executed. According to Stephen Bungay "The more alignment you have, the more autonomy you can grant. The one enables the other". Implementing frequent feedback loops and reviews, e.g. after every development cycle, will help to maximize the value created. (Humble, Molesky and O'reilly, 2015, pp. 16;109-110;189)

4.4.1 Scaled Agile Framework (SAFe)

Lean Portfolio Management (LPM) part of the Scaled Agile Framework (SAFe) is following the lean enterprise principles. It helps to align the execution with the company strategy, as does the PPM, but the operations and governance happens in a more agile way with added autonomy given to the teams. Lean portfolios consist of continuous value streams given funding usually organized by business domains, not temporary project investments. This is a key difference between PPM and LPM. A value stream covers all the initiatives needed to deliver a change contributing to company strategy, in each business domain. (Scaled Agile Inc., 2021c, 2021a)

The core idea of value streams delivering the outcomes in continuous cycles based on pre-allocated budget is illustrated in Figure 12.
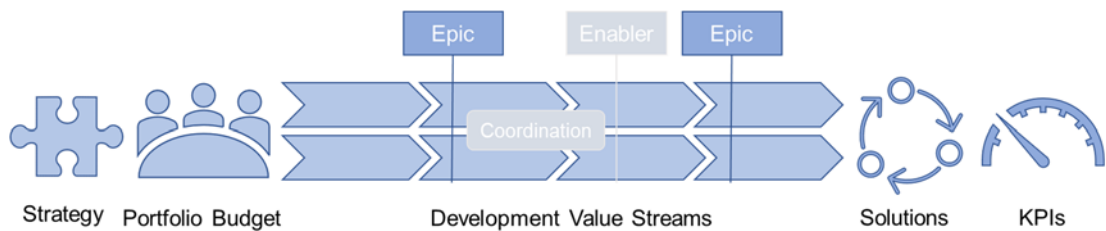
Figure 12 SAFe implementation of Lean Portfolio Management (Scaled Agile Inc., 2021a)

Portfolio budget for a lean portfolio is agreed by the company executives and stakeholders after a vision for portfolio have been formulated. The portfolio vision shall be based on company strategy. After budget is set value streams are allocated funding. Development teams are empowered to plan use of given resources in best optimal way to reach the agreed outcomes. Similar like in the traditional model the performance is measured, not as value generated by projects, but with Key Performance Indicators (KPIs). The KPIs shall tell how value streams are contributing to reaching the strategy. (Scaled Agile Inc., 2021a, 2021b)

As the allocated funding is aligned with strategy, decision to undertake new initiatives can be done in a much leaner way compared to project-based funding. Lean governance is responsible of budget follow up, forecasting, measuring improvements and impact to strategy implementation. (Scaled Agile Inc., 2021c)

Budget guardrails are a second way LPM steers the portfolio execution towards right direction. Guardrails describes the principles for spending and the detailed budgeting practices. It includes guidance for spreading the budget over time, capacity allocation policies, threshold for seeking additional approval for major initiatives and engagement practices with business owners. (Scaled Agile Inc., 2021c)

Epic is a collection of related user stories divided into tasks describing a development initiative. As a starting point epic should define the Minimum Viable Product (MVP) that can be used to experiment and validate. This reduces the overall risk as the gained learnings can be used to finetune and add more features during the next development cycles. Project-based approach is different as it targets to describe and implement a detailed final solution. The epics are approved and prioritized following lean portfolio management principles in the portfolio backlogs. (Humble, Molesky and O'reilly, 2015, pp. 76–85; Scaled Agile Inc., 2021e)

Prioritization technique used for flow-based systems to maximize the output is called Weighted Shortest Job First (WSJF). A relative comparison is made between the items to be prioritized using value calculated by dividing cost of delay with job duration. WSJF is discussed more in chapter 4.6. (Scaled Agile Inc., 2021f)

Governance of agile portfolio requires novel approaches compared to traditional gate-based governance models. Old portfolio management fundaments are still there but with new flavours to accommodate the need for speed and to manage the uncertainties in lean development. Executives, business owners and enterprise architects are the key members to define the strategic themes and budget for lean portfolio. This will give the direction and desired context for the rest of the organization. Strategic portfolio reviews are usually performed once every quarter and the budget revisited bi-annually. An integrated high-level portfolio roadmap is maintained to illustrate the future. It should include the major initiatives, i.e., epics, and the key technical enablers required. (Scaled Agile Inc., 2021c)

Portfolio flow specify principles for how epics are managed over their lifecycle. According to SAFe focus is on limiting major parallel work in progress (WIP) to avoid resource bottlenecks. It is important to acknowledge the continuous support and maintenance work done by the development resources as it impacts the total available capacity. (Scaled Agile Inc., 2021c)

Portfolio Kanban is often used a s method to manage and visualize the portfolio flow. Epics can be organized in stages (Figure 13). It will support to align the execution with strategy, i.e., ensuring agile teams are working with the right items. During review stage the intent, anticipated outcome, and other important parameters, like cost and strategic fit, are collected from stakeholders for further analysis. Agile Program Management Office (PMO) is coordinating cross-stream opportunities, execution, and dependencies across the value streams. An operative portfolio sync meeting is usually kept once a month. (Scaled Agile Inc., 2021c, 2021d)

Figure 13 Example of portfolio Kanban stages (Scaled Agile Inc., 2021d)

4.4.2 Conclusions and challenges (SAFe)

Lean approach for portfolio management has clear benefits. It can improve time to market and create incremental value flow. Learnings captured from first cycles, i.e., Minimum Viable Products (MVP), will most probably result in better product fit and quality. Fast evolving strategy or technology can be reflected to portfolio with shorter lead times than in traditional project portfolio as the demand is managed in dynamic way and decision making is decentralized. Value streams oversee planning, prioritization, and execution for the best outcome. A clear shared understanding is however required to implement the lean, mission based approach, and give autonomy to the teams. Not more command and control. (Humble, Molesky and O'reilly, 2015, pp. 80-81;189-191)

The concept of self-managed value streams and agile development requires strong organizational support. The whole organization needs to buy in and commit to the lean principles. Value streams have a hunger for strategic guidance enabling self-management and agile ways of working. Especially if teams are decentralized or virtual, strong collaboration to create shared understanding is necessary. The planning horizon vary at each level. At corporate level, the strategy may have a timespan from 3 to 5 years and is supported by annual portfolio level plans. Development teams usually break down the plans at quarterly level. All these plans need to stay coordinated and be supported by continuous finance process flows and guardrails rather than fixed budgeting cycles. (Humble, Molesky and O'reilly, 2015, p. 262; ITM Platform, 2022)

The most important thing to note is the amount of commitment and involvement required from management and executives for lean portfolio management. The agile mindset must be shared at every level and by every function. In big organizations it may include major investments and transformation to implement lean principles. In practice e.g., the quarterly portfolio planning meetings with stakeholders requires facilitation, commitment, understanding of the lean process and investment of time. Without aligned plans based on strategy and supported by company other processes, there will be a lot of room left for improvisation and "faking" to be agile. As the book Lean Enterprise put it "Real lean transformation is the result of committed, fearless leaders who encourage and enable lean thinking to propagate throughout the entire fabric of the organization". (Humble, Molesky and O'reilly, 2015, p. 206)

4.5   Business Technology Standard

The Finnish born Business Technology Standard (BT Standard) is an end-to-end open-source management framework used to co-ordinate "use of information technology anywhere in business" (Business Technology Forum, 2019, p. 1) It is popular especially in Nordic countries. The core idea of the BT Standard is to ensure technology is managed in a way it brings value for business. The standard provides a unified management model utilizing industry leading development and service management practices like SAFe, DevOps and ITIL. This is a clear merit of the standard as it helps to bridge the gap between development and continuous operations. It was selected to be included in thesis study because it recognizes both traditional projects and lean continuous efforts can be part of development portfolio. This match well with the situation in the commissioning organization of the thesis. (Business Technology Forum, 2019, p. 1;3;7)

The high-level role of **portfolio management** described in BT Standard is like in PPM or SAFe. This means maximizing strategic fit and the value created. Other duties are also well aligned. They include setting practice for evaluation and prioritization of initiatives, acting as approving authority when required, to provide visibility of portfolio items and their statuses, support execution and continuous learning and finally overseeing measurements and value creation. (Business Technology Forum, 2019, p. 29)

The key **discipline areas** of the model are demand, development, and services. They are complemented by strategy & governance and sourcing & optimization disciplines. As in SAFe the value streams are driving value creation supported by the disciplines. The BT Standard includes gates for traditional projects whereas the lean efforts can proceed more autonomously. Only three common control points are applicable for any initiative and all execution models. We are looking next specifically at how the demand and development portfolio is managed. (Business Technology Forum, 2019, p. 9;30)

The demand is guided by **strategic planning** that covers usually 2 to 5 years period. It should include the key steps required to reach the vision and objectives set by the business technology strategy. More detailed action plans are prepared e.g., for next 12 months, containing input for budgeting and resourcing. According BT Standard the work is normally organized into 3-5 key value streams having a mission statement, value drivers, owner, financial mandate, architecture, and roadmap defined. (Business Technology Forum, 2019, pp. 17–18)

The standard embraces lean thinking and therefore offers value streams Minimum Viable Governance (MVG) practice. The above-mentioned disciplines are supported by three

common top-down **control points** having evaluation rules defined by steering. The control points are outlined in Figure 14. The first control point is when development initiative has been captured. The best initiatives area authorized to start planning. After planning is completed a development request is issued for getting authorization to proceed with execution. Final third control point is when new service is approved and continues to be governed until retired. (Business Technology Forum, 2019, p. 10;44)

Figure 14 Mandatory control points (Business Technology Forum, 2019, p. 10)

E.g., before demand for a new development initiative is approved it is evaluated with rules set for sponsorship, financing, resources, architecture, and security compliance, use of approved vendors and processes to be followed. In case some of the checkpoints fails, portfolio steering is obliged to further evaluate the related risks and feasibility and help to get the missing points cleared. Development initiative can have pending, committed, or rejected status.

As explained earlier, an initiative can be implemented following traditional sequential project approach or then lean incremental development model. The way initiatives are prioritized for development vary based on the planned execution model. **Prioritization of sequential efforts** is more complex and requires factors like impact on business, cost of delay and risks if not done, e.g., technical or compliance related, to be evaluated. Portfolio steering is doing the prioritization with the input received from project owners. (Business Technology Forum, 2019, p. 96)

Prioritization of incremental efforts is normally taken care by development team together with key stakeholders e.g., in a planning workshop. Aspects like technical feasibility, desirability by end users and viability are investigated. Viability means analysis of any constraints, like regulative or financial, that may impact implementation. After all backlog items have been prioritized, they can be compared to help selection with techniques like Weighted Shortest Job First (similar than WJSF in SAFe), or Cost of Delay Divided by Duration (CD3). (Business Technology Forum, 2019, pp. 96–97)

To conclude, value streams with pre allocated budgets and resources can prioritize and decide on incremental development efforts autonomously according to lean principles

given the common control points set by portfolios are passed. Prioritization and decision making of sequential project efforts requires more formal approval from central portfolio steering. The below Figure 15 adapted from BT Standard illustrates the flow of an idea towards execution supporting both incremental development and sequential efforts. The gates G-1 to G1 are used by initiatives executed in project mode. (Business Technology Forum, 2019, pp. 10;27-29)
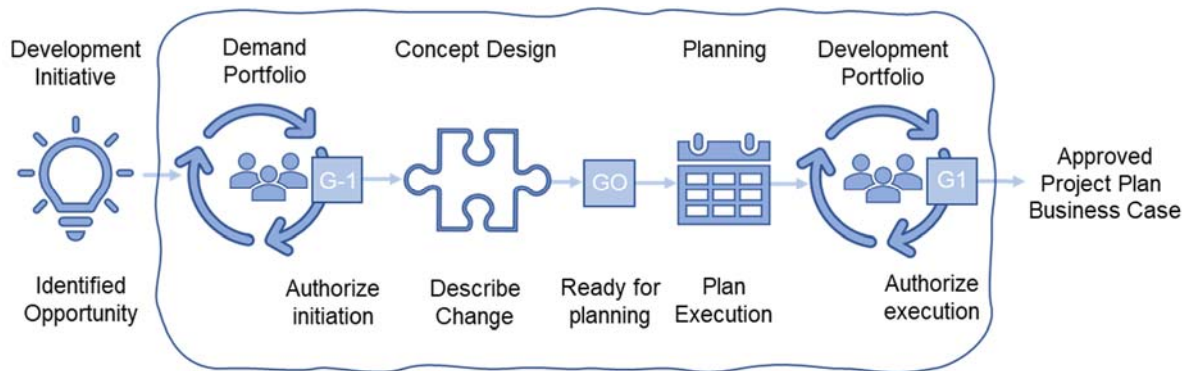
Figure 15 The path from idea to execution adapted from BT Standard (Business Technology Forum, 2019, pp. 29–30)

Business value realization is the process that measure and help to maximize the value generated over time. Measurable business objectives are defined at early stage before development is authorized. They should include timeline and conditions set for value to be realized. As value will start to cumulate after a change has been deployed it is important the roles and responsibilities for follow-up has been agreed in advance. In traditional projects value generation will take longer time but in incremental effort it can start to cumulate already after first service release. In BT Standard It is responsibility of the development portfolio to track the value generated. Service portfolio role is to constantly review value created and safeguard the reliability and fit for purpose of the services. (Business Technology Forum, 2019, pp. 32;108-109)

4.5.1 Conclusions and challenges (BT Standard)

The BT Standard suggest managing the portfolio by end-to-end value streams that have a business owner, mission statement and financial plan, guided by the strategy. Each stream is maintaining visibility for the demand, development items and services they are responsible of. Incremental efforts can proceed with minimal viable governance whereas projects require portfolio level steering. (Business Technology Forum, 2019, p. 9)

This approach is supported by Accenture who shared key learning of using SAFe in 2015. It concluded distributed teams requires an effective process that need to integrate agile

and waterfall methodologies. Consistent tooling and status tracking was mentioned as enablers to synchronize the work efforts of distributed agile and waterfall teams. Such process would need to include common definition for "Done" and consistent sizing method for the efforts. The challenge of integrating work efforts of distributed agile and waterfall teams is illustrated in Figure 16. (Ball, Nair and Hering, 2015)
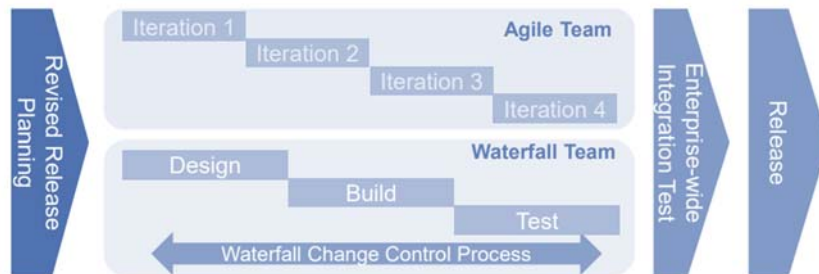
Figure 16 Integrating agile and waterfall (Ball, Nair and Hering, 2015)

Although BT Standard is a good framework as it covers end-to-end everything that is required to manage business technologies successfully, it might be challenging to deploy to an organization having established practices which of some are not connected end-to-end to the extent suggested by the standard. This challenge was also confirmed by the Accenture learnings. Such deployment would require major transformation. BT Standard provides a good handbook for leaders in charge of developing the operations. Following lean principles, defining strategy and roadmap for incremental deployment of the BT Standard over time could be a viable approach.

4.5.2   Key differences between researched portfolio approaches

By now, it has come clear from studying project portfolio (Romano, 2017) and lean portfolio (Scaled Agile Inc., 2021c) approaches that they are sharing same portfolio management knowledge (PMI, 2017) at high-level, but the processes differ. Despite some challenges the research revealed the needs of both worlds are possible to combine when managing portfolios. (Business Technology Forum, 2019)

The main differences between traditional project portfolio management and more agile lean portfolio approach starts from budgeting. In traditional approach organizational budgets are planned annually and allocated to projects. In lean portfolio value streams are getting the budget and the budget status vs. plans are review preferably more frequently. Jones try to tackle this issue by proposing a novel approach for budgeting in alignment with modern portfolio management. (Jones, 2018)

Another big differentiator is how scope is managed. Projects are having fixed scope, but agile efforts are evolving and may change in every increment. The planning of agile effort happens within the development teams. Projects are planned more top-down by portfolio and program managers. Project also rely more on control coming from above whereas agile teams are self-organizing and seek for guidance when in need. Reporting burden is usually much lighter for agile teams, both are though required to have metrics in place. Metrics for agile portfolio are usually focused on value added. Not so much on time spent or task completeness than the traditional project metrics. (Jain, Tempert and Hermsen, 2021; Scaled Agile Inc., 2021c)

The BT Standard is relying on value streams for managing the delivery of results like does the SAFe methodology. The process also accommodates the needs of gate-based projects in addition to the cyclic agile delivery models. Clear strength of the model is that it is a wider framework linking portfolio management to other organizational processes from strategic planning to operations. (Business Technology Forum, 2019)

4.6 Integrated portfolio selection framework

Now we have a good understanding of portfolio management and how it can be applied. We also know from the research that prioritization and selection of the right initiatives is important, if not the most important task, of managing portfolios. Common to all portfolio management frameworks is that the criterions and methods for prioritization needs to be defined. The frameworks do not dictate what techniques to use. In general, the methods available to choose from can be utilized across the frameworks to support the prioritization task.

Let us start with looking why portfolio selection has become increasingly important and what are the challenges? Digital transformation requires efficient management and prioritization of technology investments. (Satoglu *et al.*, 2018, p. 97) To create inclusive culture is a key challenge of future working environments to maximize the innovative ideas. (Alasoini and Houni, 2019) Having many ideas and the reality of limited resources calls for prioritization.

Use of prioritization methods help to structure the decision-making problem and evaluation of the portfolio. A solid method enables decision makers to rationalize the decision options and have a constructive dialog. This results in a more objective and aligned view. Participative evaluation also increase transparency and promote responsible decision making. (Eskelinen *et al.*, 2017)

The prioritization methodologies and selection process needs to be adapted to match with the organizational objectives. (Romano, 2016) Portfolio frameworks do not advice how a detailed portfolio prioritization and selection model should look like. There are over 100 different methods available for project selection. (Archer and Ghasemzadeh, 1999, p. 213) This is why it might become challenging to select and apply a methodology. It could even lead to wrong outcomes if no proper consideration is put into choosing a fit for purpose method.

Recognizing the inexistent of a holistic framework supporting project selection and the many methods available Archer and Ghasemzadeh propose use of "An integrated framework for project portfolio selection". It breaks down the selection process to stages and disconnect the selection process from the prioritization techniques (Archer and Ghasemzadeh, 1999, p. 207). This is a clear advantage complementing the many commercial or open-source portfolio management processes available.

For clarity, the definition used for project portfolio selection by Archer and Ghasemzadeh is similar like defined in the methodologies studied earlier. It reads:

> "Project portfolio selection is the periodic activity involved in selecting a portfolio, from available project proposals and projects currently underway, that meets the organization's stated objectives in a desirable manner without exceeding available resources or violating other constraints." (Archer and Ghasemzadeh, 1999, p. 208)

The three main phases for defining an integrated project portfolio selection framework are 1) strategic considerations, 2) individual project evaluation and 3) Portfolio selection (Figure 17). The aim is to define a simple portfolio selection model with distinct stages. (Archer and Ghasemzadeh, 1999, pp. 207–211)
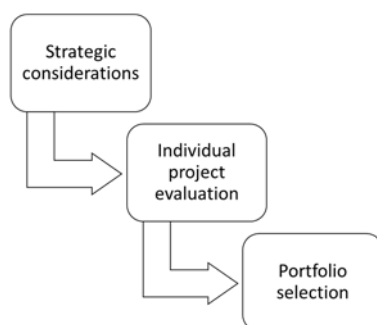
Figure 17 Defining project portfolio selection framework (Archer and Ghasemzadeh, 1999, pp. 208–211)

Next, we will walk through the three steps for defining portfolio selection framework.

4.6.1 Strategic considerations

Before deciding what methods to use for evaluation it is important to understand the strategic direction of the company. The method selection should take into consideration any internal or external business factors like strengths and weaknesses, competitive landscape, available budget, resources etc. This will help to crystalize objectives of the portfolio and give the needed input for selecting the right method. E.g., portfolio focused on advanced product development may require a more qualitative selection method than a portfolio dedicated to optimising existing services having quantitative values. According to Archer and Ghasemzadeh companies tend to go with a method that fit the culture and include the criteria's seen most useful for a specific portfolio. A flexible portfolio selection framework allow use of different methods for specific needs or stakeholders like. (Archer and Ghasemzadeh, 1999, p. 208)

Many selection methodologies are complex and involves a lot of data that makes them difficult to use. For this reason, it is proposed the selection to be organized into logical steps guiding the process. This could happen starting from strategy ending to required projects (top-down) or other way around starting from individual proposals narrowed down to an optimal portfolio (bottom-up). (Archer and Ghasemzadeh, 1999, pp. 208–209) A bottom-up approach was also supported earlier by Romano for organizations that are not yet having a mature enough strategic planning process in place. (Romano, 2016)

Whatever approach is selected every step taken need to be based on data supported by a solid method. At the same time, the process should be simple and not overload users with data. (Archer and Ghasemzadeh, 1999, pp. 208–209) This paradox requires careful balancing when defining the process.

4.6.2 Individual project evaluation

Now we can start to define the methodology for evaluating projects against portfolio objectives. Selection of projects is a Multi-Criteria Decision-Making (MCDM) problem. Measurements used depends on situation and might include both qualitative and quantitative values. At the final stage of portfolio selection, the preferred projects are chosen by differentiation based on the specified criterions. (Archer and Ghasemzadeh, 1999, p. 212; Abdel-Basset, Atef and Smarandache, 2019, p. 216)

The criterions are driven by strategic objectives, values, and stakeholders of the organization. Every project shall be evaluated with the same set of measurements. Otherwise, it would be impossible to compare the projects objectively during the final portfolio selection phase. There is not one right model or set of criteria. Ricardo Vargas

suggests main criteria groups are 1) Financial, 2) Strategic, 3) Risks, 4) Urgency, 5) Stakeholder commitment or 6) technical knowledge. (Vargas, 2010) These groups are useful as checklist when defining criterions.

Weighting the importance of criterions is a common technique used in MCDM methods. The weighting model can have a significant impact on the outcome. Therefore, it is important the weighting is based on objective assessment. Many methods exist to support defining the weights for criterions. Direct methods (e.g., scaling, ranking weight, point allocations) or indirect methods using theoretical mathematical models, like e.g., Analytic Hierarchy Process (AHP) can be applied. (Odu, 2019, p. 1450)

Dr. Miley W. (Lee) Merkhofer categorize the vast amount of available project selection methods under twelve categories in his book "Choosing the Wrong Portfolio of Projects". The categories are (1) ad hoc methods, (2) comparative methods, (3) bidding methods, (4) financial methods, (5) simple scoring model, (6) formal scoring methods, (7) cost-benefit analysis, (8) utility and decision theories, (9) decision modelling, (10) regression models, (11) ranking methods and (12) constrained optimization. (Merkhofer, 2019)

4.6.3 Project evaluation techniques

Next, we investigate the most common project evaluation categories from the list provided by Merkhofer and review a few useful techniques from each. The categories picked are referred as good practices across the portfolio management frameworks introduced in chapters 4.2, 4.3, 4.4 and 4.5. They include methods suitable for evaluating an individual project as well as methods utilized for simultaneous comparison of portfolio items.

Ad hoc methods like voting or checklists are the simplest but rarely supported by theoretical background and are not promoting objective use of data. (Merkhofer, 2019) Voting methods might be useful in case it is not possible to define objective measures. In this case voting can help to capture the collective understanding and diverse judgement for finding the best options. (Martinelli and Milosevic, 2016)

Financial methods e.g., Return on Investment (ROI), PayBack Period (PBP) or Net Present Value (NPV) are widely utilized. NPV is used to determine the value of future cash flow generated by the project. Based on my empirical observations many companies today use NPV and ROI, not anymore so much the PBP highlighting the breakeven point of the investment. Challenges of these methods are that they require monetized values as input that might be difficult for early screening of projects. Estimates may be very unreliable and focus on short term benefits. They also do not include evaluation of non-financial benefits. (Archer and Ghasemzadeh, 1999, p. 209; Merkhofer, 2019)

Cost-Benefit Analysis (CBA) compares the project cost with the anticipated benefits. In addition to CBA, it is important to also consider the time factor. The higher ROI and shorter PBP the better project. (Romano, 2017). CBA is known for being used especially for supporting government decisions. Precise values provide credibility to back up the decisions. Downside is that it is not always possible nor practical to monetize everything that needs to be considered in CBA. (Merkhofer, 2019)

Ranking methods are used to organize projects in desired order. Criterions evaluated for ranking may include e.g., cost, value or any other measurements indicating productivity. (Merkhofer, 2019) Instead of ordinal ranking (1,2,3…) unique points can also be given to projects to reflect e.g., the business value. (Rothman, 2009, p. 13) Ranking works best for a small portfolio with less than 20 projects. (Holicky, 2018). Based on empirical knowledge the number of criterions should be limited to ensure the model remain intuitive.

Scoring methods allow use of multiple criterions like e.g., reward to the company, strategic fit, leverage of resources and probability of success (commercial and technical). Artto et al. suggest finetuning the criteria used in scoring model might take several years. (Artto, Martinsuo and Aalto, 2001, pp. 37–38) For practicality and effectiveness, collective understanding is that number of criterions should be limited, e.g., to five or less. (Martinelli and Milosevic, 2016) Due to the method can be highly customized to fit different situations and projects it is widely chosen as the prioritization method. This is also a pitfall as the scoring model might easily become too complicated. (Holicky, 2018). A numerical scale (e.g., 1-3, 1-5 or 0-10) is usually defined for providing values for scoring. (Martinelli and Milosevic, 2016; Romano, 2017).

In simple **weighted sum scoring model** the values are multiplied with pre-defined weightings before summarized. This way different importance of criterions can be acknowledged. (Merkhofer, 2019) Example of weighted sum scoring model is provided in Figure 18.

STRATEGIC (represents 49% of the weighting)	FINANCIAL (represents 31% of the weighting)	RISKINESS (represents 10% of the weighting)
Strategic Objective #1 Weighting = 22%	Financial Criterion #1 Weighting = 16%	Risk Factor #1 Weighting = 5%
Strategic Objective #2 Weighting = 18%	Financial Criterion #2 Weighting = 8%	Risk Factor #2 Weighting = 3%
Strategic Objective #3 Weighting = 9%	Financial Criterion #3 Weighting = 7%	Risk Factor #3 Weighting = 2%

Figure 18 Example of weighted sum scoring model (Washington, 2018)

A more **formal scoring method** to calculate project attractiveness is using a mathematical form (Figure 19). It requires careful prework to define and get the criterions, scales, and weights right before initiatives can be evaluated and the scores calculated:

$$Score = \frac{A(bB + cC + dD)(1 + eE)}{fF(1 + gG)}$$

Figure 19 Generic scoring model (Martinelli and Milosevic, 2016)

The capital letters in the form (Figure 19) are values of the criterions. Lower case letters are the weightings used. Overriding criteria, if used, would be A. This is a must have non-negotiable criteria. If it is zero, the whole initiative scores zero. Numerator includes the benefits and denominator the costs or disbenefits. Optional criteria's, if any, not applicable for all initiatives can be included for benefits (E) and costs (G). (Martinelli and Milosevic, 2016) One clear challenge of the model is the focus on single score and mathematical model that might be difficult to open and explain for the wider portfolio audience.

Benaija and Kjiri introduced a scoring model based on a **multi-criteria matrix**. The criterias can be qualitative or quantitaive. If qualitative, a subjective scale for evaluation must be defined. They suggest to focus on the three most important criterias, e.g. value, risk, and strategic alignment. The model includes a simple method for three dimensional analysis (Figure 20) resulting in potential of each project. (Benaija and Kjiri, 2015) This type of classification could work well for early evaluation and selection of digital initiatives. Instead of accurate values a subjective scale could be utlized.
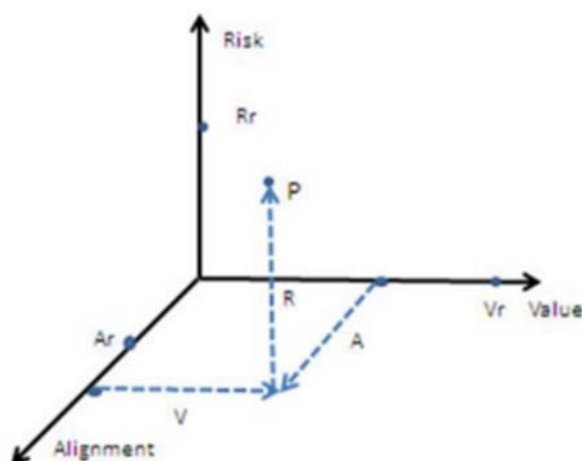
Figure 20 Three-dimensional analysis (Benaija and Kjiri, 2015)

In the model (Figure 20) analysis is done by giving a + for the criterions (R,V,A) if their value exceeds the reference value (Rr,Vr,Ar) I.e. + is given when R < Rr or V >= Vr or A >= Ar. Potential for project is the count of positive values: - Abandon, + lower priority, ++ prioritize, +++ Select. (Benaija and Kjiri, 2015)

Weighted Shortest Job First (WSJF) is example of another well-known formal scoring method. It is used widely especially in agile development to determine best sequencing of the jobs (i.e., the order that generates most value). WSJF is calculated for each item by dividing Cost of Delay (CoD) with Job Duration. Challenge is that these both parameters might be difficult to estimate in advance. Therefore, SAFe methodology suggests proxy parameters (Figure 21) and scale (1,2,3,5,8,13,20) for evaluation could be used instead. Job size or Job Cost are good examples of a proxy commonly used instead of Job Duration. After WSJF calculation items with highest scores are the ones getting highest priority. (Scaled Agile Inc., 2021f)

Feature	User- business value	Time criticality	RR | OE value	CoD	Job size	WSJF
	+	+	=	÷	=	
	+	+	=	÷	=	
	+	+	=	÷	=	

- Scale for each parameter: 1, 2, 3, 5, 8, 13, 20
- Note: Do one column at a time, start by picking the smallest item and giving it a "1."
- There must be at least one "1" in each column!
- The highest priority is the highest WSJF.

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Figure 21 WSJF calculation using proxy values (Scaled Agile Inc., 2021f)

Comparative methods are used to compare options in a systematic way. Pairwise (or paired) comparison can be done as simplest by ranking projects against each other. Strength of the method is that it is forcing to make a choice. Weakness that it is suitable only for ranking a small number of projects. In Figure 22 six projects are compared, and the preferred option of each pair is marked in the matrix. (Martinelli and Milosevic, 2016)

Figure 22 Pairwise ranking matrix (Martinelli and Milosevic, 2016)

For keeping evaluation consistent maximum 5 criterions are recommended to be prepared and used to support the decision for making pairwise comparison. After all projects have been compared mentions for each are counted from the matrix (Figure 22). The project with highest count will get the highest priority. In case two projects get similar count the one that was preferred when comparing these two projects will get higher priority. Ranking order (counts are in brackets) for projects in Figure 22 is 6 (4), 3(4), 5(3), 1(2), 2(2), 4(0). (Martinelli and Milosevic, 2016)

Analytic hierarchy process (AHP) is another well-known comparative method used for multi-criteria analyses. It is a mathematical model developed by Thomas L. Saaty back in 1970s utilizing pairwise comparison for evaluating alternatives against multiple criterions. Software tool is recommended for calculations as making them manually may get too heavy with larger datasets. (Vargas, 2010) Figure 23 demonstrates the hierarchy of AHP.
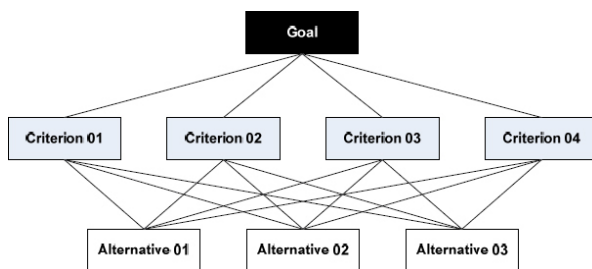
Figure 23 Example of hierarchy in AHP (Vargas, 2010)

First criterions that are important for reaching the goal are agreed. Then a pairwise comparison is performed to get weights marking relative importance of the criterions (Figure 24, Step 1). This is followed by pairwise comparisons of alternatives done for each criteria (Figure 24, Step 2). Finally, the results are consolidated and weighted with the importance of the criteria. Outcome is a summarized priority score telling how well each alternative may fulfil the goal. I.e., how likely a project will succeed. (Figure 24, Step 3).

Step 1: Pairwise comparison to calculate weights (W) for each criteria (C)

	C1	C2	C3	C4	W
C1	1	4	2	1	0.313
C2	1/4	1	1/5	4	0.207
C3	1/2	5	1	1/3	0.254
C4	1	1/4	3	1	0.226

Step 2: Pairwise comparisons of alternatives (A) for each criteria (C) resulting in priority (P)

C1	A1	A2	A3	P
A1	1	3	1/4	0.302
A2	1/3	1	3	0.332
A3	4	1/3	1	0.366

C2	A1	A2	A3	P
A1	1	1/2	6	0.464
A2	2	1	1/4	0.255
A3	1/6	4	1	0.281

C3	A1	A2	A3	P
A1	1	5	3	0.627
A2	1/5	1	1/4	0.094
A3	1/3	4	1	0.280

C4	A1	A2	A3	P
A1	1	2	1/5	0.240
A2	1/2	1	4	0.410
A3	5	1/4	1	0.350

Step 3: Consolidated priority (P) of alternatives (A) weighted by the importance (W) of the criteria (C)

W	0.313 C1	0.207 C2	0.254 C3	0.226 C4	P
A1	0.302	0.464	0.627	0.240	**0.404**
A2	0.332	0.255	0.094	0.410	**0,273**
A3	0.366	0.255	0.280	0.350	**0,318**

Figure 24 Example of analytic hierarchy process (AHP). Adapted from (Vargas, 2010).

The pairwise comparisons (Figure 24) are done by giving options that are preferred a rating using a scale (1-9). If an option gets value 9 it is extremely preferred. In this case the less preferred option gets a reciprocal value of 1/9. Options being equally preferred are evaluated as 1. After options have been evaluated the matrix is raised to powers, rows are added and normalized to get the weight or priority for each option. (Vargas, 2010)

As a mathematical model AHP has been popular among researchers. It is a multi-criteria decision making (MCDM) method seen as potential to be applied in portfolio management (Romano, 2016; Danesh, Ryan and Abbasi, 2017, p. 280). The strength of the model is that it helps to set the weights in systematic way, it simulates the outcome against a set of criterions and provides decision makers with data for making qualified decisions. However, it requires a tool capable doing the mathematical calculations. The evaluation can get complicated and laboursome when having large set of criterions to evaluate. Specifically, when done as repetitive task if a new project or criteria needs to be added in the evaluation.

4.6.4 Portfolio selection

Finally, after the criterions and evaluation methods have been defined the project selection can start. Archer and Ghasemzadeh has divided the process in steps (Figure 25). (Archer and Ghasemzadeh, 1999, pp. 210–213) This is useful information for the thesis project when considering implementation of a portfolio process and tool.
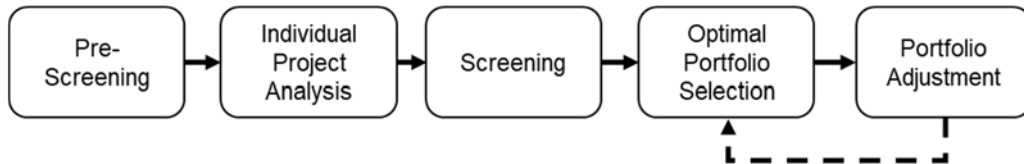
Figure 25 Decision support system (DSS) for project portfolio selection (Archer and Ghasemzadeh, 1999, p. 211;213)

Pre-screening is done manually for incoming project proposals. Key thing is to check that the items are aligned with the overall portfolio strategic focus. This step can include a feasibility analysis. Mandatory projects (e.g., changes in regulation) are spotted and marked for inclusion. It is important to nominate who (e.g., project champion) will be responsible for providing any further information and the parameters for project evaluation. (Archer and Ghasemzadeh, 1999, p. 212)

Individual project analysis is based on the information collected during pre-screening. Data from completed projects may be used to improve the estimates. In this step values, e.g., ROI, are calculated or scores given for criterions. On-going projects can be re-evaluated with latest milestone information. (Archer and Ghasemzadeh, 1999, p. 212) After completing this stage projects should have parameters that are comparable.

Screening will be done prior the selection phase. Here projects not fulfilling the pre-conditions set, e.g., for lucrativeness, project length etc., may be removed. This way the optimal portfolio selection phase can focus on projects having the required merits set for the portfolio. Naturally, any projects marked as mandatory during pre-screening may carry on to the next step. (Archer and Ghasemzadeh, 1999, p. 212).

Optimal portfolio selection is where different techniques like ranking, scoring or comparative methods discussed in chapter 4.6.3 are applied to develop optimal portfolio. The evaluation shall be based on the values calculated during individual project analysis phase. The size and complexity of the portfolio set some challenges. Comparative methods may be hard to use for a large portfolio. Also, many techniques do not consider

interdependencies, resourcing constraints, and timings. These needs to be reviewed before final portfolio selection. (Archer and Ghasemzadeh, 1999, p. 212)

Archer and Ghasemzadeh suggest portfolio optimization is done in two steps: 1) determine relative worth of the projects utilizing selection techniques and 2) include constraints like resourcing and dependencies in the final optimization. This second stage should acknowledge the relative value of the project. The combination of projects having highest total value will be selected. Not individual projects with highest value. This final optimization is however difficult to accomplish without mathematical model and supporting program. (Archer and Ghasemzadeh, 1999, p. 212)

Portfolio adjustment allows decision makers to assess the information and provide their final judgement. Only ranking the projects will not guarantee best result. Artto et al. write "portfolio should be a balanced mix of different kind of projects within different timeframes and of varied sizes." Portfolio can be balanced with dimensions such as strategic fit, risk, reward, probability of success etc. (Artto, Martinsuo and Aalto, 2001, p. 39)

As discussed in chapter 4.3.1 portfolio categorization can provide high-level structure for evaluation. O'Reilly emphasized the a healthy balance between explore and exploit. (Humble, Molesky and O'reilly, 2015, pp. 21–36) How could this be implemented in digital portfolio to make sure the strategic balancing could be done properly?

Gartner propose to divide a lean IT portfolio in run, grow and transform categories (Gartner, 2017). In equivalent way PricewaterhouseCoopers suggest "to grow, companies need to optimize and protect their core business first". (PwC, 2021) Both examples describe how the categories are contributing to strategy execution. High-level categorization will be useful to include in thesis project when building, evaluating, and balancing the digital portfolio.

For providing portfolio overview bivariate analysis can be utilized (Figure 26).
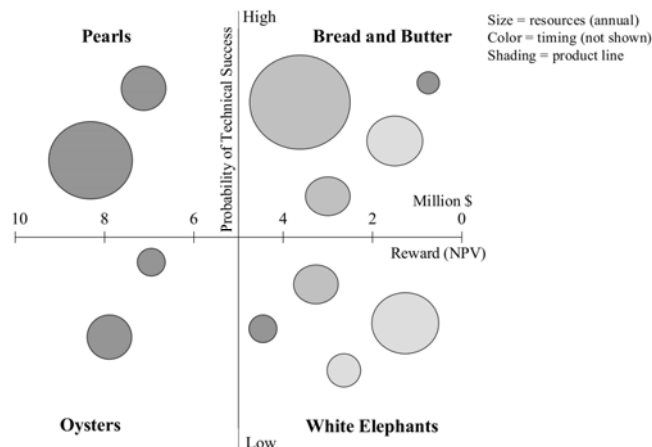
Figure 26 Balancing portfolio with risk/reward matrix (Cooper and Edgett, 1997, p. 24)

If major changes would be proposed during final adjustments techniques like sensitivity analysis can help to understand the impact. In some cases, and depending on the methodology used, the project selection model may be re-calculated. (Archer and Ghasemzadeh, 1999, pp. 211–212)

4.6.5 Conclusions and challenges (portfolio selection framework)

Prioritization method with a formula will not alone result in best outcome. A well formulated portfolio management selection process can help to run the dialog in a systematic and objective way. Company culture and values allowing different viewpoints are important for an optimal portfolio.

For a digital portfolio starting point should be the strategic priorities. This is not a new approach in portfolio management. Strategic nature of project selection was first introduced by Suresh and Meredith (1986). It has now only increased in importance during the digital transformation.

Project ranking and prioritization enables effective capacity allocation of resources to the most strategic and value adding projects. (Martinelli and Milosevic, 2016, p. 2) Project interdependencies, resource constraints and risk level are challenging to capture by looking only at project scoring. These needs to be separately considered prior final selection.

Project categorization can be used for portfolio balancing among other dimensions coming from the criteria applied. E.g., mandatory projects cannot be missed. Healthy ratio of

strategic projects versus more short-term projects needs to be in place etc. Visual matrix presentation will help to analyse the portfolio balance.

Whenever changes occurs to the portfolio it can be re-evaluated and prioritized. (Benaija and Kjiri, 2015; Hofland, Hattink and Ginkel, 2020) This will be critical in fast moving digital portfolios where new things need to be effectively started and non-successful experiments stopped. It will require simple multi-criteria scoring model for ranking projects, shared visibility, and tool support providing visuals for decision makers.

Due to the continuous and agile nature of portfolios, the prioritization is usually decentralized to value streams and DevOps teams. Role of traditional portfolio board is decreasing but it can have control over budgets and by having visibility to plans as seen in chapters 4.4 and 4.5.

Quote from the famous British statistician George Box says, "All models are wrong, but some are useful". (Box, 1976) Models can newer fully match with reality and cover all situations, but they can help to narrow down and structure the decision problem. Final judgement is done by decision makers. The principle known as Occam's razor can work as a reminder for creating useful criterions and models for portfolio selection. It states, "Entities should not be multiplied without necessity". (Barry, 2014) We should not try to overengineer the model more than necessary at the minimum.

4.7   Computer based decision support system

A central portfolio tool is essential for managing continuous changes according to the KPMG digital transformation report. Excel might be enough for single user, but it demands a lot of manual work to keep updated and does not promote co-creation and sharing. A common tool should match the need, maintain online portfolio visibility, and provide insight for decision makers. It should be used in similar way across the organization. (Hofland, Hattink and Ginkel, 2020)

The BT Standard share the need for central portfolio tool to stay in constant alignment between value streams and functions. (Business Technology Forum, 2019, p. 31) Also Romano advised in 2017 "the need for one integrated system within an enterprise" for effective project portfolio management. (Romano, 2017)

Archer and Ghasemzadeh emphasized key role of a computer-based decision system is to facilitate interaction with decision makers during all the process stages. The system should provide supporting data and models for decision making through a simple user interface. The modular design principle for a computer-based decision support system is illustrated in Figure 27. (Archer and Ghasemzadeh, 1999, p. 214)
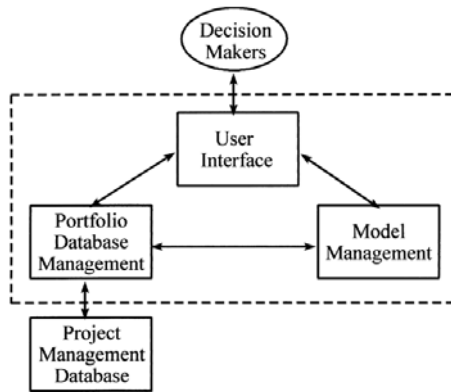
Figure 27 Computer-based decision support system (Archer and Ghasemzadeh, 1999, p. 214)

Forrester Research summarized well that data can be used to "break down the silos among business and tech leaders" and "unite planning priorities". (Visitacion, 2018, p. 28) Having visibility to priorities will support the self-organizing teams to be more effective and work towards the optimal outcomes.

5 Empirical Studies

The project was carried out for a technology company that had the need to develop simple portfolio management practice for enhancing visibility and prioritization of digital initiatives across several team. Both waterfall and lean methodologies were used for execution.

This chapter describes how the research and development was implemented in practice following the user centric design principles. Process and outcomes are organized according the UCD principles (Lowdermilk, 2013, pp. 5–13; Still and Crane, 2017, pp. 1–17). Main steps of the project were to 1) determine scope for portfolio management improvement, 2) establish portfolio management concept and 3) implement a portfolio management solution. The project was done in iterations repeating the discover, design, and deliver phases. Users were engaged throughout the process. This chapter is organized according the UCD process that was outlined in chapter 3.2, Figure 4.

5.1 Discovery of users and their needs

Qualitative research method was selected as an iterative process to understand the subject. (Aspers and Corte, 2019, p. 139;142). We used semi-standardized interviews (Flick, 2009, pp. 156–158) and user surveys to collect the data. The approach fit well with the iterative UCD process and allowed multiple methods to be used as per need to interpret the real-life situation, routines, and perceptions of the users. (Flick, 2009, p. 57)

The initial discovery phase was conducted in two steps and using two different approaches. The context and expectations for portfolio management were first gathered by interviewing portfolio owners, whereafter priority for detailed requirements were confirmed with a mixed-method survey sent to all development team members.

5.1.1 Context for portfolio management

The given assignment originated from an employee survey where need to develop portfolio management practices were brought up. More information was needed. The project started with discovering what are the main challenges experienced by users managing a portfolio of digital initiatives (RQ1).

First qualitative semi-standardized interviews (Flick, 2009, pp. 156–158) with open ended questions were organized. The work started with preparing the questions and a guideline for conducting the interviews (Appendix 1). The questions were reviewed together with the

contact person from the commissioning organization and some minor enhancements and clarifications were amended to the interview guideline.

Next, we identified four team leads and two individual contributors being responsible of managing project portfolios to be interviewed. Based on the interviews the average experience of managing project portfolios among the selected interviewees turned out to variated from 3 to 20 years, average being 10,6 years and median 10 years.

The actual execution of the interviews started with sending calendar invitations for one-on-one sessions including a virtual link to Microsoft Teams meeting platform. Due to COVID-19 all engagements had to happen virtually. During interviews, the camera was turned on.

At the start of every interview session a verbal consent to record the interview was obtained. The given consent was repeated for documentation purpose after the recording began. The interviews resulted in total 3 hours and 12 minutes of interviews recorded as MP3 files. The interviews were transcribed with the help of on-line Microsoft Word AI powered transcribe feature that use voice recognition and natural language processing algorithms. (Wiggers, 2020) Manual cleaning like removing repetitive words were done to complete the transcribe phase from verbal to written language. Altogether the final data set included 20 737 words on 40 pages (A4). The interviews and amount of data collected is listed in Table 3.

Table 3 Semi-standardized interviews conducted

Interviewee role	Words	A4 pages	Length (mm:ss)
Individual contributor #1	3486	6	25:38
Team leader #1	4580	9	46:44
Team leader #2	2700	7	25:22
Individual contributor #2	2086	4	21:19
Team leader #3	4723	8	41:51
Team leader #4	3162	6	32:20

The transcribed files where stored in PFD format and uploaded to the qualitative data analysis software QDA Miner Lite. (Provalis Research, 2021) The PDF file was also shared with the interviewee for validation and record with a thank you note included.

We used the inductive process and started with carefully reading though the interview documents and highlighted sentences with interesting findings relevant for the study. (Elo and Kyngäs, 2008, pp. 107–111) Second reading was done with focus to do open coding for the highlighted areas after having built a good overall understanding of the discussions. Notes were also added to many of the text segments. As example sentences with mentions like "visibility to plans" or "project dependencies" where highlighted and coded accordingly as important findings for what is seen relevant for a portfolio.

Altogether 165 open codes were created and used to mark 291 findings. Finally, the notes and codes were analyzed, and abstraction done under 13 categories describing the main themes arising from the interviews. (Flick, 2009, pp. 359–371) Summary of key findings and improvement areas per category are listed in Table 4.

Table 4 Qualitative content analysis of the portfolio manager interviews (RQ1). Conducted with the help of QDA Miner Lite tool. (Provalis Research, 2021)

Category	Frequency	Summary of key findings / areas for improvement
Need for joint portfolio	53 (18,2%)	Lack of: Shared visibility across teams, communication, common terminology, and joint planning.
Work effort types	37 (12,7%)	Substantial number of different work effort types are managed in teams. Portfolio model needs to be generic, flexible, and simple.
Portfolio reporting	32 (11,0%)	Desire to reduce manual creation, especially roadmaps and portfolio status reporting.
Requirements management	28 (9,6%)	Detailed requirements are managed at team level. Only major new projects or epics should be added into joint portfolio for alignment and prioritization, especially if work is required across teams.

Category	Frequency	Summary of key findings / areas for improvement
Dependency to other teams	26 (8,9%)	Making key resource or technology dependencies visible early for everyone seen important for resolving conflicts timely.
Portfolio prioritization	23 (7,9%)	Prioritization is managed together with stakeholders. Should move from individual negotiations more towards collaborative effort. Need for prioritization between functional areas competing for same resources.
Backlog management	22 (7,6%)	Several tools use for detailed backlog management: Jira, Excel, PowerPoint, Word, Teams. Portfolio tool should focus on higher-level objectives and benefits.
Manage outside portfolio	14 (4,8%)	Minor development done as maintenance not requiring resources from other teams should not be included in portfolio. Also, operative support tasks. Keep budgeting as separate process as it is well established.
Other challenges	13 (4,5%)	Architecture and technology development requires early visibility to roadmaps. Multiple execution methodologies are in use. Portfolio management concept needs to support all.
Roles in the organization	12 (4,1%)	Portfolio managers have many roles. Usually, they are also in charge of resource management. This explains the need for understanding resource dependencies and high-level timelines.
Planning horizon	12 (4,1%)	Portfolio planning is done as continuous effort, with rolling 6-12 months visibility for key projects. Quarter level accuracy at minimum. The team level roadmaps are frequently updated. Shared visibility will require central data storage and tool.

Category	Frequency	Summary of key findings / areas for improvement
High-level guidance	10 (3,4%)	Having portfolio visible with high-level priorities seen important for team motivation. Stronger guidance desired from governance bodies. Building joint portfolio and sharing it proactively will help to engage at all-levels, also the governance.
Operative portfolio challenges	9 (3,1%)	Many separate portfolio practices exist at team level making it challenging to align. Common method needed.

The main theme that came through in all interviews is the need for shared visibility. The development teams working closer together in projects expressed it more but also the supporting teams mentioned improved visibility would help to better engage and plan the workload. This finding supports well the high-level role of development portfolio which includes providing visibility of portfolio items and their statuses. (Business Technology Forum, 2019, p. 29)

In general, the organization is aware of things required for managing portfolios. There are portfolios existing at team level managed with different practices and without central tool support. Capturing high-level objectives and demand for new projects, dependencies for resourcing, prioritization at function level, and support for joint governance and reporting were pointed out as key areas for improvement. These all require shared online visibility and a common process to start with. The needs resonates well with the KPMG digital transformation report stating a central portfolio tool is essential for managing continuous change (Hofland, Hattink and Ginkel, 2020).

5.1.2 Detailed requirements

Before starting to work out the concept design, it was decided more discovery from a larger user group is needed for understanding what data is seen important for visibility to include in a joint portfolio. For this an online survey with the help of Microsoft Forms survey tool (included in M365 cloud platform) was prepared (Appendix 2). It had one close-end question asking to sort provided list of 10 items to include in the portfolio in order of importance. This quantitative method was selected as best option as it forces to make choices that helps the researcher to determine frequencies. (Flick, 2009, p. 104)

The list was prepared based on the earlier interview findings that were associated with need for joint portfolio and visibility. Engaging the whole organization early in the project was important. It also helped to avoid bias and validate the understanding received from the interviews. In addition, at the end of the survey form one open qualitative question was presented giving opportunity to provide written input if anything else was missing from the given list that was seen as important.

We received 19 answers out of the 28 invited to join the survey. People who had really used the solution did answer. An affinity diagram (Lowdermilk, 2013, p. 68; Still and Crane, 2017, pp. 86–88) was automatically prepared by the Microsoft Forms tool for analyzing the results (Figure 28).
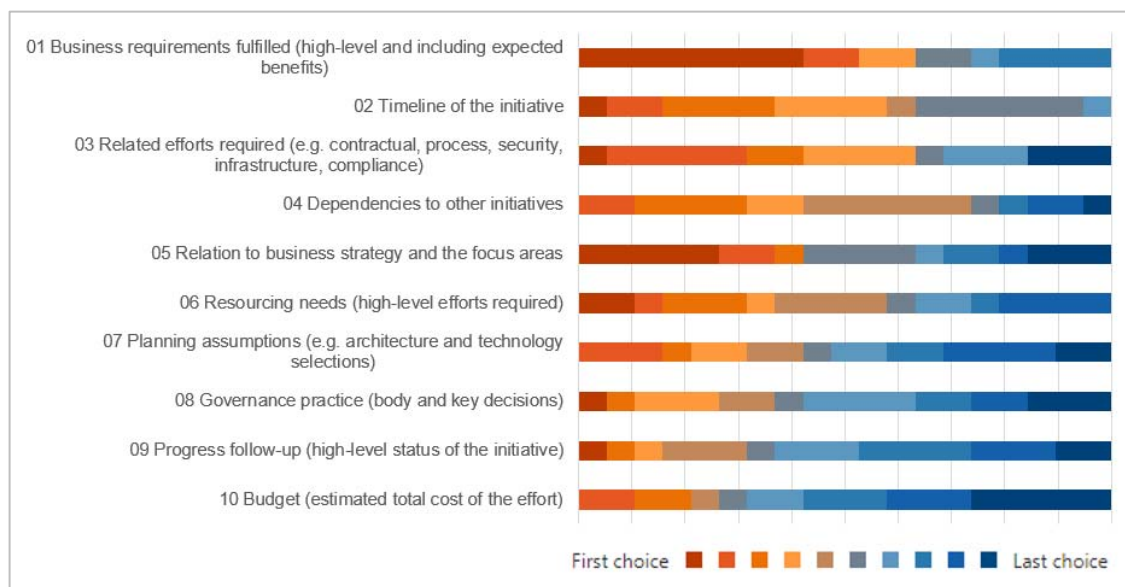
Figure 28 Priorities given for joint portfolio visibility (RQ1)

High-level objectives and benefits were seen the most relevant information to share in portfolio. 42,11% put it as the most important. This correlates with the "Relation to business strategy and focus areas" that is fifth in the diagram. It received second most likes as the most important (26,32%). Strong consensus of importance can also be seen in "Related efforts required", "Dependencies to other initiatives" and "Resourcing needs. These all has to do with understanding where effort is required and resolving potential conflicts. Time dimension is important to include (second highest in the list). Surprisingly, budget was the least important but that is explained by the mature financial process existing in the organization.

All the above findings are in alignment with the organizational focus of portfolio management that is to plan, co-ordinate and monitor the activities undertaken to reach the strategic objectives (PMI, 2017, pp. 6–13).

The data from the survey was also exported in Excel for further analyzing the numerical results (Table 5) and the detailed comments received. With the numerical data it was easier to spot significance of data condensation, e.g., the 42,11% that had marked the high-level objectives and benefits as most relevant information for the portfolio.

Table 5 Priorities for portfolio visibility

Options	1	2	3	4	5	6	7	8	9	10
01	42,11 %	10,53 %	0,00 %	10,53 %	0,00 %	10,53 %	5,26 %	21,05 %	0,00 %	0,00 %
02	5,26 %	10,53 %	21,05 %	21,05 %	5,26 %	31,58 %	5,26 %	0,00 %	0,00 %	0,00 %
03	5,26 %	26,32 %	10,53 %	21,05 %	0,00 %	5,26 %	15,79 %	0,00 %	0,00 %	15,79 %
04	0,00 %	10,53 %	21,05 %	10,53 %	31,58 %	5,26 %	0,00 %	5,26 %	10,53 %	5,26 %
05	26,32 %	10,53 %	5,26 %	0,00 %	0,00 %	21,05 %	5,26 %	10,53 %	5,26 %	15,79 %
06	10,53 %	5,26 %	15,79 %	5,26 %	21,05 %	5,26 %	10,53 %	5,26 %	21,05 %	0,00 %
07	0,00 %	15,79 %	5,26 %	10,53 %	10,53 %	5,26 %	10,53 %	10,53 %	21,05 %	10,53 %
08	5,26 %	0,00 %	5,26 %	15,79 %	10,53 %	5,26 %	21,05 %	10,53 %	10,53 %	15,79 %
09	5,26 %	0,00 %	5,26 %	5,26 %	15,79 %	5,26 %	15,79 %	21,05 %	15,79 %	10,53 %
10	0,00 %	10,53 %	10,53 %	0,00 %	5,26 %	5,26 %	10,53 %	15,79 %	15,79 %	26,32 %

The open question asked at the end of the survey was "Were the above relevant, anything critical for you that was missing, or you want to comment?".

The received answers (n=5) gave better understanding of why portfolio data is seen important. It also confirmed all the key information is covered. The input can be summarized under three main items. 1) Portfolio data is needed for communication with stakeholders. It is hoped to help with discussing business requirements and priorities. 2) Dependencies was mentioned to be crucial to include for planning the related development, testing, and deployment activities. 3) It was proposed to have a common roadmap stored that would be easy to follow and share high-level overview, discover resource needs and communicate status between the teams.

The input regarding importance of a common shared roadmap was important. Such roadmap should be visual. (Satoglu *et al.*, 2018, pp. 95–98) According PMI "the roadmap should be updated at least in every portfolio re-optimization and approval period and/or when major changes are made to the portfolio." (PMI, 2017, p. 35)

5.2 Designing the concept

The portfolio management concept combines the findings from related research and the empirical studies. Although the concept is grounded to common theory each implementation is different. The created artefact is a practical portfolio management concept focusing on building and evaluating a portfolio valid for a specific organization with own needs and a unique culture. Execution phase is not in the focus of the thesis, but the concept created allows it to be extended later to also cover portfolio level execution follow-up.

First, we decided on the lifecycle and stages for the portfolio. Based on the interview results (Table 4) management of portfolio is distributed and several different execution methodologies are in use. The proposed concept is taking influence from project portfolio management (Romano, 2017), lean portfolio management (Scaled Agile Inc., 2021a) and combination of both as adapted in the Business Technology Standard (Business Technology Forum, 2019, p. 1;3;7).

The result is a generic process with consistent status tracking enabling to follow both sequential and incremental development efforts. At high-level the process is adapted from the portfolio management process (Romano, 2017) and the portfolio Kanban stages (Scaled Agile Inc., 2021d). For projects with project governance structure, it will take longer time to move through the stages whereas a small agile initiative managed within the team can run through the steps in only a few weeks or less. The steps are designed with a common minimum mindset to cover both worlds but not to make the model more complicated than needed. The model is illustrated in Figure 29.
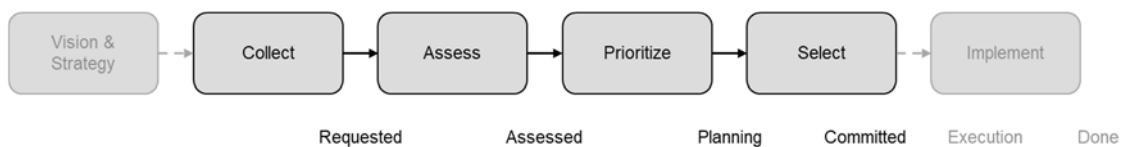
Figure 29 Portfolio management concept high-level design

The terminology for stages and statuses are meant to be self-explanatory without need to know a specific methodology. This will help to engage with teams, stakeholders, and external employees having different practices. For waterfall projects the prioritize and select phases represent major gates. Prioritized projects are allowed to start project planning and select phase includes the formal project plan and business case approval. After organization has committed to the project, implementation can begin. (Business Technology Forum, 2019, pp. 10;27-29) The same stages apply for lean initiatives, but

they are governed within value streams and with the budget guardrails. (Scaled Agile Inc., 2021c)

Next chapters describe the stages and the key portfolio management concepts as adapted to the commissioning organization. The first, vision & strategy, is not part of the thesis scope but highlighted here as an important prerequisite for any portfolio.

5.2.1   Vision & strategy

Company vision & strategy planning process should guide what mission has been decided to implement and what are the manageable and measurable objectives. (PMI, 2017, pp. 3–10) Portfolio management role is to ensure the actions taken are aligned to organization's strategy while maximizing the value an balancing the risk. (Benaija and Kjiri, 2015)

5.2.2   Collect

Intake of new ideas is done as continuous dialog focusing on strategic objectives. Also, non-strategic efforts having dependencies or that may otherwise impact delivery of objectives will be included. Key questions to ask during dialog with internal teams and stakeholder are 1) What support, enhancements or initiatives are required to execute the strategy 2) Are there new ideas and/or digital opportunities that could speed up implementation of the vision? Here we apply the idea of explore and exploit from the book Lean Enterprise. (Humble, Molesky and O'reilly, 2015, pp. 21–36).

Data captured in collect phase consist of effort name, description of objectives, expected benefits, portfolio category, and planner of the initiative. The initial capture of an idea was designed by purpose to be noticeably light. The more ideas for digital initiatives the better. An effort having been added to the portfolio will get the status requested. Detailed description of data to be managed during collect is available in Appendix 5.

Categorization of ideas at early stage will help to balance the intake activities and make sure no blind spots exist. (PwC, 2021) The portfolio categories are defined in table 6. Category mapped to an effort may be changed during portfolio lifecycle as planning proceeds and more information is received.

Table 6 Categorization of a digital portfolio. Adapted from (PwC, 2021).

Category	Description
Protect	Safeguard business continuity, i.e., cyber security, mandatory upgrades, data privacy, compliance, regulatory requirements.
Optimize	Improve performance of current business processes and models, e.g., through automation, process simplification and data analytics.
Grow	Target to grow business in new areas supported by intelligent digital solutions like artificial intelligence and data science.

5.2.3 Assess

After an item has been requested to be added to portfolio it needs to be assessed. The planner assigned in previous stage is responsible for driving the assessment. If the planner is changed the information must be updated to the effort. Purpose for this stage is to understand the value added to organization's objectives and what are the related risks. This step is adapted from project portfolio management where this step is part of demand management. (Romano, 2017)

Initial quarter level schedule is given for understanding potential portfolio dependencies and risks in time dimension. The high-level risks, assumptions, issues, and dependencies are analyzed within value streams and stored for the effort. This is proposed to be done as a collaborative task. We use a simple technique call RAID analysis (Figure 30).

Figure 30 RAID analysis (FunRetrospectives, 2022)

After RAID analysis the delivery teams required for execution are mapped to the effort and an initial size of the effort is estimated using T-shirt sizes (Small, Medium, Large or Extra Large). This is a method successfully used in the commissioning organization for early estimation of effort size. It has its roots in agile methodology. Size is important for high-level budgeting and balancing portfolio spend. Monetary range was defined for each T-shirt size as guidance for providing the size.

Finally, criterions that will be used in prioritization are assessed. We decided to include fit to strategy as the objectives related factor in addition to the traditional value and complexity measures. Value is determined as how valuable the effort is for the success of the company and the customer. Complexity is telling how feasible the effort is to operationalize within the company and how complicated it is to build technically. Strategic fit is measured against organization's objectives. (Artto, Martinsuo and Aalto, 2001, p. 39; PMI, 2017, p. 37)

Simple subjective scale were defined for the qualitative criterions (Table 7) as suggested by Maciej Nowak. (Nowak, 2013, p. 316) Teams are encouraged to seek input and validate shared understanding with stakeholders especially for the strategic fit and value creation. The purpose is to identify promising candidates for portfolio execution. The subjective scale is adapted to support the multi-criteria analysis. (Benaija and Kjiri, 2015)

Table 7 Measurements collected for portfolio prioritization

Score	Value	Complexity	Strategic Fit	Potential
1	Low	Very Complex	Low	-
2	Medium	High	Medium	-
3	High	Moderate	High	+
4	Very High	Low	Perfect Fit	+

To summarize, data captured in assess phase consist of delivery teams mapped to the effort, quarter level schedule, T-shirt size, Risks (R), Assumptions (A), Issues (I), Dependencies (D), value, complexity, and strategic fit. An effort having been assessed will get the status assessed and is ready for planning. Detailed description of data managed during assess phase is available in Appendix 6.

5.2.4 Prioritize

In this stage adapted from project portfolio management we analyze the potential and prioritize effort for further planning. (Romano, 2017) Prioritization is reviewed together with stakeholders. It provides input for high-level budgeting and resource requirements. Any identified conflicting priorities between value streams that remains unresolved are escalated to leadership. The defined method to prioritize efforts is simple and robust enough for the specific needs of the commissioning organization to evaluate potential of digital initiatives at early stage.

The prioritization method is based on a three-dimensional analysis (Figure 31). The dimensions value, complexity and strategic fit were evaluated during the assessment phase. As each measurement can have four values as it was defined in table 7. it means an effort can be positioned in a three-dimensional matrix in 64 (4x4x4) separate ways.
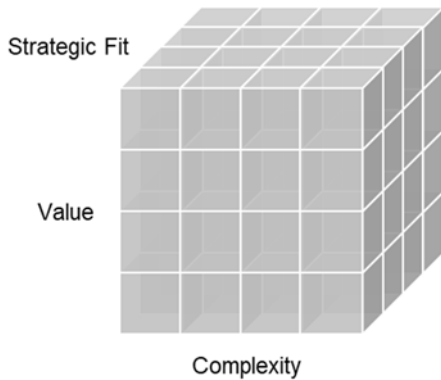
Figure 31 Three-dimensional analysis

Because we want to make the analysis simple for users and provide a clear recommendation based on the qualitative measurements defined, we adapt the multi-criteria scoring matrix suggested by (Benaija and Kjiri, 2015). The initiatives that scores higher than average (i.e. reference value>2) in all three dimensions are identified as top candidates to be included in the portfolio. The adaptation of the method is explained in Figure 32.
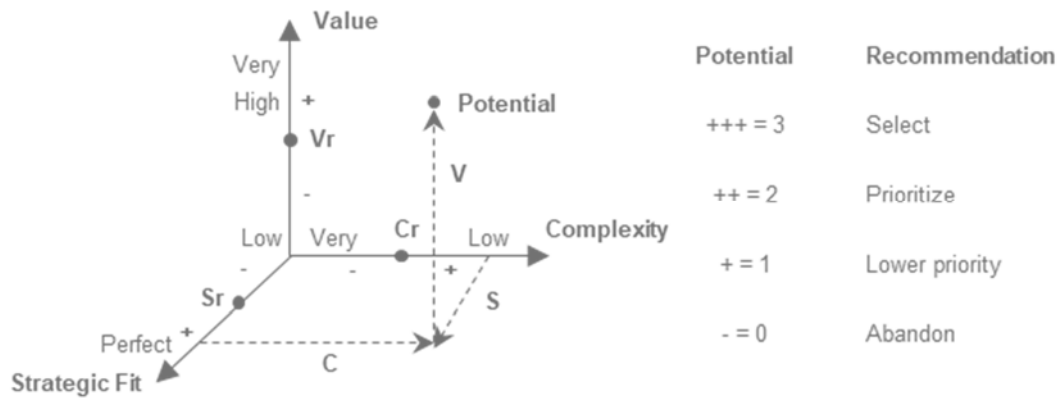
Figure 32 Model adapted for analysing potential (Benaija and Kjiri, 2015)

Analysis is done by giving a + for the criterions (C, V, S) if their value exceeds the reference value (Cr=2, Vr=2, Sr=2) I.e., + is given when C > Cr or V >= Vr or A >= Ar. Potential for project is the count of positive values: - Abandon, + lower priority, ++ prioritize, +++ Select. A computerized model is created for calculating the potential and providing the recommendation for user.

Now we can easily categorize and compare the effort with other initiatives in the portfolio based on their potential as illustrated in Figure 33. It is important that additional factors impacting feasibility are also considered. These include e.g., initial cost, required resources and timeline. The judgement should be recorder as input for selection phase.
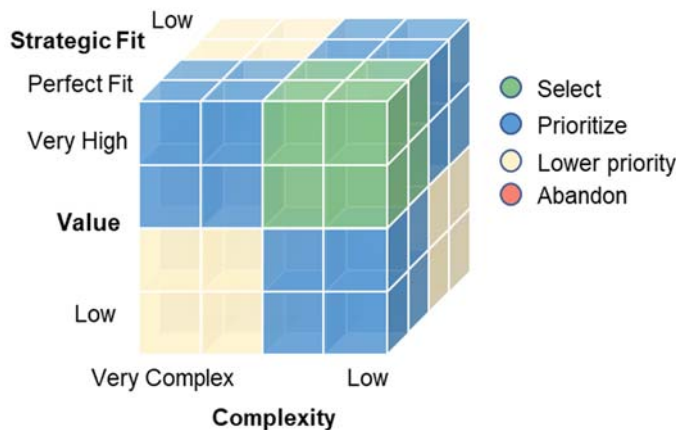
Figure 33 Potential and recommendations for selection phase

Data in prioritization phase includes the potential score, recommendation, and any additional comments. Detailed description of data managed during prioritization phase is available in Appendix 7. After the priority has been reviewed effort will be set for planning.

5.2.5 Select

Select phase is tightly linked to the previous prioritization step as in the project portfolio management process (Romano, 2016). Planners are now documenting all the needed details required for final approval for those efforts that were prioritized for planning. This could mean drafting a project plan or preparing the first iteration to be ready for execution. The benefits may be updated.

The additional data for select phase in our case includes the business owner of the strategic objective, budget owner, cost (euros), start date, end date, name of key resources and external suppliers required. These are important for aligning the ownership, dependencies and for reporting purposes. Preparing the plans should give the needed data.

After final data is in place planner will take the effort to relevant governance body, e.g., value stream governance forum, for review, final judgement, and approval. The decision shall be in balance with available budget and resources. (Romano, 2017) Approved projects are marked as committed. This means delivery organization has committed to deliver the initiative in given timeline and with agreed cost. Business owner is main responsible for value generation. The project has now permission to start. The project statuses are adapted from (Business Technology Forum, 2019, pp. 29;95-96)

When project has been mobilized the status will be set to execution and when ready it is marked as done. This is important so that the organization can have constant visibility to statuses and how many parallel initiatives are underway. Target according to agile principles should be to minimize parallel activities.

Efforts declined by governance body are marked as parked or abandoned. It could happen that a promising project has turned out to be too costly or risky after detailed plans have been reviewed. Alternative approaches can be considered, e.g., splitting the project into smaller increments and approving them one by one while getting more visibility to value generated and balancing the risk of overcommitting.

This was the final portfolio lifecycle stage part of the thesis scope. Next the concept for reporting is discussed.

5.2.6   Concept for reporting

As we recall, visibility was the number one requirement from the user interviews. Monitoring and reporting is important part of portfolio management. (PMI, 2017, p. 25) Providing reports is critical for successful implementation of the portfolio concept. Users also asked to avoid preparation of manual reports. i.e., the reports must be automated on-line reports covering different use scenarios. The following three automated reports are included in the concept based on user requirements and the portfolio management theory researched:

- portfolio data report (textual)
- prioritization matrix (visual)
- portfolio roadmap (visual)

Good filtering capabilities for the portfolio data is essential. Reports are used by many value streams and user groups like, portfolio planners, owners, development team members etc. Filtering will make the information relevant for the user. Reports shall focus on the information needed for minimum viable governance (MVG) practice. (Business Technology Forum, 2019, p. 44). Effort level details can be made available for review and editing through an on-line user interface.

Conceptual description of the three reports that will be used for solution implementation:

Portfolio Data Report provides overview of the portfolio. The intent is to review and align on portfolio balance in terms of categories, selected criterions, assigned values and the calculated potential. It can be used for decision making and when engaging with stakeholders. (Romano, 2016) Outcome of the evaluations can be presented in visual format to make the report intuitive to read. Basic data like status, cost, schedule, and planner for the effort are essential part of the report. This online report from central data storage is intended to replace need for separate manual status excels files currently in use as indicated as desire by portfolio managers during the interviews (RQ1, Table 4) The report format is tabular list with the following portfolio information to be included:

- Category (text), grouping criteria for data
- Effort name (text)
- Description (text)
- Status (text)
- Value stream (text)
- T-Shirt Size (quadrant visual)
- Value (quadrant visual)
- Complexity (quadrant visual)
- Strategic fit (quadrant visual)
- Potential (traffic light visual)

- Recommendation (text)
- Planner (text / user directory)
- Start (date / year, quarter)
- End (date / year, quarter)
- KEUR (Currency)

In addition to filtering, the rows in the on-line report may be sorted by user with any of the above-mentioned data.

Value vs. Complexity is a bivariate analysis of the portfolio data. The matrix can be used to analyze the portfolio and agree on the actions and execution order of the portfolio efforts. The healthy balance of value and complexity representing the risk is an important aspect of the analysis. Concept of the Value vs. Complexity matrix is demonstrated in Figure 34.
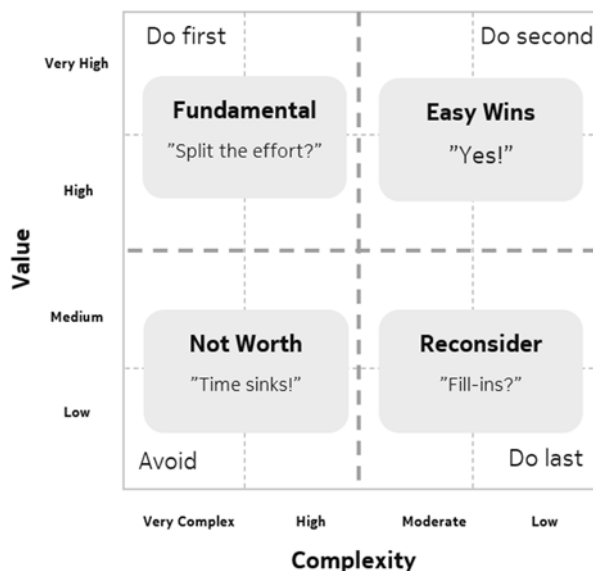
Figure 34 Value vs. Complexity matrix adapted from (Hygger, 2022)

The data in the prioritization matrix will be presented as bubble chart. Effort cost is indicated as the size of the bubble and potential with color coding. To include strategic fit would require a third dimension that would be challenging to present and read. Potential included as color codes in the bivariate analysis will indirectly cover this as strategic fit is part of the calculated potential. Ide to this multi-criteria visualization was inspired by the three dimensional analysis (Benaija and Kjiri, 2015).

The report format is a visual matrix with the following information to be included:

- Effort name (text, label for the object)
- Potential (legend of the bubble, presented as colour codes)
- T-shirt size (size of the bubble)
- Complexity (X-Axis)
- Value (Y-Axis)

Portfolio Roadmap is a presenting the portfolio data over a timeline. Implemented as an on-line visual report it will help to identify and understand the planned changes (Satoglu *et al.*, 2018, pp. 95–98) It is an important report also when communicating with stakeholders and discussing the statuses and priorities for execution order. It will provide the involved teams and individuals high-level information for resource planning. Visual presentation helps to spot potential conflicts or dependencies in the execution plan. (PMI, 2017, p. 71) This dynamic report from central data storage is intended to replace need for separate manual roadmaps created currently as power point presentations. (RQ1, Table 4) Figure 35 illustrates target layout for the roadmap report.
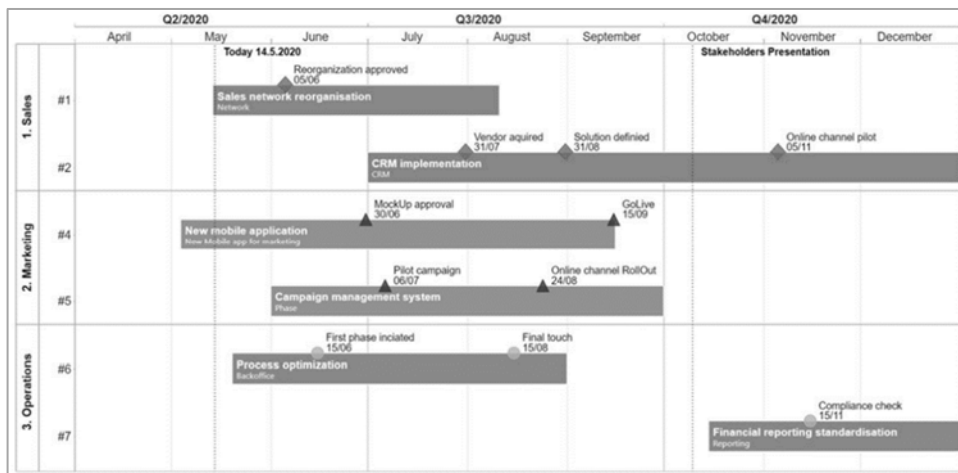
Figure 35 Example of visual portfolio roadmap (Adwise s.r.o., 2021)

The report shall contain the following information:

- Value stream (text, used as grouping criteria)
- Effort name (text, label for the object)
- Start date (date, used as default sort order)
- End date (date)
- Status (text, will be indicated with color codes for the object)

5.3 Delivering the concept to users

The concept description was shared with the commissioning organization as a post (Appendix 3) to an internal Microsoft Yammer group that included the portfolio management concept as PowerPoint presentation and a 24-minute video greeting explaining the highlights of the concept. Due to the COVID-19 pandemic and remote work mode this was selected as the method to engage with users and to get feedback on the concept.

Dialog was seen important for change management and alignment on the topic. Everyone was invited to contribute, comment and answer. The question asked (RQ2) was "How do you perceive the proposed portfolio management concept? What is good and what should be revisited?" This started a lively dialog with helpful feedback and questions from the teams. The topic was clearly interesting for everyone.

5.4 Discovery of how users like the concept

The Yammer post got attention of the whole organization. 97% of the employees in the target organization had viewed the concept. 14 different discussions were started.

Many of the comments highlighted importance of the visibility to planned projects for their own work. This was to understand where contribution to digital initiatives is required e.g., from supporting functions like cyber security and sourcing. It was noted the portfolio items should have enough information so that the need for support can be assessed but at minimum the information of contact persons who can provide the needed details.

All the information suggested to be included in the portfolio got support from users. It was recognized that there is a fine balance between having value adding visibility and too much to digest and maintain. The ask was not to make the fields mandatory to allow gradual learning and ramp-up of the portfolio data. Teams indicated they like to start piloting the solution as soon as available, that was nice.

Another good input was about how we are going to name the portfolio so that the scope is clear for the larger organization. Consensus was that we should include the organization name to the portfolio when communicating. In our case, the portfolio scope is well aligned with the organizational responsibilities and expected deliverables.

The discussion getting most attention was the level of efforts that should be managed in the common portfolio. The common view tells the key efforts imposing changes and

adding value for business should be part of the portfolio. Smaller maintenance type of activities was agreed to be kept in team specific backlogs.

Other criteria discussed should a project be included into the portfolio was visibility to resource needs. Project requiring major cross-functional participation or budget allocation beyond the pre agreed limits was given as a more likely portfolio candidate than a smaller initiative that can be managed within a single team.

Finally, the prioritization came up. It was noted there are mandatory "must do" things that cannot be de-prioritized. Some need to be implemented by certain time while others have more flexibility regarding the schedule. For the items that are not "must do" and does not add significant value it was suggested to focus on cost and risk when making portfolio prioritization. The last interesting point brought-up was the "cost of not doing". This mean that there could be projects with negative impact if not executed. We could use the categories (Table 6), e.g., "Protect", to identify such items. The impact should be noted in benefits.

5.5   Portfolio management solution design

After getting validation of the concept and support from users we proceeded with technical implementation of the portfolio management solution utilizing Microsoft M365 platform.

We followed the modular design principle for a computer-based decision support system (Archer and Ghasemzadeh, 1999, p. 214). The work started with establishing the portfolio database and user interface in SharePoint that is the web-based collaboration platform from Microsoft.

5.5.1   Portfolio database

Portfolio database was established as a Microsoft M365 SharePoint list containing all the fields for a portfolio record needed through its life cycle. The user interface is arranged into user views according to the designed portfolio stages Collect, Assess, Prioritize, Select, and Implement. The mapping of database fields to views is explained in Figure 36.

Collect	Assess	Prioritize	Select	Implement
Effort	Delivery Team	Potential *)	Business Owner	Not in scope
Description	Schedule	Proposal *)	Budget Owner	
Value Stream	T-Shirt Size	Comment	Cost	
Benefits	RAID Analysis		Schedule	
Category	Criteria: Value, Complexity, Strategic Fit		Resources, Suppliers	
Planner	Planner	Planner	Planner	
Status: Requested	Status: Assessed	Status: Planning	Status: Committed	Status: Execution, Done
Note: Items can be moved as Parked or Abandoned at any point *) Potential and Proposal calculated based on criterions				

Figure 36 Portfolio database in Microsoft SharePoint

The high-level database design and the portfolio list are available in Appendix 10. Beside the main portfolio list the database contains supporting lists created storing the possible values for drop-down fields like T-shirt size, value, complexity, and strategic fit. Supplier list was imported from Enterprise Resource Planning (ERP) system so that suppliers can be mapped to an effort for planning purposes and providing the requested early visibility for sourcing team. The potential list is storing the textual descriptions for recommendations (3=Select, 2=Prioritize, 1=Lower priority, 0=Abandon). Sort list is a system list used to define default sorting order for reports. The supporting lists will make it easy to change descriptions and values in future as they are not hardcoded to the user interface or the reports.

5.5.2 User interface

Organization is heavily using the cloud-based Microsoft M365 platform. During COVID-19 the Teams application has become a home for collaboration. A new portfolio management channel was established under Teams having the portfolio management solution user interface and the reports embedded (Figure 37). The standard functionalities of M365 platform were utilized also for dialog, storing portfolio meeting minutes and receiving feedback on the solution.
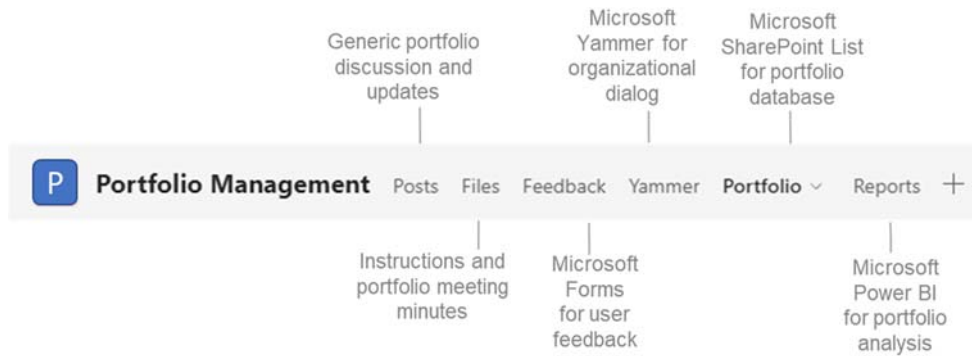
Figure 37 Portfolio management solution as part of M365 platform

User interface for the **portfolio database** was designed to have list views organized by stages minimizing the user input required in each phase. Especially the first **Collect** stage was designed to be simple so that adding a new idea is a low-effort activity (Figure 38). Views are guiding user to follow the designed portfolio process with relevant data, step by step, as it was explained earlier in Figure 36.

Figure 38 Collect view to add an idea

Instead of a list view, whenever needed, user can also open a **single record** and modify all the data fields in one window (Appendix 9). This is handy for portfolio maintenance or if multiple stages are performed in one go. This could be the case e.g., with a quick sprint executed in agile mode.

In the **Assess** view user will give initial timeline for the requested efforts and add the delivery teams required for execution. Assessment is completed by providing T-shirt size estimation and evaluation of the prioritization criterions. When user moves to the **Prioritize** section the potential calculated by the prioritization model and recommendation for the effort are visible. Effort planner can store comments, judgements, and recommendations from collaborative planning meetings. Whenever the effort is modified the assessment can be revisited and potential re-calculated. The Assess and Prioritize view is explained in Figure 39.

Figure 39 User interface for assessment and prioritization

The **prioritization model** is managed as a stand-alone module, separate from the user interface as suggested by the modular design principles for a computer-based decision support system (Archer and Ghasemzadeh, 1999, p. 214). The calculation rules were implemented as a cloud-based software robot (Appendix 11). The software robot executes every time a new portfolio item has been added or updated. This modular design makes it easy to finetune the rules when required.

After the potential is calculated and judged only the most promising efforts are moved to detailed **planning phase**, i.e., status is set to "Planning". Key output from the planning is recorder to the effort (Figure 40). The value stream, project steering or portfolio board will validate the planned projects in their scope. The projects authorized for execution are marked as "Committed" in the **Select** view. At this stage planner may be changed to the designated project manager who is responsible for updating the progress during execution and mark the effort done after completion.

Figure 40 Planning and final commitment to execute

The initial prioritization, done in collaboration with stakeholders, is not showed at this final stage but can be revisited if required. Merits of the business case and project plan should include the needed information for final approval.

5.5.3 Portfolio Reports

The three portfolio reports were developed with Microsoft Power BI. First the Portfolio database created as Microsoft SharePoint list was connected as data source for Power BI. Two additional third-party visualizations were installed for creating roadmap report and bubble chart for bivariate analysis. (Adwise s.r.o., 2021; XViz LLC, 2021)

The textual **portfolio data report** was built using matrix visual available as standard feature in Power BI (Figure 41). This report gives an overview of portfolio efforts and it is grouped by the categories protect, grow, and optimize (PwC, 2021). Categorization together with the other dimensions like size, value, complexity, and strategic fit will help to analyse and adjust balance of the portfolio. (Artto, Martinsuo and Aalto, 2001, p. 39). Values of T-Shirt size and the evaluated prioritization criterions are presented as visual boxes with blue-filled quadrants. This makes the reports intuitive for anyone to read without need to know the exact values used in evaluation.

Figure 41 Portfolio data report

The most used filters (e.g., planner and value stream) are included directly in the main page of each report. When moving between the different reports the chosen values will remain until changed.

The second report is the **portfolio roadmap** (Figure 42). For creating this report we used the roadmap visual from Adwise. (Adwise s.r.o., 2021) This was one of the most requested reports by the users. This report is intended for communication between development teams and stakeholders. It helps to understand the time dimension of the portfolio efforts. Colour codes are presenting the statuses of the efforts. When using delivery team, supplier, or individual resources as filtering criteria potential high-level resourcing issues can be spotted.

The third-party visual had some limitations regarding the layout and amount of data that can be presented but it is expected to evolve. The Czech supplier was extremely helpful and requested input for development. The clear merit of this online roadmap is that it is dynamic versus the statistic roadmaps done with e.g., Microsoft PowerPoint. Dynamic portfolio roadmaps will better facilitate the continuous change. (Bonnet, 2016, p. 7)
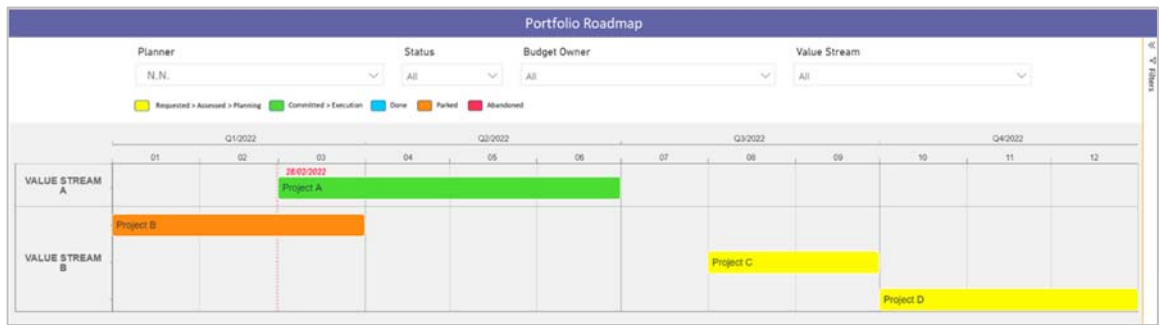
Figure 42 Portfolio roadmap

Prioritization matrix (Figure 43) was implemented with the bubble chart visual (XViz LLC, 2021). The result is a bivariate value vs. complexity report for analysing the portfolio balance. (Hygger, 2022) The third dimension, strategic fit, is acknowledged through the potential score calculated by the prioritization model. Colours of the bubbles in the chart are presenting the potential. T-Shirt size estimate is used as the bubble size.
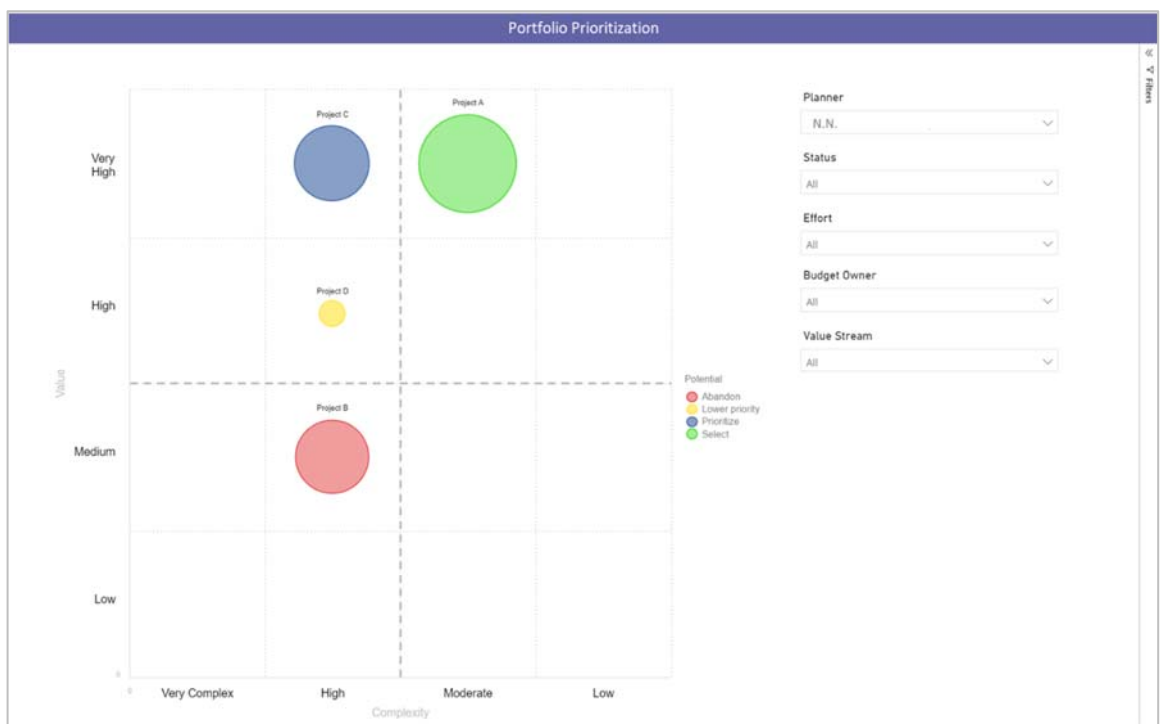
Figure 43 Prioritization matrix

Including a clear recommendation (abandon, lower priority, prioritize, select) into the traditional value vs. complexity matrix was a new idea implemented based on the previous research. (Cooper and Edgett, 1997, p. 24; Benaija and Kjiri, 2015) Similar report would

be possible to create in the future for value vs. strategic fit analysis if needed.

5.6 Delivering the solution to users

After the technical implementation of the portfolio management concept was ready, it was introduced to the organization in phases. Reason for this was that at the beginning portfolio database was empty. To get a good idea of the process and the reports for larger community we first needed to get some real projects and data in the tool. We also wanted to ensure commitment from the teams to pilot the solution before proceeding.

The launch started with demonstrating the solution in a virtual leadership meeting for the portfolio managers, the same group that was initially interviewed for input and needs (RQ1). Microsoft Teams was used for broadcasting the live demo session. The outcome of the meeting was that each lead agreed to nominate a portfolio planner from their team to start working on the tool and setup the initial data.

Next individual virtual hands-on sessions to walk through the solution with the nominated planners were organized. The planners agreed to act as change agents inside their team and ask for input from their team members to setup the portfolio data of current projects under execution and the ones that have been proposed but not yet approved.

This step required several discussions to align and agree on how to setup the data inside the teams and between the teams in the tool. Through active dialog an alignment was finally reached. Portfolio planners had vital role here. Although this step took way more time than anticipated it was extremely useful. The total duration of this setup phase was 3 months, from start of October 2021 till the end of year 2021. The two major discussion points when establishing the portfolio where 1) what size and type of effort will be added to the portfolio and 2) naming of value streams and split of the efforts between the streams.

For the efforts to be added it was concluded that continuous effort will not be added at this point to the portfolio. We focused on capturing the development efforts that have a clear goal, start, and end. Small maintenance type of efforts not requiring budget allocation or resources from other teams was agreed to be managed at operative level, outside the joint portfolio.

Naming of the value streams were finetuned to match with the scope of the captured work. Maturity of managing the efforts as portfolio variated between the teams. This resulted first in some duplicate efforts when teams added the cross-organizational efforts

based on where they are involved in versus efforts that were managed under their value stream. Duplicates were sorted out and primary reporting dimensions were agreed.

After the initial portfolio had been established and the unclarities or conflicts in data were resolved it was agreed to start a monthly portfolio meeting practice involving the whole organization. The first meeting was hold in January 2022. Purpose of the meeting was to share status information and provide visibility across the value streams. Each value stream has its own existing governance practices and budget that remains unchanged. Value streams use the portfolio data, e.g., selection criterions and statuses, to prepare for their governance meetings. In case the value stream encounters issues requiring support or prioritization across multiple value streams they will be escalated and brought up in the monthly portfolio meeting.

We collected feedback post the first portfolio meeting with a Microsoft Forms survey (Appendix 12). Number of users who provided feedback was 10. The questions asked were 1) What went well, or you found useful? and 2) What should be improved for next meeting and how?

The structure and visibility provided by each value stream was valued but the two hours duration was seen to be too long. Some value streams shared too many details, beside the key data already available in the portfolio. In the first meeting we went through the whole portfolio. Based on the received input the next meetings were agreed to have a duration of 1,5 hours and focus on portfolio highlights only, i.e., new key efforts, critical status updates and escalations requiring support. In February 2022 meeting the focus agreed worked much better, although time keeping remains a challenge. We need to allocate some more effort and central support for preparing the value stream highlights.

In March 2022, the portfolio had total 8 value streams and 74 initiatives from which 6 are committed and 22 under active execution. The rest are either requested, in planning or already done. 6 initiatives have been parked and so far, none fully abandoned. 31 initiatives have been calculated a potential score by the prioritization model. This information has been available for planners to evaluate and prepare the proposals with stakeholders. Approvals in the governance meetings are based on dialog and final judgement by the participants.

5.7   Getting final feedback on the solution

At the end of the project in March 2022 the last task was to collect final feedback and input for further improvements. The concept had been in real use supported by the

technical portfolio management solution for six months, including the 3 months setup phase of the portfolio.

The feedback was gathered with a Microsoft Forms survey covering the key artefacts resulted from the project. Evaluation was done using a Likert scale. (Lowdermilk, 2013, pp. 80–83) The values were Excellent, Good, Average, Poor and Very poor.

Visual summary of how the portfolio management concept and solution was perceived is illustrated in Figure 44. We got altogether 13 responses. Average time spent to respond to the survey was 18:48 (mm:ss). Example of the survey layout is available as Appendix 4.
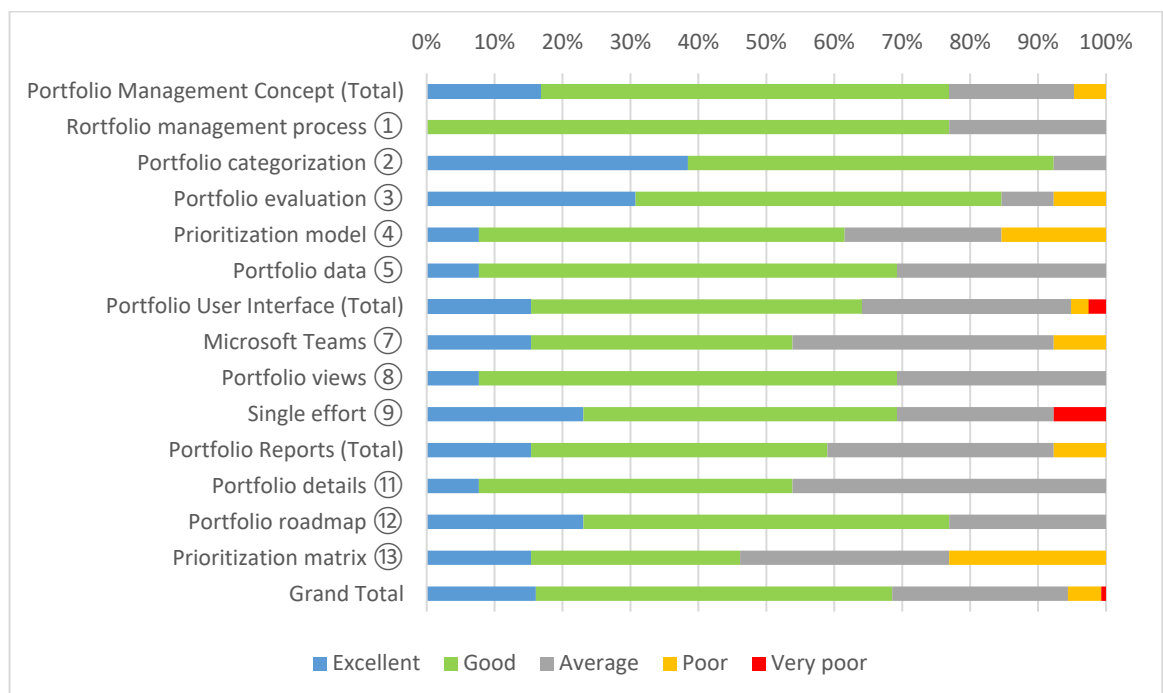
Figure 44 Final user feedback graph

The survey had three sections covering the portfolio management concept, the user interface, and the reports. From the answers we got insight of how users perceive the implemented portfolio management concept (RQ2) and the supporting technical solution. Beside using Likert scale, each section was completed with an open question "How could the concept/tool/reports be improved in future?".

The **portfolio management concept** was getting the highest total score with 76,9% giving clearly positive feedback, i.e., either "Excellent" or "Good". Highlights where the portfolio categorization model (92,3%) and the portfolio evaluation criteria's (84,6%) evaluated as positive. We can say the proposed model to categorize and evaluate digital

initiatives were very well received, especially given the variating nature and distinct size of efforts in the established portfolio.

Interestingly however, one user (7,7%) had evaluated the evaluation criterions and two users (15,4%) the prioritization model as poor. When looking into the textual feedback from these users we can see the reasoning. User liked the options and measurements to be more self-explanatory. This could also indicate need for better induction when implementing the concept. On the other hand, the concept was simple enough to be received well with majority of users, even with the short virtual briefing (video greeting and material share in Yammer).

The other poor response for evaluation criteria and prioritization model was more related to implementation challenge not the concept itself. In some areas more effort is required to establish systematic portfolio thinking with stakeholders. Implementing a portfolio concept and doing prioritization together requires strong organizational maturity and commitment.

The portfolio process, i.e., the steps, had 76,9% positive responses and no one evaluated it as poor (poor or very poor). We can say the process is widely accepted. One team told they follow the steps but tend to document the outcome to common portfolio only after approved by stakeholders. This will naturally reduce visibility to new ideas for other teams. It takes some time to let old practices go and replace with new common one. Also, more precise rules what type of initiatives should be managed with the concept were still asked for. This alignment needs to continue. Given the different nature of agile and waterfall projects a perfect solution will be newer found but a good enough should be strived for. Too many small projects reduce the visibility and makes the strategic portfolio planning challenging. This was a common challenge within agile teams.

Finally, the portfolio data as part of the concept got 69,2% positive, 30,8% average and no poor evaluations. Missing frequent updates and active use of data were mentioned as challenge. Not all fields, like the risk assessment, were used actively. Some level of continuous portfolio level facilitation is required to keep the data quality at satisfactory level. To summarize, the defined data serves the purpose for visibility, but the implementation discipline requires follow-up and support.

The **portfolio user interface** based on Microsoft M365 collaboration platform got evaluated as 64,1% positive, 30,8% average and 5,1% poor. The portfolio views and the single effort form implemented with Microsoft SharePoint got positive score of 69,2%. No one evaluated the portfolio views as poor, whereas one user (7,7%) thought the single-

entry form had some issues, hence very poor. Highlight was feedback from a user suggesting the overall tool concept is excellent and provides high level visibility of dependencies between multiple teams.

In general, the users told the tool itself was good enough. Couple of feedbacks noted that using another dedicated third-party portfolio tool would not bring additional benefits but add complexity. Simplicity of the built tool was appreciated. This assures that minimum viable portfolio management solution can be achieved with a modern collaboration platform like Microsoft M365. The terminology in the process and tool still needs some time to allow everyone to be familiar with it. A few users mentioned they quite often need to look for the descriptions when using the tool. Here there are natural differences between the teams, depending what process and terminology they have used in the past.

For improvements, it was suggested more consistency and discipline is required within the teams to use the tool regularly. Important finding was that it is expected the tool will bring more value when portfolio data is used as baseline for annual budgeting. This process did not yet occur during the pilot. As getting fixed funding is crucial for the agile value streams, to integrate the tool to budgeting is a particularly promising idea. There is a natural need to constantly maintain portfolio data with decent quality. A credible baseline provided by the tool will facilitate budget discussions and follow-up across organization and reduce the manual efforts.

There is also still room for Microsoft to improve how the different tools like Microsoft SharePoint integrates with Microsoft Teams. The two user who provided poor evaluation had encountered some specific issues, e.g., not being able to return to home screen from a full-page view. The Microsoft Teams UI could be more intuitive and readable according to the users. As examples was mentioned filtering of the data.

Good thing is that Microsoft is working on frequent releases for Microsoft Teams as it has clearly become vital for many companies during the pandemic. It is possible to access the portfolio in SharePoint and the Power BI reports also with direct URL providing slightly better UI, but it would not offer the same integrated and collaborative user experience as when consolidated under a Microsoft Teams channel.

Finally, a development idea presented was to have the tool to notify a group of people when e.g., a new effort has been added to the portfolio. This would help to activate users and drive usage of the tool. Similar idea could be implemented for major status changes like approval of the effort. Second development suggestion was to allow multiple values in

some fields like e.g., "Business Owner". The received feedback is valuable for continuous improvement of the user interface.

Portfolio reports consist of three different reports. The survey revealed that the roadmap report was perceived extremely useful. Total 76,9% of users gave positive evaluation, and no one thought it is poor. Users mentioned e.g., it is an excellent way of presenting the portfolio. One user suggested some more details could be added to the report. In contradiction another user was looking to get even better overview of the portfolio.

The visual presentation format has some limitations, but details could be added to the online roadmap report e.g., by using the PageTooltip feature in Power BI. This feature opens a window with specific details when user hoovers over with mouse an item in the report. Improving filtering would help to keep the report readable and provide a meaningful overview for the user. One idea is to apply pre-filtering based on the login user, i.e., the report could show as default the items where user is involved as planner, owner, or a resource.

The portfolio details report got positive evaluation from 53,8% users and the rest thought it is average. One comment mentioned it is a little complicated to read. This was useful and an interesting finding. The report itself has limited amount of information but it could be some users would rather prefer the traditional textual presentation of the evaluations instead the visual, blue-filled quadrants. This report clearly needs more study before proposing any changes.

The prioritization report got the most mixed reception. 15,4 % excellent, 30,8 % good, 30,8% average and 23,1% poor evaluations. No one considered it as very poor. The user feedback revealed that large portfolios experienced the issue of overlapping items, bubbles, in the chart making the report difficult to read. This happens if many efforts have the same priority and size. Some more details were requested also for the roadmap report.

Base on the mixed reception the use of prioritization matrix requires some consideration. Its purpose needs to be better communicated to users and guided by the process. It is primally not meant to be a full representation of the portfolio but to support the selection phase by comparing a few specific items. Proper use of filtering functionality plays an important role here.

Overall, the portfolio reports got the most variate feedback totalling 59,0% positive, 33,3% average and 7,7% poor evaluations. It was delighting to see the automated portfolio

roadmap report received extremely high number of positive feedback (76,9%) as it was requested by the portfolio managers during the discovery at the start of the project (RQ1).

To conclude the final feedback and the project, we can say the process was accepted across the development teams and the categorization and prioritization criterions proposed worked well for digital initiatives in the given context. While there were some improvements proposed and minor issues encountered with the user interface and the reports, Microsoft M365 collaboration platform can be considered as a good enough starting point for establishing minimum viable portfolio governance with less effort and cost than implementing a full-scale dedicated platform. It is certainly useful for the proof of the concept.

6   Discussion

The aim of the assignment carried out during the thesis project was a) to find out specific portfolio management challenges among development teams working with digital initiatives in the commissioning organization and b) to build a portfolio management solution addressing the findings. We applied iterative User Centered Design (UCD) methodology to develop the portfolio management framework. Qualitative user study data gathering methods were used for reaching the solution. The final artefact consisted of a portfolio management concept supported by a collaborative portfolio management tool.

To achieve our objectives, we formulated the following research questions:

(RQ1) What are the main challenges experienced by users managing a portfolio of digital initiatives?

(RQ2) How does users perceive the implemented portfolio management concept?

The data collected during the semi-standardized interviews (RQ1) suggested the key challenges experienced by users were lack of shared portfolio level visibility and the need to prioritize initiatives to overcome resource bottlenecks. User 1 expressed "I would hope other areas would provide better visibility". User 6 continued "We can do more realistic planning when understanding all the needs at the same time. I feel we usually take too much to the pipeline". These were important findings that had to be addressed.

Satoglu et al. (2018) recommend digital transformation requires efficient management and prioritization of technology investments. (Satoglu *et al.*, 2018, p. 97). Requirements for visibility and prioritization resonates well with the leading principle of portfolio governance that is to ensure "transparency, responsibility, accountability, sustainability, and fairness" of the portfolio. (PMI, 2017, pp. 43–50)

The user survey complementing the interviews revealed that objectives and benefits (42,11%) followed by linking initiatives to business strategy and focus areas (26,32%) were seen as the most relevant (first choice) information for improving portfolio visibility (Figure 28; Table 5). High-level timelines, resource needs, related efforts, and dependencies were also widely supported to be include in the portfolio. The organizational focus of portfolio management to plan, co-ordinate and monitor the activities undertaken to reach the strategic objectives supported well these findings. (PMI, 2017, pp. 6–13)

It was clear from the user interviews and the survey that a common portfolio management approach and a tool was needed to overcome the challenges. KPMG digital transformation report noted a central portfolio tool, used in similar way across organization, is essential for managing continuous changes and provide online visibility (Hofland, Hattink and Ginkel, 2020). The created concept (chapter 5.2) and solution (chapter 5.5) included a portfolio management process, a prioritization model with evaluation criterions and a dynamic portfolio reporting approach. This was supported by a computer-based decision support system utilizing Microsoft 365 productivity cloud. The solution was piloted by the users followed by a user survey to understand how (chapter 5.7) the solution was perceived (RQ2).

The **portfolio management process** had to acknowledge the needs of both traditional projects and agile initiatives. It follows project portfolio management and lean development principles (Romano, 2017; Scaled Agile Inc., 2021c). A fast moving constantly changing digital portfolio calls for simplicity. To address these needs, a minimum viable governance practice was defined with steps (collect, assess, prioritize, and select) and the supporting portfolio gates (Figure 29). The most crucial decision gate is at the end of selection phase when organization commit to deliver the anticipated benefits.

The selected minimal viable governance approach was clearly the right choice for the commissioning organization as 76,9% of users (Figure 44; Appendix 13) gave positive rating for the concept (RQ2). Significant was that none of the users called for a more through process. The process shall indeed be simple and not overload users with data (Archer and Ghasemzadeh, 1999, pp. 208–209). More straightforward process, than the one created, would have been challenging to achieve without discarding the aim for optimal portfolio selection. (Archer and Ghasemzadeh, 1999, p. 212)

Portfolio categorization is outmost important for understanding the different nature of initiatives and to do planning accordingly. The implemented categories used for digital initiatives were protect, grow, and optimize (Table 6). PricewaterhouseCoopers suggested "to grow, companies need to optimize and protect their core business first" (PwC, 2021). During digital transformation organization needs to balance all the three categories. 92,3% of the users (Figure 44; Appendix 13) felt positive these were right categories for their specific portfolio (RQ2). The proposed categorization is useful for any company working with digital transformation initiatives to analyse the portfolio.

The proposed criterions for **portfolio evaluation** were value, complexity, and strategic fit (Table 7). Strategic fit is vital for transformative digital initiatives. It is measured against

the organizational objectives (Artto, Martinsuo and Aalto, 2001, p. 39; PMI, 2017, p. 37). As idea of digital portfolio was to collect many ideas and provide early visibility to teams, the criterions were decided to be qualitative, hence subjective values were defined to support early evaluation. 84,6% of users (Figure 44; Appendix 13) perceived the criterions positive (RQ2). Consistent use of the evaluation mechanism, even simple one, calls for training and continuous change management we learned. Evaluation is required not only to find the best projects supporting execution of strategy but also to balance the portfolio e.g. in term of risk and value (Artto, Martinsuo and Aalto, 2001, p. 39). Some easy quick wins are also important to include in the portfolio.

The introduced three-dimensional **prioritization model** (Figure 31-33) builds upon the evaluation criterions value, complexity, and strategic fit. Unique for the adapted implementation is that utilizing the qualitative evaluation and subjective values, the model calculates a clear recommendation should an initiative be selected, prioritized, priority lowered or abandoned (Cooper and Edgett, 1997, p. 24; Benaija and Kjiri, 2015).

This approach enabled prompt evaluation of larger number of items in early phase. The key thing was to find the most promising initiatives for detailed project planning. As a qualitative model it trusts on the judgement done by the portfolio planner. For reliability, a good idea is to do the judgement collaboratively with expertise of a larger group. This will increase transparency and promote responsible decision making (Eskelinen *et al.*, 2017). For analysis purpose a prioritization matrix report (Figure 34 and Figure 43) was created to help compare multiple initiatives (Hygger, 2022).

During the relative short three-month pilot 61,5% of users (Figure 44; Appendix 13) experienced the prioritization model as positive (RQ2). The rest clearly needed more time to explore and run through multiple initiatives. This should be acknowledged in future portfolio implementations. To mature and finetune a model can take years. (Artto, Martinsuo and Aalto, 2001, pp. 37–38)

The computer-based **decision support system** was developed with the standard Microsoft M365 collaboration platform (Table 1). The project revealed a minimum viable tool for managing a digital portfolio is possible to achieve with a modern productivity cloud. The user-interface to manipulate the data and run the designed process steps got positive score of 69,2% (Figure 44; Appendix 13). No one evaluated it as poor (RQ2). According Program Management Institute up-to date portfolio provides a window to the "intent, direction and progress" of the organization and help business to align on the priorities (PMI, 2017, pp. 3–10).

The productivity cloud also provided a meaningful way to pilot and mature the portfolio management concept in the organization without expensive upfront investments. This is a clear benefit as each organization must work out the concept and align their portfolio management approach with organizational objectives. (Romano, 2016)

The solution follows **modular design** as suggested by Archer and Ghasemzadeh. It consist of the database, user interface, prioritization model and the reports providing visibility for the development teams. (Archer and Ghasemzadeh, 1999, p. 214). The modular design enables easy finetuning of e.g., the prioritization model and the reports as the organization learns to think portfolio and new needs start to emerge.

The dynamic **portfolio reports** for visualising the portfolio data were essential for the success of the project. During the interviews one of the common requests was to automate manual creation of reports (RQ1). Especially the automated portfolio roadmap was well received as it helps to understand the planned changes and timings at portfolio level. 76,9% of users (Figure 44; Appendix 13) gave positive evaluation of the portfolio roadmap (RQ2). Satoglu et. al. highlighted the importance of visual roadmaps in the book "Industry 4.0: Managing The Digital Transformation" (Satoglu *et al.*, 2018, pp. 95–98).

To conclude, it is meaningful to acknowledge the **limitations of the study**. The created artefact was a practical portfolio management concept focusing on building and evaluating a portfolio valid for a specific organization with own needs and a unique culture. The portfolio concept was piloted for a brief time as part of the thesis by the commissioning organization. Although encouraging first steps taken, at minimum a full year with the strategic planning cycles and budget planning will be recommended to go through before final conclusions taken. Establishing portfolio management is not a sprint but a marathon. This thesis provides one scenario how to get stared.

6.1 Recommendations and guidelines

This chapter contains two areas as recommendation for future research and development. The areas are related to reporting and the prioritization model.

Having shared portfolio level visibility was one of the key issues raised by the users (RQ1). Beside the three on-line portfolio reports created, there were two new report ideas presented by users after the final survey. First an automated single project charter, a project proposal, could be developed using the data collected in the database. This would ease the work of creating manual presentation materials for periodical project selection meetings with the stakeholders. (Archer and Ghasemzadeh, 1999, p. 208)

Secondly a centralized portfolio dashboard for the organization that would include portfolio level key metrics like number of ideas under evaluation, ongoing projects, number of projects per category, average lead times, benefit realization etc. would help to provide an overview for leadership of how the strategic objectives are met. (Romano, 2017)

The other area is the prioritization model for digital initiatives. A good model will and should evolve over time. Applying modern data science and machine learning algorithms to improve the evaluation and prediction accuracy would be an interesting subject for future research. Here we could utilize the data collected in the database from past project evaluations and the measured outcomes. This could help to automate and speed up growing the maturity of the model that otherwise could take years. (Artto, Martinsuo and Aalto, 2001, pp. 37–38)

6.2   Reliability and validity

The applied user centric design principles had a key role to ensure the reliability and validity of the research for the commissioning organization. Data was collected during multiple stages of the project (Appendices 1,2,3,4,12,13). Analytical procedures like frequency analysis (Yin, 2011, p. 196) and affinity diagram (Lowdermilk, 2013, p. 68; Still and Crane, 2017, pp. 86–88) were used to quantify the findings and increase the accuracy of the research.

The recorded and transcribed interviews (Figure 1) and the surveys included several user groups like portfolio planners and development teams to ensure different viewpoints were captured. We applied detailed questioning and asked feedback for improvements at every stage (Lowdermilk, 2013, p. 77). The proposed development items are based on evidence received from the empirical research and backed up with the portfolio management theory researched as part of the thesis.

The thesis recognizes that multiple realities exist. The findings are valid for the given context and the research subject, i.e., the commissioning organization. The application of portfolio management should be measured periodically and taken part of organizations continuous improvement practices. As strategy of the company objectives may change over time, it is important to maintain a valid portfolio management concept and do the needed changes when required.

7   Conclusion

The leading theme of the thesis was to understand how the commissioning organization could improve prioritization of digital initiatives. The digital transformation requires the organizations to be agile and creative. There are vast number of opportunities to capture. Companies being able to first capture the opportunities will get the biggest rewards.

Organizations that are not applying strict portfolio management practice across all areas of the company may benefit from establishing the portfolio with the bottom-up approach presented in the thesis. The developed process and a supporting tool will help to engage the functions of the organization to think portfolio.

The portfolio management concept proposed is a minimal viable governance practice that fulfil the needs of agile development but also through common decision points is applicable for projects requiring traditional steering committees. This was possible to achieve although the level of items ending up in the portfolio requires constant facilitation and follow-up. Too many small items decrease the visibility of the strategic direction.

The key outcome of the thesis was the three-dimensional prioritization model that includes the strategic fit in addition to the traditional complexity and value. For digital transformation, the strategic fit is a must have measure. The evaluation of potential initiatives is done at early phase by using qualitative values with defined subjective scales. Specific for the developed prioritization model is the textual and easy for anyone to understand recommendation given. Doing the final judgement collaboratively through dialog is strongly recommended.

The digital initiatives require constant alignment of the priorities across the organization. The thesis project proved a cloud-based collaboration platform, that is a standard nowadays in many companies, can be utilized for collecting portfolio data and to introduce a portfolio management concept. Dynamic on-line reports, like the roadmap, were found to be extremely important for users. Implementing a portfolio management concept must balance the needs of the organization but also recognize the requirements of individual users that are maintaining the portfolio data. The user centric design methodology applied in the thesis project was a right choice.

Developing portfolio management is a journey. This thesis provides ideas how to get started with a simple approach that can be later extended with learnings captured when the digital transformation advances and the organizations adapt their objectives. Think portfolio!

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Table of Figures

Attachments

Appendix 1. Qualitative interview guideline

Introduction

- Length of interview 45-60 min
- Goal is to understand expectations for high-level portfolio management based on your experience, opinions, and feelings you have about the subject
- The interview will be conducted in English language to ensure consistent interpretation of the data collected among participants

Obtaining verbal consent

- Data gathered will be used anonymous in the study. Ask "would it be ok for you if I record the interview and keep it only until I have done the transcript?"
- If consent give start recording and say "ok, thank you XXXX for giving consent to record the interview. Let us start with the first question…"

Interview questions (open ended)

<u>Descriptive</u>

- Please explain your role(s) in the organization.
- How long (years) have you been in this role(s)?
- What type of different work efforts are you managing?

<u>Contextual</u>

- Please tell in your own words how you are managing your work portfolio today?

- Ideas for follow-up question

  - How do you capture and purify requirements?
  - How do you manage the backlog and prioritization of the requirements?
  - What are your key dependencies and collaboration interfaces towards other teams?
  - What software tools do you use in requirements and portfolio management?
  - To whom, where and how do you report your portfolio today (either meetings, reports or ad hoc)?
  - What is the key information that you would benefit to receive from other areas?

<u>Opinions</u>

- In your opinion, what would the most important things to manage in a joint portfolio?
- In your opinion, what would be the most important top-down feedback and guidance to receive to the portfolio?

<u>Structural</u>

- Can you elaborate a bit more, why these would be important things to manage jointly?

Contrast / Comparison

- What things you believe should not be managed in a joint portfolio?

Controversial Questions

- What in your opinion is not working in the way we manage work efforts today?

Ending Question

- Anything else you like to add that we did not cover?

Thank you for your valuable time! The recording will be stopped now.

Appendix 2. Survey for understanding visibility needs

Microsoft Forms

Please sort the below list as your priority order for having VISIBILITY to portfolio item details. The one you set as first is the most important for you and the last is least important! *

Budget (estimated total cost of the effort)

Business requirements fulfilled (high-level and including expected benefits)

Governance practice (body and key decisions)

Dependencies to other initiatives

Planning assumptions (e.g. architecture and technology selections)

Progress follow-up (high-level status of the initiative)

Related efforts required (e.g. contractual, process, security, infrastructure, compliance)

Relation to business strategy and the focus areas

Resourcing needs (high-level efforts required)

Timeline of the initiative

Were the above relevant, anything critical for you that was missing or you want to comment?

Enter your answer

Appendix 3. Engaging users to discuss concept

Microsoft Yammer

Appendix 4. Survey for getting final user feedback

Example of the user survey sent to portfolio planners at the project closure.

Microsoft Forms

Appendix 5. Collect - intake of new ideas to the portfolio

Effort	Name of the effort
Description	Short description of the effort and high-level objectives.
Value stream	Name of the value stream initiating the request.
Benefits	How is this effort expected to contribute to the realization of the strategic objective? Qualitative or quantitative, preferably measurable benefits.
Category	**Protect**, **Optimize**, or **Grow**. Used later to evaluate balance of the portfolio.
Planner	Name of the person who is contact and responsible of keeping the portfolio item updated.
Status	Items in this phase shall be marked as **Requested** for easy filtering and visibility to new demand.

Appendix 6. Assess - assessment of added benefits and portfolio risk

Delivery Team	What delivery teams (resources) will this effort require? Teams should be consulted as part of the assessment.
Schedule	Initial Start- and End dates for the effort (to identify the quarters).
Size	T-shirt size of the effort (Small, Medium, Large or Extra Large). Each T-Shirt size is mapped with a value range defined in euros.
RAID Analysis	Known high-level initial Risks (R), Assumptions (A), Issues (I) or Dependencies (D) that may impact successful delivery of the benefits expected and should therefore be know when making prioritization of the effort.
Value	Low, Medium, High, Very High How valuable is this effort for the success of the <u>company</u> and the <u>customer</u>?
Complexity	Low, Moderate, High, Very Complex How feasible is this to <u>operationalize</u> within our company and how complicated is this to build <u>technically</u>?
Strategic Fit	Low, Medium, High, Perfect Fit Expected contribution or alignment to the results of the given strategic objective
Planner	Name of the person who is contact and responsible of keeping the portfolio item updated
Status	Items passed this phase shall be marked as **Assessed** for easy filtering and moving to prioritization

Appendix 7. Prioritize - analyse the potential and prioritize the effort

Potential	Score with value 0-3 Calculated by scoring model based on Value, Complexity and Strategic Fit. Recommendation is populated from the score.
Recommendation	3=Select, 2=Prioritize, 1=Lower priority, 0=Abandon
Comment	Free format comment regarding the priority. Includes judgements from stakeholders.
Planner	Name of the person who is contact and responsible of keeping the portfolio item updated.
Status	Items prioritized shall be moved to **Planning**. At any stage items can also be marked as Parked or Abandoned.

Appendix 8. Select - commitment to implement expected results

Business Owner	The person who authorizes the effort and is responsible for the results of the given strategic objective.
Budget Owner	Owner of the CC who takes and authorize the OPEX cost.
Cost	The cost for the effort to be authorized.
Start Date	Start date specified during planning.
End Date	End date specified during planning.
Resources	List of known key resources committed for implementation.
Suppliers	List of intended suppliers for the implementation.
Planner	After selection items shall be moved to **Committed**, Parked or Abandoned.

Appendix 9. Single portfolio record

Microsoft SharePoint

Appendix 10. Portfolio management database

Conceptual model
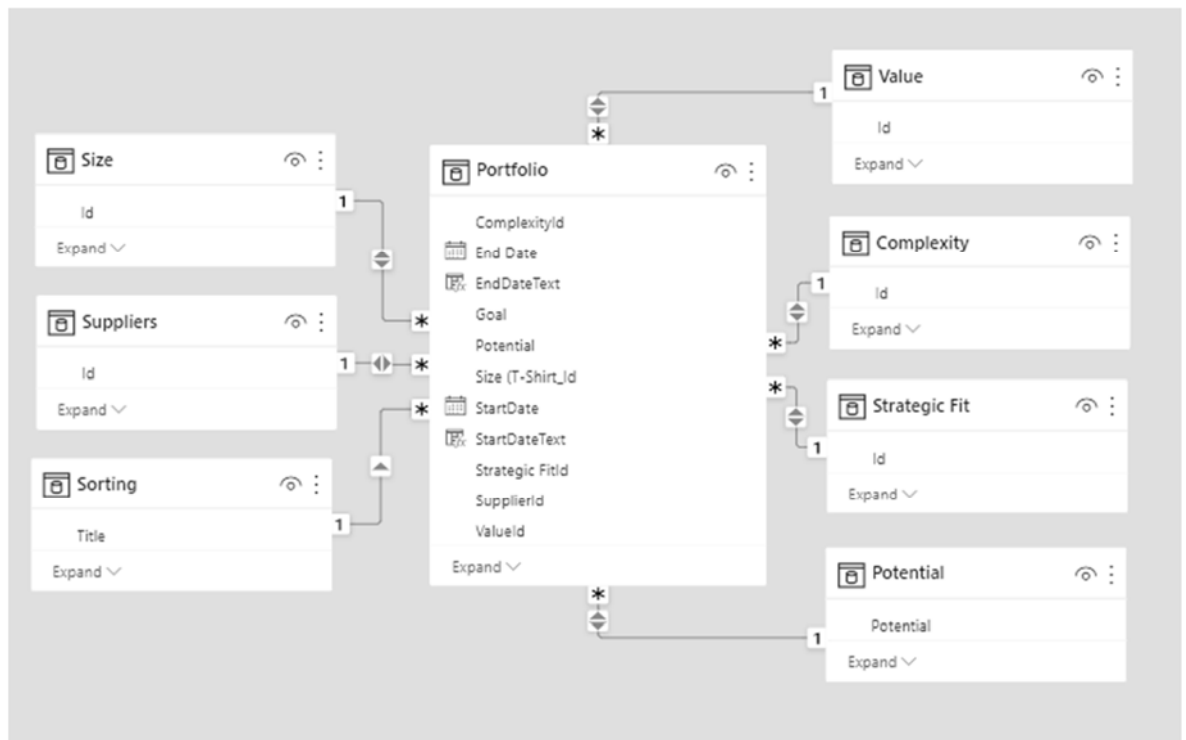
Database list

Portfolio

| Column	Type	Values
Effort	Single line of text	Free text
Description	Multiple lines of text	Free text
Value Stream	Choice	Choises are the value streams exsisting in the organization
Benefits	Multiple lines of text	Free text
Category	Choice	Protect, Optimize, Grow
Planner	Person or Group	From user directory, single value
Status	Choice	Requested, Assessed, Planning, Committed, Execution, Done, Parked, Abandoned
Delivery Stream	Choice	Choises are the DevOps teams exsisting in the organization
Start Date	Date and Time	Date
End Date	Date and Time	Date
T-Shirt Size	Choice	Small, Medium, Large, Extra Large
RAID Analysis	Multiple lines of text	Free text (Risks= , Assumptions= , Issues= , Dependencies=)
Value	Lookup	Low, Medium, High, Very High
Complexity	Lookup	Low, Moderate, High, Very Complex
Strategic Fit	Lookup	Low, Medium, High, Perfect Fit
Potential	Number	0-3 (calculated by software robot containing the prioritization model)
Comment	Multiple lines of text	Free text
Business Owner	Person or Group	From user directory
Budget Owner	Person or Group	From user directory
Cost (€)	Number	Integer
Resources	Person or Group	From user directory, multiple values possible
Suppliers	Lookup	List imported from ERP system, multiple values possible
Roadmap Type	Choice	Phase, Milestone (used for roadmap report to separate milestones from efforts)
Modified	Date and Time	System field
Created	Date and Time	System field

Appendix 11. Model management

The prioritization model was implemented with Microsoft Power Automate. The software robot calculates potential and recommendation every time a portfolio record is updated.
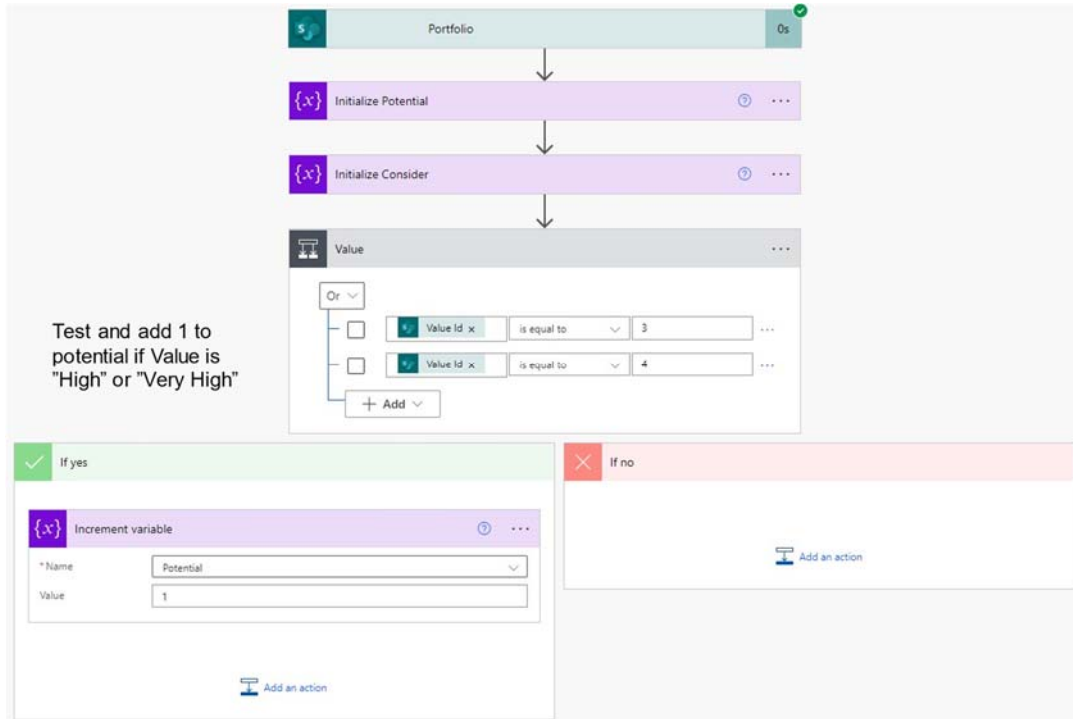
Same is done for Complexity and Strategic Fit, whereafter total value of potential is tested and textual recommendation added for the effort.
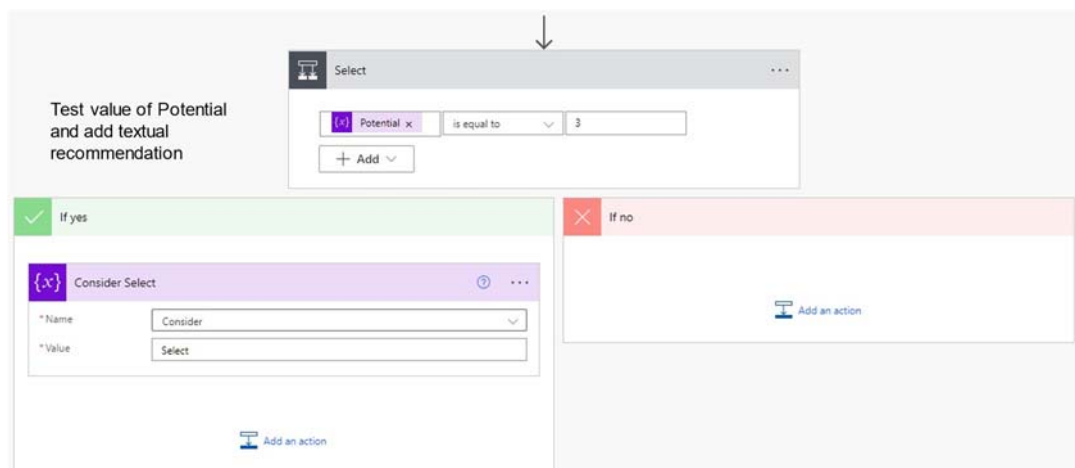
After potential has been calculated and recommendation given the record is updated.

Appendix 12. Monthly portfolio meeting

Microsoft Forms survey

Appendix 13. Final user feedback survey

How does the users perceive the portfolio management concept, the portfolio user interface, and the portfolio reports?

	Excellent	Good	Average	Poor	Very poor
Portfolio Management Concept	10,9 %	63,6 %	20,0 %	5,5 %	0,0 %
Portfolio management process	0,0 %	81,8 %	18,2 %	0,0 %	0,0 %
Portfolio categorization	27,3 %	63,6 %	9,1 %	0,0 %	0,0 %
Portfolio evaluation	18,2 %	63,6 %	9,1 %	9,1 %	0,0 %
Prioritization model	9,1 %	45,5 %	27,3 %	18,2 %	0,0 %
Portfolio data	0,0 %	63,6 %	36,4 %	0,0 %	0,0 %
Portfolio User Interface	12,1 %	45,5 %	36,4 %	3,0 %	3,0 %
Microsoft Teams	18,2 %	27,3 %	45,5 %	9,1 %	0,0 %
Portfolio views	9,1 %	54,5 %	36,4 %	0,0 %	0,0 %
Single effort	9,1 %	54,5 %	27,3 %	0,0 %	9,1 %
Portfolio Reports	15,2 %	36,4 %	39,4 %	9,1 %	0,0 %
Portfolio details	9,1 %	36,4 %	54,5 %	0,0 %	0,0 %
Portfolio roadmap	18,2 %	54,5 %	27,3 %	0,0 %	0,0 %
Prioritization matrix	18,2 %	18,2 %	36,4 %	27,3 %	0,0 %
Grand Total	12,4 %	51,2 %	29,8 %	5,8 %	0,8 %