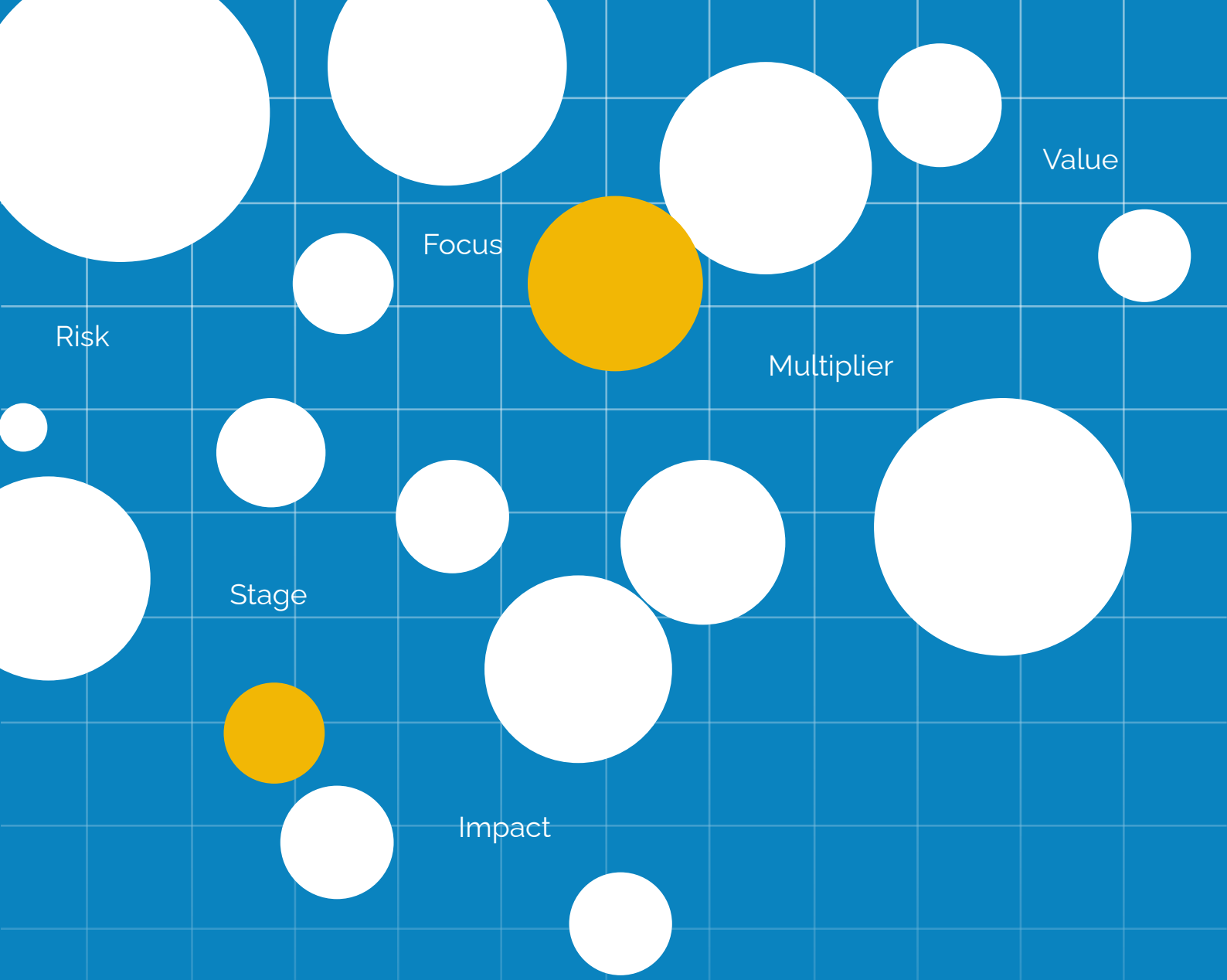


# Enabling informed decision-making in strategic portfolio management

Master Thesis
Nard van der Werff

TNO innovation for life

TU Delft

# Enabling informed decision-making in strategic portfolio management

A human centered approach to supportive tool design

Master Thesis
Nard van der Werff


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TNO innovation for life

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# EXECUTIVE SUMMARY

With more and more companies focusing on innovating, whether it is because the market desires it or to outrun the competition, the importance and difficulty of the innovation process increases. Innovation is not the process of finding that one great idea anymore. It is a complex and company-wide endeavor that requires structured, organized, and encouraging processes. Portfolio management aligns the product development activities with the organization's strategy. The literature review in chapter 2 aims to gain a better understanding of the context and the portfolio management process. The three goals of the strategic portfolio management process were defined as follows:

- Achieving the right balance, the portfolio can be balanced on several parameters, among others are the lead time, risk, the number of products, and the spread across the funnel.
- Align with strategy, by creating an overview portfolio management allows aligning the research activities with the strategy set by the executive board.
- Maximize the value, realize the most value out of the limited available resources.

This thesis explores the practice of portfolio management within TNO, an independent research organization in the Netherlands. The focus lies on the usage and transfer of data needed in the portfolio management process, in this case, the strategic meetings and Flightmap, the digital tool used to manage the portfolio data. In chapter 3 a systematic analysis is presented of the implementation and use of portfolio management within TNO, including the reason for implementation, the position of portfolio management in the organization, the governance, and the process activities.

To increase the efficiency of data presentation for the decision-making process the field of information transfer is explored in chapter 4. The interactions around and in strategic meetings as well as Flightmap are analyzed.

Three problem clusters are identified: the lack of data tracking, the lack of a clear meeting focus, and the poor Flightmap user experience. To explore the solution space a diversity of design generative tools is used. After an ideation phase, a concept was created and improved through three iterative cycles including ideating, prototyping, and testing. Eventually, an integrated solution with three deliverables is presented in the form of a meeting format, an annual plan, and a Flightmap redesign. The solution contributes to four aspects:

- Creating an overview on all levels of TNO's portfolio management.
- Creating strategic structure and awareness.
- Providing an integrated solution to manage the portfolio on each level.
- Enabling to make informed decisions on the balance, the status, and the impact.

Since this solution represents a future vision, an implementation plan is presented to outline the steps towards the realization.

The final design is validated through three activities. The solution was discussed in a team of directors meeting where the decision was made to use the status board, the portfolio review meeting, and the meeting format in the coming strategic meetings. Next to this, the Flightmap redesign was validated in two sessions with business developers. The concept was received extremely well. The final design was discussed in two sessions with experts from the strategy department. In the next Flightmap update a first version of the dashboards introduced in this thesis will be implemented.

Finally, several recommendations resulting from the literature research and the context analysis that were not included in the final design are presented.

*"There is nothing so useless as doing efficiently that which should not be done at all"*

PETER DRUCKER

# TABLE OF CONTENTS

# CHAPTER 1:
# CONTEXT & TNO

*This chapter outlines the context, the scope, and the objective. It starts with providing background information from the research fields and industry. Following the problem is stated and the project aim is presented with the approach taken.*

Content:

# 1.1 Introduction

*"Too many products and not enough budget"* or *"so many ideas but which one do we develop"*, are not uncommon phrases in the field of innovation. There is not one organization where the budget is not limiting the creation of value. Therefore it is essential to maximize the value creation with the given budget. Efficient innovation starts with a clear organization.

## 1.1.1 Innovation management

With more and more companies focusing on innovating, the importance and difficulty of this process increases. Innovation is not the process of finding that one great idea anymore. It is a complex and company-wide endeavor that requires structured, organized, and encouraging processes (De Jong et al., 2015). Each organization has its drivers to innovate, e.g., because the market desires it or to outrun competitors.

**Field of innovation**
A popular field for innovation research is New Product Development (NPD), where the focus lies on the effectiveness of the development process of products from idea till market launch. An important group of organizations that is often overlooked when it comes to innovation management is the research institutes. Where NPD companies mostly innovate because of competitor advantage, research institutes have a wider aim to solve societal issues. Research institutes are the booster for innovation in the market. What these organizations connect is the structure and success of their innovation process.

Because of the high level of similarity in the innovation process and advanced stage of innovation research in NPD this thesis will utilize the findings from the NPD innovation management field.

**The connecting factor**
To sustain the success of the organization and long-term business growth there has to be a continuous flow of new products (Hauser et al., 2006). This range of products in the pipeline is the innovation portfolio. Managing this (wide) range of products can be a problem, therefore many organizations use a form of portfolio management (Lee & Markham, 2016).

## 1.1.2 Portfolio management

**"Portfolio management is the set of activities that allows a firm to select, develop, and commercialize a pipeline of new products aligned with the firm's strategy that will enable it to continue to grow profitably over the long term."**
(Kester et al., 2011)

The portfolio management process aligns the product development with the strategy set by the executive board. It enables the management to select the right products to achieve strategic objectives. Choosing the right product is not always easy, some of the difficulties faced often are conflicting goals, qualitative results, uncertainty, risks, and the number of feasible solutions (Ghasemzadeh & Archer, 2000).

**Importance**
The Comparative Performance Assessment Study (CPAS) into best practices by the Product Development and Management Association (PDMA) in 2003, as well as the study in 2016, shows that the best firms review their portfolio more and use more portfolio management tools compared to the rest of the firms. The association identifies portfolio management as an important future research theme. In table 1.1 the success rates of the Best firm versus the Rest firms. (Barczak et al., 2009) (Lee & Markham, 2016)

Table 1.1 Success rate results from the comparative performance assessment studies 'best practices' in 2004 and 2012 by the Product Development and Management Association

| Best versus the Rest: Succes Rates | | | | |
|---|---|---|---|---|
| | 2004 | | 2012 | |
| | The Best | The Rest | The Best | The Rest |
| Number of Firms | 96 (24.1%) | 303 (75.9%) | 88 (24.7%) | 268 (75.3%) |
| Successes | 75.5% | 53.8% | 82.2% | 52.7% |
| Successes-Profits | 72.4% | 47.9% | 78.2% | 47.7% |
| Sales from New Products | 47.6% | 21.4% | 47.9% | 25.3% |
| Profits from New Products | 49.1% | 21.2% | 48.5% | 24.9% |
| Number of Ideas from One Success | 4.0 | 9.2 | 4.5 | 11.4 |

## 1.1.3 Why strategic decision-making

Good innovation management is the art of making the right decision. Portfolio management creates an overview of the portfolio and enables the management teams to make an informed decision. Guided by the strategy, on every layer in the organization there are important decisions to make. Portfolio management can counter common decision-making processes like informal power and opinion based which are detrimental to a company's success. (Kester et al., 2011)

As Kester et al. (2011) describe in their model for effective strategic portfolio management, one of the key factors is evidence-based decision making. To take decisions in this complex environment there is a need for a relevant, true, and constant flow of data. An example of relevant data is the impact a product has, the value it brings to the company. With the value visible the products can be prioritized, compared, and selected. (Martinsuo et al., 2017) Organizations found their solutions to gather this data and store it, where it often lacks is the usage of this data. (Meifort, 2016)

## 1.1.4 Importance of data analysis

By systematically analyzing and presenting the available data the real value of the data can be used to support the decisions to be made by managers. A challenge in this process is to find, in this pile of data, the right information for each decision. (Nauyalis & Carlson, 2010) (Lin & Hsieh, 2004) The complexity of the products and organization have a big influence on data utilization. (Meifort, 2016)

Another challenge is the way the data is presented to the target group. Killen et al. (2020) describe in their paper the effect of information transfer in portfolio decision-making through visual representations.

*"You can't manage what you can't measure."*

PETER DRUCKER

Visualizations help the user to understand a large quantity of complex data and increase the amount of information that can be processed. A point of attention should be made to the sensitivity when it comes to the use of visualizations in the decision-making process, e.g., to not include biases and incorrect data.



# 1.2 TNO

## 1.2.1 Introduction TNO

This project is carried out within TNO, an independent research organization in the Netherlands. The organization based in The Hague was founded in 1932 to make knowledge better accessible for companies and the Dutch government. Although TNO works together with several government agencies, TNO is an independent organization, it is not owned by the government, universities, or companies. By collaborating with companies and the government, the 3400 employees within TNO work together to improve innovation in the market.

**Organizational values**
The mission of TNO is to bring people and knowledge together to create innovations that boost the competitive strength of the industry and the well-being of society in a sustainable way.

TNO is a non-profit organization that receives most of the funding from government agencies and European Union support. Therefore, objectives should have a social need, the innovation should be unique, and not block any companies in the market. Special about TNO is the collaboration with the industry, either in direct orders or in larger partnerships. Therefore, the focus is a combination of the societal and economical value of the knowledge and it ensures the application of the end product. This makes choosing the right objective and managing the objectives over time even more important.

The organization consists of 9 units which each focus on a different knowledge domain relevant to The Netherlands and


Figure 1.1 The introduction of TNO.

Europe. This project is carried out at the unit Buildings, Infrastructure and Maritime (BI&M). The focus of the unit lies in the reliability of existing and future structures as well as the transition to an energy-neutral and circular economy.

Derived from the TNO-wide strategy plan, each unit has roadmaps. These describe the vision and ambition, as well as the steps how to achieve the goals set. In the case of BI&M, there are two roadmaps: Buildings & Infrastructure and Maritime & Offshore. The roadmaps count as the boundary for the portfolio management process by providing the goals regarding the topic.

**Organizational structure**
Through the whole organization, there is a separation of market, science, and operation. Each with their management positions and responsibilities. The market will focus on the clients, by finding companies and get them to invest together with TNO in innovation programs or projects. The science division ensures TNO creates impact and develops the right knowledge. They provide the analysis of which knowledge is necessary and what is possible. The operation division is responsible for the execution, does TNO have enough resources, people, facilities, etc.

Woven into this structure the portfolio management process is situated. Portfolio management can be seen as a horizontal layer that connects these vertical divisions with the Director of market being responsible for the execution of the process. BI&M is one of the frontrunners in the level of implementation and usage of portfolio management. Because of the friction with the current way of working and the organizational challenges other units decided to either not use it yet or implement it partially.

## 1.2.2 Method

The unit BI&M started three years ago with the implementation of portfolio management, consisting of a method and a digital tool. Through organization-wide training modules, employees become familiar with the process.

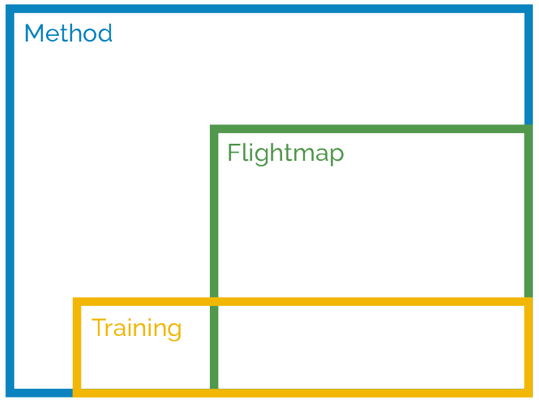



Figure 1.2 The implemented portfolio management instrument elements.

This paragraph will briefly explain the method that was implemented, in chapter 3 a more elaborated analysis of the method is presented.z

Since TNO does not create products like used in most portfolio management practices, they created their version of a product with the PMC, Product Market Combination. The PMC is a strategic objective that focuses on a specific topic within the unit's knowledge domain. All PMC's together should fulfill the strategic direction described in the roadmaps. To make it better manageable the PMC's are clustered based on their topic, these clusters have their own strategic goals and management teams. An overview of the clusters and PMC's in BI&M can be found in figure 1.3.

**Development process**
Every PMC follows a funnel with different phases, similar to the stage-gate model documented by Cooper (1990), which will be elaborated on in the next chapter. The funnel management method helps to keep track of the progress and to focus on the relevant aspects of the PMC.

The PMC's are assessed through two sets of criteria, the content quadrants (CQ) for the goals and progress in each stage and the FRITS scores to determine the value the PMC will create for TNO. Two times a year there is a strategic meeting between the cluster teams and the team of directors where the PMC's are discussed and evaluated along with the content quadrants and progress results. Next to this, each PMC will be evaluated every time it passes a gate where it enters a new phase in the funnel. In chapter 3 the assessment criteria and portfolio management activities are elaborated.

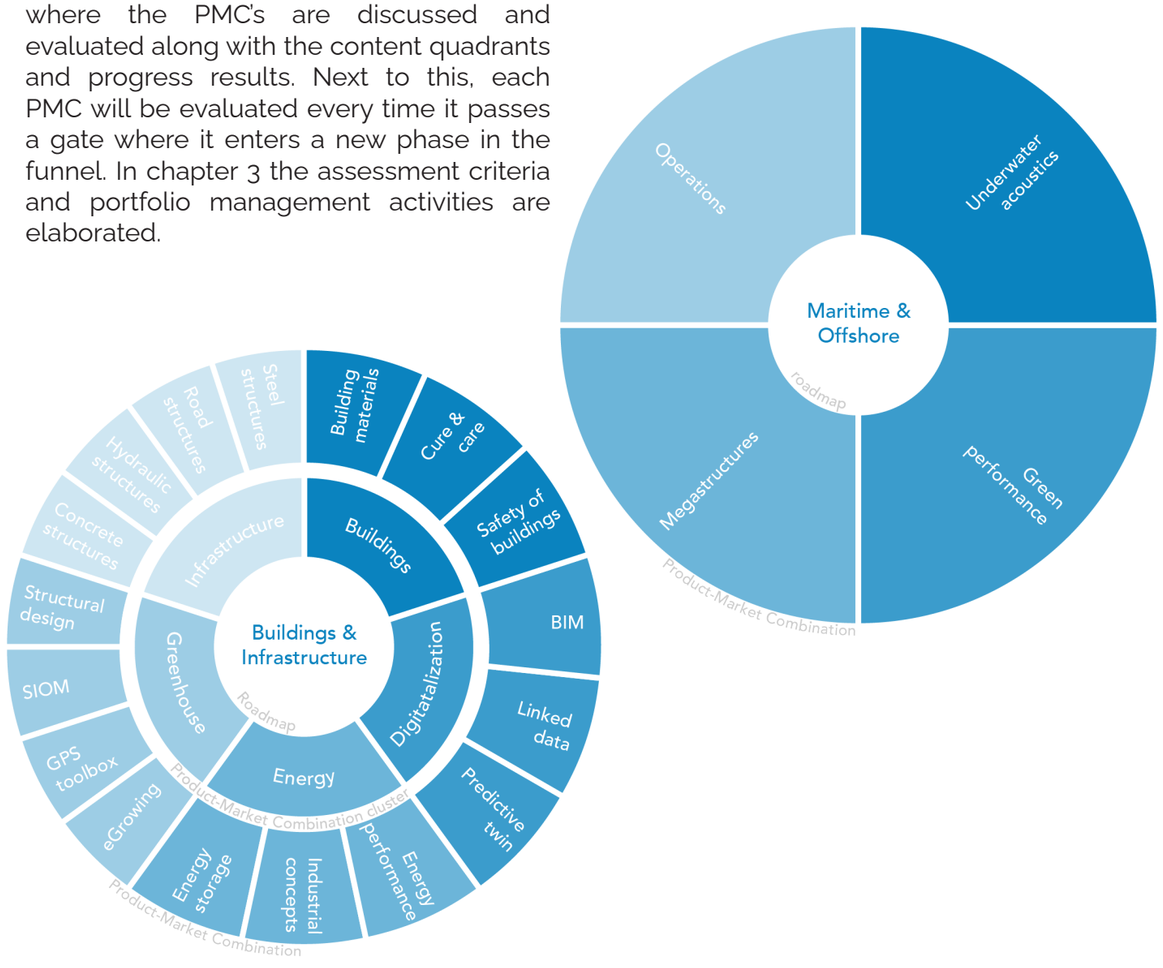



Figure 1.3 Roadmaps, Clusters and PMC's in the unit Buildings, Infrastructure and Maritime.

### 1.2.3 Information system

The data of all PMC's is stored in an information system called Flightmap. This is a digital tool developed by Bicore Services B.V. TNO purchased the tool three years ago with the start of the implementation of portfolio management. Each year the Strategy department together with the developers at Bicore provides an update with small improvements on the available data and accessibility.

**Usage**
Employees with an account can interact with Flightmap through an online portal. They can browse through the PMC data permitted by the access rights linked to their function. Figure 1.4 shows an overview of the main interactions between employees and the system during the portfolio management process.

The data is inserted by the PMC managers (1) and regularly updated. The unit is successful in gathering the data, for every PMC there is a clear description and list of attributes as well as the content quadrants and FRITS criteria. The data is used in the review activities (2), e.g., the strategic meetings and gate crossings.

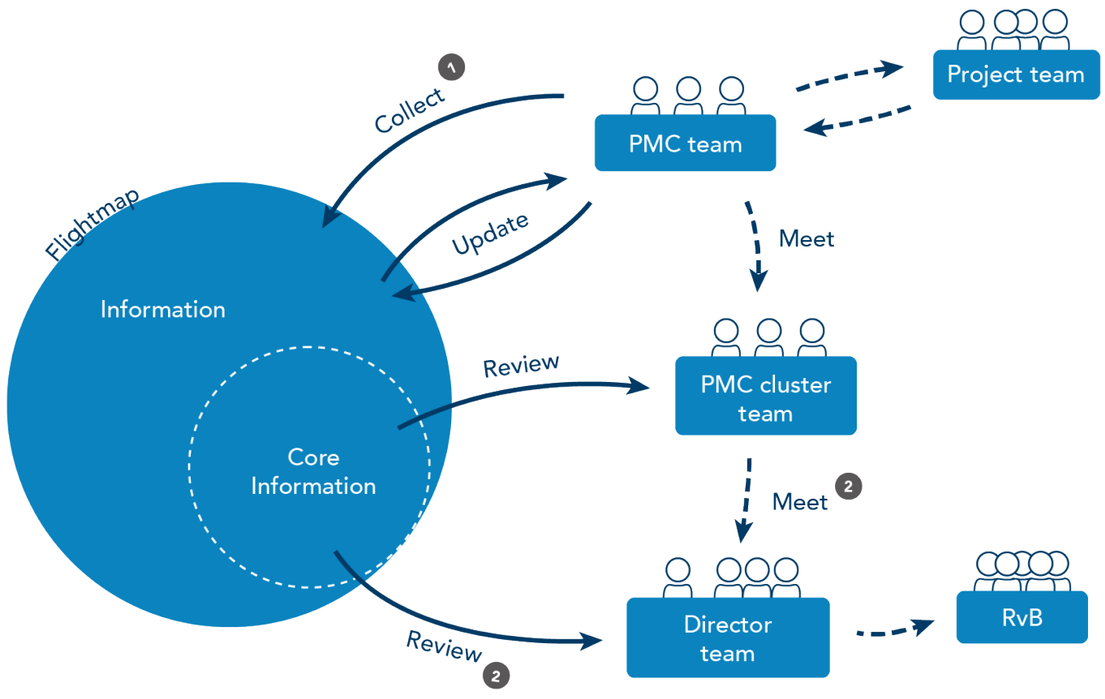



Figure 1.4 Information system model and interactions.



# 1.3 Project Scope

### 1.3.1 Problem statement

After an evaluation in 2019, the team of directors concluded the portfolio management solution is not yet what it should be.

In meetings, it is often not clear what the focus is, which decisions have to be made, and which data is necessary. For example, during strategic meetings cluster managers and directors sometimes end up in a discussion about the details of a PMC, which is not the aim of the meetings. The lack of knowledge on what data is necessary to make strategic decisions and the misalignment of Flightmap to provide this data are constraining the efficiency and communication in the unit.

Flightmap is often perceived as unclear with too much data, employees cannot find the right information. There is a lot of data stored but it is not used to the fullest, especially the output of the tool was identified as a big bottleneck in the portfolio management process.

A problem is the way data is presented, the data is often irrelevant to the user or too much data is shown. The information is always shown in the same format, it is not personalized for the different users. An example of this usability problem is the director meeting, to prepare the data for this meeting the strategy manager copies the text from different pages in Flightmap into a Word document or PowerPoint presentation. These inefficient actions and poor integration make it impossible to constantly use the tool and integrate it into the way of working.

The unit started well with the implementation of the portfolio management method and tool, there is a clear vision and governance system. On the other hand, the knowledge about the necessary data and information transfer as well as the integration of Flightmap can be improved.

### 1.3.2 Project Aim

This project aimed to improve the digital strategic innovation management tool (Flightmap) by utilizing the available data and organizational structure. Creating a digital tool that provides the optimal experience for the team of directors and cluster teams to manage the portfolio, to have an overview of all objectives, and to enable them to make informed decisions. The information displayed had to be aligned with the user needs and make the tool suitable for usage in the ongoing review process. Therefore, the main research question was as follows:

**How to improve the integration of Flightmap in the process of portfolio management by the team of directors and PMC cluster managers?**

To answer this question there had to be knowledge about the information necessary to make the strategic decisions and how to transfer this to specific users. Next to this, there are limiting factors that had to be analyzed and explored to develop a realistic design. To understand this, the three sub-research questions were defined as:

**RQ1 - What information do the team of directors and PMC cluster managers need to make decisions about strategic objectives?**

**RQ2 - How to best inform and transfer the information for the different stakeholders?**

**RQ3 - Which changes in Flightmap can be made to align with the ideal information transfer structure?**

### 1.3.3 Stakeholders

This project focused on the meetings between the team of directors and cluster teams. Figure 1.5 shows an overview of the structure of the unit BI&M and the impact the solution will have on the stakeholders. The unit consists of a total of six clusters with 22 PMC's. The main stakeholders in this thesis are the team of directors with the cluster teams.

Within every unit, there is a strategist from the strategy department located. This person supports the team of directors with the overall strategy and aligns this with the other units. She prepares the files for the meetings and is present during the meetings. It is also the person in the unit that most of the time is exporting data from Flightmap.

The research included members of the PMC teams on a less intensive basis. The teams insert the data but are not involved in the decision-making process about the portfolio on the roadmap and cluster level. Although the involvement in the project is less intensive, it was insightful to understand the perspective of every user of Flightmap.

The solution has a small indirect impact on the researchers working in the project teams, part of the PMC's. They are less involved in the portfolio decision-making process and were therefore not involved in this project.

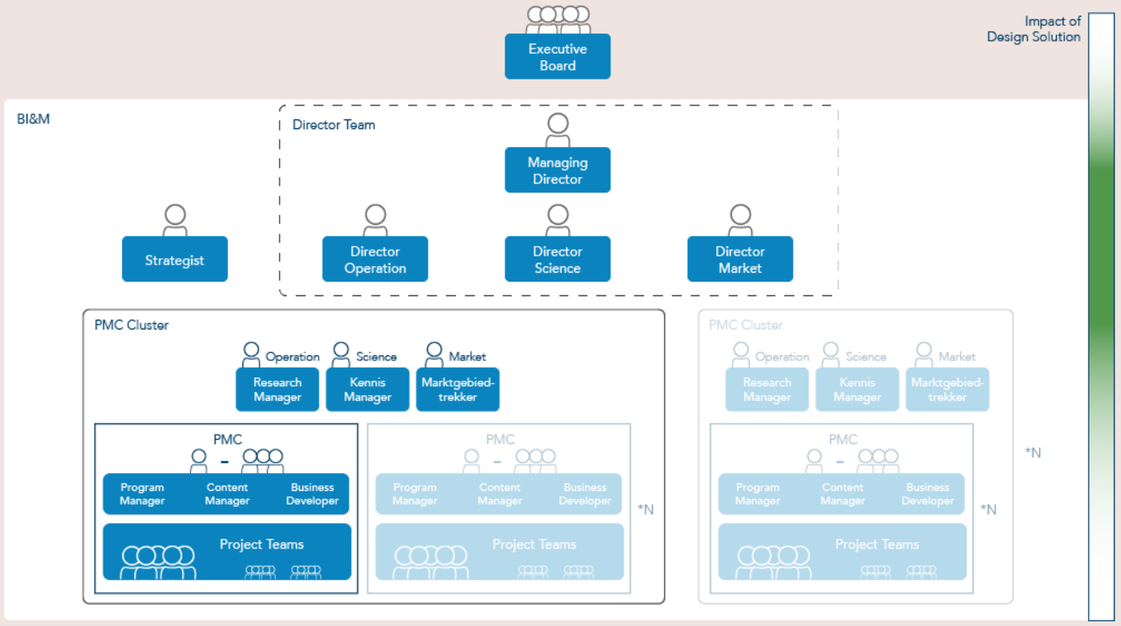



Figure 1.5 Information system model and interactions

An overview of the stakeholders:

Team of Directors (DT)
- Managing Director (MD)
- Director Market (DM)
- Director Science (DS)
- Director Operation (DO)

PMC cluster managers
- Research Manager (RM)
- Knowledge Manager
- 'Marktgebiedtrekker'

PMC team
- Program Manager
- Content Manager
- Business Developer (BD)

Strategist BI&M

Strategy department

### 1.3.4 Approach

This project is positioned in the middle of three fields of expertise in design, also known as the sweet spot see figure 1.6. Digital solutions and human interactions were explored to meet the user needs in an organizational context. This thesis delivered a complete solution with a future vision that is ready to be implemented.

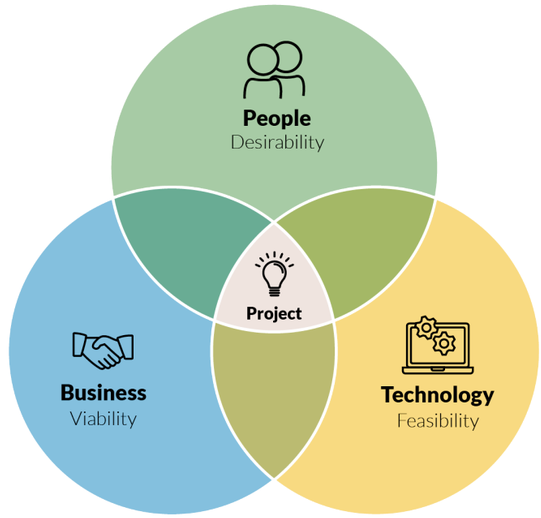



Figure 1.6 Three important fields of expertise in design.

**Process**

This project was carried out through a design-driven approach with a focus on human behavior. The process applied is based on the British Design Council's double diamond design model, see figure 1.7. (British Design Council, 2005)

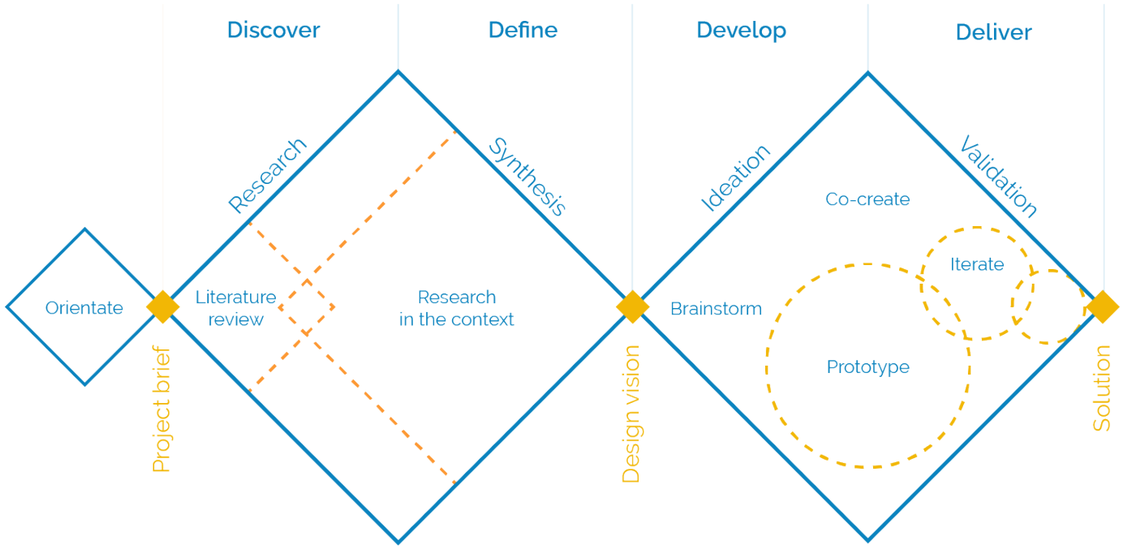



Figure 1.7 Project process based on the double diamond (British Design Council, 2005).

Discover
After a short orientation phase to define the project, the project started with a research phase in which the context and organization were analyzed. Through a literature review on portfolio management, information transfer, and the decision-making process important findings are combined with the current state of the fields. By conducting several interviews with stakeholders and observations of meetings the problems and opportunities were identified. The following methods were used during this phase: stakeholder mapping, user journey mapping, information and communication flow charts, and usability analysis. The goal was to understand the portfolio management process and the way it is implemented in the context.

Define
The findings from the literature review and the context analysis were clustered in three problem statements. From the problem statements, a design vision was derived. The design vision consists of an intended interaction experience and design requirements, it was used to guide the design process.

Develop
The design phase of this project was started with ideating through sketching and brainstorming. A creative session was organized with Industrial Design Engineering students from the Technical University of Delft. In this phase, two generative sessions and several interviews with users and other stakeholders were conducted to explore the solution space.

Deliver
The ideas were developed into a concept, a low-fidelity paper prototype. After feedback sessions and two co-creation sessions, a first iteration was made, developed into a digital prototype. In the third iteration cycle, an ideal but realistic (regarding the relationship with the developer of Flightmap) solution was designed. This final concept contains a strategic meeting format, annual plan, and redesign of the Flightmap experience.

### 1.3.5 Limitations

There are limitations regarding the improvement of Flightmap. TNO is working together with the developers of Bicore to adjust the tool to their needs. Bicore is cooperating until a certain level. They do not want to make a company-specific tool and are not willing to make drastic changes, especially on the user experience side. This limited the possibilities for the solution. Therefore an ideal solution was created with a focus on the possibilities for implementation. The moments the design process was influenced by the limitations is mentioned in this thesis.

Another challenge faced was the effect of the Corona crisis, this project was executed in the second half of 2020 when serious Corona prevention measures were active. Therefore all interviews and observations were conducted via Microsoft Teams. To reach the same level of creativity different solutions were used, e.g., a digital whiteboard platform and digital generative tools.

## CHAPTER 2:

# PORTFOLIO MANAGEMENT

*This chapter presents an overview of the literature on portfolio management. Starting with the origin where the basis of current portfolio management strategies are formed. The essence of portfolio management is discussed with goals and benefits to lay the basis for the design process. Last, the current state of the research field is presented with challenges faced.*

Content:

# 2.1 Introduction

To gain a better understanding of the method that is implemented and to include recent activities in the research field, first the topic of portfolio management was explored.

## 2.1.1 Origin

In the early 1960s, one of the first documented versions of portfolio management was found in the method of portfolio selection. Markowitz (1952) did research on a method used in the business of stock trading to assess assets and get an overview of the investment portfolio. When the stakes are high the importance of spending the budget on the right asset becomes vital to a firm's success. (Rubinstein, 2002)

**Innovation industry**
Inspired by this success, many firms from different industries adopted this process, as did the R&D field. A serious development in the portfolio management method came at the beginning of this century when Cooper researched the practice of portfolio management in new product development (NPD) firms. By presenting best practices Cooper explains the utilization of portfolio management to steer a big portfolio of products in the development process. Unlike the early methods that were used in the investment industry, the innovation portfolio management process does not only look at financial data, it is not a mathematical process. (Cooper et al., 2000)

Innovation portfolio management is a process that enables the higher management to make an informed decision to prioritize, select and manage products in the portfolio. It is a dynamic decision-making process that allows the management to allocate resources based on the strategy. By aligning the operation to the strategy, the higher management is better able to steer the organization. This increased agility allows the organization to shift faster towards opportunities in the market. (Kester et al., 2011)

(Innovation) portfolio: All products being developed in an organization.

Portfolio management is closely related to other management processes like project management and program management, see figure 1.8. Before going into dept it is good to define these processes. The definition of a program, program management, and project management by the Project Management Institute (2013) can be found on the next page.


Figure 1.8 Project and program management related to portfolio management.

Program: "A program is a group of related projects managed in a coordinated manner to obtain benefits not available from managing them individually."

Program management: "The application of knowledge, skills, tools, and techniques to meet program requirements."

Project management: "The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements."

**The pieces on the board**
Since most literature about portfolio management is focused on new product development and discusses portfolios consisting of tangible products. First, the definition of a product and the difference this makes in the portfolio management process should be researched to ensure this project can learn the most out of existing literature and experiences from other companies.

This project is carried out in research practice for knowledge creation, the way this knowledge is delivered can be through tangible products, service products, or intellectual property rights. As found by Killen et al. (2008) the portfolio management practices in organizations that deliver tangible products and services products are merely similar. The distinction between practices in organizations with tangible and service products is becoming blurry. A wide range of product types is not uncommon, e.g. in the pharmaceutical industry, the value can come from the development of new medicine, health care programs, or intellectual property. (Backer, 2016) Therefore, the PMC can be considered a product and for this thesis, products are determined as solutions. During this project, there was a continuous evaluation of the application of portfolio management processes in this context

## 2.1.2 Doing the right products

Where project and program management are focused on doing the products right, portfolio management has the function to support in doing the right products. It helps select the products that are in line with the strategy and deliver the most value.

Instead of looking at each product as a separate deliverable with its own development process, portfolio management creates a holistic view. It enables the management to compare products and make decisions when necessary. The decision to be made by the management team can be to start, adjust or terminate products. To keep an ideal balance in the portfolio and create the most value with the available budget. (Coulon et al., 2009)

The holistic view provided by the portfolio management process creates insight into the progress of all products and links this to the organizational objectives, which makes it easier to act on possible issues. It supports and rationalizes the decision-making process.

Next to this portfolio management creates awareness of the organization's vision. As described in the model by Spotify as aligned autonomy (Garton & Mankins, 2017), it gives the employees autonomy to contribute to the product their way but aligned with the strategy.

**Prioritization**
To create the overview and develop the best possible combination of products within the organizational and financial constraints there has to be a product prioritization. The products should be assessed on the value they contribute to the company and how this will be achieved. Calculating the value is not easy, especially for innovative products which in their nature are explorative and not always predictable.

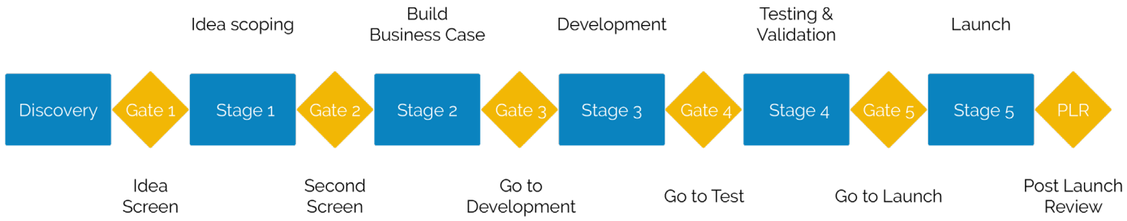



Figure 1.9 Stage-gate model (second version) introduced by Cooper in 2014.

### 2.1.3 Stage-gate model

A framework used often in the portfolio management process is the stage-gate model or funnel management. Extensively documented by Cooper in 1990, the framework describes the total development process a product follows from idea to launch. As displayed in figure 1.9 the development process is divided into several stages, each with the corresponding focus. In between the stages is a gate where the product is being evaluated, this controls the progress and quality of the product. The results of a gate assessment can be to go, kill or hold. When the product successfully passes a stage it will start with the next stage, with a new focus, new goals, and activities. (Cooper, 1990, 2014, 2017)

In figure 1.9 the full stage-gate model as proposed by Cooper in 2014 is shown. (Cooper, 2014) This model and his latest research into the stage-gate model (Cooper, 2017) proves the context is changed and becomes more complex. It is up to the organization itself to find the best stages for its product development process.

**Benefits for the portfolio management process**
The stage-gate model is a good addition to the portfolio management process. A reason for this, among others, is that the portfolio can be reviewed with the data of the stages the products are in, this way the balance becomes clear and gaps can be determined.

Using the same process for all products allows the management to create integral assessment criteria and have a coherent approach. The products can be compared based on the information coming from the stage-gate model attributes and assessments.

The model rationalizes what is being worked on and it helps to track the progress. All people involved in the development process are more aware of the goals and activities. Intermediate goals are set per stage these are more concrete and relatable.



## 2.2 Strategic portfolio management

Portfolio management has three main goals: achieving the right balance, align with strategy, and maximizing value creation. (Cooper et al., 1997) (Kester et al., 2011)

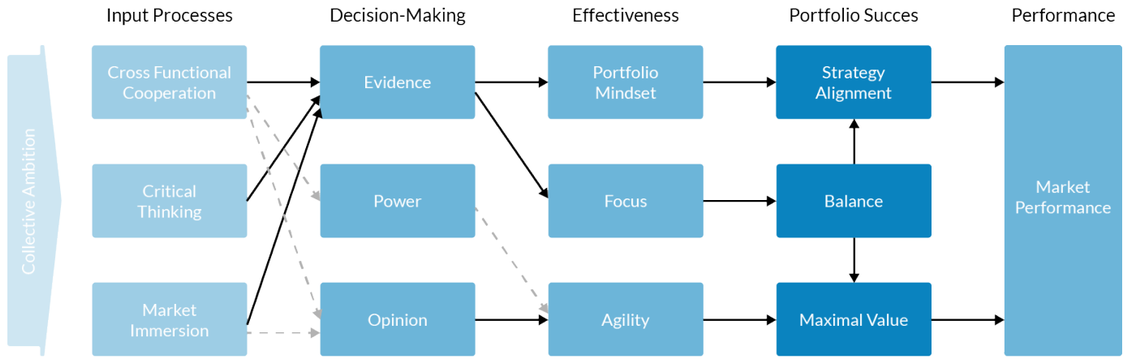



Figure 1.10 The strategic portfolio management model by (Kester et al., 2011).

### 2.2.1 Achieving the right balance

For an organization to reach long-term success it is important to have the right balance of products. The portfolio can be balanced on several parameters, among others are the lead time, risk, the number of products, and the spread across the funnel. (Kester et al., 2014) An example is an organization that takes every product idea into the development funnel, this results in a big group of products at the start of the funnel which uses resources and does not allow products to be developed successfully.

To create this balance the higher management should be provided with the portfolio overview and information related to the balance. Only then the management can steer on individual products to reach the right balance.

Having a balanced portfolio enables the organization to create a portfolio aligned with the strategy which maximizes the value with the available budget.

### 2.2.2 Align with strategy

Instead of going from product to product resulting in high risks, there has to be a vision, the strategy. An important goal that can be achieved with portfolio management is to align the products with the strategy and increase the success of the organization in the long-term.

**Portfolio overview**
By providing an overview of the portfolio the higher management can steer with individual products to achieve the goals in the strategy. This insight into the total portfolio can be used to maximize the

effect on the goals set in the strategy. The overview can make areas with an overload of products as well as areas with gaps visible. The identification of these areas can prevent a loss in efficiency and show possible opportunities that lie in the gaps.

**Portfolio mindset**
Portfolio management is not only a practical process or a method. It is also a mindset, to make everyone aware of which products fit in the portfolio and which do not. By creating this mindset through the whole organization the focus is strengthened and efficiency increased. (Kester et al., 2011) (Garibaldi et al., 2015)

### 2.2.3 Maximizing value

One of the most important drivers of work is creating value. Value makes the effort visible and appreciated. The same amount of effort does not always result in the same amount of value that is created.

For the organization, the goal is to get the most value out of the resources that are used. Therefore it is necessary to have control over these resources and use them optimally. The overview provided by portfolio management enables the management to make decisions on how to deploy resources, to use the resources where they are most needed.

**Agility**
The level of agility of the organization has an impact on the maximization of the value. Higher agility helps to shift resources and use them where it is necessary. By quickly responding to changes in the organization and market the resources can be optimized resulting in higher value development.



## 2.3 Challenges in portfolio management

Several challenges are faced in portfolio management. The sensitivity of defining product value and the implementation of portfolio management in an organization is described here because of the relevance to the context of this thesis. In the designing phase, these challenges were used as background information for several design decisions.

### 2.3.1 Actual value

Defining the value of a product is in most cases not easy, let alone comparing these with each other. Try to define the value your water bottle has to you and compare this with the value of your phone. The spread of the parameters is wide, they both contribute to the objectives in your life on totally different aspects. In this example, these are two items, when we look at organizations there are tens to hundreds of products to compare.

Therefore, calculating the value and the way it is presented should be done with care. The decisions made based on the presented value or prioritization can have an impact on operational excellence.

In the process of defining value, there has to be a balance between all factors that together represent the total value. Some factors are easy to compare e.g., financial data or lead time. On the other hand, there are a lot of factors or a combination of factors that are less easy to compare. Qualitative factors are often hard to compare, i.e., employee satisfaction versus brand awareness under clients. Quantifying these factors can help but the complexity of the total value makes it a process that should be done by people. (Christiansen & Varnes, 2008) It takes time to understand the process and the focus of the company. (Mikkola, 2001)(Killen et al., 2008)

### 2.3.2 Implementation

Portfolio management is a centralized process and has to be integrated with all the other existing processes. It has to fit in a working organization and has to be implemented without stopping this organization. As the research of Meifort (2016) stated the process of portfolio management occurs in a highly complex network of relationships in multiple hierarchical levels where different parties are involved. The process is extremely context-specific, which makes it difficult to create a good framework.

**Human behavior**
An important factor in the success of the portfolio management process is acceptance. The success of portfolio management highly depends on the number of people in the organization using it. The higher management takes decisions based on information provided by multiple product teams or product managers if there is data missing about one of the products. Often the value the portfolio management process brings is not directly for the user, e.g., product teams input data but the value of having this data in the system is for the higher management who use it for a portfolio review.

Depending on the culture of the company it can have a big effect on the emotion of people, e.g., in a low authority environment, the portfolio management process can feel like monitoring or judging.

## Key takeaways

Evidence-based decision making
An important benefit of portfolio management is evidence-based decision making, it enables the higher management to make informed decisions based on the activities and the strategic objectives.

Strategic portfolio management goals
- Achieving a balanced portfolio, the portfolio can be balanced on several parameters, among others are the lead time, risk, the number of products, and the spread across the funnel.
- Align with Strategy, by creating an overview portfolio management allows for the alignment of the research activities with the strategy set by the executive board.
- Maximize Value, realize the most value with the limited available resources.

Portfolio mindset
To increase the success of portfolio management everyone in the organization should be aware of what is being worked on and the strategic objectives.

A dynamic process
Portfolio management is a dynamic process, it should be continually updated and reviewed.

Implementation
The environment is complex, implementation of portfolio management should be done with care. It has to be integrated with all other systems and processes running in the organization.



*"Objectives can be compared to a compass bearing by which a ship navigates. A compass bearing is firm, but in actual navigation, a ship may veer off its course for many miles.* **Without a compass bearing, a ship would neither find its port nor be able to estimate the time required to get there.**"

PETER DRUCKER

## CHAPTER 3:

# PORTFOLIO MANGEMENT IN TNO

*This chapter presents an overview of the way portfolio management is practiced within TNO. The reason it is implemented, the decisions to be made at each level in the organization, and the method used in the process. The activities and processes related to portfolio management are analyzed, including the governance, and meetings. This chapter presents the business context where the solution is integrated.*

Content:

# 3.1 Introduction

## 3.1.1 Reason of implementation

The decision to use portfolio management was taken by the executive board in 2016. In the TNO strategy plan of 2018-2021 portfolio management is mentioned in the section organization and management as well as the section healthy financial management. The goals described are to increase the multiplier[1], improve the application of resources and adjust better to market requirements. (TNO, 2018)

**Definition and goals**
The portfolio management definition by TNO:

> **"The integrated management of activities aimed at achieving the goal of the roadmap and the associated strategic objectives of the roadmap."**

As published in the portfolio management introduction document by the Strategy department, the goal is to create "a professional, transparent, uniform and structured way of steering on the goals in the roadmaps and to help clarify the purpose of what we do." It has to lead to "nourishing innovation". Portfolio management improves the efficiency of the innovation in TNO, by making informed decisions on what to do and what not to do, goals will be achieved quicker and with less effort.

With portfolio management, the executive board wants to implement a framework to enable the higher management to better steer the product portfolio. Another reason is to create an overview of what TNO should do and should not do.

**Impact on roles**
Portfolio management enables the Director of market to steer on the goals set in the roadmap, to create an overview of all PMC's and to align these with the strategy. Also, it enables the directors to find stakeholders inside and outside of the organization.

The PMC and cluster managers get a better view of the goals set. It helps to find new projects that will contribute to these goals and to rationalize the running project and share this with stakeholders.

**Implementation approach**
Together with Philips a method was created and introduced in the whole organization. All employees can follow a training to learn the method and how to use this in their work. It explains all elements, e.g. PMC, funnel management, FRITS, and content quadrants.

The implementation of portfolio management is managed by the units themselves. This resulted in a diversity of approaches and schedules of implementation. BI&M is one of the frontrunners, which is partly due to the directors who embrace this solution and try to get it to work on every layer in the unit. This finding corresponds to the report from the Project Management Institute (2015) which defines strong leadership as one of the three key factors for success in portfolio management. The commitment of the senior management, as well as practitioners, is required to maximize the benefits of portfolio management.

1 Total turnover divided by the available Research Cooperation Funds (Samenwerkingsmiddelen Onderzoek, SMO)



Another reason to implement portfolio management is to counter informal power and opinion-based decisions, which are reasonably present within TNO. Informal power meaning, the PMC's or projects staying on the agenda because of personal relations. Also, when one stakeholder or PMC team has a strong opinion and motivation to direct the focus towards a particular subject. Using PMC data and making evidence-based decisions counter this problem and make the environment fairer, by funding the products that add the most value to the organization.

## 3.1.2 Method

The first chapter gave a brief explanation of the portfolio management instrument in TNO. This section will further explain the method.

**Funnel management**
To organize the PMC development process, TNO implemented funnel management, known as the stage-gate model in the literature. All PMC's will pass through the funnel, the stages in the funnel help to create focus and evaluate the work. This process is visualized in figure 1.11. A PMC is a multiple-year plan, so is the funnel. Currently, the average time spent on each stage is around two years, one year can be seen as short and three years is seen as long.

Since the method is implemented three years ago the experiences on this process are limited and improvements are made regularly.

Two assessment criteria are used Content Quadrants and FRITS criteria, respectively measuring the progress and value of a PMC.

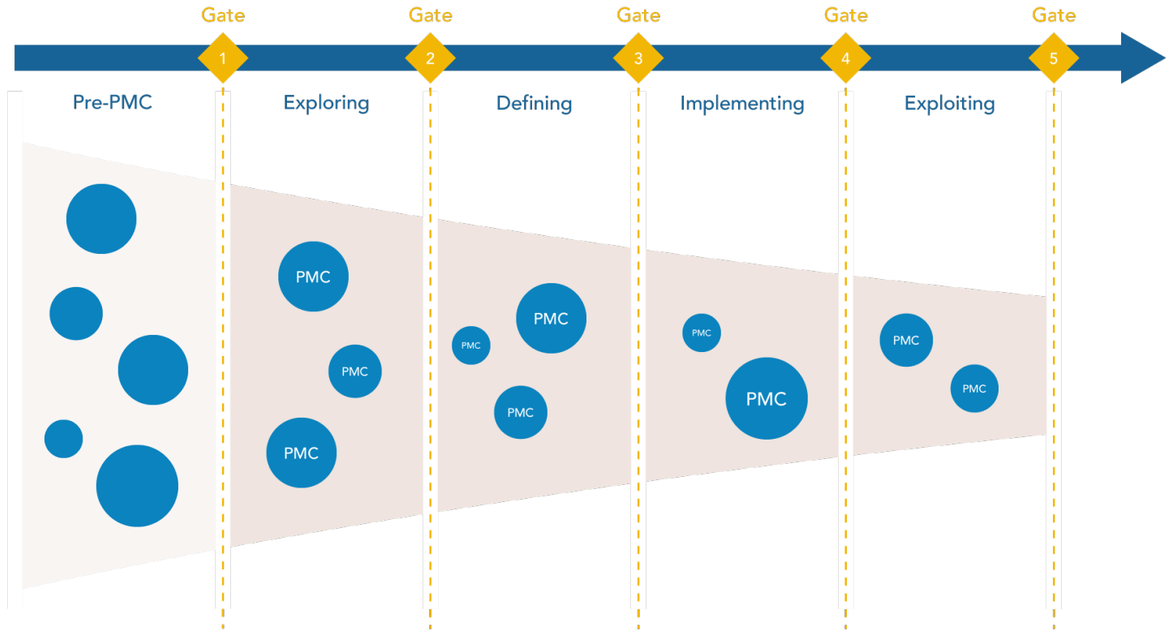



Figure 1.11 The funnel as it is implemented in TNO.

| Category | Criteria | Description | Scale |
|---|---|---|---|
| FIT | Fit with strategy | Does the PMC contribute to the roadmap strategy? Does it actually add to what TNO wants to achieve? | 1 - 10 |
| RISICO | Technical feasibility | Do we have the technical / scientific / social scientific knowledge and the means to do this and can we properly estimate the "technical" feasibility? | 1 - 10 |
| | Commercial feasibility | Are external stakeholders willing to (co) finance? What is the multiplier over the entire life of the PMC. | 1 - 10 |
| | Practical feasibility | What are the risks that TNO cannot control itself? How big are they?<br>Risk appropriate within risk profile roadmap.<br>Risk = effect x chance | 1 - 10 |
| VALUE | Achieving value | The value of the PMC is determined on the basis of Triple P:<br>- Economic value factor Profit based on the Multiplier<br>- Contribution to sustainability and the environment in the form of factor Planet<br>- Contribution to safety, health and well-being in the form of factor People<br>Final score = factor Profit x factor Planet x factor People | 1 - 10 |
| TIME | Lead time | What is the lead time of the PMC through the funnel? Long duration is a risk. Ceteris paribus, choose the shorter one. | 1 - 10 |
| SALDO | Budget of the PMC | What is the contribution percentage of this PMC to the total intake of the roadmap during the entire term.<br>Intake = SMO + Order intake | 1 - 10 |
| | Possible impact on other roadmaps | Can the PMC contribute to:<br>1. Technical development other roadmap<br>2. Market<br>Contribution is substantiated based on input from "contributed" roadmap. | 1 - 10 |

Figure 1.12 FRITS criteria.

**FRITS criteria**
Before a PMC enters the funnel the team will fill in the FRITS as complete as possible. The FRITS consists of nine criteria which have to be rated with a number between 1 and 10, shown in figure 1.12. A reference guide is provided to ensure the consistency of the data. By assessing the criteria one by one the total value the PMC will contribute to the roadmap is defined.
The data is used in the gate meetings to discuss the value and impact the PMC will have.

**Content Quadrants**
This method consists of a matrix (figure 1.13) with criteria categorized into four topics: uniqueness, concreteness, relevance, and impact on TNO values. The questions in each category describe the ambition at the end of the stage and the activities to reach this.

At gate crossings, the content quadrants of the previous stage are reviewed and assessed to make sure the PMC is ready for the next stage. In case the criteria are not met, the stage can be extended or the PMC can be terminated. When the gate is passed, the ambition for the end of the next stage and the activities will be defined by the PMC team.

| Uniqueness | Concreteness |
|---|---|
| - Novelty of PMC for Markt described<br>- TNO has knowledge (see FRITS 2 indicators)<br>- TNO lead described | - Deliverables have been identified<br>- IP potential is described (type and size) |
| **Relevance** | **TNO economic value** |
| Qualitative description of:<br>- Impact on People & Planet<br>- Impact on Roadmap strategy<br>- Impact on other Roadmaps<br>- Benefits for Markt<br>- Negative impact on stakeholders | - SMO money is in proportion to Mutliplier & People & Planet<br>- Multiple expectation has been described<br>- "Value Pool" described<br>- Market parties and "value" stakeholders identified |

Figure 1.13 Content quadrants.



# 3.2 Position

This section discusses the position portfolio management has in the organization and the level of integration with other management systems and methods.

## 3.2.1 Organization

Figure 1.14 shows an overview of the management systems in the organization.

The vision of TNO is published every four years in a companywide strategy plan, here the focus and priorities for the organization are described. Based on this plan the senior management in every unit together with the strategy department defines a roadmap, ideally one, in case of bigger unit it can be multiple. The roadmaps contain strategic objectives focused on a specific topic and are used to set the borders for the innovation activities within the units. These objectives are long-term goals TNO wants to achieve in the field, besides it contains a plan of steps to be taken to reach these goals.

The PMC is a set of projects that together fulfill a strategic goal in the roadmap. This means that every PMC has to be part of a roadmap and all PMC's of that particular roadmap together should achieve the total goals.

On the project level, this works similarly, every project is part of a PMC. However, each research group contributes to multiple roadmaps, so one researcher may work on multiple PMC's.

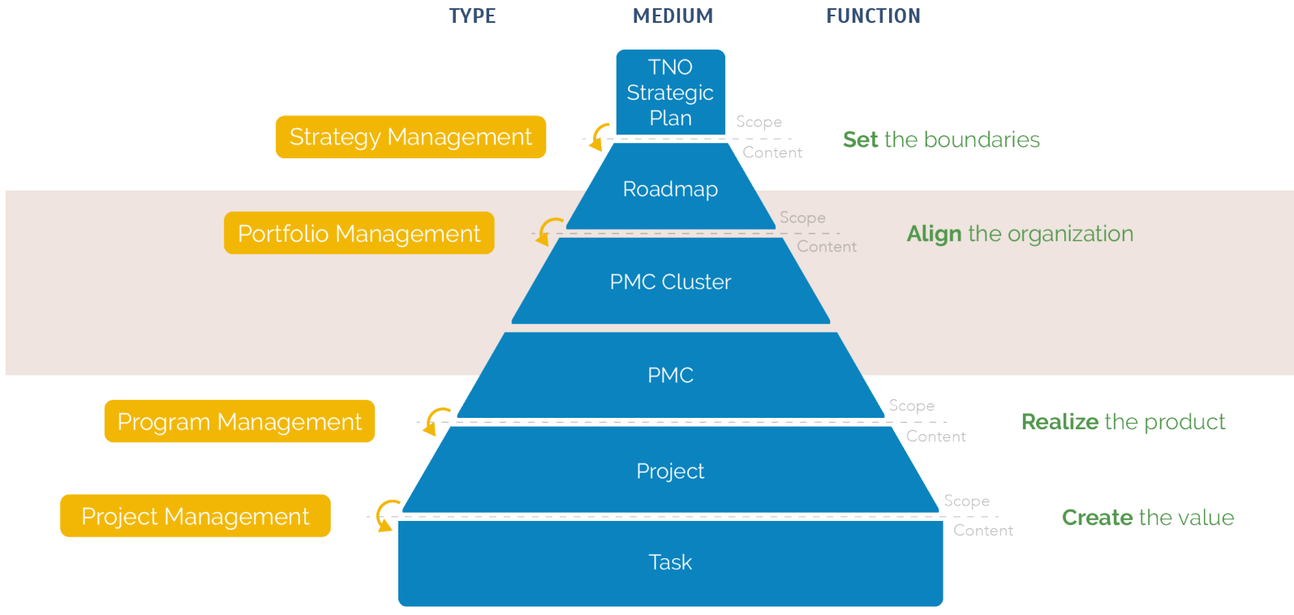



Figure 1.14 The position of portfolio management in the organization and the relation to other management processes.

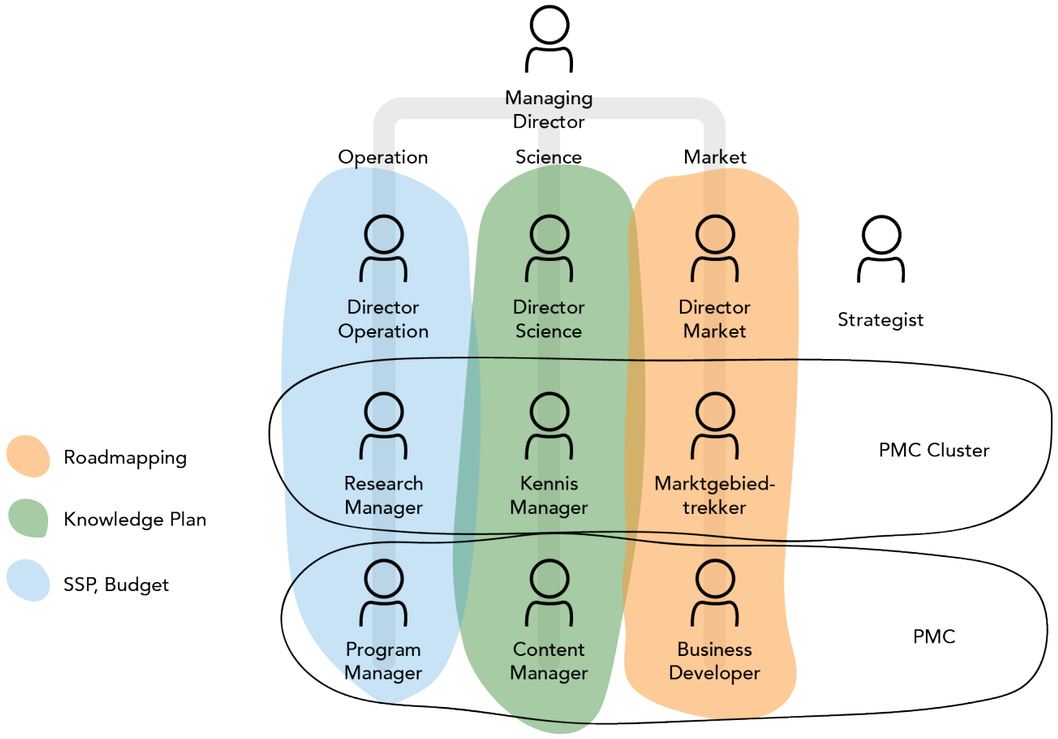



Figure 1.15 The governance and position of portfolio management.

### 3.2.2 Governance

The data used in portfolio management is closely related to other processes in the organization, the related processes and plans are analyzed. Because these relations in the organization are complex, this thesis took the approach to map them out based on the governance structure.

The portfolio management process can be positioned as a horizontal layer in the organization, it is an integrated view of all three divisions. From the governance perspective, it is a bit different. Here it is not defined as a separate process, but part of roadmapping. The governance in TNO is divided into six processes: roadmapping, knowledge programming, the TNO annual plan, budgeting, Strategic Personnel Planning (SPP), and Strategic investments. In figure 1.15 the different responsibilities are visualized.

**Roadmapping**
All activities related to the creation and management of the roadmaps are part of the roadmapping process. It is the responsibility to have relevant and clear roadmaps which are used to define the strategic objectives for the people working on the specific topic, i.e., buildings and infrastructure.

**Knowledge programming**
Knowledge plans are written every year to justify the funding received from government agencies. All research activities that use 'Samenwerkingsmiddelen Onderzoek' (SMO) funding are linked to one of these plans. The plans describe the knowledge goal TNO wants to achieve and how this will be achieved. The plans are based on innovation programs within the government and therefore do not always align with the way TNO is organized, therefore one PMC can contribute to several knowledge plans or vice versa.

**TNO annual plan, SPP & budget**
The annual plan is the responsibility of the operation division, it describes how the unit will manage its resources. Next to this, budgeting which is the administration of financial activities and the strategic personnel plan that defines how the unit will divide its personnel resources are also the responsibility of the operation division.

### 3.2.3 Decision-making

Although the Director Market is the owner of the portfolio management process, the decision-making is done with the full team of directors. The three directors of the respective divisions are in their daily activities closely connected to the division and therefore know best what is going on in the division. The director meetings have an integral view, where every director can share their perspective and expertise. Currently, the data from Flightmap used here is limited.

In meetings with the cluster teams, the information regarding the cluster and PMC's is discussed, decisions are made about the progress, strategic goals, and execution. The portfolio management process plays an important role in these meetings and is the leading method for all decisions.

The cluster managers are responsible for the activities in their cluster, including the portfolio management process. They make sure the objectives of the cluster are achieved by the PMC's in the cluster.

# 3.3 In practice

## 3.3.1 Yearly cycle

This section analyzes the activities in the yearly cycle where the portfolio is discussed.

**Strategic meeting**
*Participants: the directors, cluster team, and strategist. Sometimes PMC team members are present to give detailed information.*

Two times a year the cluster teams sit with the team of directors and strategy manager to assess the progress. Based on a request of the team of directors the cluster team prepares a presentation with relevant data to discuss, often financial progress data, highlights, and resource information. During the meeting, these are discussed one by one and actions are formulated based on the decisions made. The actions can be for the team of directors as well as the cluster team members.

**Gate meeting**
*Participants: Minimal one director, cluster team and strategic*

Every time a PMC finishes a stage it will pass a gate, in the gate meeting the last stage will be discussed and checked if the goals are met. The team will discuss new goals for the next stage and a plan of how to achieve these. Based on the discussions the goals or action plan can be adjusted. In case of small adjustments, the team can start the new stage, when the adjustments are bigger another meeting will be planned.

**Business review**
*Participants: executive board and team of directors.*

Next to these meetings in the portfolio management process, the business review meetings with the executive board use the output of portfolio management.

The team of directors and executive board have three business review meetings spread over the year. Each meeting with a different focus: evaluation t-1 and redefine plans for coming period, evaluation progress yearly plan, progress year plan, and concept next year. Since the implementation, the portfolio management method is more and more used in these meetings. Currently, the executive board asks five questions to evaluate the portfolio of the unit.

1. What is the overall assessment of the built-up and quality of the roadmap portfolio?
2. What is the assessment of distribution of SMO in the funnel and key actions taken?
3. What is the assessment of development of OIT (multiplier) and key actions taken?
4. What is the assessment of the realization/ progress of PMC's in the funnel and key actions taken?
5. What is the valorization/end-of-life strategy for PMC's in the exploiting/ mature phase?

Plans are made to involve data from the portfolio management method in these meetings, to start this will be the bubble and the number of gate crossings.



## 3.3.2 Meeting Journey

Since the focus of the projects is on strategic meetings, this section analyzes the meeting content, interactions, and information.

To analyze the strategic meeting the method of user journey mapping (Boeijen & Daalhuizen, 2013) is used. Minor adjustments are made to this method to fit the context, instead of the emotion of one user, the average emotion of all participants is estimated. The stages in and around the meeting are defined and analyzed on the following aspects:

- The goal of the meeting.
- Actions are taken during the meeting.
- The stakeholders involved.
- The data used.
- The touchpoints necessary to gather this data.
- User highs and lows, the average emotion during the meeting.
- Pain points

**Meeting stages**
The full meeting journey map is presented on the next page, see figure 1.16.

Preparation
Before the meeting, the team of directors sends an invoice with topics they would like the teams to address. The cluster teams gather the data from multiple sources and create a PowerPoint slide deck which is used during the meeting. This slide deck is sent to the directors before the meeting.

> *"Preparation falls short, no discussions in the teams and no analysis."*
> - Employee

The difficulty faced is the gathering of data, this has to be done from multiple sources. Often, the data is not available and has to be found, generated, or calculated.

Highlights
The meetings start with the presentation of several highlights that happened during the last period. This can be news publications, important activities, or milestones. This is a happy and proud moment in the meeting since good moments and achievements from the work are discussed.

> *"Super good"*
> *"I am proud of what we delivered."*
> - Employee

Goals
First, the goals are presented. The goals are discussed and redefined if necessary.

When goals are not clear or people involved have different interpretations it can result in a heated discussion. Also, the cluster team is confronted with the goals and responsibilities that are attached which makes it a relatively negative emotional stage.

Progress
The progress of the cluster is presented by the cluster team, including the action points of the previous meeting. This is discussed and challenged by the directors, the conclusions are documented in action points.

During the evaluation of the progress, the cluster team is confronted with their progress and possible pain points that happened during the execution of the PMC, this can cause negative emotions.

Resources
Problems with resources are discussed for each PMC. The problems with resources can create bottlenecks in product development and are not always easy to solve. The directors have an integral view that can help to solve these problems. The directors can

| Stage | Preparation | | Highlights | Goals | | Progress | | Resources | Cooperation | Follow-up | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Goal | Gather relevant information | Prepare presentation | Inform DT about recent activities | Recap on the goals | Redefine goals | Inform DT about progress | Evaluate progress | Improve use of resources | Find new cooperations | Review action points | Inform PMC teams |
| Actions | Search data<br>Select relevant data<br>Combine data | Align the team<br>Create presentation<br>Create slides | Share selected highlights per PMC<br>Show important updates | Present goals | Discuss changes<br>Define action points | Present progress | Discuss progress<br>Define attention points | Present resource overview<br>Present problems<br>Discuss solutions | Suggest cooperations<br>Discuss suggestions | Check action point from strategist<br>Update Flightmap and documents | Show an overview of the meeting results and action points<br>Discuss next steps |
| Stakeholders | Cluster team<br>PMC team<br>Project teams | Cluster team<br>PMC team | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | DT<br>Cluster team<br>Strategist | Cluster team | Cluster team<br>PMC team<br>Project teams |
| Data | Highlights<br>Goals<br>Progress<br>Resources | Presentation content | Short stories about recent activities<br>News articles<br>Completed orders | Cluster goals<br>Action points | Experience DT members<br>Define action points | Current status<br>Financials<br>Predicted | Current vs. planned financials<br>Action points | Issues related to resources<br>Possible solutions | Potential cooperation partners<br>Desired cooperation partners | Action points | Meeting summary<br>Action points<br>Decisions made in meeting |
| Touchpoints | Flightmap<br>Intranet<br>OneDrive<br>Person-to-person | Powerpoint<br>OneDrive<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person | Powerpoint<br>Person-to-person<br>Flightmap<br>Onedrive | Powerpoint<br>Person-to-person |
| Users Highs & Lows | | | | | | | | | | | |
| Pain Points | - A lot of work to gather the information<br>- Information not available<br>- Multiple sources of data | - No clear structure, own interpretation | | - Confrontation with goals | - Different interpretations<br>- Disagreement<br>- Additional resposibilities | | - Confrontation with pain points | - Confrontation with bottlenecks | - Possibly new (difficult) dependencies | - Update data on all platforms<br>- Additional responsibilities or tasks | - A lot of meetings with the same information |

Figure 1.16 The strategic meeting journey map.

move around resources or decide to hire new people.

Cooperation

The cluster team presents possible strategic collaborations within or outside the organization, e.g. other clusters, units or companies. Since the directors have a better cross-unit connection, they likely have suggestions or required collaborations.

New collaborations from either decided from top-down or out of necessity can cause new and possibly difficult dependencies in the product development process.

Follow-up

The strategist of the unit processes the conclusions of the meeting into action points. The action points are shared with all stakeholders after the meeting via e-mail. In the next meeting, these will be evaluated. It is up to the cluster teams to decide how to solve the action points.

## Key takeaways

Steer on portfolio
TNO aims with portfolio management to steer the portfolio better, make conscious choices, and define what they do and don't.

Transparent
Portfolio management is used to increase the transparency and structure of the organization's activities.

Complex organizational structure
The portfolio management process and supportive tools should be integrated with all other processes and plans, which makes it a complex situation.

Roadmap is leading
The objectives defined in the roadmaps form the scope of the clusters and PMC's.

Complex funding
Since the activities of TNO are partially funded by government agencies or EU projects, the build-up of the funding is complex.

Market is responsible
The market division is responsible for the execution of the roadmaps and therefore also responsible for the management of the portfolio. The people working in this division are the main stakeholders on every layer.

Integration with other processes
The data used in the portfolio management process is linked or similar to data in other plans and processes in the organization, e.g., activity goals are also defined in the knowledge plans.

Operation less involved
The operation division is less involved in the portfolio management process. Whether this is positive or negative is questioned a couple of times during the project and should be further researched.

Missing focus in meetings
The focus of strategic meetings is often not clear or missing. This results in inefficient discussions, e.g., either abstract or too detailed.

Missing structure in meetings
The strategic meetings are not structured, the data discussed is very diverse and differs a lot between the clusters. The missing focus is not beneficial for the structure.

Methods not familiar
The methods used in the portfolio management process are not familiar, e.g., content quadrants and FRITS criteria. This results in inefficient discussions.

Multiple data sources
The data used in the strategic meetings has to be gathered from multiple sources, this makes it a time-intensive task.

## CHAPTER 4:

# INFORMATION TRANSFER

*This chapter details the use of data in TNO combined with practices from the literature and the industry. The information system where the data is handled is explored and analyzed on usability and efficiency to identify issues.*

Content:

# 4.1 Information system

As described in chapter 2 the portfolio management process relies on data to make informed decisions. This section will analyze the data and information system used.

### 4.1.1 Introduction

The data used for portfolio management is stored in an information system, in this case, Flightmap. On one side the PMC teams insert data into the system where on the other side the management teams review this data.

### 4.1.2 Flightmap

To manage the information used in the portfolio management process TNO purchased the software tool Flightmap. The tool is developed by Bicore, a consultant firm that after success continued developing. It is an off-the-shelve tool that was derived from a software tool originally used in Philips. The structure of the tool is adjusted to the needs and method used in TNO.

The tool can be accessed through an online portal. Employees who require access for their role in the organization get an account and have access to their roadmap or PMC.

**Improvements**
The strategy team together with developers from Bicore are improving the tool to integrate it better in the work process of TNO. Bicore does not want to create a company-specific tool and is therefore not willing to make radical changes. The changes are limited to text fields and displayed information. This is a big limiting factor and since the acceptance of portfolio management within TNO is at stake something to pay attention to.

### 4.1.3 Information flow

The meeting journey showed the data that is being used in the strategic meeting. To get a better understanding of the information flow and the role of Flightmap in this process, the type and source of the data are analyzed.

The data is gathered from several sources, which is a time-consuming process for cluster managers. In figure 1.17 this process is analyzed by linking the data used in every meeting stage with the data source.

**Opportunities**
Currently, the data coming from Flightmap is minimal, according to cluster managers either the data is not available or there is no good way of exporting. In the latter case, the export possibilities are often not known or too time-intensive.

A problem is the lack of overview to find the right information. The information presented in Flightmap is not accessible as a complete picture of the PMC, the data is scattered across multiple pages.

The defined goals and financial details are available in Flightmap, although there is overview of these goals which makes it hard to evaluate. This makes the goals not interesting to use in progress meetings. The financial data is exported in a table and discussed in the meeting; a downside is that not all financial data is available in Flightmap. To access all financial data the cluster managers have to use SAP and Dynamo, both financial platforms.

| | | Meeting content | | | | |
|---|---|---|---|---|---|---|
| | | Highlights | Goals | Progress | Resources | Cooperation |
| Data source | Extern | News articles | | | | Business relations |
| | Person | Activities Stories | | | Experiences | Experiences Connections |
| | Flightmap | | Basic PMC info Defined goals | Financial Prediction | | |
| | Dynamo | | | Financial Prediction | Financial Human resources | |
| | Files | Images Articles | Defined goals Action points | | | Activities |

Figure 1.17 The data used in the meeting linked to the source.

Since the latest update in February 2021, users can access the basic information of all PMC's. The big list of PMC's makes it difficult to find any related or interesting PMC.

> *"How do we work together more between all clusters and silos?"*
> - Employee

# 4.2 Interaction

To gain a better understanding of the interactions that happen in the context and the intended interactions, this paragraph explores the interactions around the portfolio management process. First, the interaction cycle around the strategic meeting, then the interactions with Flightmap.

## 4.2.1 Interaction cycle

The complete cycle is visualized in figure 1.18. Before the meeting the data is exported from Flightmap by the cluster team, the PMC data from Flightmap is combined with the data from other sources and presented with a PowerPoint slide deck in the meeting. The team of directors analyzes this information and discusses it if necessary with the cluster team or strategist. The decisions taken about the cluster or PMC's are either conclusions from the discussions in the strategic meeting or taken by the team of directors in a directory team meeting. In both cases, the decision is the responsibility of the team of directors. During the meeting, the decisions are noted as action points and documented in a file, which is shared after the meeting by e-mail to all participants. Action points are accounted for to participants and it is up to them to act on this. The cluster team is responsible to update Flightmap with the changes in the cluster or PMC.

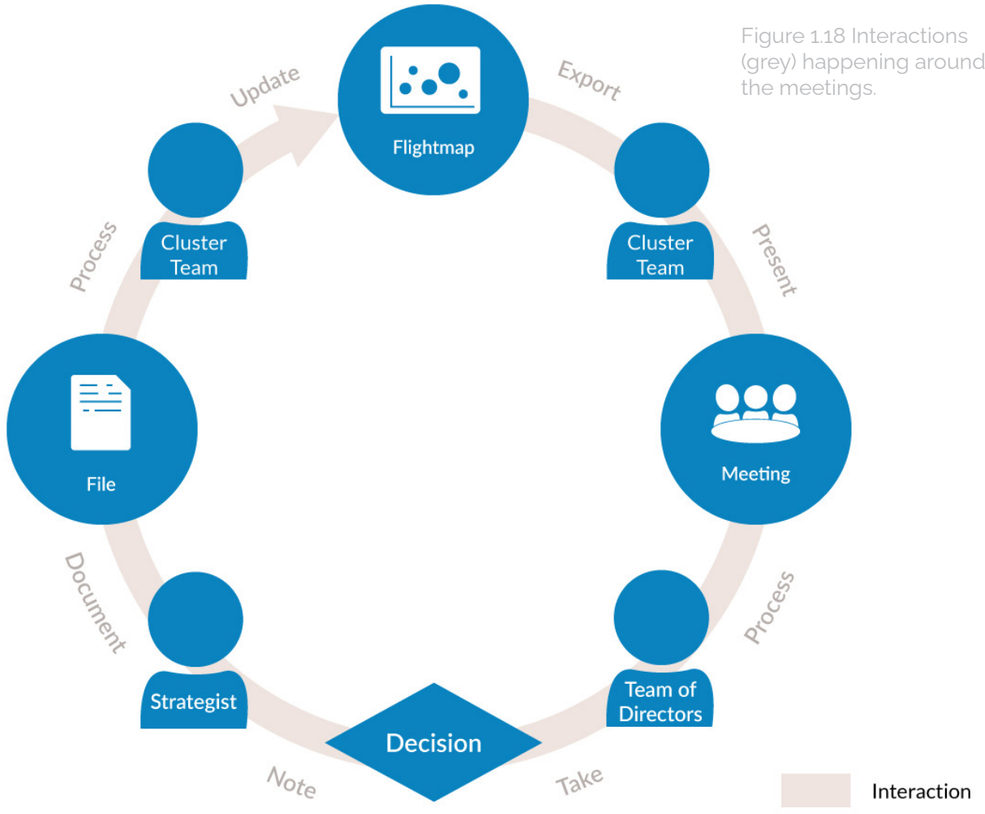



Figure 1.18 Interactions (grey) happening around the meetings.

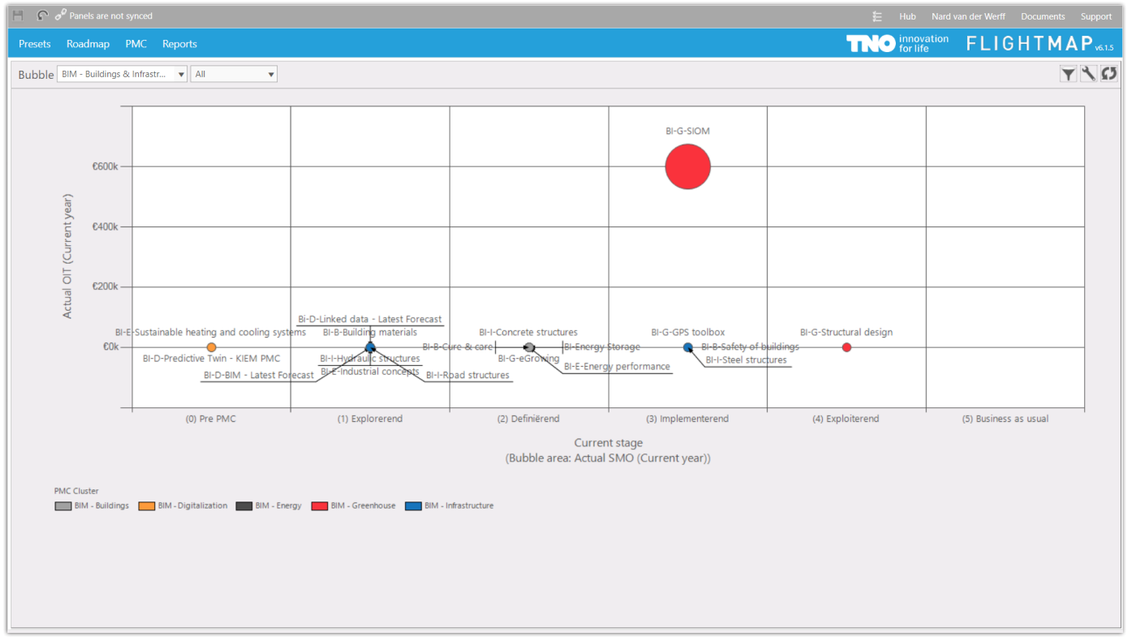



Figure 1.19 The first screen of the current Flightmap version.

## 4.2.2 Usability

This section describes the usability of the digital user interface of Flightmap. The tool can be accessed through every internet browser, by entering the web address the user reaches the landing page, see figure 1.19.

There is no specific page flow in Flightmap, it is up to the user which screens they want to select from the navigation menu. From the interviews with users no common use pattern or approach was identified, therefore the usability analysis is focused on the navigation flow and the most used pages, the activities on those pages.

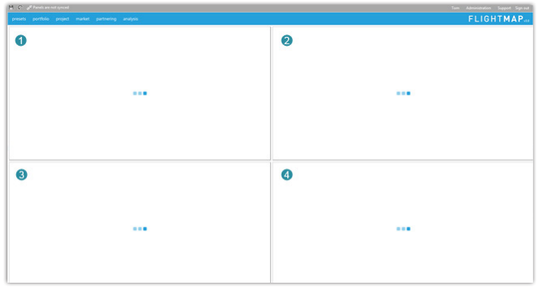


Figure 1.20 The possible configuration of the graphs and pages.

### Buildup

The main navigation buttons are found on top of the screen, see figures 1.22 and 1.23. Several graphs and visuals are provided in the drop-down navigation menu, see figure 1.21. It is possible to show up to four different graphs next to each other (figure 1.20), in the menu the user can select the position of the element.

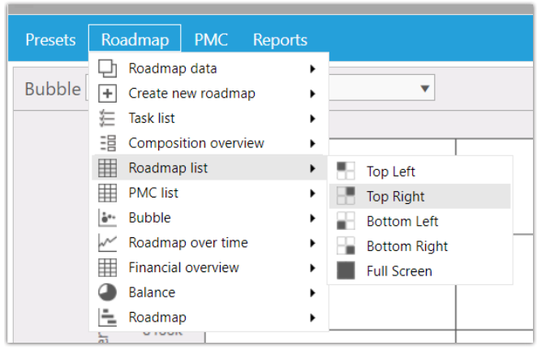



Figure 1.21 The navigation menu.

The tool is only used around strategic and gate meetings, roughly 2 months each year. This decision is made by the users because the data in Flightmap does not change regularly, the portfolio management-related progress on PMC's is slow. The learning curve of the tool is relatively long. This causes the learning curve of the user to be relatively long.

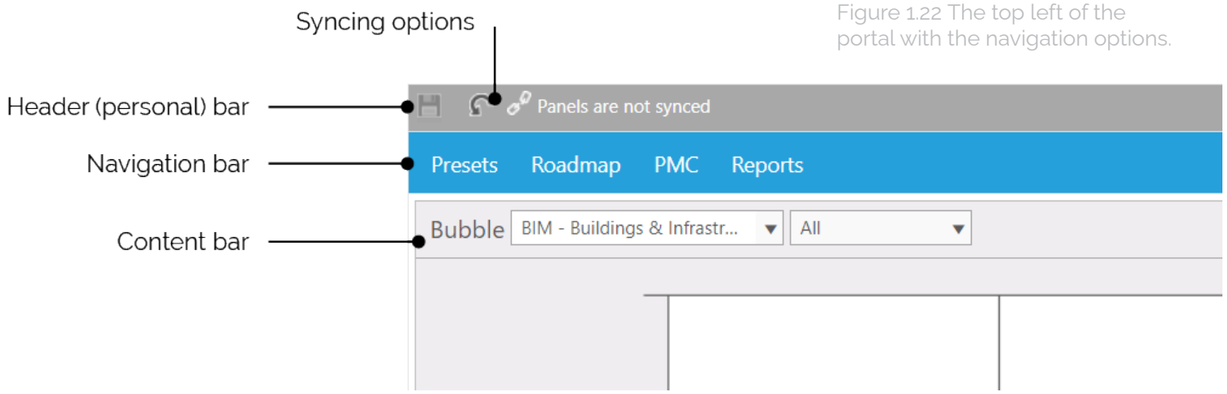



Figure 1.22 The top left of the portal with the navigation options.

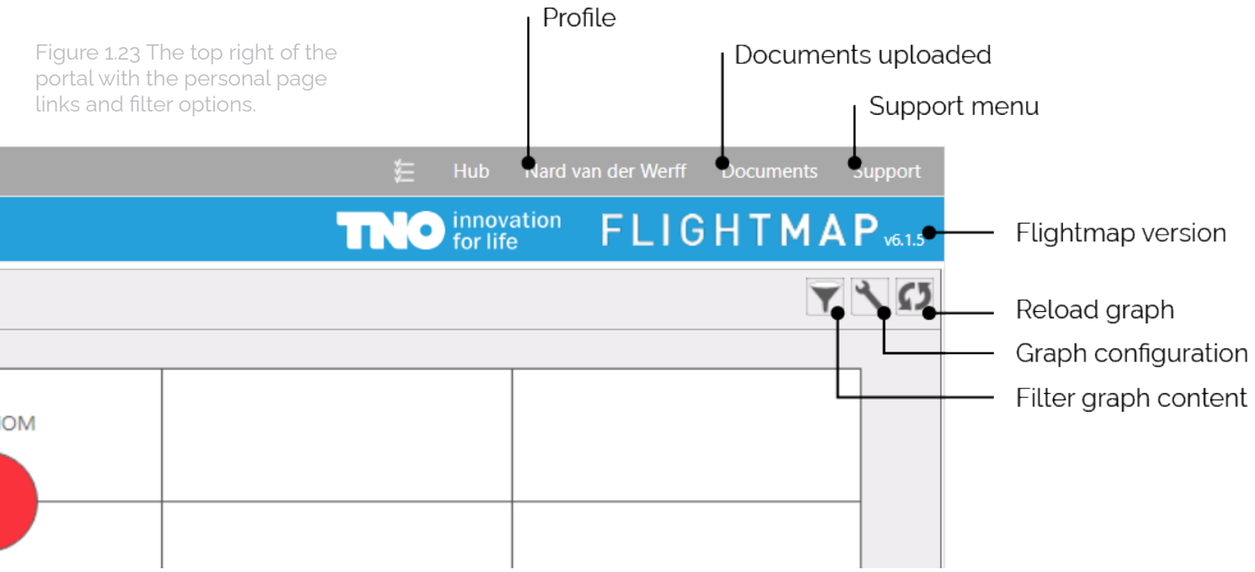



Figure 1.23 The top right of the portal with the personal page links and filter options.



## 4.2.3 Interaction issues

The most important issues in the interaction are discussed below. These issues are derived from the analysis including user interviews and an interview with two experts from the strategy department.

**Navigation**
Navigating through the tool is difficult, all buttons are the same and there are a lot of possibilities. For example, the navigation bar, the main way to navigate, the text is small and does not pop out. The long list in the drop-down menu makes it hard to find the right page.
The number of use cues is limited. The user does not get guided and has to find their way through the immense number of options.

**Too many options**
The problem with an overload of possibilities is also visible in the customization of the graphs, captured in figures 1.24 and 1.25. Through the small icons in the top right, it is possible to adjust every detail in the graph which makes it confusing and inefficient to use.

**Appearance**
The digital interface is outdated and not very attractive, this influences the opinion of the user about the tool. According to the interviewees, it does not motivate them to use it. It does not feel modern and innovative, it is not perceived as an improvement to the current work process.

> "This is not acceptable"
> "It looks like a tool from 1980"
> - Employee

**Guidance**
The support manual of the Flightmap can be accessed through the support button on the top right, visible in figure 1.23. This is a link to a long interactive document, see figure 1.26. It explains every element which makes it hard to find the right information.

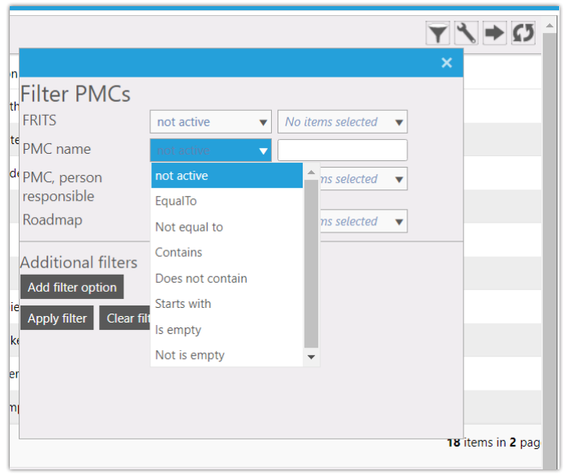



Figure 1.24 The overload of filter options and customizations.

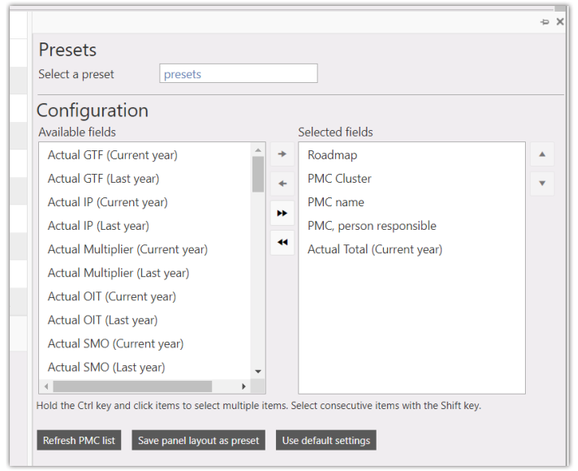



Figure 1.25 The overload of configuration options.

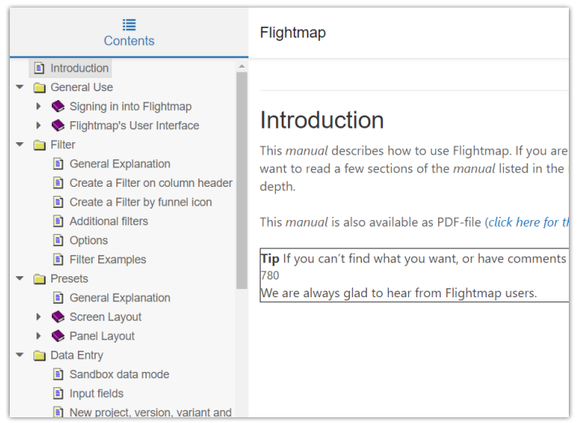



Figure 1.26 The support manual navigation menu with a long list of topics.

# 4.3 Examples from the field

As discussed in chapter 2, portfolio management is a highly context-specific process. This is visible in the available literature, which consists of a lot of case studies and models which were created in organizations. To understand the status of portfolio management and learn the most out of successful methods this subsection will discuss two best practices.

## 4.3.1 The Spotify model

The Spotify model is well known for the hype that started around agile processes. This scaled agile model is developed within Spotify. The success it had in the organization made it into a model. It describes an agile organization by the creation of an organizational structure with a corresponding method. The organization is build up out of squads that work on the projects, where the guilds are overarching expertise groups.

An interesting tool used in meetings is the status board shown in figure 1.28, through this tool all stakeholders get a quick understanding of the status of each squad and can act appropriately. It identifies problems and creates a scope for the meeting, this way the meeting can be focused on the topic where discussion is necessary and decisions have to be made.

| Area | Squad 1 | Squad 2 | Squad 3 | Squad 4 | Squad 5 |
|---|---|---|---|---|---|
| Product owner | ○↗ | ●↘ | ●→ | ○→ | ○→ |
| Agile coach | ●↗ | ●↗ | ●→ | ●↗ | ●↘ |
| Influencing work | ○↗ | ○↗ | ○→ | ●↗ | ●↗ |
| Easy to release | ○↗ | ●↗ | ●↘ | ●→ | ○↘ |
| Process that fits team | ○→ | ●↗ | ●↗ | ●↗ | ○↗ |
| A mission | ○↗ | ●↘ | ○↘ | ○↘ | ●→ |
| Org. support | ●→ | ● | ○ | ○→ | ○ |

*The circles show the current state, arrows show the trend. For example we can see a pattern where three squads reports problems around releasing and that it does not seem to improve - this area needs urgent focus! We also see that squad 4 does not have a great situation with agile coach support, but that it is already improving.*

Figure 1.27 An status board example used in Spotify to follow the status of all teams.

## 4.3.2 Magic quadrant

Research by Gartner (Light et al., 2019) presents the top companies working on the project and portfolio management process, specifically on the tools and methods to support this process.  several leaders are defined. One of the leaders identified in this field is the company Planisware. The company published research and innovative ways of managing the portfolio. In this thesis, these reports are used as inspiration to develop improved and innovative supportive tools, which are tested in the context. (Planisware, 2020a, 2020b, 2020c)


Figure 1.28 The magic quadrant from Gartner with the top companies working on project portfolio management.

### Key takeaways

Usage Flightmap is minimal
Flightmap is currently not used by the directors. Also, the use of data from Flightmap in the meetings is minimal.

Development Flightmap
The situation with the developer is complex and limits the development of Flightmap as an integrated information system.

Long learning curve
Flightmap is only used for two months each year which makes the learning curve for the user is relatively long.

Poor usability
The usability of Flightmap is not intuitive, it does not allow for smooth navigation and a pleasant user experience.

Misalignment Flightmap
The tool is not aligned with the work process in the portfolio management method of TNO. The language is inconsistent, this results in an unclear tool and inefficient workflow.

# CHAPTER 5:
# DESIGN VISION

*This chapter presents the problems determined from the research and presents the design vision defined for the solution. The problems are clustered into three categories. The vision includes the design goal, intended user experience, and design requirements.*

Content:

# 5.1 Problem statement

## 5.1.1 Introduction

From the analysis in chapter 2 and the research in TNO in chapters 3 and 4, the main problems were derived. The issues were identified and clustered into three overarching problem categories.

## 5.1.2 Problem clusters

**Missing history**
The current work process lacks an overview of PMC data, the data of each PMC is scattered over several sources. This causes there to be no overview and awareness by the teams in every layer of the organization. Gathering data for meetings is very time-intensive.

The PMC data is often overwritten and not properly visualized, there is no good view of data over time. The evaluation of the portfolio is therefore not optimal, data is missing.

Evaluations are mostly done based on current data. The usage of past experiences is limited, these good and bad moments can be used more. decisions are not evidence-based because the data from Flightmap is not evaluated, it is not used in meetings.

**No meeting focus**
The meeting goal is often missing. Every strategic meeting is the same and depending on the teams a wide range of information is discussed.

A good meeting structure is missing, questions are sent out and it is up to the teams to come up with a meeting format. This causes the meetings to be from a wide range of content and discussions.

Participants are not always aware of the purpose of the meeting and the information used. The preparation depends on the individuals and is not discussed, the teams do often not prepare together. The instruments used in the portfolio management method are not always clear, e.g., when are the content quadrants used, and what are the FRITS criteria for?

**Flightmap experience**
The usability of Flightmap is not intuitive, the interaction of the user with the tool is complicated. The interface is not appealing, it looks outdated and therefore feels not innovative and useful.

The way information is presented is inefficient, all data is displayed and it is up to the user to find relevant data. There is no filter on the content and the information density is low.

The way information is presented is inconsistent and unappealing. The information displayed is often hard to understand and the interaction is not intuitive, e.g. minimal use of graphical presentation.

The integration of Flightmap with other systems used in TNO is minimal. The work process does not align with the portfolio management process, e.g., meeting process and yearly cycle.

# 5.2 Design focus

With the problem statement in mind, a design vision was created. First, the focus was defined which narrowed the solution space. A design goal was created with an intended user experience. From the design goal and intended user experience, multiple design requirements were defined to make sure the solution would solve the users' needs.

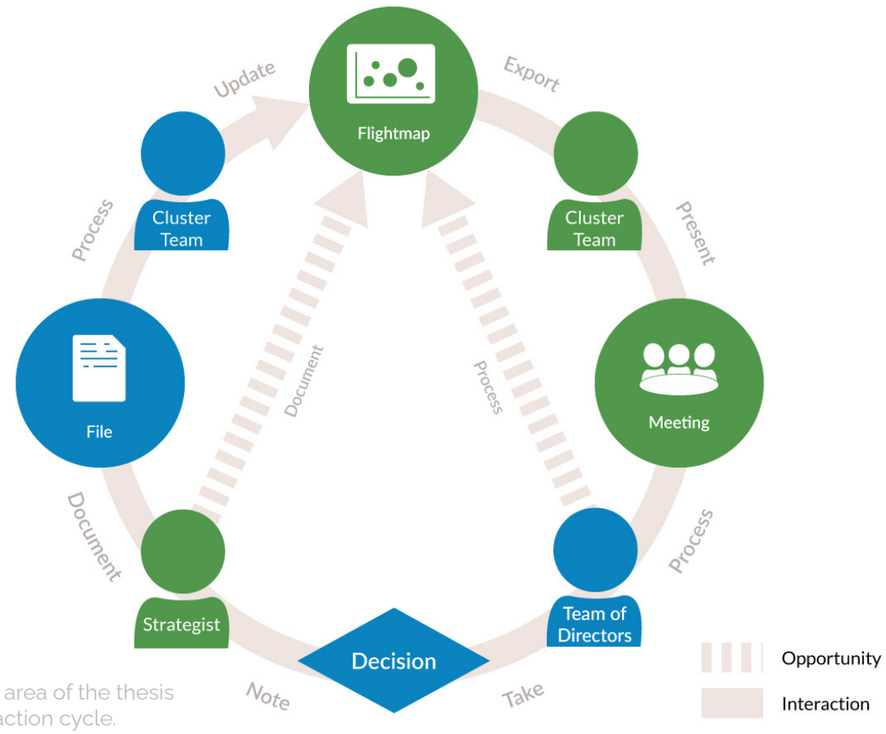



Figure 1.29 The target area of the thesis visualized in the interaction cycle.

### 5.2.1 Target group

The solution space derived from the problem statement was narrowed down by selecting a target group. Based on the interaction cycle from chapter 4.2 the main user was identified as the cluster manager. With the redesign of Flightmap and the introduction of the meeting format, the efficiency of the overall process improves. Also the process of the meetings changes, the solution therefore has an indirect effect on the team of directors.

The strategist was involved in the design process to improve the output and determine the data necessary to show in on different screens. The strategist is also present in the strategic meetings.



### 5.2.2 Design Goal

The was used as a guideline for the design research phase. The design goal stated the deliverables and the intended user experience.

The design goal is to create a **clear meeting process** and **annual cycle** with an **aligned Flightmap** user experience.

The user should feel **confident and in control**, while using Flightmap, it should **motivate** them. The interaction should be **guided, familiar and enable them to work efficiently**.

### 5.2.3 Intended user experience

The intended user experienced stated in the design goal was defined after an explorative session. Here different emotions and experiences were explored, the ones that fit the best were chosen and used as a goal for the project. A selection of the intended interactions explored is displayed in figure 1.30.

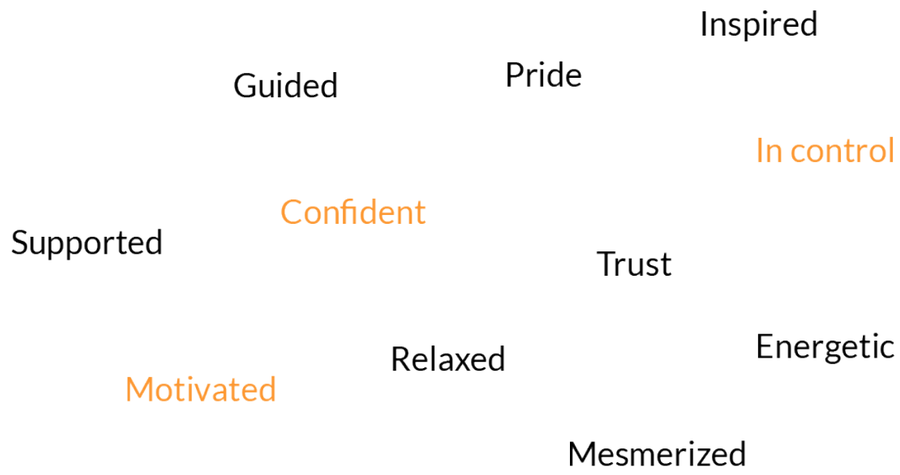



Figure 1.30 Several emotions and experiences used in the exploration of the intended user experience.

### 5.2.4 Design requirements

The properties the design should contain to reach the design goal are laid out in figure 1.31.

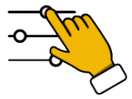
| | | | |
|---|---|---|---|
| **EXPERIENCE** What should the user feel? |  Confident |  In control |  Motivated |
| **INTERACTION** How to achieve this? | Guided by relevant and trustworthy data in a consistent language | Familiar with an optimized and transparent system. | Being enabled by an appealing and clear system. |
| **DESIGN REQUIREMENTS** What are the required product properties? | Meeting: A clear meeting structure, including steps coherent with the portfolio management method. | Flightmap: Present a limited set of possibilities to personalize the interface. | Flightmap: Intuitive and unambiguous usability. |
| | Meeting: A meeting focus known by all stakeholders. | Flightmap: Aligned with the way of working, a consistent method in all channels. | Flightmap: Attractive appearance with the use of graphical communication. |
| | Meeting & Flightmap: Consistent language and a clear PMC build-up. | Flightmap: Transparent system by increased accessibility and visible content connections. | Flightmap: Clear PMC overview and presentation. |
| | Flightmap: Actively providing relevant data to the user, i.e. suggestions, news or activity. | Flightmap: Easy navigation and connection with platforms, e.g. dynamo, intranet, file storage. | |
| | Flightmap: Validated and traceable data. | | |

Figure 1.31 An overview of the intended interactions and design requirements

## CHAPTER 6:

# TOWARDS A SOLUTION

*This chapter details the design activities undertaken in this project to develop the solution. With the context and design vision in mind, ideation was started, through creative and generative sessions the solution space was explored. Next, through iterative prototyping, the concept was improved with a human-centered approach.*

Content:



# 6.1 Approach

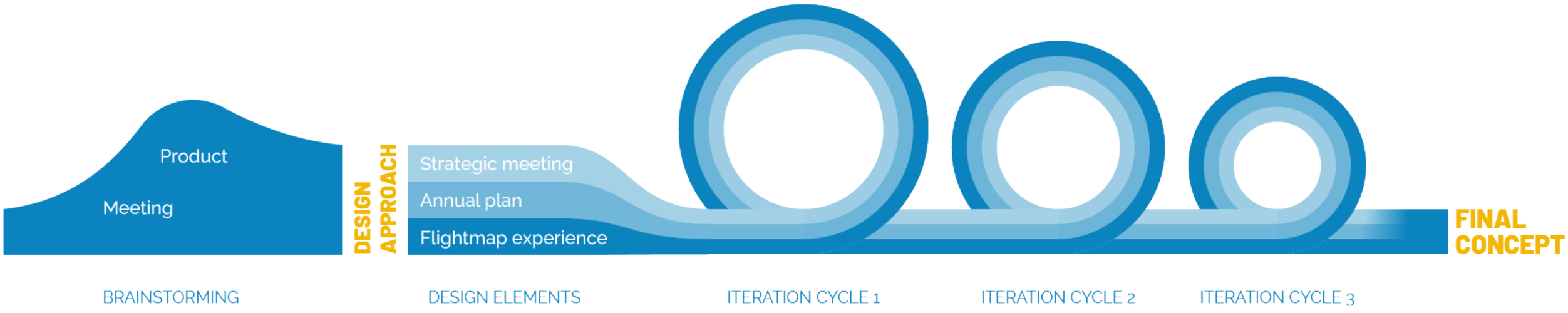



Figure 1.33 The design research approach taken in this project

## 6.1.1 Ideation

To explore the solution space several methods were used in this project. At the start of the ideation phase, the context was split into two solution spaces: the meeting and the project. These were chosen because they are both relatable for participants, project was chosen since PMC's have a similar process as projects and all participants had experiences from working on projects, this generated more ideas. In the next phase, the connection was made back to the PMC and the ideas were evaluated. Both solution spaces were explored separately. The ideas generated formed the building blocks for the next phase.

At the end of the ideation phase, an approach was defined for the rest of the design research process. To create a structured design process the solution was divided into three directions. This way the concept could be explored more extensively and evaluated with the users of each direction. During the process, there was a continuous evaluation of the integration with the other directions to ensure a complete and integrated solution.

## 6.1.2 Iteration

The concept was improved through three iteration cycles, each cycle included ideation, prototyping, testing, and evaluating activities. The first cycle was conducted with a low-fidelity prototype to enable the participants to evaluate the basis of the concept. With this prototype, two co-creation sessions were organized where the navigation and the build-up of the tool were explored. For the next iteration cycle, the fidelity level was increased to put the focus on less abstract elements of the concept. In evaluation sessions, the workflow and elements to represent the data were discussed. The last iteration cycle resulted in the final design, this is presented in the next chapter. This cycle was focused on the completeness of the solution and data for the decisions to be made.

An overview of design steps taken in each cycle is displayed in figure 1.33.

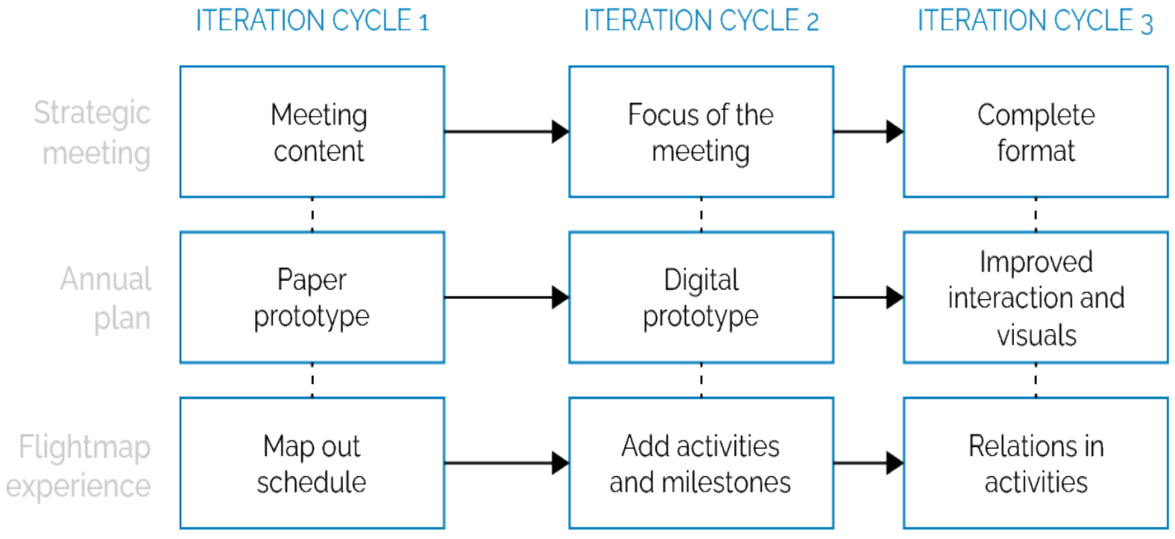



Figure 1.32 Important design activities in the iteration phase.

# 6.2 Ideation

### 6.2.1 Introduction

First, the solution spaces were explored through several individual brainstorm sessions. This created a good view on the possibilities in the meeting design and the presentation of PMC data. These ideas were clustered, the best were selected and combined into the first concept.

### 6.2.2 Creative session

A creative session with students from the faculty of Industrial Design Engineering at the TU Delft was organized to share perspectives and generate ideas. Through several design methods, the two solution spaces were explored separately and eventually combined.
First, the solution spaces were explored by building on their own experiences, since the students all worked on projects and had progress meetings. After introducing the context of this project the ideas were aimed towards the situation in TNO while still preserving a brought solution scope. By building on each other's ideas, a wide range of ideas was generated. The two solution spaces were combined and the ideas were combined into five focus areas. A full description of the session can be found in appendix B.

### 6.2.3 Generative sessions

The two solution spaces were also explored with experts from TNO. Two generative sessions were organized, one where the possibilities in the meeting were explored and one which was focused on the possibilities in Flightmap.

The data in the meeting was explored via the online tool MS whiteboard. The current agenda of the strategic meeting was mapped out to reflect on the content used and possibilities in the presentation. The goal of the session was to find the right meeting structure to support in making the informed decisions in strategic meetings.

The outcome of the session was not enough, it did not go as predicted. Partly because of the limitations of the tool used. It also showed that exploring the meeting based on the current discussion points is not beneficial for the desired solution. Therefore, the decision was made to do the exploration again in another online session. In a session with the same expert, the meeting was explored based on the goals of portfolio management, achieving balance, align the portfolio and maximize value. This resulted in interesting results which are used and explained in the next chapter.

The Flightmap configuration and build-up were discussed by showing and building on ideas generated in the creative session and individual brainstorm sessions. A first idea for the tool was drawn and used as the basis for the first concept, described in the next section.



# 6.3 Iterative prototyping

From the ideation activities, three directions were defined with a strong connection. These directions later to be the deliverables were a strategic meeting format, an annual plan, and a redesign of Flightmap. Each iteration cycle and the key design decisions made are described in this section.

### 6.3.1 Paper prototype

First, the concept was created on paper. This low-fidelity prototype enabled to get feedback about the key elements in the basis of the concept. In two session with experts from the strategy department several adjustments and a new vision for the next concept was created.

**Flightmap experience**
The focus of this first concept was to improve the presentation of the data, mainly by only showing relevant data. Ideas from the previous activities are combined into a set of pages, including dashboard, cluster, PMC, timeline, and report pages. On each page, the relevant information for the purpose of making decisions on that level is visualized.

**Meeting format**
The agenda points used in the meeting were explored and reordered based on the outcome of the generative session. The highlights which have a minimal contribution to the progress discussion were replaced by the progress on the content (CQ goals) of the PMC.

**Annual plan**
A schedule for the annual plan was developed. By mapping out the current governance cycle, portfolio management activities, and meetings on a calendar a logical integration was drawn.

**Evaluation activities**
The first concept was evaluated in four feedback sessions, two with experts from the strategy department, one with the director market, and one with the unit's strategist.

In an interview with a product owner from Bicore Services, the possibilities and feasibility were discussed.

### 6.3.2 Digital prototype

The first concept was used to create a digital prototype with better integration between the directions.

**Flightmap experience**
The decision was made to build each page out of several elements, these elements were designed to fit a specific goal, e.g., impact progress, an overview of the content quadrants, etc. For the roadmaps, clusters, and PMC's a set of pages was designed to give a complete overview of the data. This way when the user needs to make a specific decision the respective page can be accessed and all necessary data will be displayed.

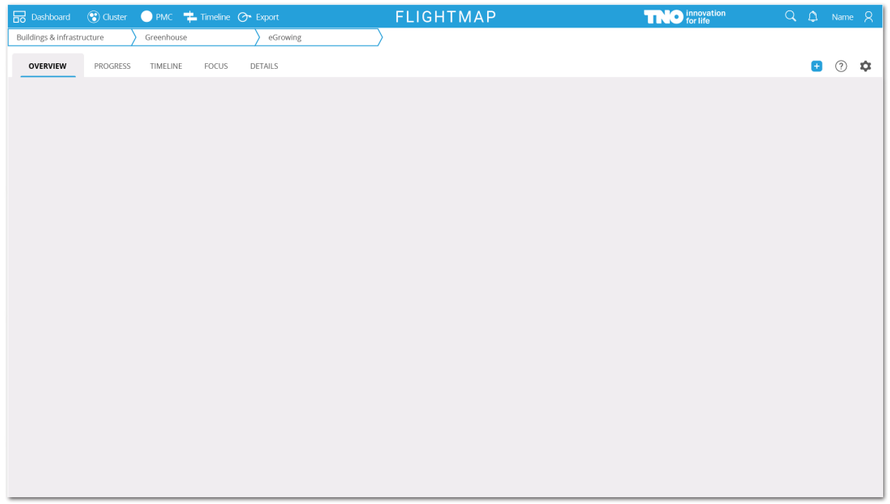
An important element is 'the milestones', to boost morale and motivation. To share the good work of the PMC which will create pride for the team and can inspire other teams.

The timeline creates awareness about the portfolio management activities. It guides the user in taking actions that benefit the cluster. The complete set of elements is explained in chapter 7.

During this iteration step, the design style of the menu was explored. Ranging from incremental to disruptive. The three interface designs are displayed in figure 1.34.

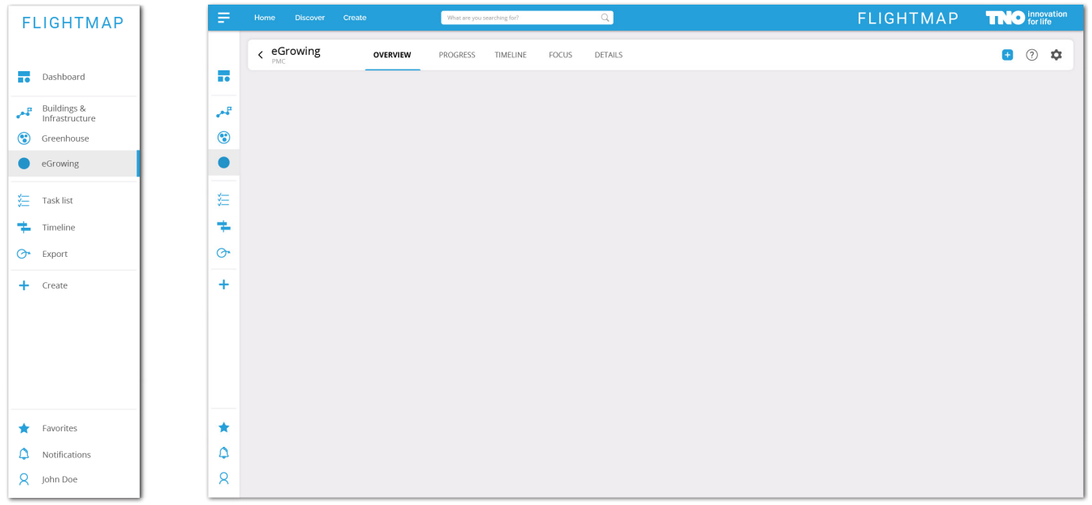
After the user tests the second design is chosen to develop further. The first design is familiar but the purpose of the links and bars is not clear. The second design was received well, especially the personal bar which gives quick access to relevant data. The third design caused some confusion because the iconic top bars are moved and the buildup of the screen is different.

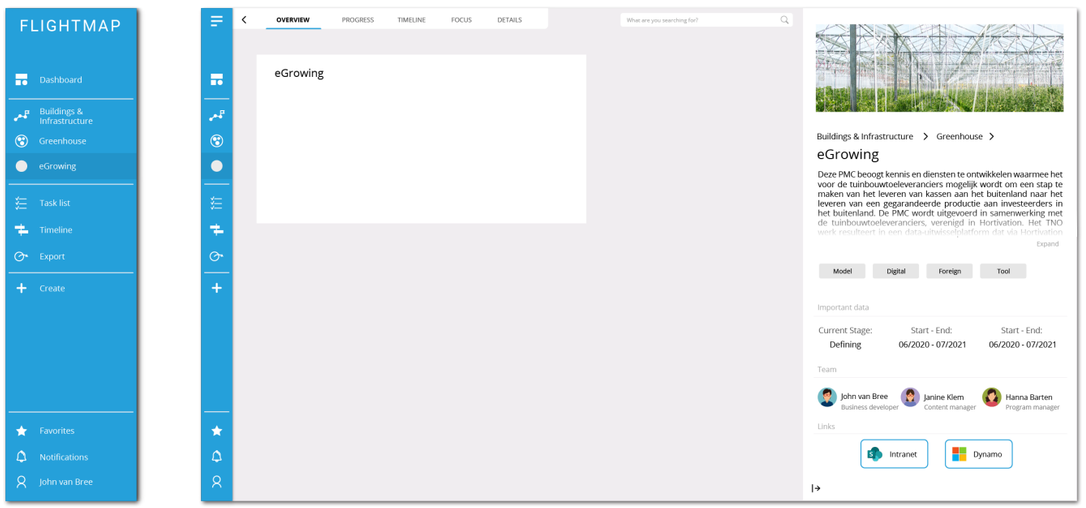
The third design has a lot of positive points but the process of learning the new interface is too much. Since portfolio management is already a new process and a complex method the new design is experienced as an extra barrier for the portfolio management method. It was perceived as too confusing because it was too far from the current design. This design is also further from the Flightmap style. The second design has a good combination of the qualities from the first and third designs.




Interface 1
+ Familiar design, current Flightmap style
+ Clear navigation hierarchy of roadmap, cluster, and PMC.
- All navigation at the top, cluttered.
- No clear separation in button functions

Interface 2
+ Personal menu bar
+ Search function easy accessible
- New location of actions




Interface 3
+ Personal menu bar
+ Efficient use of the screen space
+ Search function easy accessible
+ Clear and intuitive screen dividing
- Far from old design style, learning necessary

Figure 1.34 Three interface designs created to improve the user experience.

**Meeting format**
In this design step, the aim was to improve the focus in the meeting and to increase the awareness of the meeting goal. The different types of meetings in the portfolio management method are mapped out of the goals of portfolio management, this way the relevance of each meeting is identified. The means of information transfer and the data that is used are explored. By linking this with the current agenda points gaps became visible, the outcome is shown in figure 1.35. In the current process, there is minimal attention for the balance of the portfolio, it is discussed through other agenda points but there is no focus on the decision making with this goal. This was confirmed in the feedback sessions and was identified as a desired improvement.

**Annual plan**
The activities on each level (PMC, cluster, and roadmap), were defined and added to the plan. The goal was to create an overview for the user of what has been done or has to be done related to the portfolio management process. The plan was integrated into Flightmap as an element on each level, an additional element was created to update the user on the activities and tasks.

**Evaluation activities**
In a co-creation session, the participant could move around with the elements on the screen. This way the screen could be created with only the necessary information for the specific task or decision. The session was carried out twice online with cluster managers from two different clusters.

In two feedback sessions, the concept was discussed on each direction, one feedback session with a director and one with the unit's strategist.

## 6.3.3 Improved design

This iteration step resulted in the final concept, which is presented in the next chapter. During this iteration, the missing and suggested elements from the co-creation sessions were added to make the content more complete. The detail in the elements and the pages was improved.

**PORTFOLIO MANAGEMENT GOALS**

| | Align with strategy | Balance | Maximize value |
|---|---|---|---|
| **TYPE OF MEETING**<br>Relevance of the strategic meeting | 1. Gate meeting<br>2. Strategic meeting<br>3. Directory meeting | 1. Directory meeting<br>2. Strategic meeting<br>3. Gate meeting | 1. Strategic meeting<br>2. Gate meeting<br>3. Directory meeting |
| **INFORMATION TRANSFER**<br>Relevant infomation and the means of transfer | Goals:<br>- Description<br><br>Value to strategy:<br>- Heatmap (FRITS)<br>- Radar graph | Balance in the funnel:<br>- Bubble<br><br>Long-term vs. short-term:<br>- Timeline<br>- Bubble<br><br>Financial (SMO vs. OIT, SMO spread):<br>- Line chart<br>- Bar chart | Progress<br>- Bar chart<br>- Line graph<br><br>Value:<br>- Heatmap (FRITS)<br><br>Cooperation:<br>- Network map<br><br>Resources:<br>- Bar chart<br>- Table |
| **AGENDA POINTS**<br>In the current strategic meeting | Goals | | Cooperation<br>Resources<br>Progress |

Figure 1.35 The meeting type, information and agenda points mapped out on the portfolio management goals.

# CHAPTER 7:
# COMPLETE CONCEPT

*This chapter presents the solution developed in this thesis. As described in the last chapter, the solution consists of three deliverables, these are elaborated in the build-up section. An implementation plan is created to show the steps to be taken towards the future vision. The final solution was validated through four sessions with users and experts.*

Content:

# 7.1 The final design


## 7.1.1 The complete picture

The solution presented in this thesis is not just an improvement of a digital tool. It is a seamless work experience that is realized by a supportive tool with an integrated meeting format and annual plan. The annual plan provides guidance and creates the basis for the work activities related to the portfolio management method, it takes into account the current activities in the organization. The strategic meeting is an important part of this method, the plan includes a step-by-step guide for the activities around this meeting. This thesis also presents a new meeting format, the agenda is created to provide a clear meeting focus and supports to make the decisions.

This all is supported by an improved version of Flightmap. This tool will provide all necessary data to make informed decisions on the portfolio. With the user as the center, Flightmap is redesigned to provide the optimal support for portfolio management activities. The data about the roadmaps, clusters, and PMC's is composed into a logical set of pages, only the relevant data is presented to enable the user to make the decision-making process as efficient as possible.

Figure 1.36 An impression of how the portal looks like for the user.

## Creates an overview on PMC, cluster, and roadmap level.

In the redesigned Flightmap portal each user has access to their own dashboards. The dashboards are carefully assembled, presenting all the data needed to make informed decisions on the strategic portfolio management goals. The meeting format available in Flightmap guides the participants in two hours through the full evaluation of the cluster.

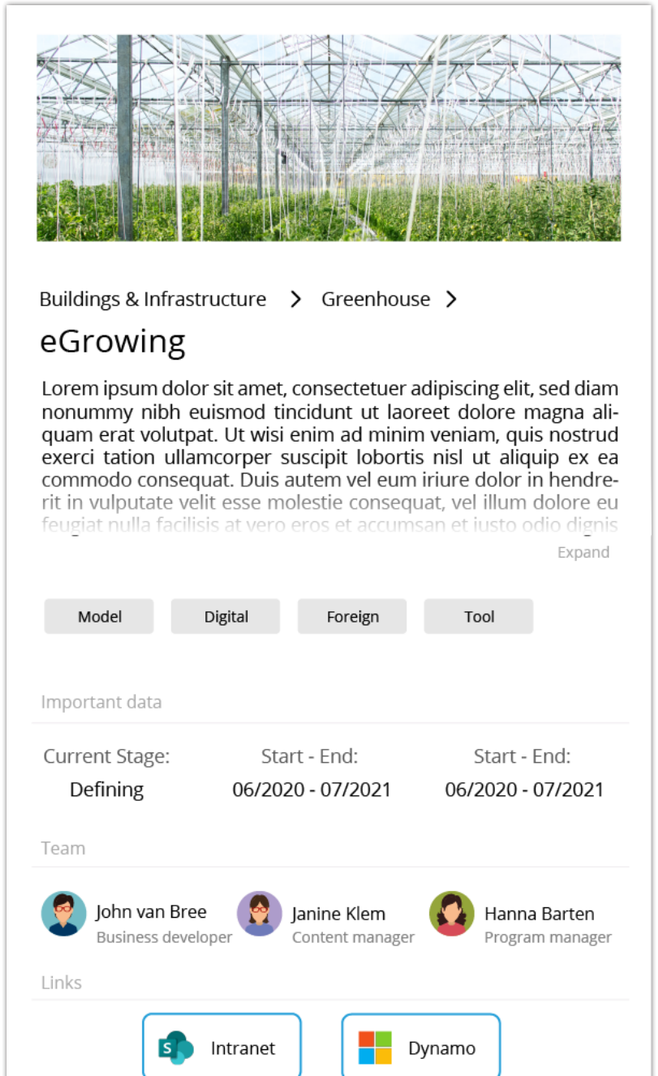



Figure 1.37 A compact view of all PMC data.

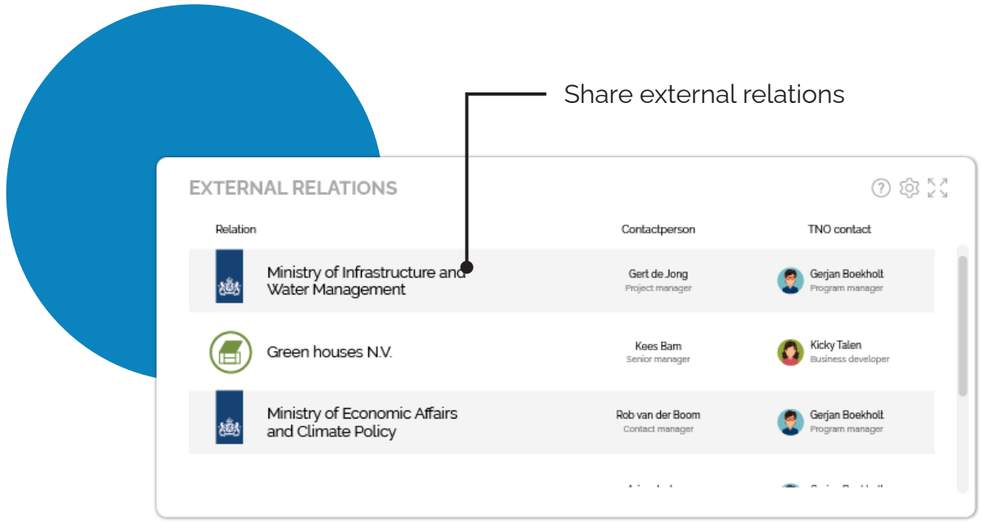



Figure 1.38 An overview of the external relations of the PMC.

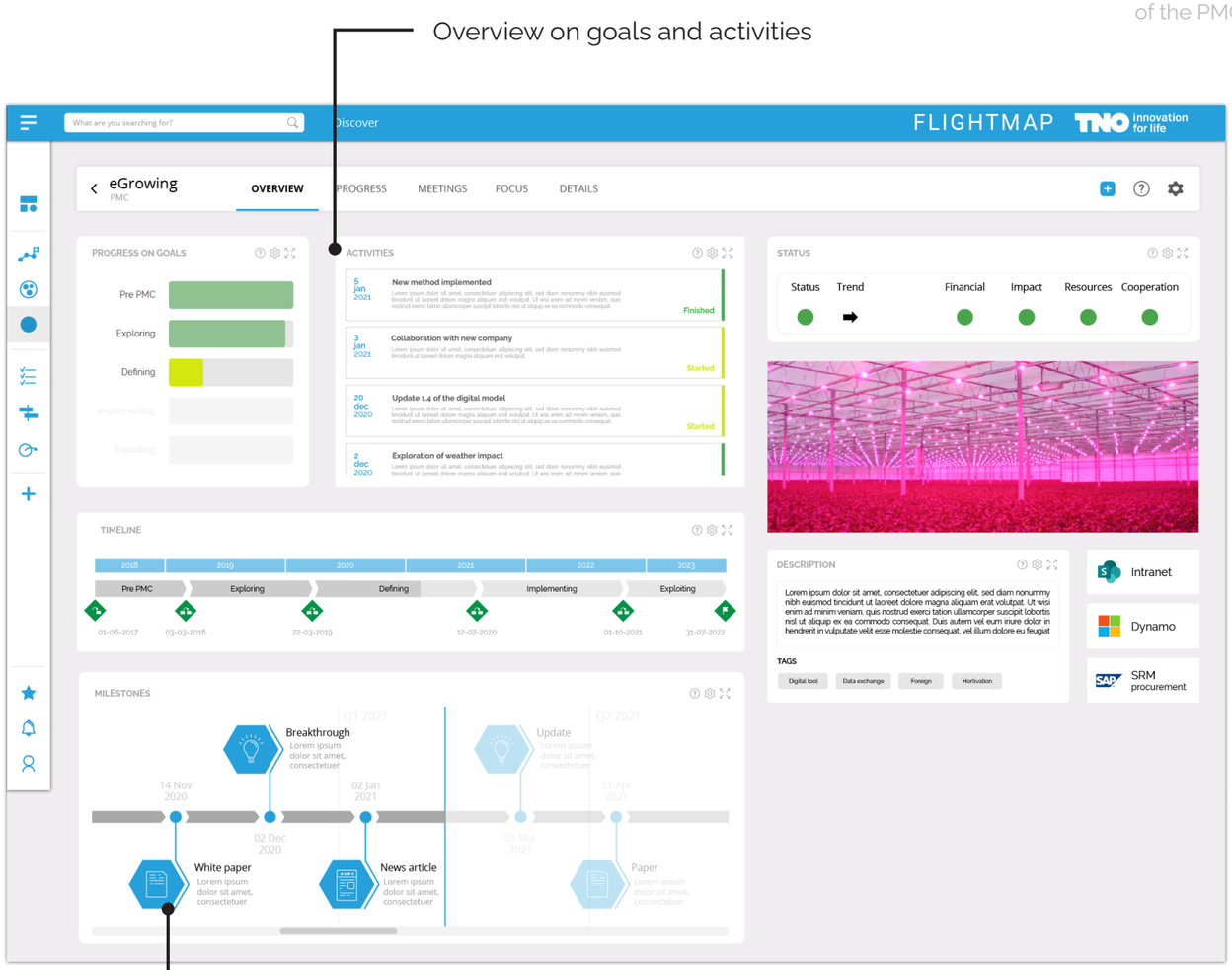



Figure 1.39 The overview screen for the PMC eGrowing. (all data is simulated)

## Strategic structure and awareness.

Through this solution, the strategy can be shared and the portfolio management activities can be evaluated. It provides a structured way of working to align the activities to the strategy and evaluated them efficiently. By setting the goals at each stage and evaluating them around each meeting the team becomes more aware of what is being worked on and the contribution of their work.


Increase awareness of stage and future steps

Figure 1.40 The timeline presented on the PMC overview page

Recognizable goal categories

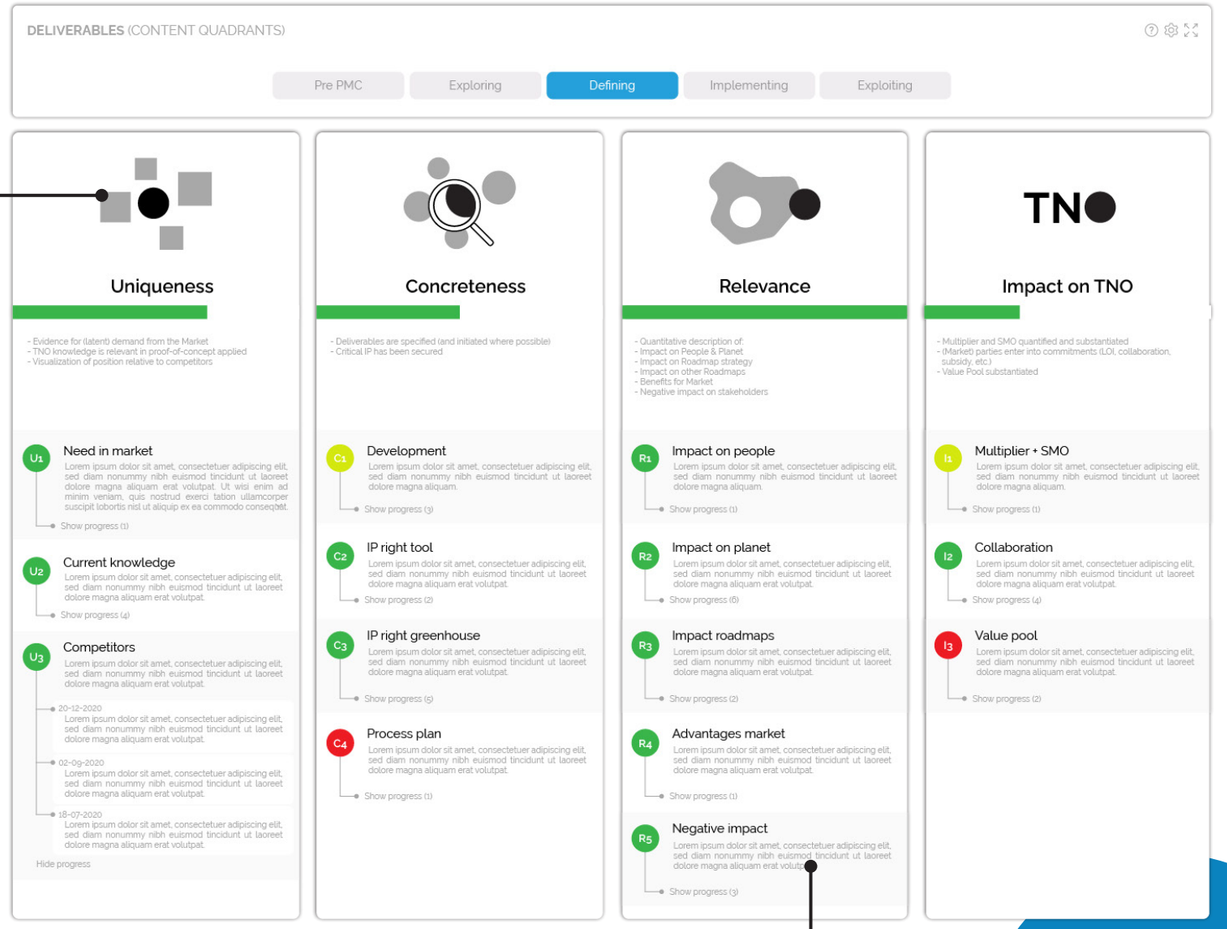



Figure 1.41 An improved structered visualization of the goals in the content quadrants.

Manage goals and actions

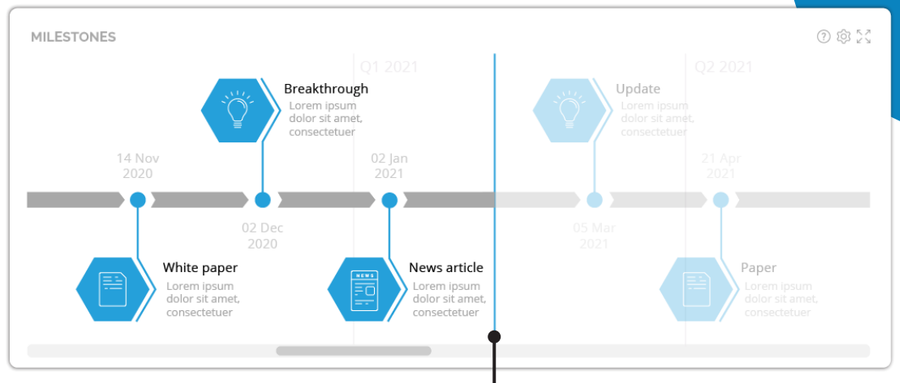



Figure 1.42 An overview of the achieved and planned milestone.

What is done and has to be done?

## An integrated solution to manage the portfolio on each level.

The solution presented in this thesis is not three different products, it is a way of working with supportive tools to make the portfolio management process as efficient as possible. It brings together the evaluation of the full roadmap portfolio, the strategic objectives, and the evaluation of PMC's in one platform. It is the place to go for all information on each level, e.g., descriptions, external links, meetings, goals, etc.

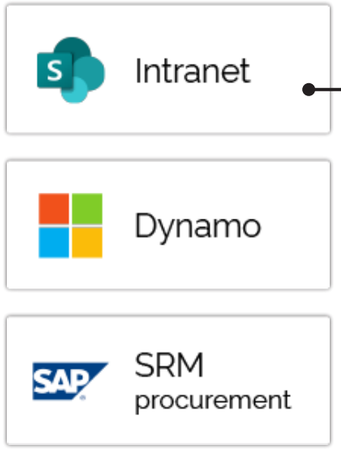



Figure 1.43 External links presented on each level.

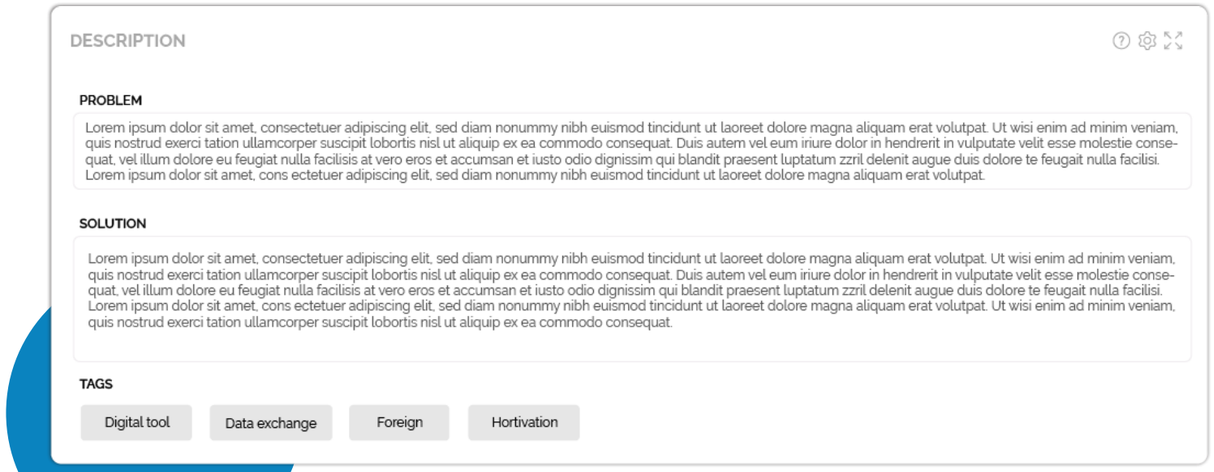



Figure 1.45 The full description of a PMC.

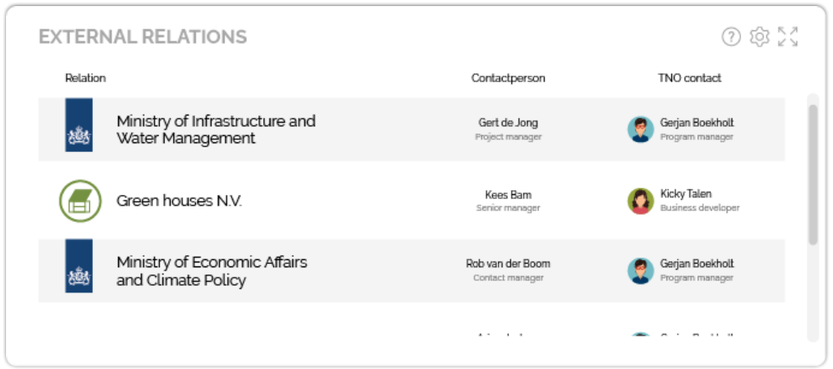



Figure 1.46 Full data of the PMC is displayed including external relations.

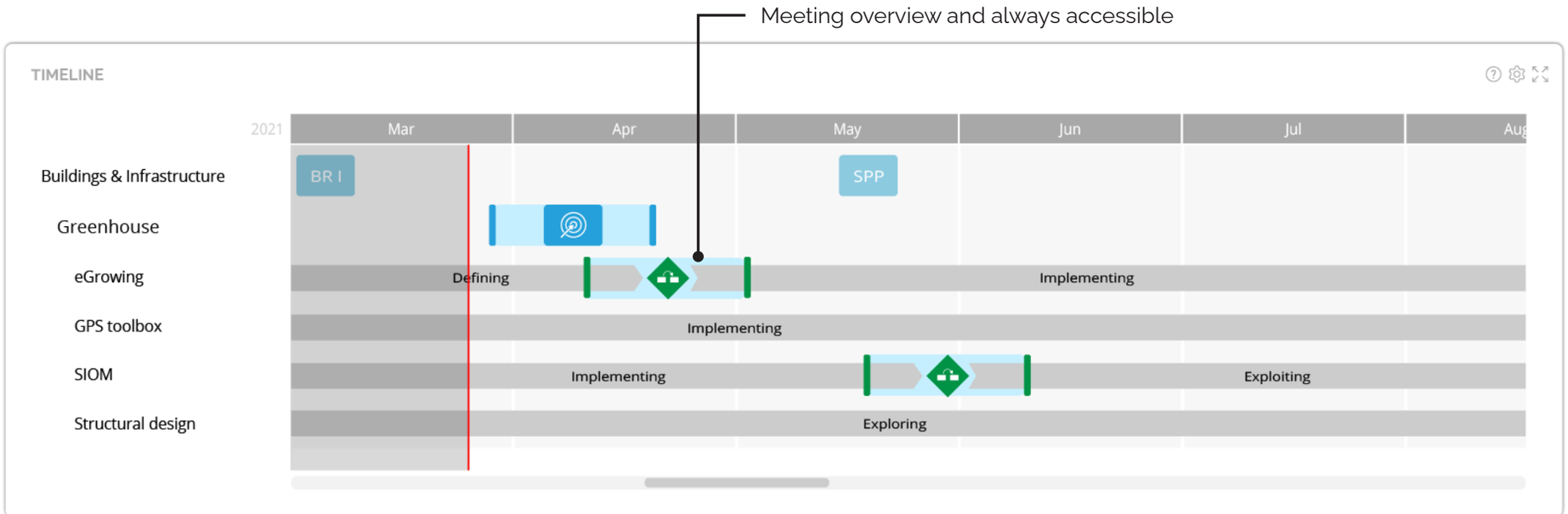
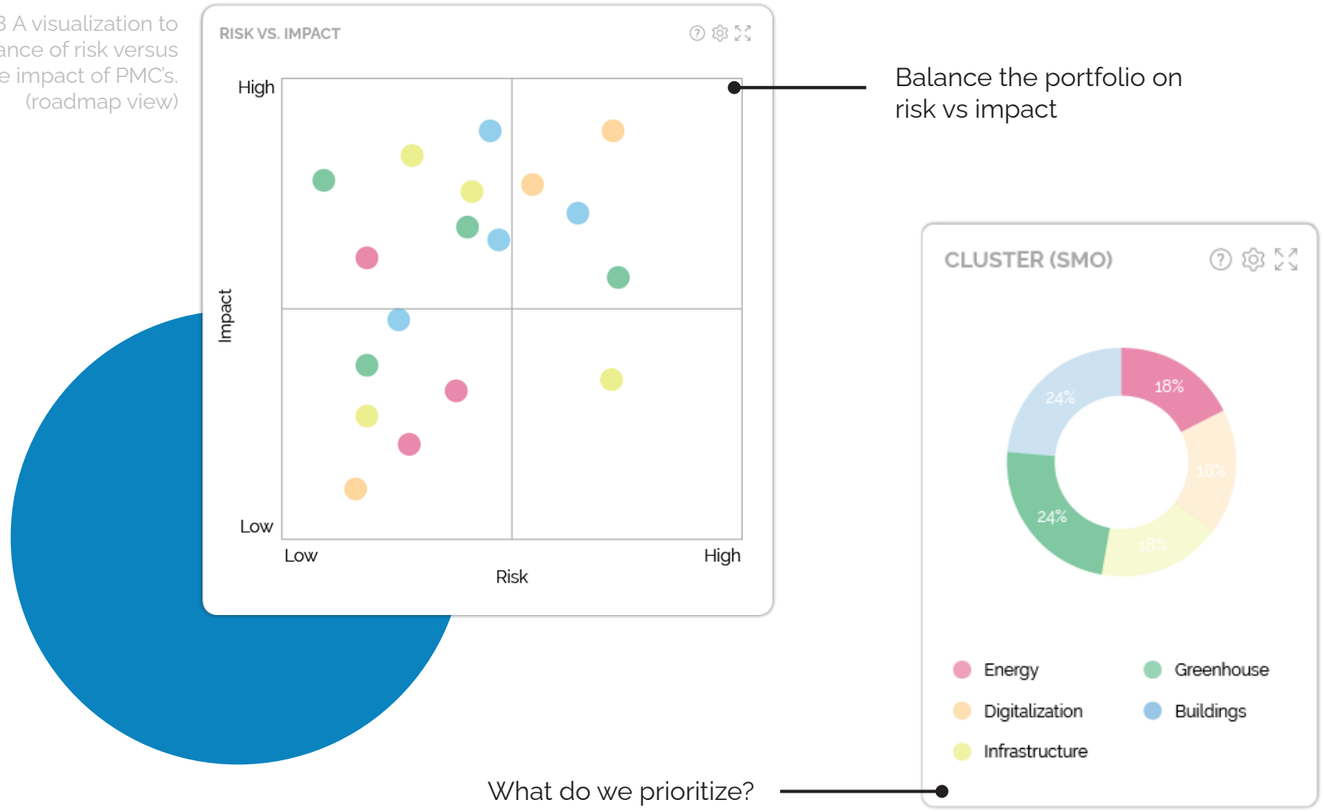



Figure 1.44 A representation of a cluster timeline.

## Enables to make informed decisions on the balance, the status, and the impact.

The dashboards enable the management to make decisions on the balance of the portfolio supported by data from PMC's. It creates a quick insight into the progress and status of PMC's, clusters, and roadmaps. Not only the financial data is visualized but also the impact of the PMCs, this allows for a complete evaluation of the products worked on.

Figure 1.48 A visualization to assess the balance of risk versus the impact of PMC's. (roadmap view)



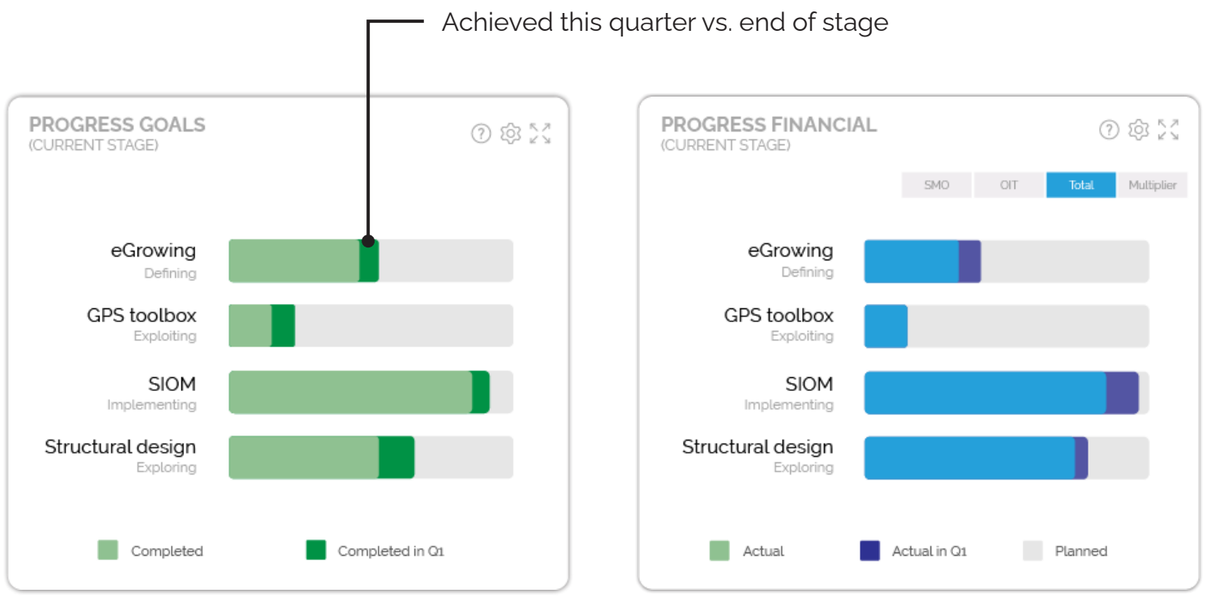




Figure 1.47 Progress on the impact and financial goals.

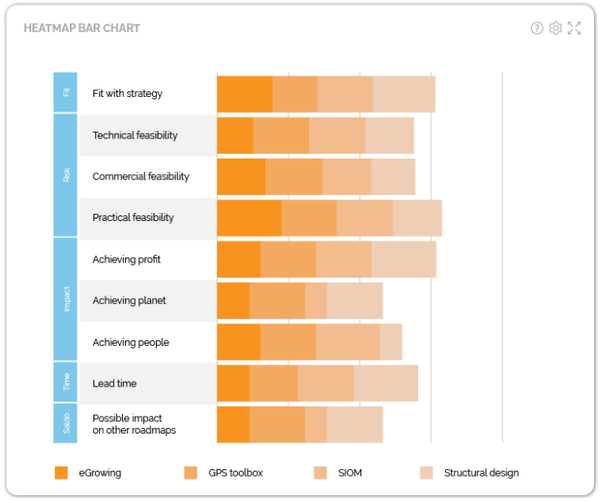



Figure 1.49 The balance of a cluster on the FRITS criteria.

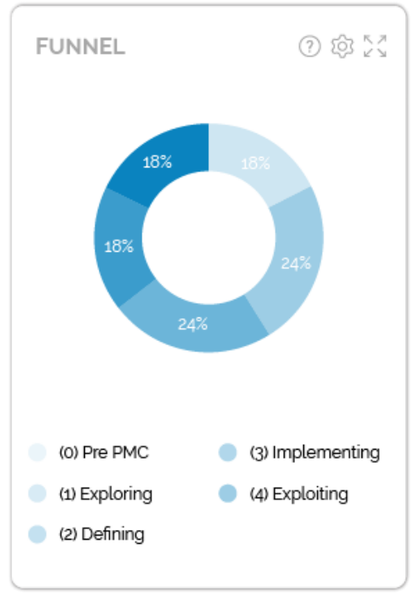



Figure 1.50 The balance on topics in the form of clusters and funnel spread.

## 7.1.2 The annual plan

The annual plan includes activities part of the portfolio management method and the relation to other processes in the organization. This improves the awareness of the user of portfolio management activities. It also guides the user in the usage of the portfolio management method.

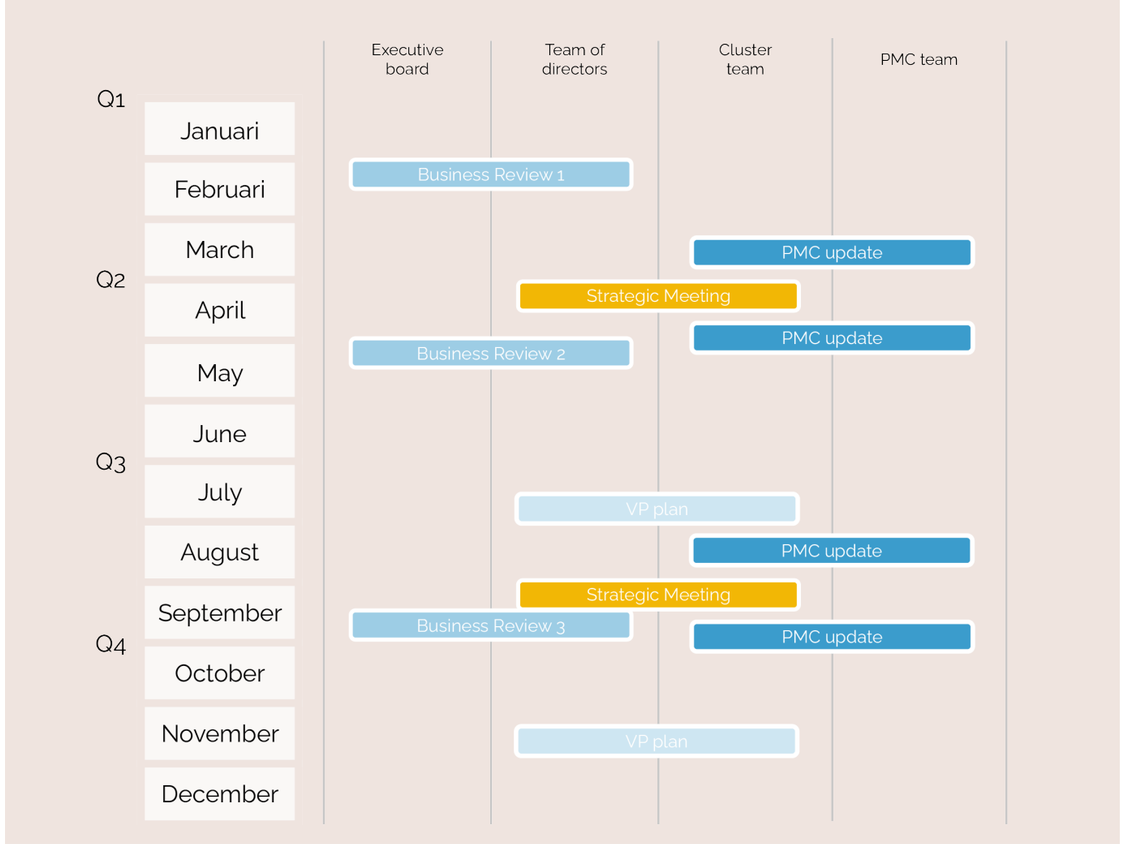
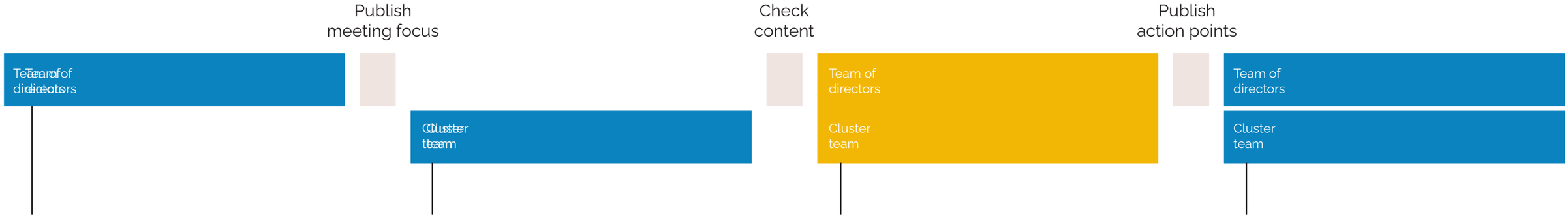



Figure 1.51 An overview of the business reviews, VP plans and portfolio management meetings.

**Flightmap integration**
In Flightmap the full plan is available on the timeline page and the actions are automatically added to the task list. The participants of the meeting will get a notification in Flightmap with the actions that have to be taken in the preparation phase. This will help to get an overview and align everyone to focus on the meeting. Flightmap provides a suggested meeting agenda for the type of meeting and the moment in the year. At any time, directors or the strategist can adjust the meeting suggestions to be aligned with the strategy and vision of the unit.

**The flow around a strategic meeting**




Portfolio review
A meeting of the team of directors and the unit's strategist to discuss the portfolio on roadmap level. A meeting format can be retrieved from Flightmap. The focus of the meeting is to evaluate the balance, progress, and impact of the roadmap. Each cluster is discussed and important discussion points are raised.

Content preparation
The cluster team prepares content for the strategic meeting. In a meeting, they discuss the progress of the cluster, based on the focus the team of directors has set. When this is done the meeting can be accepted, the directors get a notification and can check the final proposal for the meeting. This to make sure everyone is aware of the focus and content of the meeting.

Strategic meeting
The strategic meeting follows a strict schedule based on the proposal of the cluster team. The next section elaborates on the meeting format.

Follow-up
The cluster team is advised to bring the results of the meeting into their meetings with the PMC teams.

Each stakeholder is responsible to complete the action point next to their name. This will be discussed in the next strategic meeting.

## 7.1.3 The meeting format

The meeting format is designed to make strategic meetings more efficient. The standardization in the process helps participants to become familiar and make the process fluid. Important is the awareness of the meeting goal which is set in the preparation phase. To describe the meeting format, it is broken down into three features: the status board, the meeting agenda, and Flightmap integration.

**Status board**
To improve the meeting focus the status board is introduced. The PMC teams update the status of their PMC two times a year, the schedule can be found in the annual plan. The status indicates how it is going with the PMC, when there are issues the status color is changed. This way the management can quickly see where attention is needed. The trend indicates the delta since the last measurement. Next to the indicators, a small description from the PMC team is provided where the status is elaborated.

The color code is as follows:

- **Critical issues** which prevent achieving the goals set for this stage.
- Issues exist but are currently manageable, **it could become critical** in the future.
- Everything is **going well**.

STATUS

| PMC | Status | Trend | Financial | Impact | Resources | Cooperation |
|---|---|---|---|---|---|---|
| eGrowing | ● | → | ● | ● | ● | ● |
| GPS toolbox | ● | ↘ | ● | ● | ● | ● |
| SIOM | ● | → | ● | ● | ● | ● |
| Structural design | ● | ↗ | ● | ● | ● | ● |

Figure 1.52 The status board introduced in this thesis.

> *"Especially useful because it allows you to steer the discussion."*
>
> *- Cluster manager*

**An improved agenda**
The first strategic meeting is focused on the progress that will be made the year. The goals to be achieved and the necessary actions. The second strategic meeting is an evaluation of those actions, did the cluster successfully finish the activities and are the goals met. If this is not the case the question is what can be done to still achieve the goals in the coming period.

| The beginning of Q2 | The end of Q3 |
|---|---|
| 1 Meeting focus<br>State the meeting focus and evaluate the status board. | 1 Meeting focus<br>State the meeting focus and evaluate the status board. |
| 2 Evaluate action points<br>Follow up on the action points defined in the last meeting. | 2 Evaluate action points<br>Follow up on the action points defined in the last meeting. |
| 3a Financial progress<br>On financial goals and prediction. | 3a Financial progress<br>Evaluating the past period. |
| 3b Impact progress<br>On impact goals at the end of the stage and coming activities. | 3b Impact progress<br>Overview of goals at the end of the funnel. |
| | Milestones<br>Two important milestones. |
| 4 Balance in the cluster<br>The balance on funnel spread, risk and impact. | |
| In case of a red/yellow status on the board: | In case of a red/yellow status on the board: |
| 5a Resources<br>Issues with resources, based on the status board. | 4a Resources<br>Issues with resources, based on the status board. |
| 5b Cooperation<br>Issues with collaborations, based on the status board. | 4b Cooperation<br>Issues with collaborations, based on the status board. |
| 6 Follow-up<br>Activities worth the attention of the Team of directors. | 5 Follow-up<br>Activities worth the attention of the Team of directors. |

Figure 1.53 The meeting agenda proposed in this thesis.

**Flightmap integration**
The meeting page in Flightmap provides the necessary data and links for each meeting step. Roles are defined to the cluster managers, PMC team members can be included but this is not advisable since it can drag the meeting into a detailed discussion. These discussions should be held outside of the meeting. The cluster team can adjust the time set for every agenda point.

During the meeting, the notes or minutes can be added to the meeting page. At the end of the meeting, the action points defined in the meeting can be added to the page with the responsible person added. The action point will be added to the person's task list and can be evaluated at a later moment.



## 7.1.4 The Flightmap redesign

The biggest impact of the solution in this thesis is on the improvement of Flightmap. The interface and build-up are developed with the problem statements and design vision in mind. During the development of the concept, a continuous link to the portfolio management goals was being made. First, an overview of the tool will be explained in the build-up, followed by an explanation of key pages and elements.

**The build-up**
To make the navigation more efficient the menu is redesigned to fit the workflow of the user. Next to the header bar containing the search function and the discover link, a vertical personal bar is added. This bar contains all pages related to the user's profile and frequently accessed pages. Since Flightmap is not used often and the learning curve is long the bar contains titles for quick understanding, it is possible to close the titles and only have icons visible to expand the space for the main content on the screen.

The roadmap, cluster, and PMC pages are built out of elements. On each page, multiple elements are combined to create an overview of data used to make specific decisions in the portfolio management process.

Figure 1.54 displays the workflow of the user. The interaction with Flightmap.

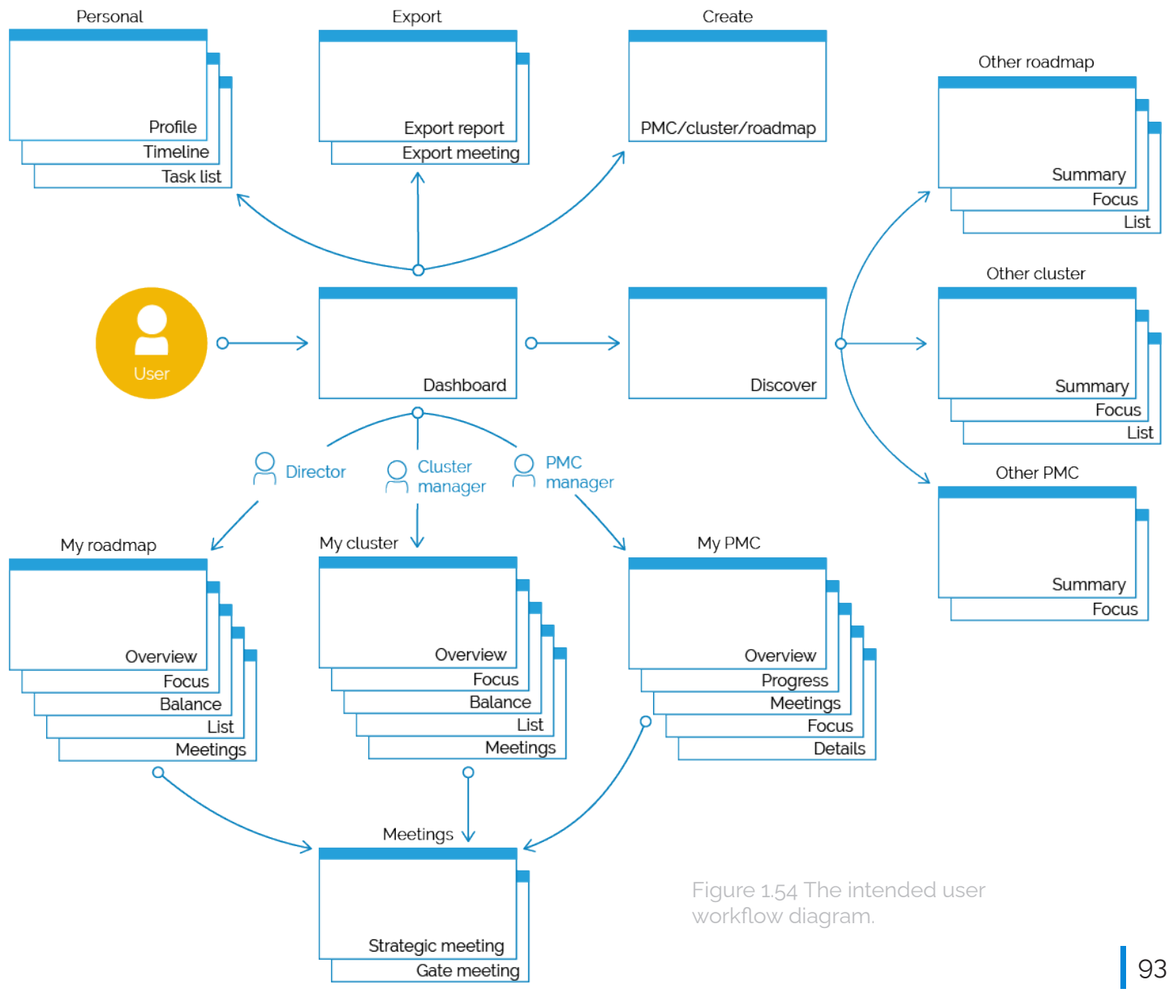



Figure 1.54 The intended user workflow diagram.

Every element has three interactive icons in the top right. With the edit icon the user can make minor adjustments to the elements, the best possible representation of the data is chosen but there are always personal preferences. The question mark allows the user to get an explanation about the data, portfolio management method, and decision to be made. The expand icon can be used to have a bigger view of the element, this will also help with the adjustment to the new design since all data in the current version is on a big screen, and to have a better view of the element.

To make the digital interface more intuitive a set of icons was designed. These contribute to a more consistent language. By using the same icons which are recognizable the communication can become quicker and more efficient.

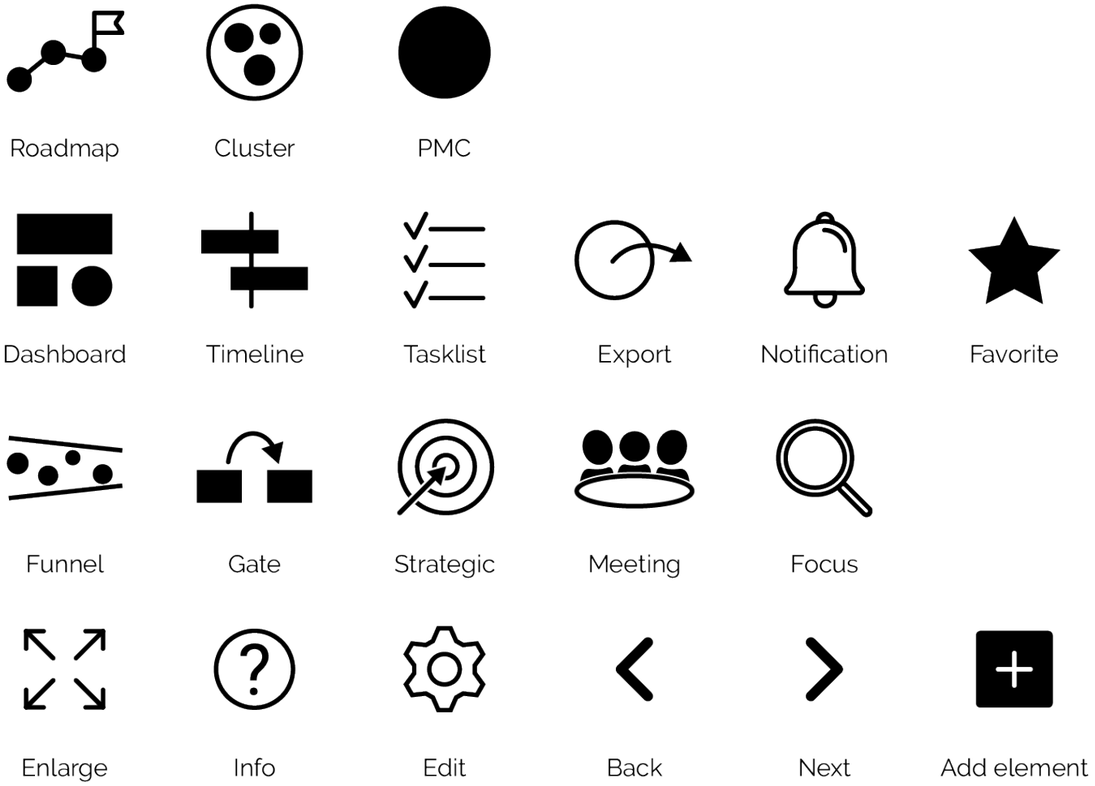



Figure 1.55 The icon set for the purpose of this thesis, to provide intuitive navigation.

**Personal dashboard**
The first page the user will see is the personal dashboard, this is an overview of information that is recently changed and information that needs to be checked, i.e., meeting preparations. The data presented is based on the profile of the user, their role, and their tasks.

As with all other pages in the concept, by hovering over the elements extra information is shown, e.g., the status shows a short description by the PMC team of the reason for the status color, the bubble shows key information about the PMC, etc.

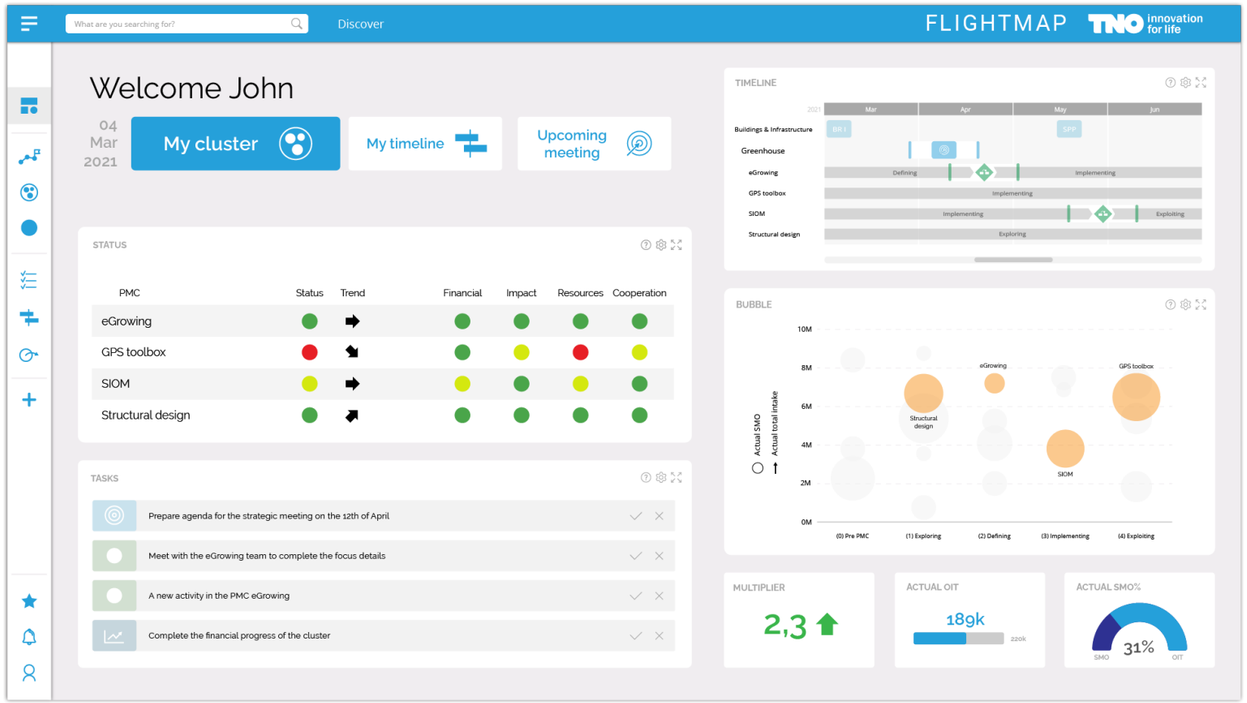



Figure 1.56 The personal dashboard to inform the user on changes and tasks.

**Portfolio pages**
A difference is made in private and public pages of a roadmap, cluster, or PMC. The private pages are for owners and owners in the tree, e.g., a cluster manager has access to the full page of all PMC's in the cluster. To increase the portfolio mindset everyone with a Flightmap account has access to all public pages. These pages provide the basic information of the roadmap, cluster, or PMC, all information to understand what is going on and identify possible collaborations.

The private portfolio pages give a complete picture of respectively a PMC, cluster, or roadmap. The pages have different tabs with each a different purpose, an overview is displayed in figure 1.54. In this section, key pages will be presented.

PMC

*Tabs:* Overview, progress, meeting, focus, and details.

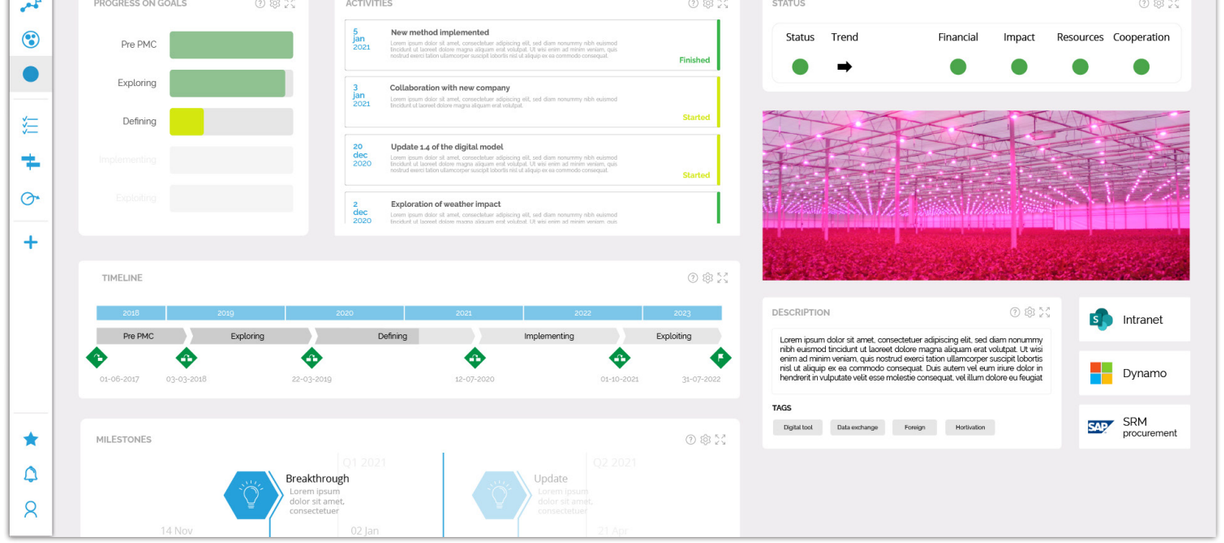
*Private page accessible by:* Directors, cluster team, and PMC team.

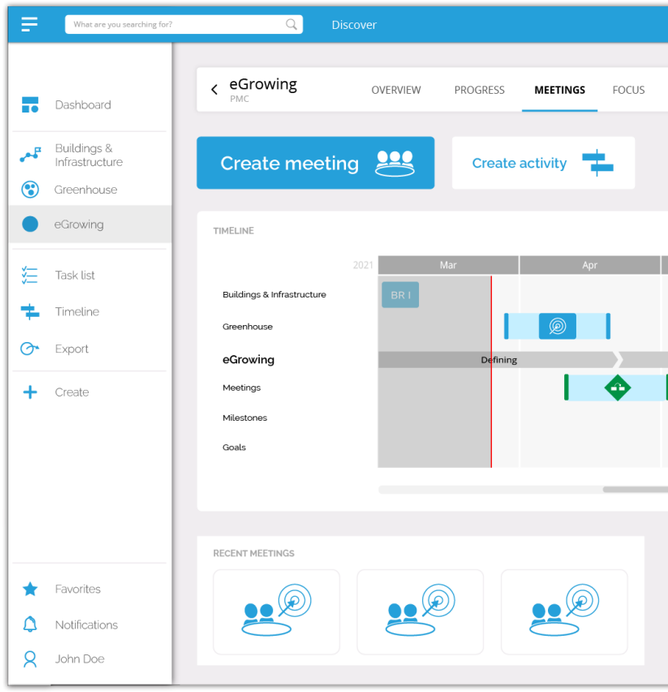
The overview helps to get an impression of the full PMC; the description, status, and key numbers. The progress page contains the goals of the content quadrants in a structured way. For each goal the progress is tracked, the PMC team can update the status of the goal by the color-coded circles. The progress on the goals indicates the progress of the PMC. It is not meant to be a strict management tool because the number of goals is limited and reaching a goal will have a big impact on the overview, the purpose is to indicate how it is going and what has to be done to finish the stage. The progress on the impact goals is used in the overview to get a quick view of the progress in the last period and the progress towards the deliverables.

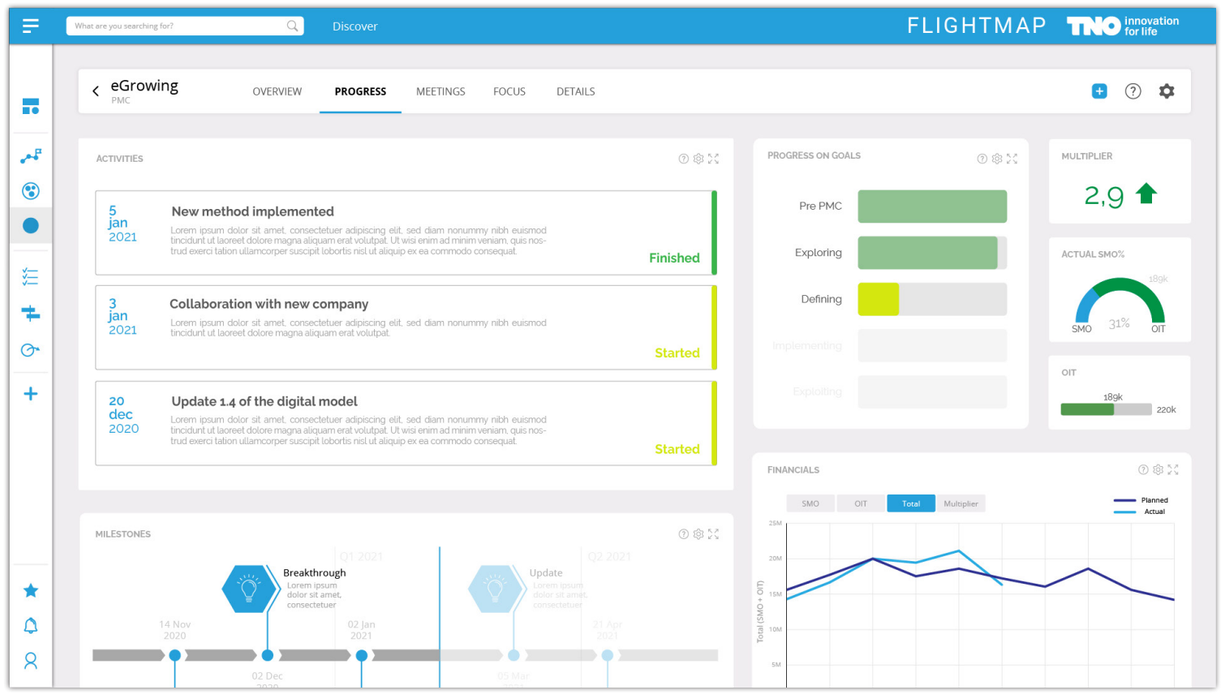
Milestones can be set to track important moments of the PMC, i.e., papers published or news articles. This can boost the morale of the team and shows colleagues who follow the PMC what is achieved.

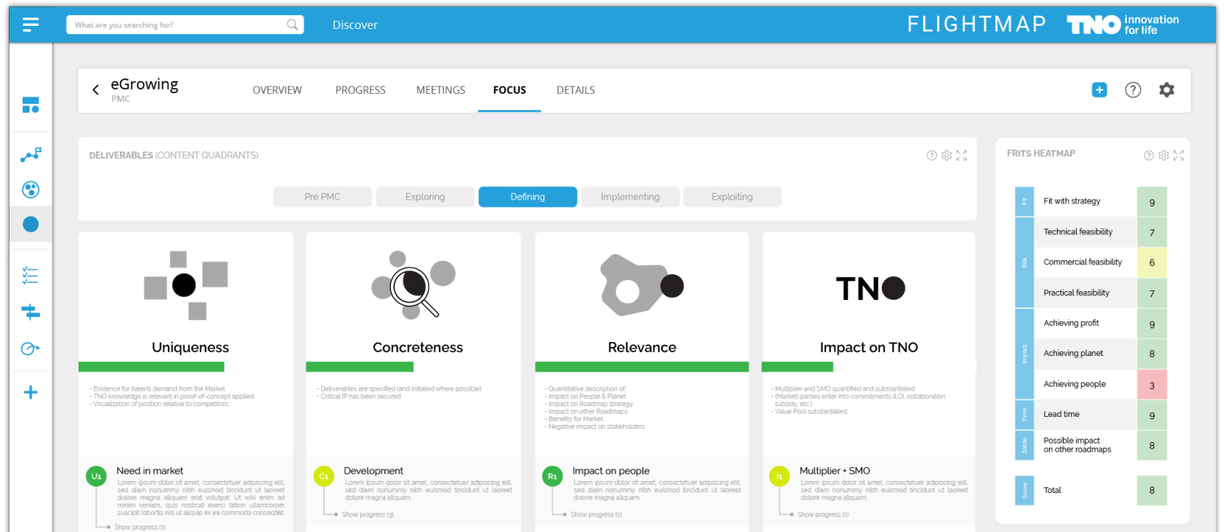
The timeline and milestone plan helps the user to understand which activities are necessary to successfully use the portfolio management method. The annual plan is integrated into the tool, this way there is a consistent process that will guide the user in the portfolio management activities.

The details page displays the information on the PMC that is not used as much for decision making but to complete the PMC information, i.e., the team composition, a detailed description, an overview of the dependencies, and the documents uploaded.



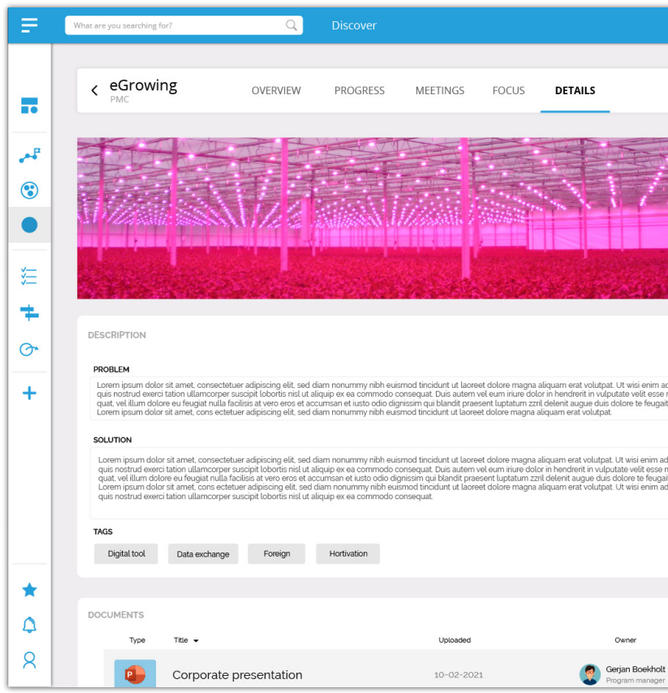




Figure 1.57 All PMC pages

Cluster

*Tabs:* Overview, progress, meeting, balance, and details.

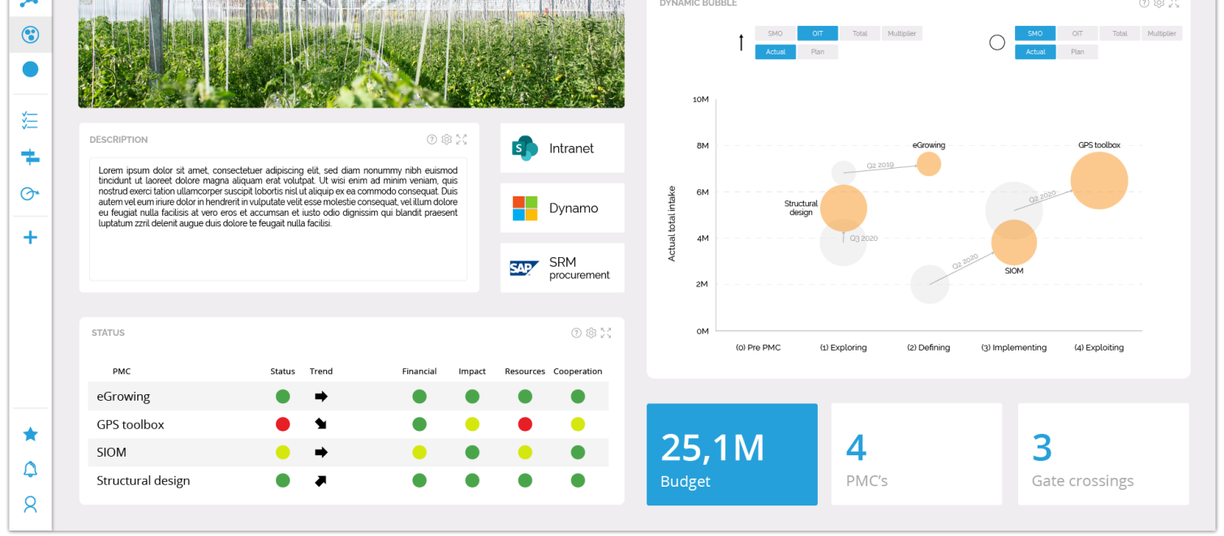
*Private page accessible by:* Director and cluster team.

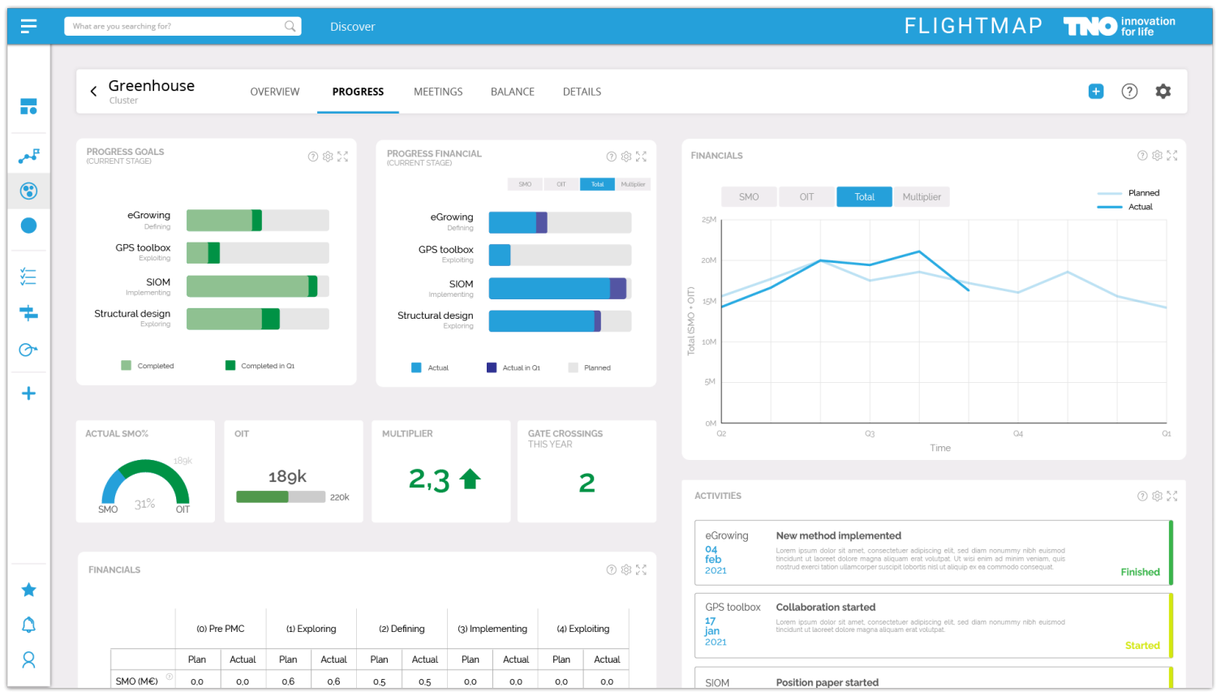
The first page creates an overview of the cluster, this creates in one overview the understanding of how and what the cluster is doing. The status board indicates the status and trends of each PMC. The dynamic bubble gives an overview of the speed the PMC's have in the funnel. This way the team can evaluate if the cluster is dynamic enough.

The progress can be tracked on impact as well as financial data, this is combined to create a complete picture. By evaluating the complete progress attention can be divided and the team can steer better on the different PMC's.

The meeting page gives an overview of all meetings that are coming up and the planning for each PMC. It creates awareness for the user of what is coming and what has to be done for the portfolio management process. Here meetings can be created and ordered, past meetings can be accessed.

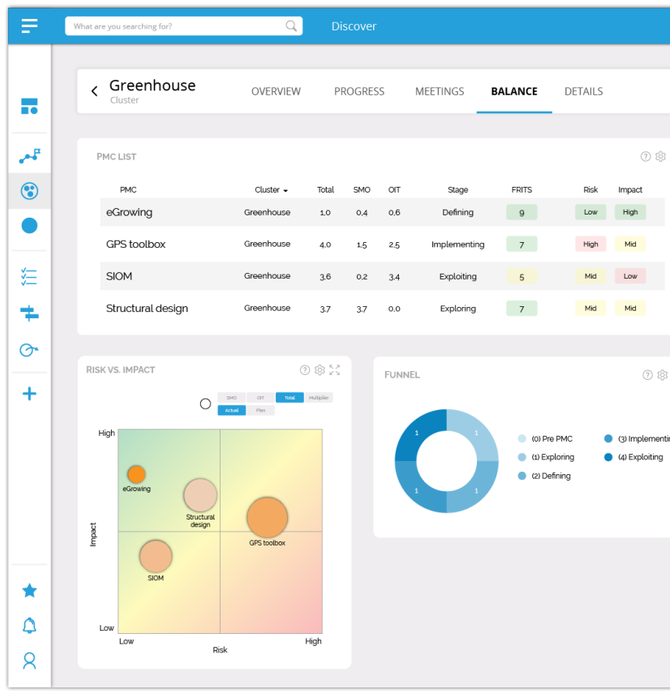
An important new page in the tool is the balance page, the team can access all information to make decisions to improve the balance in the cluster. The full PMC list with key information is presented as well as a risk versus impact graph. Goals can be set to reach a certain balance or the goals of higher management layers can be followed.









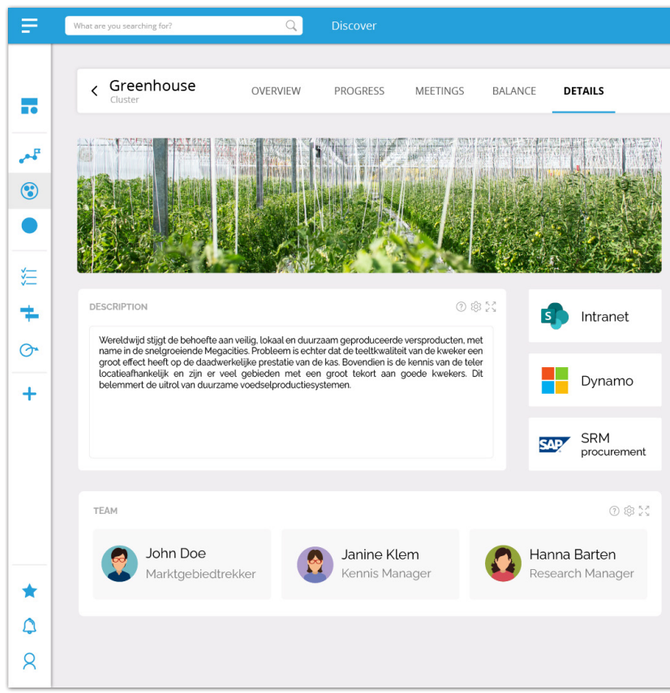




Figure 1.58 All cluster pages

## Roadmap

*Tabs:* Overview, progress, meeting, balance, and details

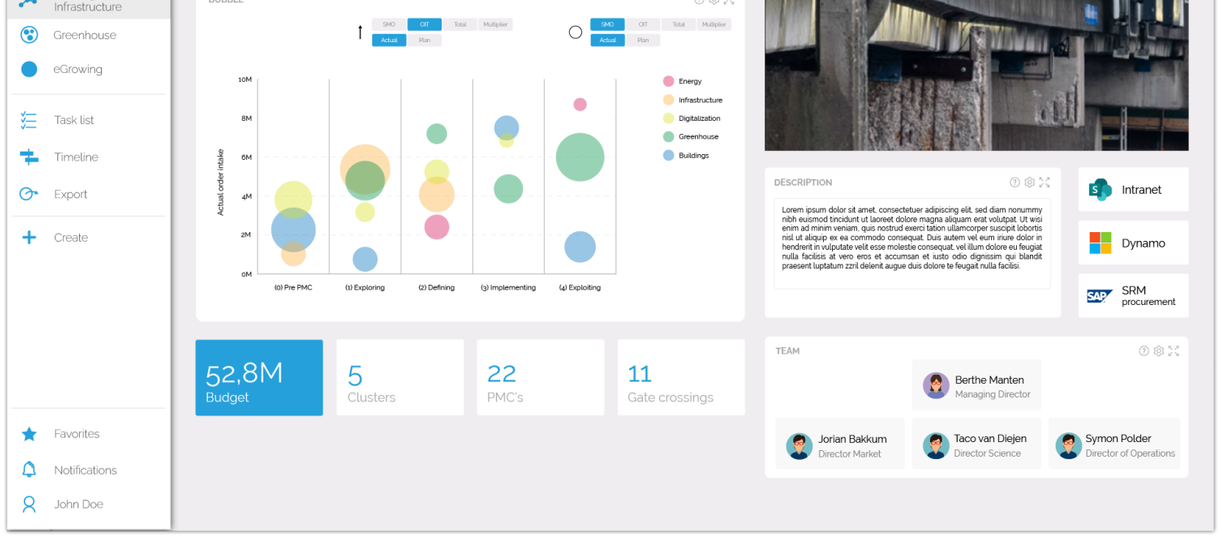
*Private page accessible by:* Director

The last and the set of pages with the most holistic view are the roadmap pages. These give an overview of the complete roadmap data, including the clusters and PMC's. Since the amount of PMC's to track is bigger these are color-coded per cluster. The bubble gives a good overview of the spread in the funnel. The roadmap set serves two purposes, it provides information for the directors to make decisions and it should give guidance to the clusters and PMC's.

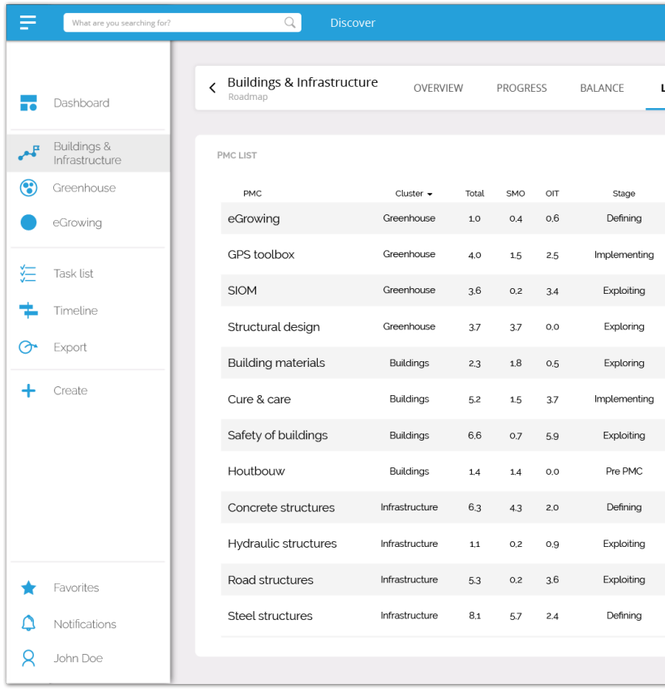
The progress presents the data on the roadmap and the build-up. The graphs show the contribution of each cluster, which allows the management to steer on individual clusters. The details of PMC data are intentionally left out to prevent the directors from making in-depth decisions on PMC's.

As important as the cluster balance page is the roadmap balance page. Here several elements are provided to evaluate the balance of the roadmap. The portfolio can be evaluated based on the risk, impact, spread through the funnel, and the number of PMC's. This allows the directors to indicate gaps or overload in the portfolio. It enables decision-making to balance the portfolio according to the goals set in the strategy.

The PMC list shows all PMC's in the roadmap with key numbers and clusters, by clicking the user will be directed to the PMC.







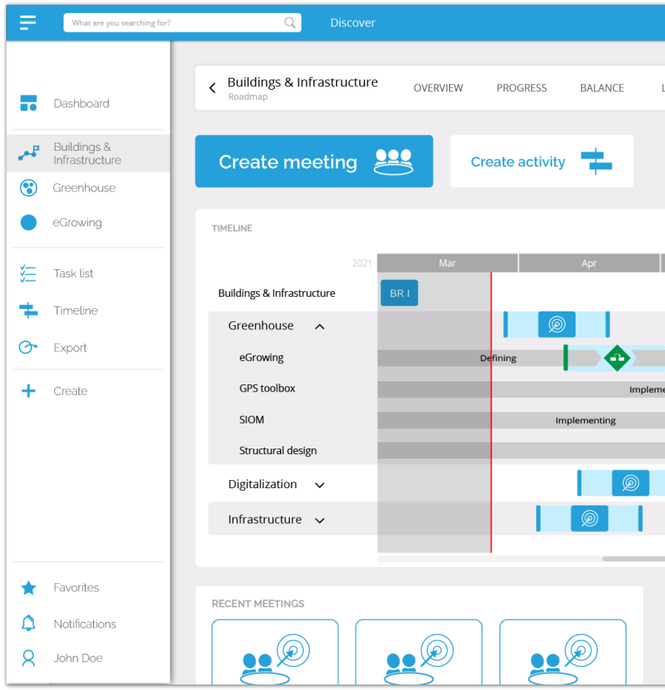




Figure 1.59 All roadmap pages

**Meeting pages**
Currently, two types of meeting pages are integrated into the concept. These pages provide all data about the new meetings and previous meetings. Through the page, the PowerPoint for the meetings can be configured and exported with the necessary data from Flightmap. Flightmap proposes a meeting set up which can be adjusted by the cluster team. During the meeting, the notes or minutes can be documented. The actions point can be listed and linked to the responsible person, when the meeting is finished the action points are added to the task list of the respective person. Documents used in the meeting can be added to share or save for later.

In the overview, a link to every meeting is located. This makes it easy to check a past meeting again to either refresh the memory or evaluate the progress.

**Discover**
The discover page promotes exploring other PMC's in the organization. This way the awareness of what is going on in the organization increases and knowledge is shared. This will also have a positive effect on the collaboration between PMC, hopefully even inter-unit. It provides the user with a hierarchical overview of all roadmaps for easy navigation.

Next to the discover page, Flighmap allows the user to search on PMC. It is possible to select the tags, dependencies, or external relations, to bring up a list with related PMC's. A use case example is a need for new collaborations, when a team identifies the need for new acquisitions they can explore important external relations of related PMC to see if their expertise can be expanded to different domains or even start a consortium.

On public pages, there is always a sidebar present with the key information about the roadmap, cluster, or PMC. This improves intuitive actions and increases awareness.

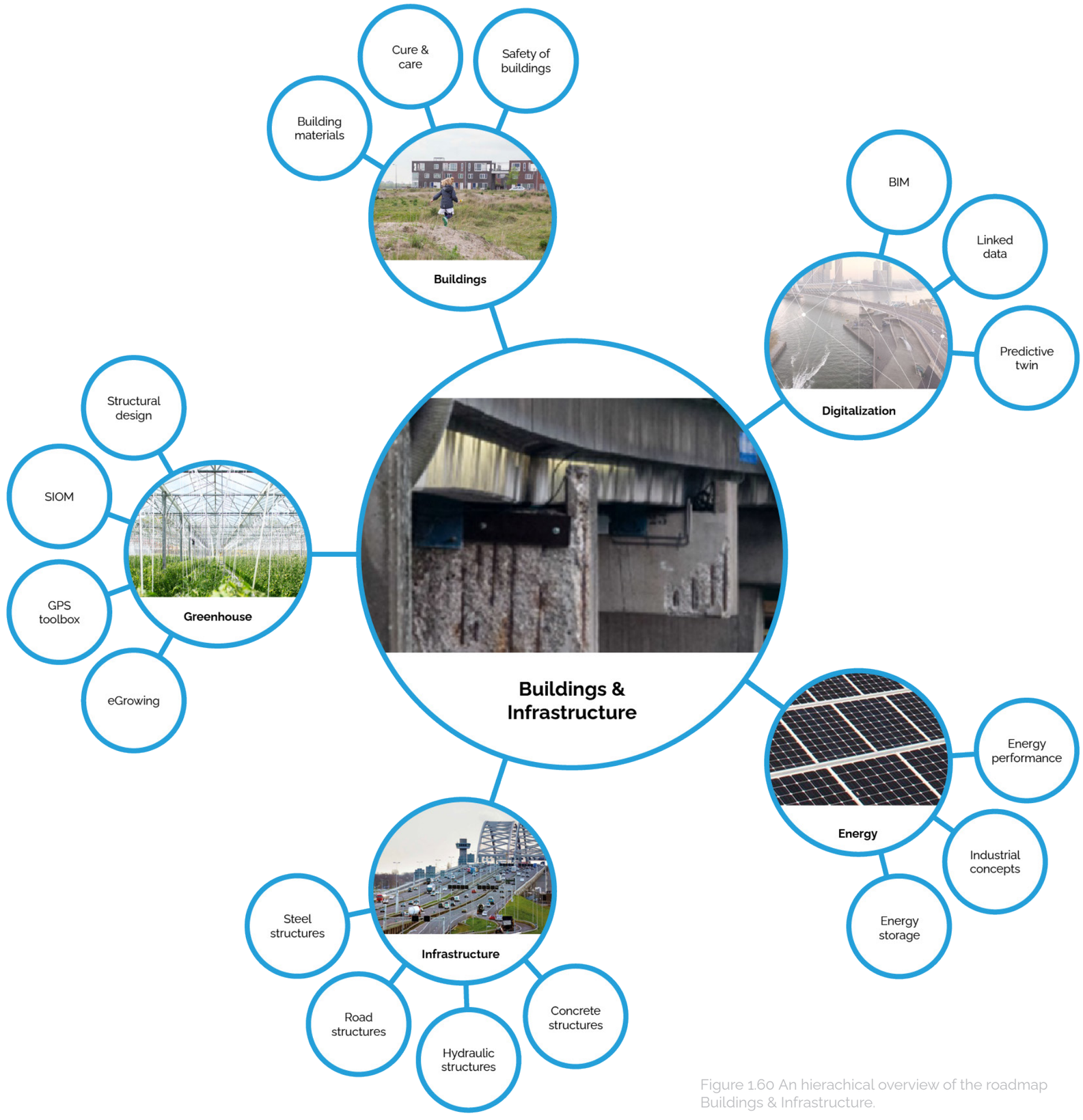



Figure 1.60 An hierachical overview of the roadmap Buildings & Infrastructure.

## 7.1.5 Scenario

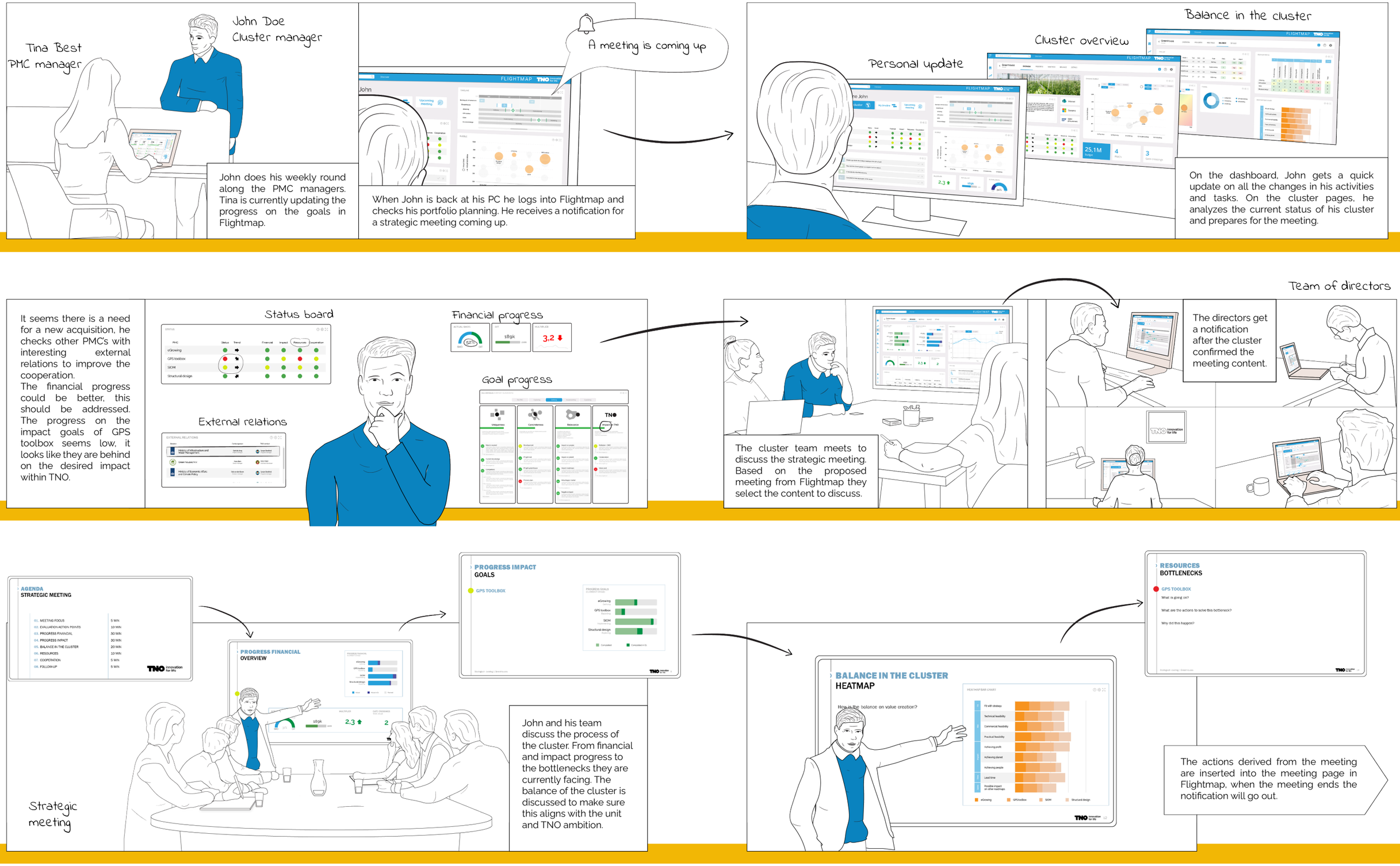



Figure 1.61 The scenario presenting the user interaction with the solution.

# 7.2 Implementation

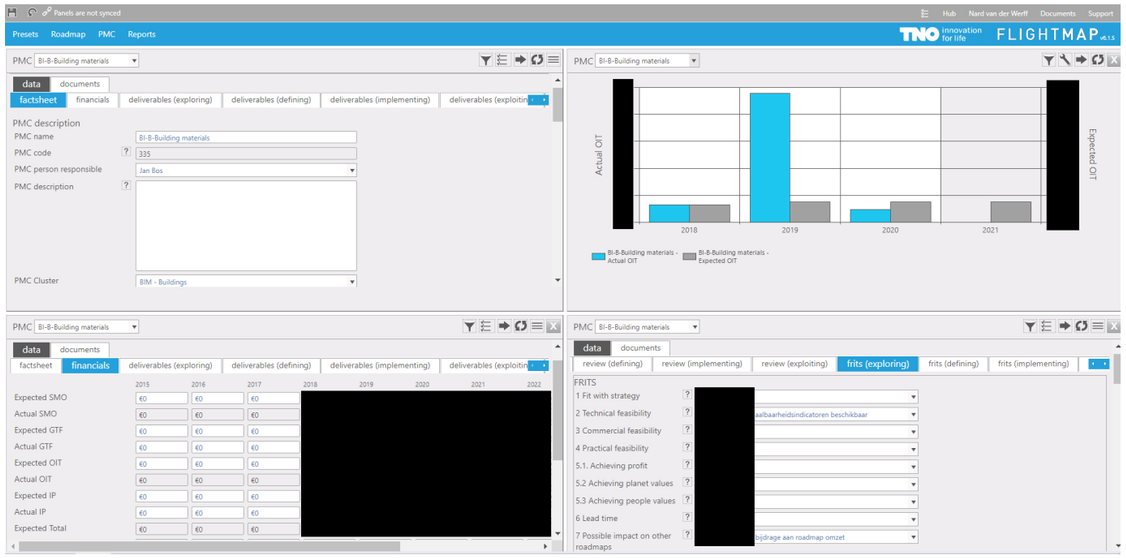



Figure 1.62 A possible preset in Flightmap.

## 7.2.1 Future vision

The presented solution is an ideal concept, it describes the preferred interactions and design. This thesis was aimed to be of contribution in practice. Therefore an implementation plan is made to ensure the realization of the concept. In multiple steps, the concept will be implemented which makes it easier to fit into the organization. The first step is already taken and soon to be implemented.

## 7.2.2 Quick wins

Implementing a completely new design would have a big impact on the way of working and the experiences of users. The best way to reach the ideal solution is to implement it gradually. Starting with easy to realize updates that have a big effect, quick wins.

**Dashboard**
By combining graphs and pages currently available in Flightmap a first version of the portfolio pages can be created. Based on the decision to be made four pages can be combined. These presets can be placed in the navigation drop-down menu.

The next step would be to create presets for each role in the organization, e.g., PMC managers, cluster managers, and directors. The presets can be presented in the navigation menu to users that fit the profile.

When full user profiles are added the dashboards can be created, based on these profiles the presets can be developed and actively presented to the user.

**Status board**
Since it is not possible to implement a status board in Flightmap any time soon, a first version has been created in PowerPoint slides. The status information of the PMC's can be gathered by cluster managers and used in strategic meetings or PMC meetings. In interviews, cluster managers mentioned the board like this would already be useful to their working process.

*The first version of dashboards is currently being implemented. Later this year the strategic meetings will use the status board to steer the focus of the meeting.*

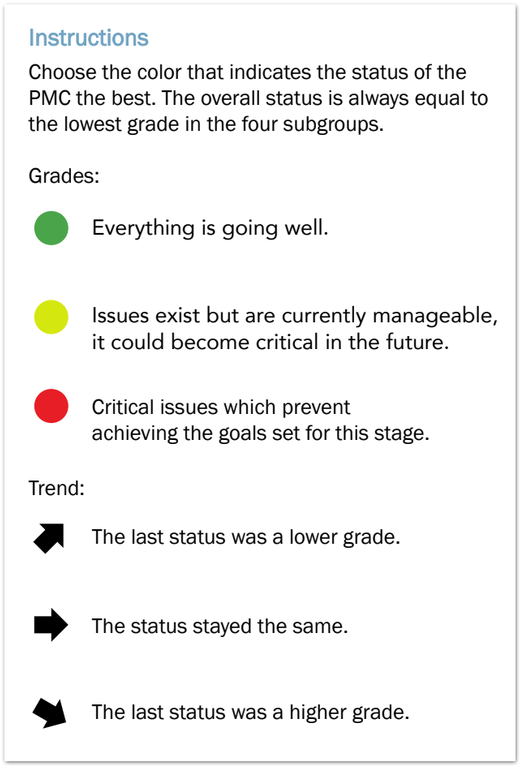
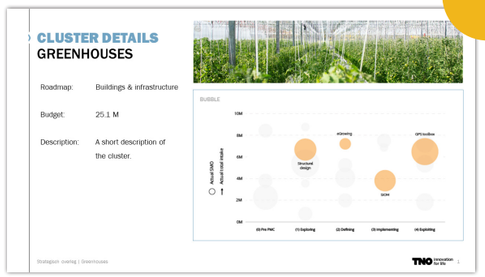


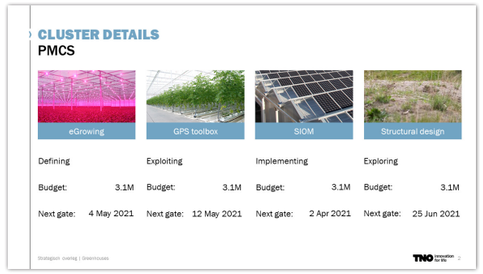

Figure 1.63 Instructions created to guide the user in the use of the status board.

**Consistent language**
Flightmap has a feature called waves which is a group of products with a common goal. These are currently not used by TNO. This is a simple addition that makes Flightmap more aligned with the portfolio management method.

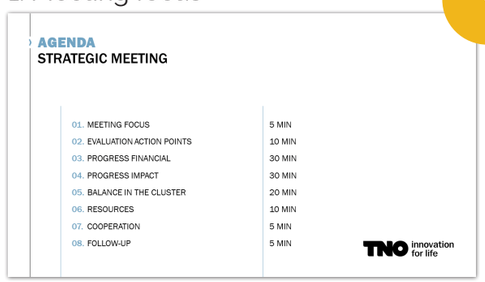
**The slide deck**
A set of PowerPoint slides proposed to use in the strategic meetings. It is designed based on the current time frame and future vision presented in this thesis.

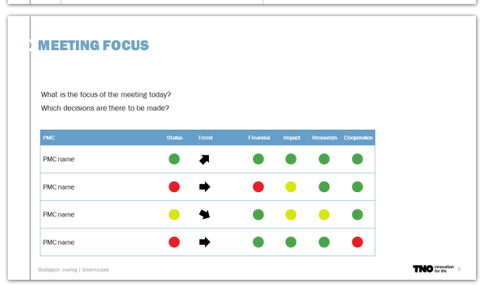
0. Cluster introduction



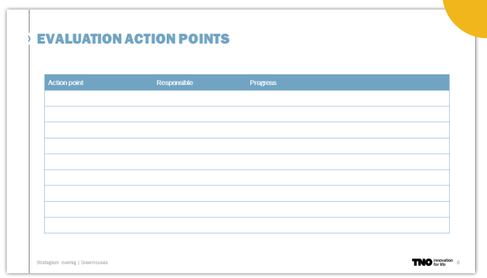




1. Meeting focus

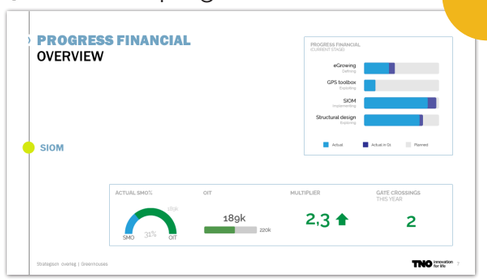


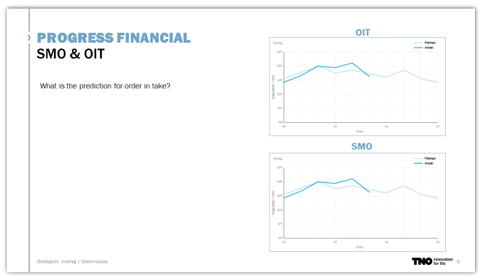




2. Evaluate action points

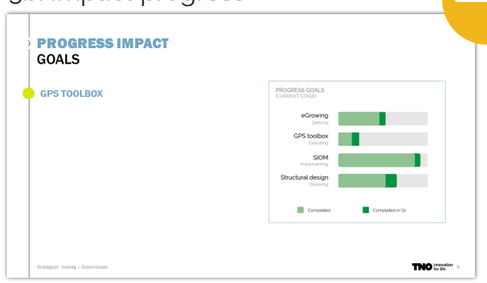



3a. Financial progress

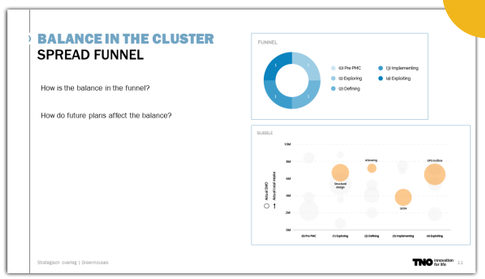


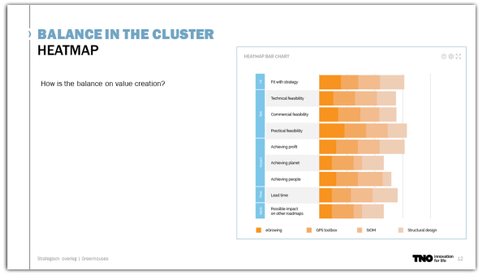



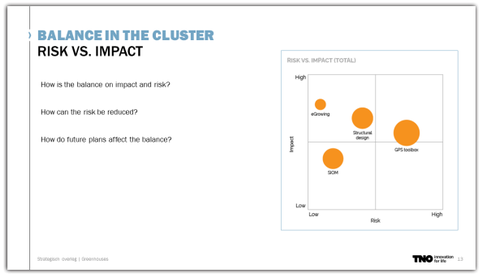

3b. Impact progress



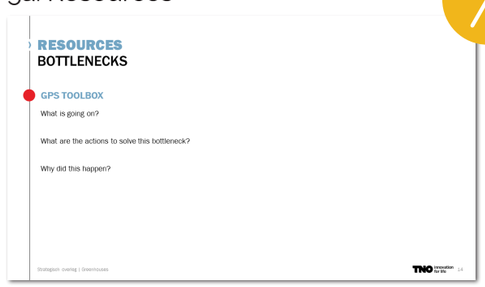

4. Balance in the cluster




5a. Resources





5b. Cooperation


6. Follow-up


Figure 1.64 A slide deck as inspiration for the next strategic meetings.

# 7.3 Validation

## 7.3.1 Approach

During the iterative process, the concept was continuously tested with users and experts. This last validation is aimed to validate the full concept, therefore a couple of sessions were organized. The solution was validated along the design requirements defined in the design vision. The validation process is based on sessions with cluster managers, the team of directors, the market team, and an expert from another unit.

Two sessions were organized with the main target group, the cluster managers. Here first the Flightmap redesign was discussed, followed by the annual plan and meeting format.

Next to this, the results of this project were presented in a team of directors meeting. This presentation was focused on the strategic meeting format and annual plan since the participants are actively interacting with these parts of the solution. After the presentation, a discussion was held to evaluate the results and proposal for the next meetings. A goal in the meeting was to define the setup of the upcoming strategic meetings.

The solution was presented in a meeting with all the business developers of the unit. Here the full concept was presented with a focus on the Flightmap redesign and workflow.

In an interview, the full solution was presented and discussed with a strategist from another unit.

## 7.3.2 Results

Cluster managers

The solution was discussed by going through the workflow of the solution. Several comments were made on the dashboard. It was experienced as clear and valuable to become aware of what is going one.

> *"It also helps to set the accents for the PMC meetings."*
> - Participant 1

A good comment was made on the status board:

> *"The risk that everyone will question the colors."*
> - Participant 1

The purpose is to indicate the status, not to make it a fixed progress tool. None the less the issue mentioned is possible to happen, there should be a clear description for the use of the status board and that should be managed by the resposible portfolio manager.

The overview of the FRITS criteria was received very well. Unfortunately, the information icons did not work in the prototype, this showed there is a need for the explanation of methods used.

> *"FRITS overview is good. I see a few red areas, that will make us consider whether we can change something about the proposition."*
> - Participant 1
>
> *"FRITS, what was that again?"*
> *"If there is a number, why is it?"*
> - Participant 2

The response on the progress elements in the tool also received a positive response.

> *Substantive progress very welcome, "we are very busy, but where is that leading to?"*
> - Participant 2
>
> *"We are now very dependent on one consortium, but we will see if we can create a second one in the coming period."*
> - Participant 1

A comment was made to add SuccessFactors of PMC's to the pages. This is a good option for the next design iteration, it aligns with the design vision.

> *"What are the success factors of a PMC?"*
> *"A success factor of [name PMC] is, for example, in addition to good technology, is building a good network and organizing the sector."*
> - Participant 2

The timeline is perceived as helpful to create an overview and awareness about the activities and goals.

> *"The timeline is certainly good, creating an overview so we are briefly reminded where we are."*
> - Participant 2

Team of directors meeting

The meeting and annual plan were presented in a team of directors meeting and followed by a discussion. The discussion had the goal to create an approach to the next round of strategic meetings. The decision was made to hold a portfolio review meeting by the team of directors prior to the invoice towards the clusters, to create multiple focus points for discussion in the meeting. Next to this the status board will be implemented and used by the cluster managers to prepare the meeting content. In the meeting, the status board will be used to display an overview of all PMC's.

A comment was made on the contribution of highlights in the strategic meetings. These indeed have a minimal contribution to the meeting outcome, however, the stories and examples presented are often used in other conversations to explain what the unit is doing. Therefore the decision was made to keep highlights in the meeting format with the addition to limit the time spent on this agenda item.

Market team

The full solution was presented in a meeting with all business developers in the unit. Due to technical difficulties, the discussion was limited but the overall response was positive.

> *"I become happy with your alternative 'final design' idea. Very important that both the interface and the dashboards speak themselves."*
> *- Business developer*

A good point was made on the input of the tool. Unfortunately outside the scope of this project but it is an important part of the tool. Especially because the research in this thesis found that the value of portfolio management often ends up with senior management while the teams do most of the work, collecting the data is a time-consuming task.

> *"In my opinion, a point of attention, in addition to a good dashboard, is also the 'data input' itself (logical, accessible, and inviting). This is often forgotten."*
> *- Business developer*

Strategy experts
The solution was validated with the help of a strategist from another unit to get a perspective from an expert not as much involved and connected to the project. The verdict was very positive, especially the feedback on the overview of goals was defined as valuable. More attention could be made towards the FRITS criteria and the definition of impact, this is added to the recommendations of this thesis since it is outside of the scope.

### 7.3.2 Conclusion

The validation of the solution is concluded by evaluating the design requirements set in the design vision. Below all requirements are listed with the outcome, green means the requirement is fulfilled, yellow means decisions are made to change the goal of the requirement, and red means the solution did not meet this requirement.

| Design requirement | | Validation |
|---|---|---|
| **Guided by relevant and trustworthy data in a consistent language** | | |
| *Meeting:* A clear meeting structure, including steps coherent with the portfolio management method. | 🟢 | The meeting structure is provided and integrated into Flightmap. The solution is designed to fit the workflow by the method. |
| *Meeting:* A meeting focus known by all stakeholders. | 🟢 | The meeting focus is defined in the preparation phase and is visible in Flightmap and the slide deck. |
| *Meeting & Flightmap:* Consistent language and a clear PMC build-up. | 🟢 | The structure of Flightmap is based on the portfolio management method with a clear build-up of roadmaps, clusters, and PMC's. This extends in the meeting format. |
| *Flightmap:* Actively providing relevant data to the user, i.e. suggestions, news or activity. | 🟡 | Dashboards display the data the user needs to make the right decision, which in most cases is chosen to have a passive approach. |
| *Flightmap:* Validated and traceable data. | 🔴 | This is not specifically implemented. Although, the concept creates an increase of transparency of the data. |

| Design requirement | | Validation |
|---|---|---|
| **Familiar with an optimized and transparent system.** | | |
| *Flightmap:* Present a limited set of possibilities to personalize the interface. | 🟢 | Multiple dashboards are provided with relevant elements, the user can change the elements on the pages. The personal navigation bar guides the user through this. |
| *Flightmap:* Aligned with the way of working, a consistent method in all channels. | 🟢 | The roadmap, cluster, and PMC pages are a complete set of data, the external links are integrated, which increases the working efficiency. |
| *Flightmap:* Transparent system by increased accessibility and visible content connections. | 🟢 | Through tags, team members, external relations and a hierarchy tree other PMC's can be found. The public page provides all necessary information. |
| *Flightmap:* Easy navigation and connection with platforms, e.g. dynamo, intranet, file storage. | 🟢 | All external systems are integrated into the concerning roadmap, cluster, or PMC page. |
| **Being enabled by an appealing and clear system.** | | |
| *Flightmap:* Intuitive and unambiguous usability. | 🟢 | The usability is increased by a navigation flow that fits the workflow and by creating a structure with elements with additional clear quick link buttons (use cues). |
| *Flightmap:* Attractive appearance with the use of graphical communication. | 🟢 | Different interfaces are explored and a clear style is chosen. All data is displayed in the best possible way, either visual or textual. |
| *Flightmap:* Clear PMC overview and presentation. | 🟢 | Multiple pages of the PMC's are designed to create an overview and enable the user to make the right decision. |

# CHAPTER 8:
# FINAL THOUGHTS

*In this chapter, the outcome of this thesis is discussed. First, the research questions and design goal are evaluated. The limitations of the project are described. Next, several recommendations for TNO as well as recommendations for future research are presented.*

Content:


# 8.1 Discussion

The conclusion is explained by reflecting on the goals set for this project. First, the research questions are evaluated by measuring the impact of the final design. Next, the achievement towards the design goals is discussed.

## 8.1.1 Conclusion

complexity and intensity of the portfolio management process of which success highly depends on the context and implementation. It touches all layers and every employee in the organization. Important is the integration with other processes and plans already familiar and running in the organization.

TNO was already working with portfolio management for the last three years which made it possible to study the methods that work and that don't. This thesis could learn from the experiences from these years.

**How to improve the integration of Flightmap in the process of portfolio management by the team of directors and PMC cluster managers?**

This turned out to be a complex question and could not be solved with one deliverable. Eventually, a solution was designed with three deliverables: the meeting format, annual plan, and Flightmap experience. The combination of supportive systems is necessary to create an effective workflow, e.g., Flightmap will not work properly without a connected way of working and the meetings will not work without the data support of Flightmap.

This shows the need for integration of all processes. The context research showed that the level of acceptance is an important factor in the success of portfolio management. The poor integration of the processes disrupting the workflow of users causes a negative impact on the acceptance. When the acceptance drops too low it will cause a gap in the data necessary for the portfolio management process and eventually makes it impossible to effectively carry out the process.

**RQ1 - What information do the team of directors and PMC cluster managers need to make decisions about strategic objectives?**

To answer these questions research in both the literature and the real context was necessary. From the literature, the three goals of portfolio management are derived and used for the basis of the solution. The importance of evidence-based decisions is pointed out, which was affirmed by the analysis of the portfolio management activities in practice. The context research showed the minimal evaluation on the balance of the portfolio and the need for a structured way of evaluating the progress.

The dashboards in Flightmap are carefully put together to enable the user to make decisions to achieve these goals. The strategic meetings format is presented to guide the managers in two hours through the portfolio management decision-making process and updates on the progress.

**RQ2 - How to best inform and transfer the information for the different stakeholders?**

The use of portfolio management is explored, this provided several insights to improve the current situation. Most of the data is available but not used to the fullest, by improving the output of Flightmap a better integration into the workflow of the user is realized.

Improvements on the information transfer are made to the method as well as Flightmap. The core of these improvements is on the visualization and guidance, i.e. the status boards provide a quick overview and point out the important information to focus on. Another example is the personal bar in the redesign of Flightmap, the icons improve the intuitively of the tool and lead the user quickly to the pages that best used to make the decisions.

**RQ3 - Which changes in Flightmap can be made to align with the ideal information transfer structure?**

The potential for the digital tool did not align with the possibilities in the development of Flightmap. Therefore, this thesis took the approach to design a future vision, this way a bigger impact could be made. In each step of the process, the concepts were tested with the user which ensures the possibility of realization. For the solution to be fully implemented the developer must be willing to make more changes. An implementation plan is created to show the steps to be taken to towards the realization of the solution, to which level this is possible depends on the future decisions in the development of the tool.

The design goal is to create a **clear meeting process** and **annual cycle** with an **aligned Flightmap user experience.**

The user should feel **confident and in control,** while using Flightmap, it should **motivate** them. The interaction should be **guided, familiar and enable them to work efficiently.**

This project fulfilled the design goal with the solution presented. The goal is achieved by the combination of the three deliverables, the awareness created by the annual plan, the structure of the meeting format, and the integration of Flightmap in the portfolio management process.

The pages on PMC, cluster, and roadmap level enable the user to confidently make decisions supported by evidence. Both the meeting format and the pages in Flightmap guide the user in the decisions to be made and if this is not clear Flightmap provides an explanation of the method to be used. All data that first was available in a big list is now structure based on the decision to be made. It enables the user to make decisions on the balance, the status, and the impact.

Strategic structure and awareness are realized by the integrated solution which guides the user and makes them familiar with the method, it creates a consistent language.

The improved navigation and build-up of Flightmap provides an efficient workflow, it presents a limited set of configurations that makes the user feel confident and in control.

## 8.1.2 Limitations

User tests with a more sophisticated prototype would be valuable to support the research in this thesis. The decision was made to not create an interactive prototype because of the complexity of the context, which took too much time to research. In the user tests, the downside of this decision was visible, some design decisions made did not become clear or were not included. Although the user tests gave good feedback to iterate on the concept it was limited by the number of possibilities in the prototype. A good next step in the development of the solution would be to test with an interactive prototype, especially focused on the workflow. A side note should be made, this project was carried out in a time of covid

virus regulations which did not allow to test in person which made it harder to evaluate the user experience since the response could not be researched as well as it would in an in-person user test.

As mentioned the workflow is interesting to research. Currently, there is not one workflow, it is up to the user to navigate their way in the system, in this research no pattern is found. The number of users in the unit is limited, therefore the development of Flightmap should be extended to tests with users from other units. Further research should be done into this pattern and can help the user to execute portfolio management more efficiently and consistently.

Because of the complexity of the context the scope was set on the strategic meetings. To make the solution complete the gate meeting should be explored. This is another important meeting in the portfolio management process and should be integrated into the Flightmap redesign next to the strategic meeting.



# 8.2 Recommendations

This section defines recommendations found in this project, these insights did not fit in the scope or could not be realized in the final design. The recommendations are grouped based on their topic: the organization, the portfolio management method in TNO, Flightmap, and future research.

## 8.2.1 Organization

**Acceptance**
As described in chapter 2 portfolio management has a big impact on the culture. This and the complex context it has to be implemented in can cause a lack of acceptance, which is visible in the difference in implementation between the units in TNO.

For the effectiveness of portfolio management, the organization must support the usage. The decisions are only as good as the data that is provided. “Garbage in is garbage out”. As found in chapter 3 the process is often received as a lot of extra work without a clear value for the user. It has the image of being useful for the higher management but not for the product teams, who do most of the work by gathering and inserting the data.

This thesis tried to improve the acceptance by creating a system that is appealing and creates value for the different users, e.g., searching for related PMC’s, creating overview on all levels, and an intuitive and seamless workflow. To further improve the acceptance the integration of all systems can be improved and the gaps in portfolio management can be filled, e.g., as described later in this chapter: the usage of impact and balance.

*“Promote portfolio management by showing the value it brings to the user.”*

**Role structure**
Currently, governance is based on the organizational structure of operation, science, and market. With portfolio management being introduced as a new horizontal layer it does not always have the proper governance support. Based on the research done in this thesis there is a responsibility missing in the validation and assuring consistency of the data. A solution can be to create a portfolio manager role, this is close to the unit’s strategist and can therefore be combined.

**Sharing**
The findings in chapter 3 show the desire to share highlights and update each other on the progress of PMC’s. The highlights have a big impact on the motivation of employees but do not have a big contribution to the portfolio decision-making process. Therefore in this project, the decision was made to move this process into Flightmap, by providing the possibility to create milestones and share the progress of PMC’s. This can be extended into the work process in the form of conferences, where PMC’s present to share work, problems/issues, experiences, and ask questions. This is already used in other units and frequently present in the portfolio management literature.

Next to this TNO started with knowledge-sharing meetings on portfolio management-related topics. This is a good initiative and helps with the success of portfolio management, consistency, and acceptance.

**Involvement**
As found in chapter 2 the portfolio mindset affects the outcome of the portfolio management process. Currently, portfolio management is only used by the higher management. The possibility for PMC and cluster managers to see all PMC's is received well and improved the awareness in the organization. Therefore it would be good to extend the access of Flightmap to the layers under PMC's. For the experts working on the project it is beneficial to have access to the PMC they are working on. To see what they are working towards and how their project contributes to the PMC's and the TNO ambitions.

## 8.2.2 Method

**Review process**
It is briefly mentioned in the presentation of the solution in chapter 7, an evaluation on the full portfolio of a roadmap can be of great value for the unit. In literature often referred to as portfolio management review meetings enable the higher management to steer the portfolio towards the corporate goals and trends in the market. Additional to the review meetings it would be a good opportunity for the directors to do their own review in Flightmap.

**Impact**
The factor impact is currently minimally used in the portfolio management process. This thesis introduced the aspect of balance and content goals in the portfolio, where a first step into the use of impact of PMC's was made. To use the impact in these evaluation methods it should be defined carefully, to keep it consistent and fair.

**FRITS and Content quadrants**
The criteria are very helpful to make portfolio management more tangible, it gives the management grip on the complex content. Found in the research phase of this thesis is the lack of understanding and awareness. The consequence is an inefficient execution process of the portfolio management activities, e.g., decisions are not made the correct way or with wrong interpretation of the data. The exact cause of this problem should be further research. It could be because of the training, which is very basic and based on the method during the introduction, over the years a lot has changed which can lead to confusion. Or not enough guidance in the process, this is partly provided in the solution in this thesis.

## 8.2.3 Flightmap

**Usability**
Given the limitations in the contract with Bicore, this is a difficult point. Changing the content on the screen can only help to a certain extend. The biggest downside of the current tool is the interface, it is outdated and not attractive, it has a big effect on the work experience of the user. Therefore TNO and Bicore should look into options to solve this.

**Flightmap potential**
Even though the design possibilities in the current tool are limited there are several functions in Flightmap available which are not currently used by TNO. In chapter 7 the possibility to create clusters called 'waves' is pointed out to improve the consistency with the method. The creation of dashboards is a good start and can be improved by using graphs that are currently not used.



## 8.2.4 Further research

As figure 1.65 shows the development and hype of strategic portfolio management is not on the top yet, there is still a lot of need for solutions. Research topics found are explained in this section.

**Calculation**
Defining the impact, finding the right balance in the prioritization, and preventing bias in the process all complex questions with no clear solution yet. As found by Gartner in figure 1.65 AI-Enabled PPM is on the rise, this has great potential but should be handled with care. The outcome of these calculations can have a big impact on the organization, e.g., it can steer the organization in a completely wrong direction or create a negative culture within the organization. It can make or break the activities in the organization.

**Automation**
Automating the decision-making process, how far can a computer program go in the prediction of the best portfolio. It is likely possible to create an algorithm that calculates the most valuable products and combines the best portfolio based on several parameters. These parameters can be changed by the management. The question is if this is possible, on a technical as well as social level. What is the impact on the cultural aspect in the organization and on the success of the portfolio?

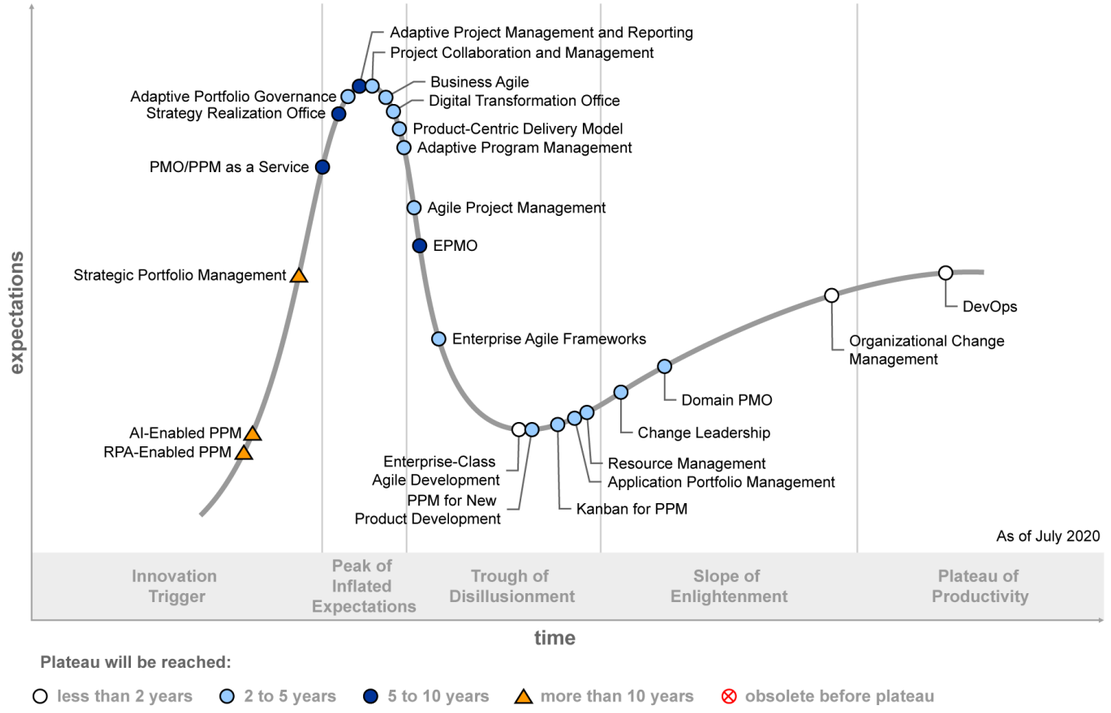



Figure 1.65 The hype cycle analysis on Project and Portfolio Management in 2020 by Gartner.

# 8.3 Personal reflection

## 8.3.1 My experiences

Covid-19 tested my patience. I was thrilled to start with my project in the aviation industry. Unfortunately, the industry got hit hard by the Corona crisis, where the best decision was to not start. I was lucky enough to find TNO, which was the perfect situation to conduct this research project. The first steps were made with portfolio management which allowed me to analyze this and make improvements. It could use research literature, research in the context, and use my past experiences with portfolio management to bring this project to the right end.

This past half-year was over really quick, even with working from home it was a fun and great learning experience. The reason I liked it so much is the setup of the project, all my interests are combined into one journey. From researching in a business context and the topic of innovation management to working with digital solutions.

**Stakeholder management**
After the first endeavor, I had the opportunity to do my graduation project intern at industrial design engineering. I deliberately chose for a company to learn and find my way within an organization. After this half-year I can say the contacts with so many people in the organization helped me during the project, it gave me motivation and inspiration. I learned to find my way through the different departments and silos.

**Presenting and reporting skills**
Having so many stakeholders involved also learned me to present my results in a lot of different ways. To colleagues that I met every week or colleagues that I met at the beginning and end, a wide diversity of departments and expertises. It felt good to change my way of presenting and experiment with new methods.

## 8.3.1 Personal ambitions

At the start of this project, I had, next to delivering a great result, a couple of learning goals for myself.

**Drawing and storytelling.**
Drawing was never my favorite, whenever I had a choice I would go for digital solutions to solve the problem. During this project and especially the scenario part I improved my skills. It showed me the possibilities and ease, the combination of drawing on paper and digital solutions together is a great way to present content.

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# APPENDICES

# Appendix A Initial project brief

DESIGN FOR our future

TU Delft

## IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

**USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT**

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

### STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: van der Werff
initials: N.C. given name: Nard
student number: 4161556
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): IPD | Dfl | SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: Honours Programme Master
specialisation / annotation: Medisign | Tech. in Sustainable Design | Entrepeneurship

### SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Niko Vegt dept. / section: DA
** mentor: Albert Plugge dept. / section: DOS
2nd mentor: Peter Paul van 't Veen
organisation: TNO
city: Den Haag country: The Netherlands
comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.





TU Delft

**Procedural Checks** - IDE Master Graduation

### APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Niko Vegt date 02 - 10 - 2020 signature

### CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed
NO missing 1st year master courses are:

name date - - signature

### FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED | NOT APPROVED
Procedure: APPROVED | NOT APPROVED
comments

name date - - signature



Initials & Name N.C. van der Werff Student number 4161556
Title of Project Improving a strategic digital innovation management tool

Improving a strategic digital innovation management tool — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 30 - 09 - 2020 — 10 - 02 - 2020 end date

## INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The 'Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek' (TNO) is an independent research organisation. TNO consists of 9 units which each focus on a different knowledge domain relevant to The Netherlands and Europe. This project will be carried out at the unit Buildings, Infrastructure and Maritime (BI&M). The focus of the unit lies on reliability of existing and future structures as well as the transition to an energy-neutral and circular economy.

BI&M started 3 years ago with the implementation of portfolio management, consisting a process/structure and a digital tool (Flightmap). The structure is set up as follows, the unit has several clusters with their own topic. Within each cluster there are several PMC's ('product markt combinatie'), which is a set of projects that together fulfill a need in the market.

This project's main focus is on the use of data and the digital tool for the process of strategic decision making in portfolio management. Portfolio management (PfM) is the set of activities that allows the company to select, prioritize and follow the progress of projects or strategic objectives, in this case PMC's. (Pennypacker & Dye, 2002) PfM creates an overview of all objectives and enables the higher management to make an informed decision. By making the value of each objective visible and link it to the strategy, the need and funding can be justified.

TNO is a non-profit organisation which receives most of the funding from government agencies or EU support. Therefor, objectives should have a social need, the innovation should be unique and not block any companies in the market. This makes choosing the right objective and managing the objectives over time even more important. The selection of these objectives is not always easy, some of the difficulties faced often are conflicting goals, qualitative results, uncertainty, risks and the amount of feasible solutions (Ghasemzadeh & Archer, 2000).

Less than a year ago in an evaluation the director team concluded the PfM solution is not yet like it should be. Flightmap is often perceived as unclear with too much data and employees can not find the right information, too much data is shown and there is not always space for the necessary information. On the side of the management teams the data shown is not clear or irrelevant, therefor it is hard to constantly work with the tool.

A limitation that this project will face is conducting the interviews and user test sessions. The people who will use the solution have a full-time job and will be busy which makes it harder to plan everything in the short period of time. Because of Corona it's harder or impossible to have meetings in person so meetings via digital platforms will be necessary, which can be difficult for user tests with a prototype.
Another limitation is the development of the tool. The tool is developed by another company, which makes it more difficult to make changes and do user tests. There are multiple workarounds such as creating a prototype or temporary client-side changes which need to be explored.

Ghasemzadeh, F., & Archer, N. P. (2000). Project portfolio selection through decision support. Decision support systems, 29(1), 73-88.
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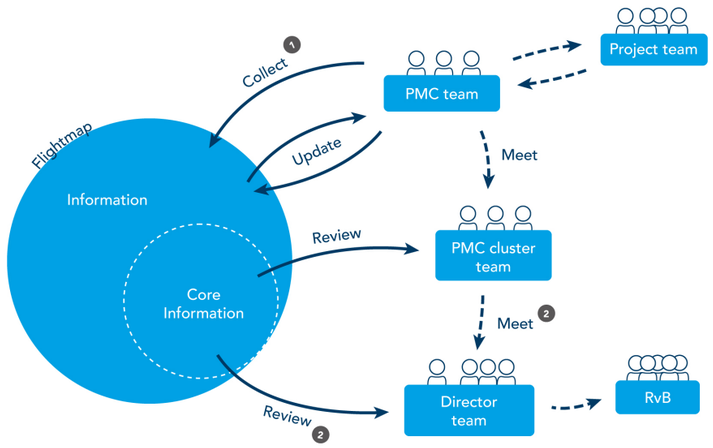



image / figure 1: Interactions of stakeholders with Flightmap and the flow of data

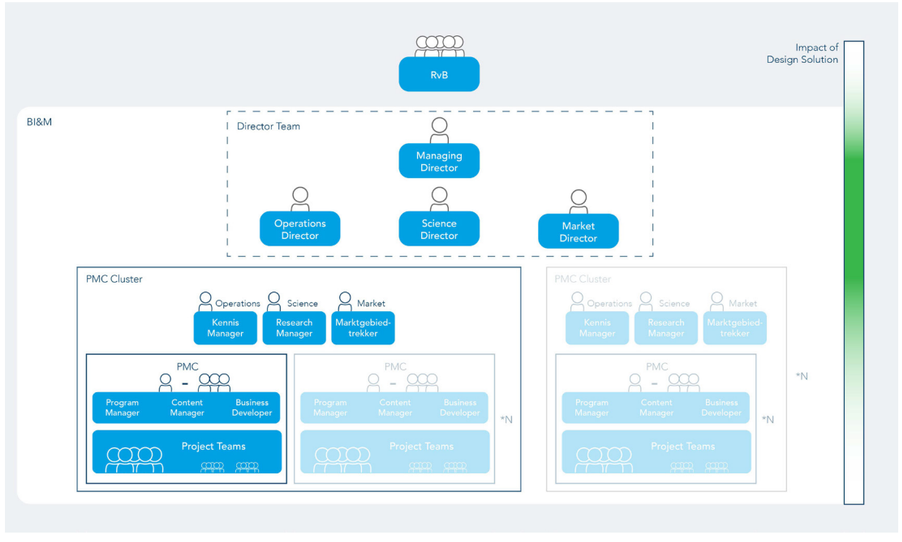



image / figure 2: A visualization of the organizational structure and impact of the design solution

## PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

TNO made the first steps in the implementation of PfM, where BI&M is one of the units with the most progress. There is a strong vision on the method of managing the portfolio and how to use this in the current organizational structure.

To create a holistic view of all the PMC's in the unit there is a need for data. This data is inserted by the PMC (cluster) managers into Flightmap (note 1 in figure 1), Flightmap is in a way the front-end of the PfM instrument. TNO is doing a good job at gathering this data, from every PMC there is a clear description and list of attributes. But it takes time, managers often do not understand the need or the value it brings them.

There is a lot of data stored but it is not used to the fullest, the output of the tool can be improved. The data is often not relevant to the user or too much data is shown. The information is always shown in the same format, it is not personalized for the different users. An example of this usability problem are the director meetings (note 2 in figure 1), to prepare the data for this meeting the strategy manager copies the text from different pages in the tool into a Word document or PowerPoint presentation.

During meetings it is not always clear which data is needed, e.g. during PMC progress meetings with PMC managers and the team of directors they often end up in a discussion about the details of a PMC, which is not the aim of the meetings. The vision on which data is necessary to make strategic decisions and align the tool to provide this data will improve the efficiency and communication within the unit.

TNO started well with implementing the PfM structure and method, on the other hand the knowledge about the necessary data and information transfer as well as the usage of the digital tool in the PfM process can be improved.

## ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... . In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Improving a digital strategic innovation management tool by utilizing the available data and organizational interactions. The aim is to create a digital tool that provides the optimal experience for the director team and PMC teams to manage the portfolio, to have overview of all objectives and to enable them to make informed decisions. The information displayed should align with the user needs and make the tool suitable for usage in the ongoing review process.

As described throughout the paragraph above, the usage of the tool and available data in the management process can be improved. The most progress to be made is on the reviewing part of the method and digital tool (note 2 in figure 1). The aim of the project will therefor be to align Flightmap with the implemented PfM solution, where the focus lies on human behavior. The current tool is pre-made and doesn't always fulfill the needs of the users. This project will improve the use of the tool in the ongoing process of PfM, the main stakeholders will be the director team and PMC cluster managers (see figure 2). The research questions to be answered are:

- How can TNO better integrate Flightmap in the process of PfM, with the focus on the output of the tool?
- What data do the team of directors and cluster managers need to make decisions about the portfolio?
- What data do the different stakeholders need and how to visualize this?

Flightmap is an of the shelf tool, a strategy team of TNO is working together with the developer to improve the tool. The collaboration is limited because at this moment the developer is not willing to make big changes in the tool for TNO. In this project there will be a close relation with the strategy team as well as the users of the tool, see the planning for examples. The project will be a combination of a digital prototype together with a vision on the method. This will be an ideal but realistic (given the limitations in the collaboration with the developer) redesign of the current solution.

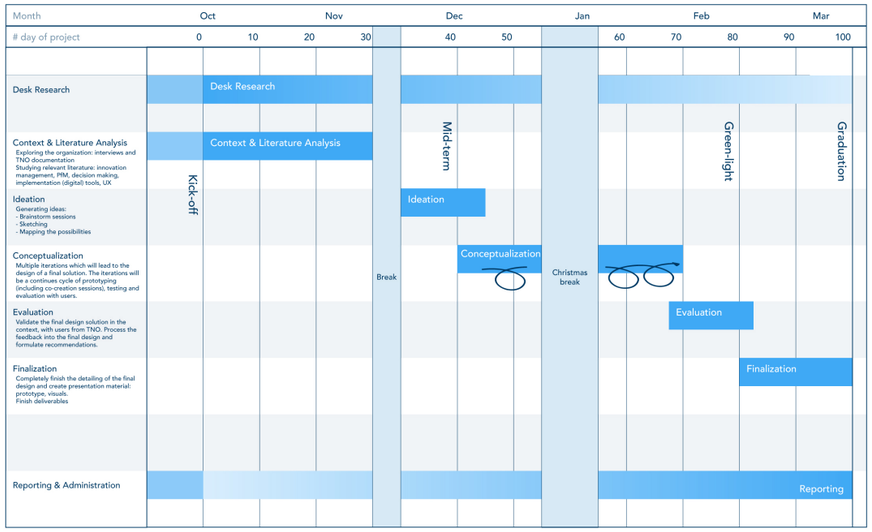




## PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 30 - 9 - 2020 10 - 2 - 2020 end date




To make it better readable I translated the Gantt chart from Excel into an image. During the project I will use my Excel planning and update it during the way.

- Before the kick-off I took three weeks to orientate within TNO and in the topic of portfolio management to define an interesting and relevant project for TNO and for me. In these weeks I could already look around and talk with people.
- After the official kick-off I will continue this context analysis and dig deeper into literature that can help me understand the situation. By conducting interviews and join meetings with stakeholders I plan to define the problems and opportunities. Deliverables will include a stakeholder map, user profiles, information and communication flow and usability analysis.
- When I have a clear view on the problem I will start thinking about solutions, first start ideating by sketching and brainstorming with users and fellow design students, followed by quick feedback session with users. With the first idea I will start prototyping bring life in the ideas and get better feedback, starting with low fidelity paper prototypes or digital sketches.
- Depending on the maturity of the ideas I will develop my solutions into concepts and make higher fidelity prototypes, which can contain of graphic screens or click through programs. After multiple iterations fed by co-creation and feedback sessions, I will come to an ideal but also realistic (regarding the relation with the developer of Flightmap) solution. Next to that is the review model of the meetings, for this part I would like to illustrate it and report the findings with a vision.
- I will do a final validation with the users and finalize my project by making visualizations, a neat prototype and the thesis.

**Personal Project Brief** - IDE Master Graduation

TU Delft

**MOTIVATION AND PERSONAL AMBITIONS**
Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... . Stick to no more than five ambitions.

Personal motivation
This is a unique opportunity to learn more about innovation management within a big organization. It is a nice combination between SPD and DFI. I can show my competences from X-Lab (master elective) where we worked on a portfolio management project within KLM and from my DFI master which is focused on the user perspective. On top of this I always liked the combination of the digital environment and psychology, what do people think and how would they react to products.

In my personal time I often take the time to learn new topics, from reading books about cognitive incentives to learning a new digital program or program-language. I am planning to use this knowledge and these programs in this project to bring everything together into practice, i.e. Axure for building quick prototypes.

Personal ambitions
Ownership - during my study, especially the master, I did projects with groups where companies are involved. But this project I will do on my own and I will be part of the organization, this way I want to show what I personally can add to TNO. I think TNO is a beautiful organization which purely focuses on innovations, this drive for better solutions and looking into the future makes it for me as industrial designer the perfect place to gain experience.

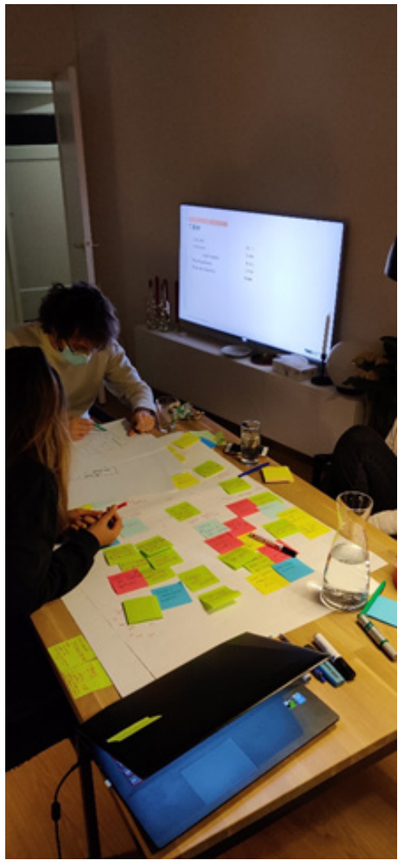
Stakeholder management - I never did a project with so many different stakeholders. Not only on different levels within the organization but also a lot of different roles on those levels, i.e. in most management teams there is someone from market, science and operations. Between all teams there are a lot of different methods used, they all have their own way of working. The challenge is to find a solution that meets the expectations and improve the collaboration.

Reporting – During previous projects most of the time I took the roll of interviewing and focusing on the questions, e.g. the content and knowledge to gain. In this project one of my goals is to improve my reporting. I would like to learn new techniques to report my findings and to translate them into useful insights. One of the directions is the use of visuals or sketching during my notetaking. Within TNO I would like to look around and learn from the collaborations with other people to improve these skills. At the end I want to present a report that I can be proud of.

**FINAL COMMENTS**
In case your project brief needs final comments, please add any information you think is relevant.



# Appendix B Creative session



**Participants**
For the session a group of four people (including myself) is chosen, this is within the Corona crisis measures. The participants are Industrial Design Engineering students from the master Design for Interaction. The session is in-person to maximize the creativity and interactions of the participants.

To facilitate the session the room is prepared with generative and documentation items, e.g. different Post-Its, pencils, flip-over, and enough paper.

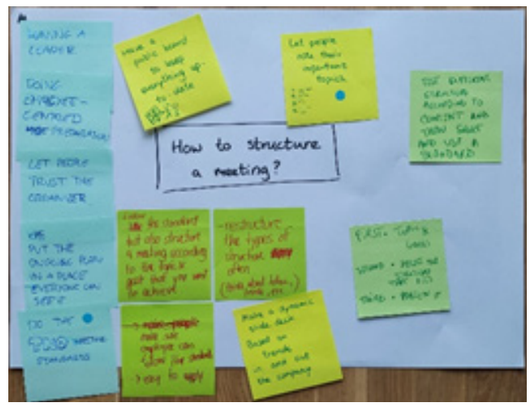
**Goal**
Generating ideas. Exploring other perspectives.

Gathering ideas from people that know the creative process and are not biased by their experiences in the organization.

## Schedule

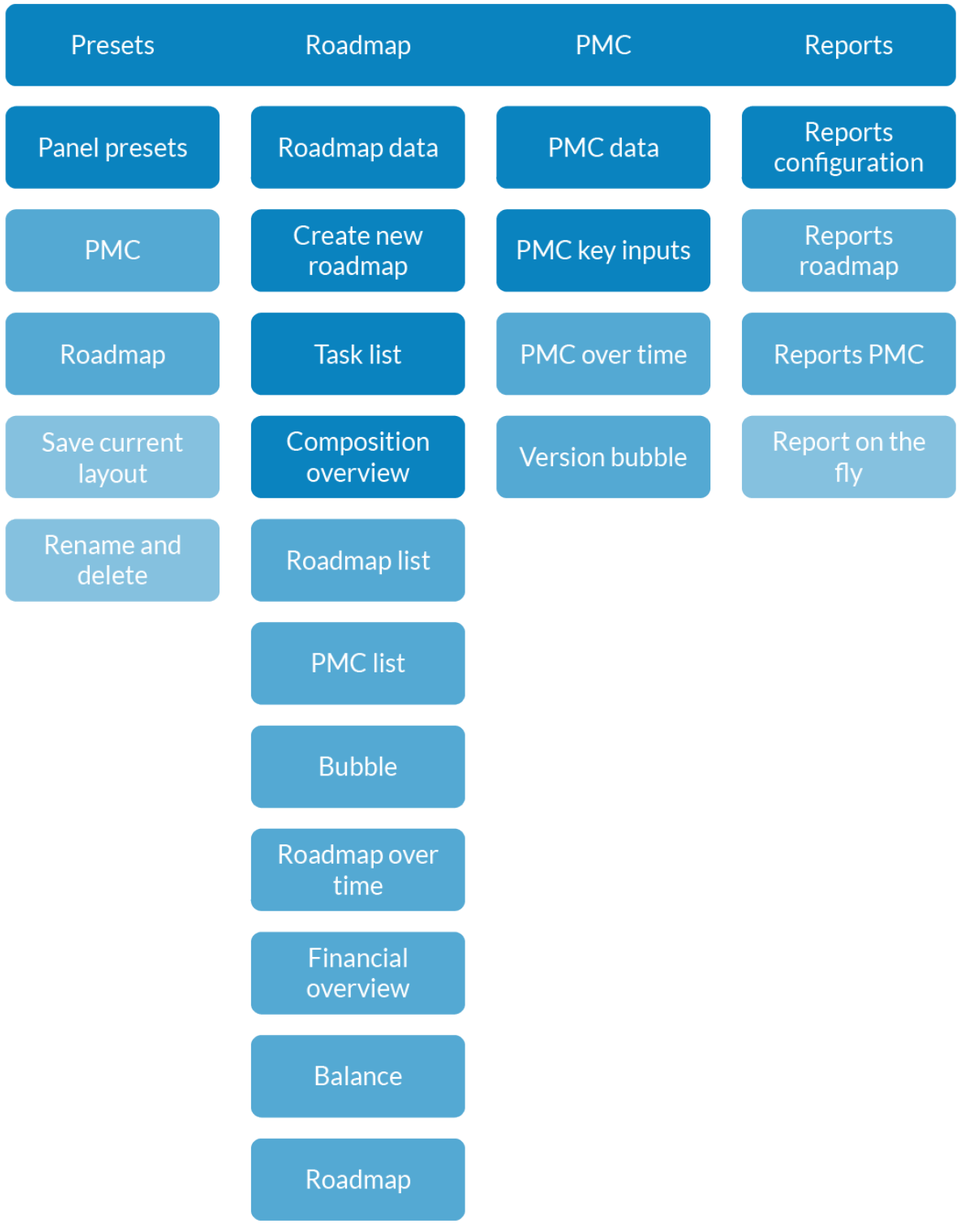
| | |
|---|---|
| Icebreaker | 15 min |
| Get everyone comfortable and into a creative mood.<br>“Draw your day” | |
| Brain dump | 5 min |
| Put the first ideas based on their own project and meeting experience on paper. To clear the mind and get the participants involved in the creative process. | |
| Explain project | 15 min |
| A presentation with an introduction of TNO, basics of portfolio management, the key findings, and design vision. | |
| Problems possibly occur | 10 min |
| Exploring different perspectives on the problem statement and design vision. | |
| Cluster | 5 min |
| Create clusters of problems | |
| Formulate 5 How To’s | 5 min |
| From the clusters create 1-5 How To’s to explore and ideate about. Multiple How To’s are prepared by the host to add or combine with the created ones. | |
| *Break* | *10 min* |
| Brainstorm with How To’s | 15 min (5x 3 min) |
| Cycling through the How To’s. Every participant puts their ideas on a Post-It on the paper in front of them. They can draw new ideas or build forth on previous ideas. | |
| Select 4 good ideas and 2 crazy ideas | 15 min |
| Each participant selects 4 good ideas and 2 crazy ideas by using colored stickers. | |

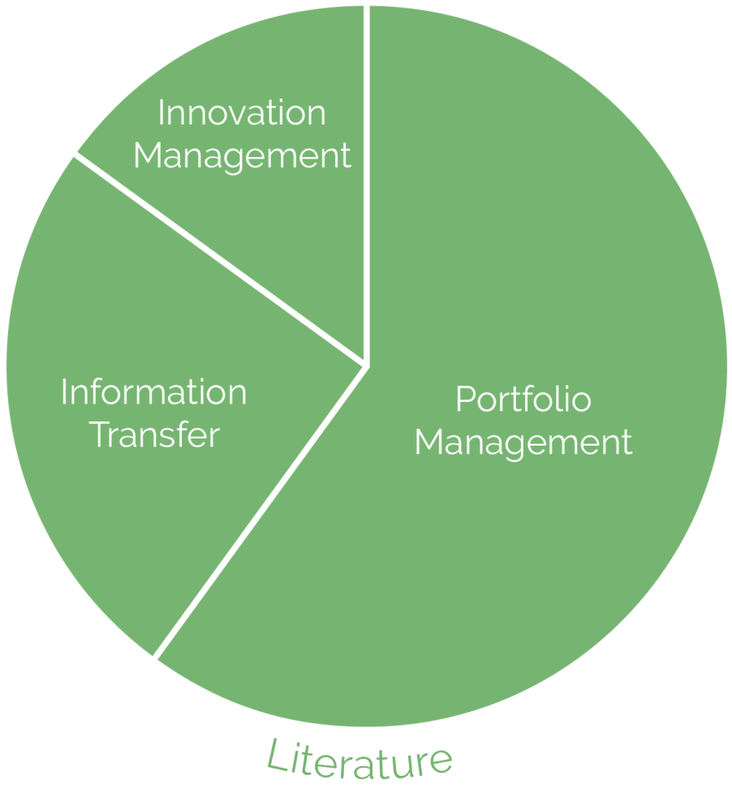
## Results

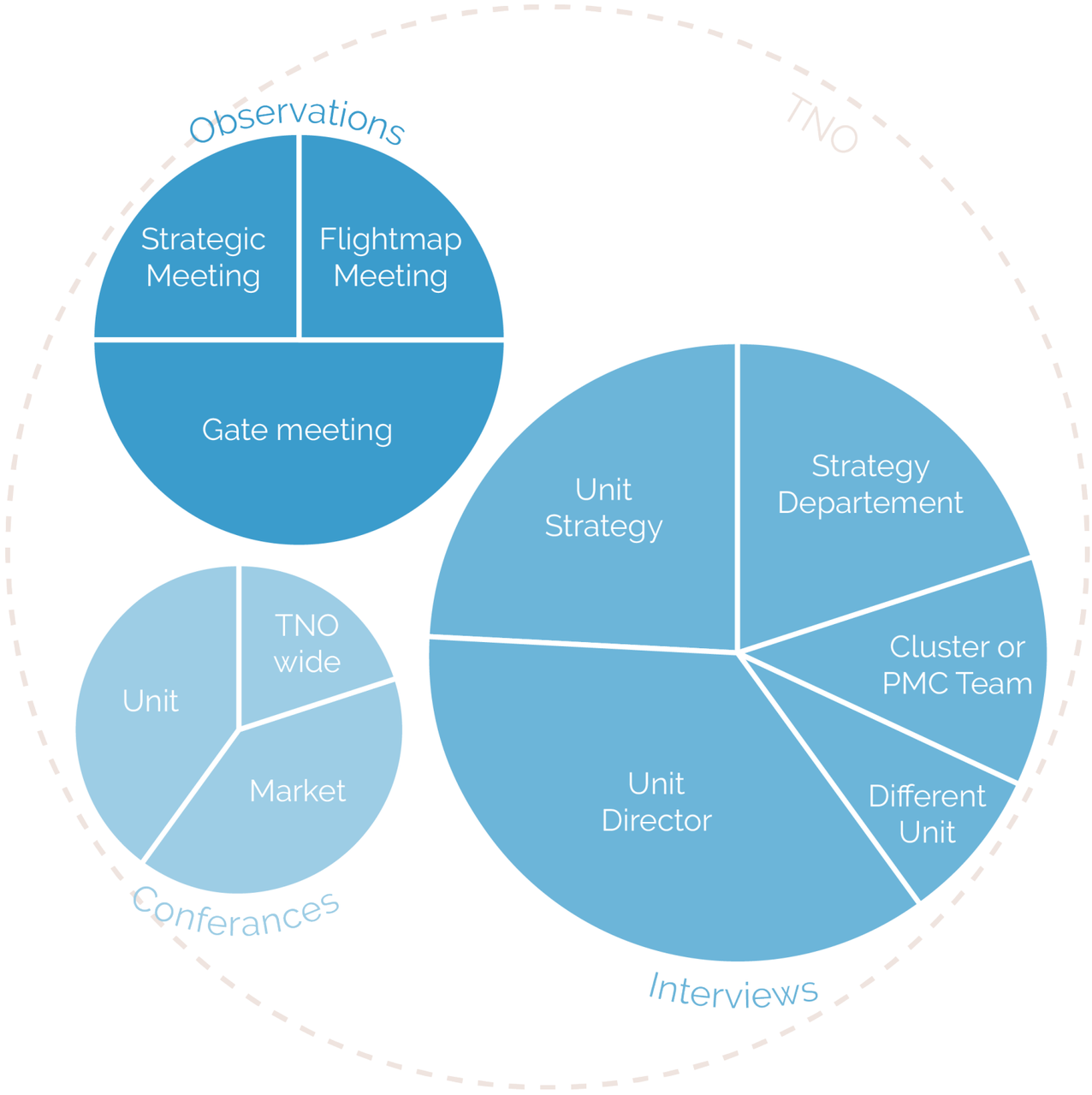



# Appendix C Flightmap analysis

The navigation drop-down menu of Flightmap




Innovation Management
Information Transfer
Portfolio Management
Literature


TNO
Observations
Strategic Meeting
Flightmap Meeting
Gate meeting
Unit
TNO wide
Market
Conferances
Unit Strategy
Strategy Departement
Cluster or PMC Team
Unit Director
Different Unit
Interviews

# Appendix D Final design overview

## Roadmap

### Owner

**Overview**
Name, description
Image
Milestones
Bubble: Total (SMO + OIT) spread

**Focus**
Problem
Goals
Content Quadrants
Description
Image

**Balance**
Bubble: SMO spread
People, Planet, Profit (heatmap)
Number of PMC's
Funnel spread
Risk
Type

**List**
Cluster, PMCs
PMC status
Total (SMO + OIT)

**Timeline**
Meetings
Preparations

### Public

**Summary**
Name, description
Image
Team
Milestones
Bubble: Total (SMO + OIT) spread

**Focus**
Problem
Goals
Content Quadrants
Description
Image

**Cluster + PMC list**
Titles
Budget

## Cluster

### Owner

**Overview**
Name, description
Image
Milestones
Bubble: Total (SMO + OIT) spread
Gate crossings

**Focus**
Problem
Goals
Content Quadrants
Description
Image
Contribution to VP plans

**Balance**
Bubble: SMO spread
People, Planet, Profit (heatmap)
Number of PMC's
Funnel spread
Risk
Type

**List**
PMC names
PMC status
Total (SMO + OIT)

**Timeline**
Meetings
Preparations
Gate crossings

### Public

**Summary**
Name, description
Image
Team
Milestones
Bubble: Total (SMO + OIT) spread

**Focus**
Problem
Goals
Content Quadrants (with identifiers)
Description
Image

**PMC list**
Titles
Budget

## PMC

### Owner

**Overview**
Name, description
Image
Milestones
Goals

**Progress**
Actual vs predicted SMO & OIT
Milestones + meeting reports/links
Goals, actions and status
Financials

**Timeline**
Meetings
Preparations

**Focus**
Problem, solution, target group
Goals
Content Quadrants
Contribution to VP plans

**Details**
Title + description
Image
Heatmap
Financials?
Roadmap, cluster, unit
Important dates
Stage
Team

### Public

**Summary**
Name, description
Image
Roadmap, cluster, unit
Important dates
Stage
Milestones
Team
Tags

**Focus**
Problem, solution, target group
Goals
Content Quadrants (with identifiers)

Discover

### Structure
Roadmaps
Cluster
PMC
Connections

Personal

### Dashboard
Quick links
Tasks
Timeline
PMC status
Bubble + changes
Key insights

### Timeline
Upcoming meetings and tasks

### Task list
Tasks to be done
Checklist

Meetings

### Strategic meeting
Agenda
Goal of the meeting
Progress (financial, milestones, bottle necks)
Resources
Cooperation
Results + action points

### Gate meeting
Agenda
Recap on old goals + progress
New goals
Activities to reach the goals
Results + action points

Export

### Report
Several presets for reports which can be adjusted and composed by the user

### Meeting
Several presets for meetings which can be adjusted and composed by the user

Create

### Roadmap/Cluster/PMC
A guided process to set up a roadmap, cluster or PMC