UNIVERSITY OF TWENTE.

·mobina·

SUPPORTING THE INNOVATION PROCESS OF INDUSTRIAL SMES USING MOBINA

The first design cycle using mockups and a validation focus group

Master thesis
Business Information Technology
02-02-2018

J.G.J. (Jochem) Verburg

Examination committee

Prof. Dr. J. (Jos) van Hillegersberg

Dr. N. (Klaas) Sikkel

Preface

When I started my Master, I would not have imagined this journey to graduation. I'm very grateful that I have been able to combine my study with setting up our company Mobina. It has been a challenging and rewarding journey, that has made me the person I am today. This combination has allowed me to develop my skills and knowledge to an extent that wouldn't have been possible otherwise. This graduation project has been a great way to finish this chapter of my life by really bringing my Master and company together.

I would like to thank my supervisor Jos for being so supportive of this combination already in an early stage. This has allowed me to graduate while continuing to build our company. He has always provided me with great guidance and advice to make sure I could bring this project to a successful end. I also want to thank Klaas, my second supervisor, for his trust in me and extensive feedback to ensure my thesis combined practice with scientific rigor. When necessary, he would always make time to give me additional feedback.

Of course, I also want to thank all people in Mobina. Our software team, Jasper and Marlène, made sure I could easily make my designs. A special place is also reserved for René and Marlène, who have always supported me to a great extent. They always made time for me to review my progress, even with very short notice. More importantly I'm very grateful, how they always supported me and were looking out for me. They made sure that I redirected my graduation project in such a way that it would not only provide value for Mobina, but would also align with my personal interests.

Next to this, I would like to thank all people who have helped to review my designs and deliver a great result. All participants to the focus group and interviews have tried unselfishly to improve my work and Mobina with their feedback. Therefore, I would like to thank Marc Droste, Bart Jansen, John Stevens, Matthias de Visser, and Bram de Vries for their contribution to this final result. Special thanks to Hans Wortmann, who has not only contributed to my focus group, but also helped me on multiple other occasions to improve my results.

Finally, I would like to thank my family and friends for their emotional support throughout my Master and Master's thesis. A special thanks to my parents who have supported me in all possible ways throughout my entire (academic) life. Marlène also had a very special place in this. She was always there for me if I needed it, even in the busiest and hardest of times.

Jochem

Abstract

Mobina provides Knowledge-as-a-Service through collaboration software which gives companies the opportunity to collaborate with the entire organization on discussions related to business processes, innovations, and their information landscape. The Mobina software hands small and medium-sized industrial companies the tools and knowledge to analyze innovation opportunities and optimize performance by aligning business and IT.

Mobina wants to extend its software to improve the support for innovating (business) processes. This report describes the design of functionality to support the following aspects, which have been identified as essential for the intended support:

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);
Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

This report describes the design research executed as the first iteration of the design cycle. Mockups and global data models have been developed to present global designs which support these aspects. The designs have been validated using a focus group and interviews with experts. This design and validation method have led to a structured approach, which ensures a solid view on the usability of the designs. Focus groups can also provide a useful validation method in other design science research, as well as for software evaluation in practice. Therefore, this report extensively describes the usage of focus groups and the lessons learned from this case.

The design exists of three functionality areas: open innovation, strategy & goals, and actionables & projects.

Two concepts have been developed to support open innovation: partner discussions and innovation ideas. These can be implemented independently from other functionality. Partner discussions provides an additional discussion space for users to collaborate with business partners, while keeping control of the shared information. Next to this, by using a separate knowledge object for innovations, Mobina can help users by providing innovation ideas in a structured way for useful innovations in processes and documents.

Secondly, it is useful to include goals in Mobina. A number of goals can be marked as strategic, whereas more operational goals can also be used to link to comments, innovations, and others. The strategy allows company to develop a vision on the innovation process instead of adopting innovations ad hoc. The definition of goals can help companies to communicate this vision and make goals more concrete. It is important to also relate the goals to each other and other objects to create insight in cause and effect.

Finally, actionables can be used to transform from the current software, which is mainly issue-oriented, to idea-orientation for prioritizing and monitoring. Functionality linked to actionables can effectively help companies in the void between idea generation and the actual project. Actionables can be combined in projects to provide project management functionality, like prioritization, risk management and business cases.

The validation led to several important conclusions for Mobina. The designed functionality can lead to continuous usage of Mobina. The two concepts for open innovation, partner discussions and innovation ideas, are most ready for implementation, and most well-received. They can be

implemented independently from other functionality. Actionables in combination with goals can help companies effectively in the void between idea generation and the actual project, the pre-project phase. Therefore, this would be a logical first step to expand the support for the innovation process. The usefulness of strategy functionality will differ per organization and should be tested further in the future. Next to this, project management functionality should probably either be supported fully, or not at all. Supporting project management functionality fully in Mobina would be a logical next step.

This research also provides implications and recommendations for others than Mobina. The design and validation method proved effective for this design phase. This research shows the usefulness of mockups for the first design iteration in software development. Focus groups can also be used as a validation method in design science research and for software validation.

Next to this, lessons on each of the functionality areas have been learned. Open innovation is useful for industrial SMEs, but they need support to effectively adopt open innovation. SMEs need support on selecting open innovation practices, identifying pitfalls, and finding partners. Strategy in decision-making can help achieve long-term success, but more research on the usage of strategy in SMEs is needed. Traceability and monitoring functionality are important to adopt a successful innovation process.

Finally, software companies and users should carefully consider their position on the scale from best-of-breed to integral support. Each has its advantages and pitfalls. Researchers might add to the body of knowledge with guidelines for this decision.

Table of Contents

Acronyms

AR	Action Research
BPR	Business Process Reengineering
BSC	Balanced Scorecard
EA	Enterprise Architecture
ERP	Enterprise Resource Planning
FMEA	Failure Mode and Effects Analysis
IoT	Internet of Things
IP	Intellectual Property
IS	Information Systems
IT	Information Technology
KaaS	Knowledge-as-a-Service
KPI	Key Performance Indicator
OEM	Original Equipment Manufacturer
OI	Open Innovation
RPN	Risk Priority Number
SME	Small and/or Medium-sized Enterprise
SPMS	Strategic Performance Measurement Systems

1. Introduction

Mobina is a software tool which gives companies the opportunity to collaborate with the entire organization on discussions related to business processes, innovations, and their information landscape. Industrial companies are continuously challenged to improve. Mobina hands these companies the tools to analyze innovation opportunities and optimize performance by aligning business and IT.

The tool offers a process reference model, tailormade for a specific type of industry, with an extensive collaboration environment to identify innovation opportunities and discuss business processes. It helps businesses to align processes with their information systems and gives insight in the qualities of different information systems with a special focus on ERP systems. Mobina is developed to mobilize organizations, discuss innovations, and make sure the IT landscape stays aligned.

The strength of Mobina is believed to be its ability to make a match between a top-down and bottom-up approach. Mobina stimulates companies to consider the knowledge of people in the organization and match the strategy and ideas of the management with the consequences and possibilities at the work floor.

Mobina would like to identify opportunities to extend the application for even better support to stimulate innovation in small and medium-sized industrial enterprises, especially in the manufacturing industry. The current product is really focused on a project basis. Employees work with the product for several months to identify issues and potential improvements. In some cases, they will use it for ERP selection and try to identify a shortlist of candidate ERP systems. However, Mobina IT would like to explore whether more continuous support can be given to stimulate continuous improvement in industrial enterprises at the edge of business and IT.

This thesis proposes an extension. This extension focuses on the following aspects, identified for Mobina in an earlier stage:

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);
Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

This chapter first describes the problem statement. It gives an overview of the problem Mobina tries to solve, why this is important and how Mobina could add value for this problem. In the last section, the thesis structure is described.

1.1. Problem statement

Mobina is a tool that helps companies improve themselves. It tries to stimulate innovation and process improvement in companies by helping their employees identify opportunities and collaborate to grasp those opportunities. Next to this, Mobina believes that a large potential to improve lies within company's information systems and that these systems should be aligned with the company. This information landscape is often complex and difficult to overlook. Mobina believes innovation, process improvement and information systems are crucial for companies to stay competitive and that their tool can help them. Mobina doesn't only provide them tools, but central to the software is the so-called Knowledge-as-a-Service which helps companies on these topics. This problem statement describes why Mobina is a useful software application for its (potential) users, and why it provides a good basis for additional innovation support.

This section will first describe why innovations and process improvement are important for the competitiveness of companies, especially industrial SMEs. Afterwards the importance of aligning information systems is discussed, an important aspect of Mobina's Knowledge-as-a-Service. Then, it will discuss which type of options currently exist for industrial SMEs to support these aspects. Finally, the problem statement contains a section about the additional value of software tools, and specifically Mobina. This helps establish the value to extend Mobina with additional support for the innovation process.

1.1.1. Competitiveness of companies

Innovation is recognized as a very important aspect for a sustainable competitive advantage (Roger J. Calantone, Harmancioglu, & Droge, 2010; Moore, 1993). Companies that don't innovate, are bound to lose against competition that improve their product and/or processes to give customers better offers. Two companies which have survived because of their ability to innovate are for example 3M (von Hippel, Thomke, & Sonnack, 1999) and IBM (Moore, 1993). IBM lost its position in personal computing, however managed to survive by continuously finding new market opportunities.

Innovations can happen at two levels: products and processes (also process improvements). Although emphasis changes throughout the development of a product, both are important to continuously improve as is shown in Figure 1 (Utterback & Abernathy, 1975).

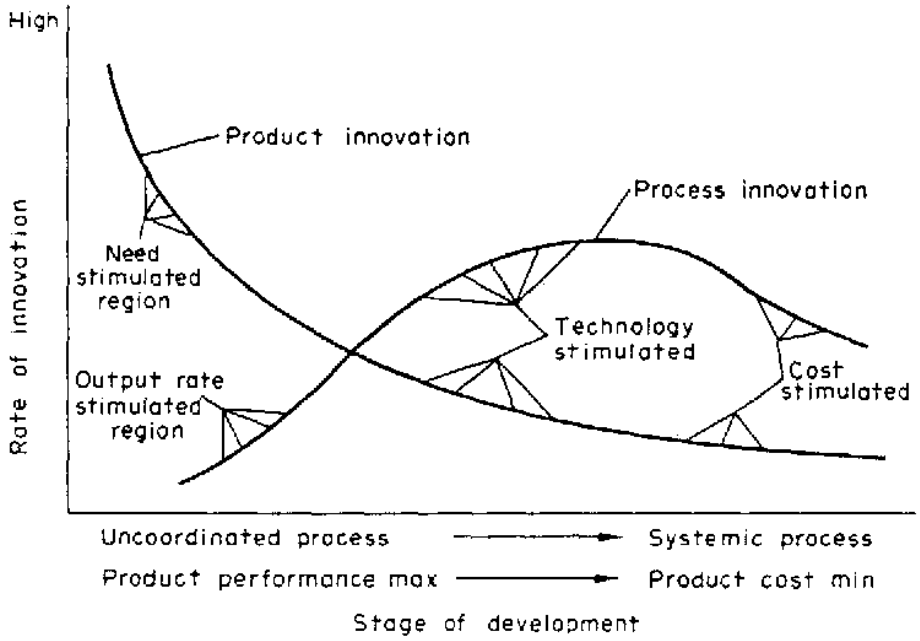


Figure 1 Innovation and stage of development (Utterback & Abernathy, 1975)

A popular method for improving processes is Business Process Reengineering (BPR). The BPR principles demanded radical change in which processes were designed from a clean slate. However, in many organizations this is not possible and a more incremental approach needs to be taken (Kettinger, Teng, & Guha, 1997). This is also what Mobina focuses on. Its process reference models can help users to completely start from scratch, but is mainly focused on analyzing possible improvements on existing processes.

Even though Mobina currently focuses its content on process improvement and innovation, these improvements can also lead to product innovation. To innovate products, processes need to change, and improved processes can also give way for new products by for example being able to combine different modules.

Another important part of most modern-day companies are information systems. Mobina helps companies to improve information systems and align it with the business needs. Information systems can create higher business performance by improving processes. It is therefore also a vital part of BPR approaches (Kettinger et al., 1997). It can for example lead to cost reduction, higher quality and better customer responsiveness (Ross & Vitale, 2000; Shang & Seddon, 2002). Information systems were found to have even more effect in manufacturing companies than service companies (Shin, 2006).

A good alignment between business and IT is needed to achieve the right benefits and create a synergy effect, in both small and larger firms (Cragg, King, & Hussin, 2002). The fit between ERP and an organization is for example an important indicator for successful implementations (Hong & Kim, 2002). Innovations that are not supported by information systems will never reach its full potential. It is therefore important to consider innovations and IT not as two fully separated silos, but as two interwoven areas. Processes should be redesigned to become more effective, and IT can then make sure that their full potential is reached (Mondragon, Lyons, & Kehoe, 2004).

Chan and Reich (2007) made a comprehensive overview of alignment literature and defined several key takeaways for practitioners. They identified that alignment should be a joint responsibility of IT and business executives. Next to this, both business and IT professionals should share their knowledge to achieve good alignment. These lessons also correspond with the lessons related to success of projects, including business in the IT discussions (Bernroider, 2008; Meyers, 1999).

1.1.2. Support options

Currently, industrial SMEs have several options to improve their performance. They can mainly be categorized in: develop in-house competencies, consultancy, and (software) tools.

The first option is straightforward. Companies can try to attract (human) resources that are able to support the innovation and continuous improvement process. However, for many SMEs this is a huge investment. Next to this, it will be difficult for these employees to develop all knowledge necessary, and they will still need additional support to completely function.

Next to this, there are many consultancy services available. There is an abundance of BPR consultants for example (Kettinger et al., 1997), and also IT vendors often offer additional services. However, SMEs are often reluctant to use consultancy services, both in the Netherlands and other countries (Abee, 2014; Barisic & Bozicevic, 2013; Consultancy.nl, 2014; Europe INNOVA, 2012; Urîtu & Ștefan-Florin, 2016). They often find consultancy too expensive and try to use only in-house expertise. When they ask for advice outdoors, they often use already trusted people like accountants or tax advisors. However, these people often don't have the expertise to help them effectively on issues like innovation and IT. It seems that larger SMEs are already more open to investing in consultancy than smaller SMEs. Next to this, SMEs are often unaware they lack knowledge, making it even harder for consultants to convince them of their worth (Kaufmann & Tödtling, 2002).

The last option is an abundance of tools or applications that might also be used in this context. These can be both analog and digital. A well-known example of such a tool is the Business Model Canvas (Osterwalder & Pigneur, 2010), which is used a lot to get insight into business

models. Of course, there is also an application in which this tool can be used digitally[1]. These tools and applications can be categorized and all have their advantages and disadvantages. The full list of tools can be found in Appendix A.

One category of tools which can be used by companies are analog. These mostly have the huge disadvantage that they're for a very specific task and therefore companies will have the difficult task to find out which ones to use and in which context. Because they're analog (or at least not integrated with other tools, since people will have to use generic tools like Word and Excel), it will also be difficult to get an integrated view since data will often be stored redundantly and this can lead to conflicting records. Working together in these tools will also be very difficult when not sitting together. However, being analog also has its advantage. They can easily be adapted by organizations for their specific situation.

Next to this, there are many tools which are very specific. This has a clear advantage, they can be very good at what they support. However, like analog tools this gives companies the difficult task to find out themselves which tools to use, and to integrate different tools.

Another category of tools is innovation software. This software often includes idea management as an important part. However, many tools don't offer a lot more besides idea management. These tools are often very generic, all ideas can easily be shared. This makes it easy to use. Next to this, collaboration is strongly integrated in these tools, making it possible to involve multiple people.

However, being so generic is also their main pitfall. All ideas have to come from the users themselves, companies shouldn't expect any suggestions from the software. In many applications this is centered around specific challenges (for example, how can we make our lead times shorter), which can be useful at times, but doesn't reflect how many ideas arise during everyday work. Idea management often includes only the first phase, which is important but not sufficient for successful implementations.

In some of the innovation software, more is offered. Features like idea evaluation and sometimes even project management are present. This makes them very well suited for a lot of companies to use. However, most companies don't know where to start when trying to innovate or improve. Innovation software has such a broad focus, that it can be overwhelming. Some support for identifying innovation opportunities might be really useful. Information systems are also often deeply integrated into the processes of industrial companies and information exchange is often standardized. This makes it important for companies to be able to keep this link in mind at all times.

1.1.3. Mobina support

Software, and especially Mobina, can help innovation and process improvement in these companies. Voigt, Ortbach, Plattfaut, & Niehaves (2013) researched the properties a system supporting business process innovation should have. They identified two main properties: task heterogeneity and collaborativeness. Innovation also consists of different capabilities: sensing, seizing and transformation.

This collaboration in the software is important to use tacit knowledge in the organization. Tacit knowledge is seen as an important source of sustainable competitive advantage (Johannessen, Olaisen, & Olsen, 2001). R.J. Calsantone, Cavusgil, & Zhao (2002) researched the influence of learning orientation on firm innovativeness and performance. Stimulating the evaluation of operational routines and intraorganizational knowledge sharing were identified as important

[1] https://strategyzer.com/app

aspects. Collaboration inside the whole organization and involvement of the employees is also seen as an important success factor for both innovation and IT projects (Bernroider, 2008; Meyers, 1999). Stimulating companies to use their tacit knowledge and share this within their organization can therefore effectively help their competitiveness.

An important aspect of Mobina is its ability using reference models to allow people to share knowledge regarding their processes in a semi-structured way. Mobina has industry-specific reference models in which people are confronted with their entire range of processes, e.g. the production or sales process, and gets them to share their knowledge about how they work and how processes can be improved. The reference model is an important aspect of Mobina's KaaS, which differentiates it from other software. Companies and users don't have to begin from scratch but have an extensive knowledge base to build on.

Mobina's focus is mainly on process innovation, but it also challenges people to think about how process innovations can improve products and how changed products can be supported by processes. Next to this, Mobina helps organizations identify which information is crucial to exchange between processes and as such stimulate communication between different organizational units.

Mobina tries to improve performance of information systems in industrial SMEs by providing a platform to align processes and IT. As explained, alignment between business and IT is important to effectively support strategy. It links processes to applications in the information landscape to analyze the improvement potential of the combination. However, many businesses don't know where to start. Mobina also helps them identify aspects that could be critical for an enterprise. Gupta, Karimi and Somers (1997), and Cragg et al. (2002) identified that it is important to focus on the most important competitive factors of companies for aligning IT. Mobina challenges its customers on critical aspects, which have a large impact on IT, and whether their information landscape has to change to stay aligned.

Innovation and information systems are critical for sustainability of companies. Mobina seems to provide a sufficient basis to support (process) innovation and alignment of information systems in industrial companies. However, it wants to expand its support. Some aspects of innovation software are for example not yet extensively supported in Mobina, like evaluating ideas and managing a portfolio of ideas and projects. By extending the support throughout the innovation process, Mobina wants to provide a platform for continuous usage by its users.

1.2. Thesis structure

This introduction described the problem and why software would provide a solution. The next chapter describes the research objectives, approach and questions. This gives a better idea of what has to be developed and how it is developed. Chapter 3 describes the choice for a focus group as the validation method, and which aspects to keep in mind for designing the focus group.

To give a better idea of on which software this research builds, chapter 4 describes the current software of Mobina. This has some implications for the research. Chapter 5 describes the way the extension is presented, in the form of a mockup, and which areas of functionality are added. These areas are described in more detail in the succeeding chapters: open innovation in chapter 6, strategy & goals in chapter 7, and actionables & projects in chapter 8.

Chapter 9 describes the validation set-up and the results. This led to several issues that can be resolved in the next design phases. Therefore, chapter 10 includes recommended improvements to take into account in the artifact implementation.

A discussion of the designs, results, and the validity is included in chapter 11. The thesis ends with conclusions and the implications and recommendations for three different types of stakeholders: Mobina, scientists, and (other) practitioners.

2. Research design

2.1. Research objectives

Mobina wants to extend their software to improve their support for small and medium-sized industrial enterprises to innovate their (business) processes. Special attention should be given to those innovations having a large impact on the information landscape or being influenced by the information landscape, since this is one of the most complex aspects for realization and is also one of the core strengths of the Mobina software.

The targeted industrial enterprises are defined as companies which manufacture discrete products. Mobina's software currently does not support companies in for example the food and chemicals sectors. In this thesis, both terms industrial and manufacturing enterprises are used to denote this population, unless mentioned otherwise.

SMEs are often denoted in terms of staff, turnover and balance total, for example by the EU[1]. Mobina targets customers mainly in the personnel size ranging from 50 until 500. These are companies that can benefit most from more cost-effective software. The target customers are not yet highly automated, or 'high-tech', but are looking for a good balance of automation and manual labor. The knowledge and experience of the employees on the shop floor is often an important competitive factor. These companies can therefore highly benefit from the input and collaboration of employees to achieve operational excellence.

Verburg (2017) identified critical success factors of the innovation process to help guide the development efforts of Mobina. Mobina used his research to identify which aspects are most interesting for Mobina to incorporate into the application. A next step in the development of Mobina is to decide which functionality is needed to support the identified aspects:

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);
Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

Persona target customer

Smart Crane is a fictional customer of Mobina. The company has about 300 employees and produces hoisting cranes on customer order which are configurable with predefined options. It has one site where the cranes are produced and sales is coordinated.

The company produces subassemblies based on forecasts of the configuration items and assembles the final product on customer order The employees are crucial in this process, the crane is a complex product which is not engineered in detail for every customer but partly assembled and finished off based on the employees' experience.

To achieve short and reliable lead times in combination with a wide range of options for the customers, good information exchange between all parts of the company is essential. From sales to planning, and from engineering to production. The process is complex and delicate, so wrong or missing information can disrupt the whole company.

Therefore, Smart Crane uses Mobina to discover how it can improve its process and information exchange. This allows them to stay competitive in the future.

Mobina is a tool that positions itself connecting both top-down and bottom-up approaches. It helps management to translate plans into specific consequences and actions; and to identify the impact of changes in the organization. The people in the organization can use their knowledge to make sure the company changes for the better.

The goal of this research is to design and validate functionality in the identified areas for Mobina, that enforces the position of Mobina at the edge of top-down and bottom-up. Mobina doesn't want to develop an Enterprise Architecture (EA) approach or a project management tool, but rather focus on making these concepts approachable for SMEs and the work floor.

The designed functionality should be validated, but will not be incorporated yet in the working application. The focus is on deciding which functionality is needed and creating an artifact to validate the usefulness of the functionality. As such any interface designs should support the demonstration of the functionality, and does not focus on details of like button placement or other user friendliness aspects.

2.2. Research approach

Mobina currently already has a software tool aiming to improve company's success by helping them to effectively and efficiently innovate and improve their processes. A strong focus in the product is on achieving this by making sure the information landscape is well-aligned. The goal of the research is to design an extension to Mobina. As such, this is a design problem. Using the template for design problems (Wieringa, 2014), this is the design problem:

Improve the innovation and improvement process of industrial SMEs (on factors like speed and quality of innovation, and strategic alignment)
by incorporating extra functionality in Mobina
that helps companies discover innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (or open innovation); assess and select those possibilities that are best for the organization; and monitor and control the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.
in order to improve their competitiveness (on factors like speed, through put time control and costs).

Both Wieringa (2014) and Peffers et al. (2007) presented methodologies for executing design science. These methodologies can be used to structure the design science process, even though part of the process of transforming objectives to an artifact might seem intangible. Due to its simplicity and clarity, I use the Design Research Methodology by Peffers et al. (2007) presented in Figure 2.

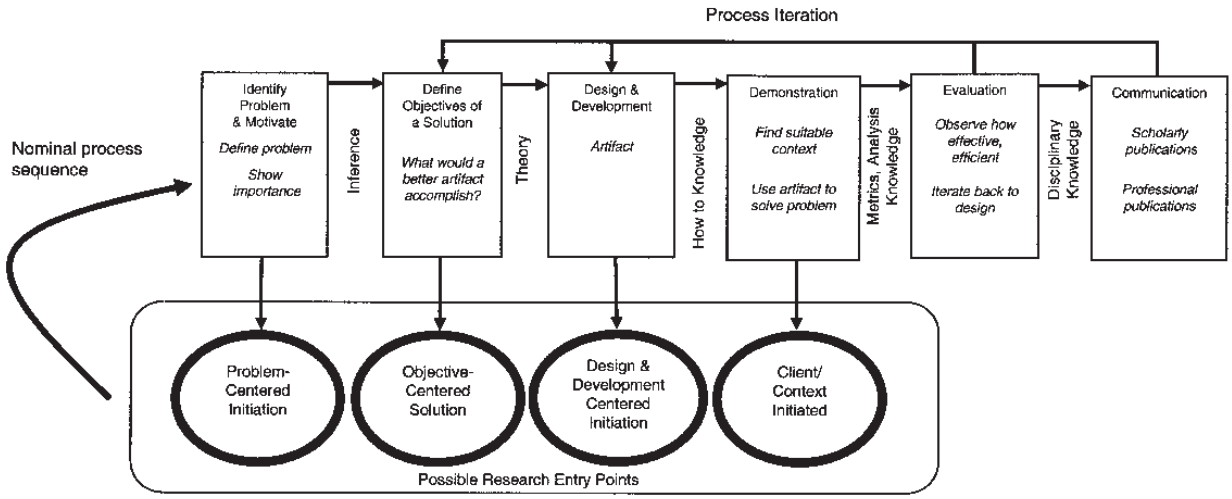


Figure 2 The Design Science Research Methodology (DSRM) Process Model (Peffers et al., 2007)

Research can be started in different phases. In this case, both the final goal (or the problem to be solved) and the objectives of the solution have already been set by Mobina and thus the research will be entered through a design & development centered implementation. Although the first phase of the research will be to shortly establish the problem (see section 1.1), these will be largely taken as a given. The objectives have been defined by Verburg (2017), the report can be found in Appendix B. The design research will be focused on designing and validating the artifact to reach the objectives.

The main goal of the research is to design an artifact that helps reach a better performance in industrial SMEs. This artifact needs to be validated, but doesn't have to be implemented in practice to achieve this goal. Validation can be done by using an artifact prototype and looking at its effect through a model of the context.

"Design science research projects do not perform the entire engineering cycle but are restricted to the design cycle. Transferring new technology to the market may be done after the research project is finished but is not part of the research project." (Wieringa, 2014)

The design phase is made up of setting the requirements and designing the artifact. However, specifying the requirements can be an implicit part of designing and validating the artifact (Peffers et al., 2007), which is appropriate since the requirements can only be checked through the artifact. An important part of the design of the artifact is deciding how industrial SMEs need to be supported. In this case, the target population of the tool (industrial SMEs) most likely doesn't know how they would execute the tasks to be supported, and if they do, it's not necessarily the best way.

The design needs to be tangible enough to validate. This might include data models, mockups, and other design artifacts. The choice for the final form of presentation will be made based on a combination of factors like the appropriateness of the format to convey the design and the effort needed to develop the presentation format. This is described in chapter 5.

The prototype will be developed iteratively. A first design will be made based on literature, the research into critical success factors and our own experience. This design will be iteratively improved using reviews with important stakeholders of Mobina: board members, employees, shareholders and strategic partners. They will also ensure the product fulfills the ambitions of

Mobina. After sufficient iterations, the design will be validated using a focus group of subject experts. The choice for a focus group will be further explained in chapter 3. Using this feedback, recommendations for a next version will be made, which provides a basis for Mobina to further develop their software.

2.3. Research questions

As mentioned in last section the design problem is:

Improve the innovation and improvement process of industrial SMEs (on factors like speed and quality of innovation, and strategic alignment)
by incorporating extra functionality in Mobina
that helps companies discover innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (or open innovation); assess and select those possibilities that are best for the organization; and monitor and control the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.
in order to improve their competitiveness (on factors like speed, through put time control and costs).

To support the design, several research questions need to be answered:

RQ1. Which areas of functionality have to be added to Mobina to support industrial SMEs effectively on these aspects, being open innovation; assessing and selecting the best possibilities; and monitoring and controlling innovations?
RQ2. How can these areas of functionality be included in these modules to support industrial SMEs effectively?
RQ3. Do experts believe this functionality can help industrial SMEs on these aspects?
RQ4. How should the next version of this artifact look?

The first two research questions can be answered in part by the objectives of the design and related literature, and is largely a design effort. Section 5.1 describes how this design looks, considering the validation set-up described in chapter 3. It is important that the global set-up of research question 3 is already available since this poses important requirements to the design method.

The actual validation will be discussed in chapter 9, which describes the expert opinions on this design. This gives a basis for conclusions of this research as well as for recommended improvements in the next design cycle. The design can consist of several iterations to make sure an effective product is developed, and this research describes the first design iteration for this functionality.

The third question is maybe the most important question, namely the validation of the designed artifact. In the end, the designed artifact should serve some goal, whether it is providing a more cost-effective solution or adding more support than existing methods. Wieringa (2014) mentions four important kinds of validation questions:

- Effect questions; what effects does it create and what is its performance?
- Trade-off questions; how does it compare to other artifacts or different versions?
- Sensitivity questions; what assumptions does the artifact make about its context and what happens in different contexts?
- Requirements satisfaction questions; does it satisfy functional and nonfunctional requirements?

An important goal of evaluation missing in this definition is to identify weaknesses and areas of improvement for the artifact (Venable, Pries-Heje, & Baskerville, 2012). More specific quality attributes to evaluate are: 'functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization' and more (Hevner, March, Park, & Ram, 2004). This leads to the following sub-questions for the last research question:

a. To what extent does the artifact support industrial SMEs?
b. In which conditions can the artifact best support industrial SMEs?
c. Can the artifact replace (low added value) work now done by consultants?
d. Can the artifact support industrial SMEs in new ways, currently not supported through e.g. consultants?
e. Can the artifact lead to better results for industrial SMEs?
f. What are the largest risks for industrial SMEs when using the designed artifact?
g. What can be improved to the designed artifact?

Figure 3 gives an overview of this research. It visually describes the deliverables and the dependencies between them.

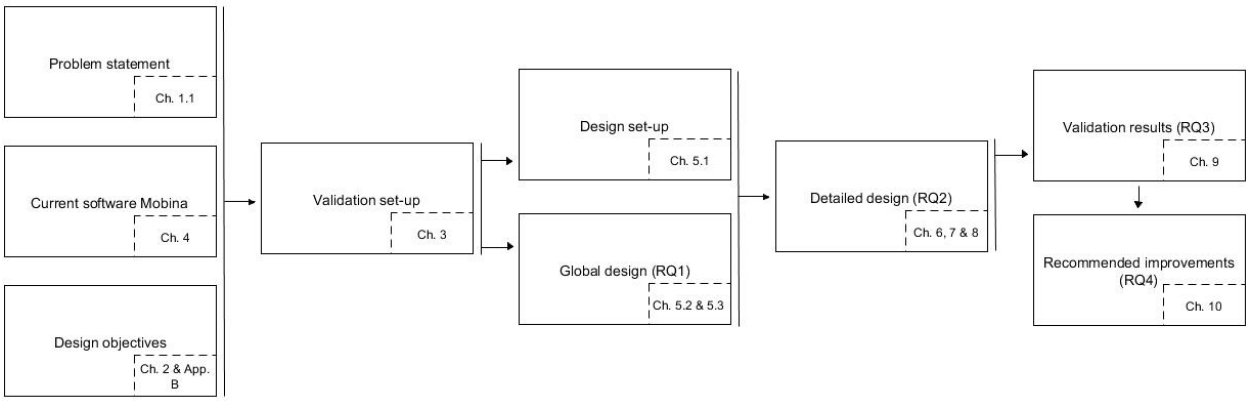


Figure 3 Research deliverables and dependencies

3. Validation method

This chapter describes the choice for a validation method. It explains which method is most applicable on this research and which aspects have to be taken into account. This can also help the choice for a design method, explained in chapter 5. The actual set-up is described in chapter 9, where also the results are described.

Peffers et al. (2007) recognize two phases for evaluation of an artifact in design science, a single act of demonstration to prove that the idea works, and a more formal evaluation. However, the line between these two is thin, and in reality the means of demonstration also depend on the needs of evaluation and vice versa. Therefore, the two phases are both seen as part of the validation.

Many overviews for design evaluation methods exist, but clear guidelines to picking the right evaluation method in IS design is scarce. Hevner et al. (2004) categorized design evaluation methods into five categories: observational, analytical, experimental, testing and descriptive. An important evaluation method missing is the focus group (Gibson & Arnott, 2007). However, this still doesn't guide the selection of an evaluation method.

This guidance is given in a framework using two dimensions: naturalistic vs. artificial and ex ante (before implementation) vs. ex post (after implementation) (Venable et al., 2012). They describe which criteria guide to the most suitable evaluation methods, see Table 1.

Mobina is a socio-technical artifact and therefore benefits of naturalistic evaluation. Its effectiveness is most important and it will be used by people. Next to this, the functionality to be developed will be in its first phase, which poses different demands to validation than when scaling up (Wieringa, 2014). The need in this phase is mainly to filter out bad designs and improve good designs for scaling up. Mobina wants to avoid high costs before initial validation is done, and it will also be impossible to get a fully functional product within the research period. Therefore, Ex Ante evaluation fits best to the needs of this research.

Venable, Pries-Heje & Baskerville (2012) also present a framework to select the evaluation method. The criteria posed by this research leads to the selection of an Ex Ante naturalistic evaluation method, which can be both action research and a focus group.

It is important to create an overview of which evaluation method is most suitable to the current situation. Therefore, the next subsections will discuss both focus groups and action research, to come to a conclusion.

Table 1 A DSR Evaluation Strategy Selection Framework (Venable et al., 2012)

DSR Evaluation Strategy Selection Framework		**Ex Ante**	**Ex Post**
		• Formative • Lower build cost • Evaluate design, partial prototype, or full prototype • Less risk to participants (during evaluation) • Higher risk of false positive	• Summative • Higher build cost • Slower • Evaluate instantiation • Higher risk to participants (during evaluation) • Lower risk of false positive
Naturalistic	• Many diverse stakeholders • Substantial conflict • Higher cost • Longer time – slower • Organizational access needed • Artifact effectiveness evaluation • Desired Rigor: "Proof of the Pudding" • Higher risk to participants • Lower risk of false positive – safety critical systems	• Real users, real problem, and somewhat unreal system • Low-medium cost • Medium speed • Low risk to participants • Higher risk of false positive	• Real users, real problem, and real system • Highest cost • Highest risk to participants • Best evaluation of effectiveness • Identification of side effects • Lowest risk of false positive – safety critical systems
Artificial	• Few similar stakeholders • Little or no conflict • Purely technical artifacts • Lower cost • Less time – faster • Desired Rigor: Control of Variables • Artifact efficacy evaluation • Less risk during evaluation • Higher risk of false positive	• Unreal users, problem, and/or system • Lowest cost • Fastest • Lowest risk to participants • Highest risk of false positive re. effectiveness	• Real system, unreal problem and possibly unreal users • Medium-high cost • Medium speed • Low-medium risk to participants

3.1. Focus groups

A focus group is a method that evaluates designs through the interaction of participants in a group on a topic determined and guided by the researcher (Gibson & Arnott, 2007; Morgan, 1996; Powell & Single, 1996; Rabiee, 2004; Sutton & Arnold, 2013). The participants are

selected to form a useful group focused on the given topic, not necessarily representative of the population (Rabiee, 2004). The definition distinguishes focus groups from group meetings with another primary purpose (such as decision making or therapy), groups without interactions (nominal groups or Delphi groups), and natural groups without an interviewer (Morgan, 1996). Although focus groups are widely used in both social and health sciences, it can also be useful as an evaluation method in (IS) design science research (Gibson & Arnott, 2007).

A focus group is mainly useful when the subject is complex (Powell & Single, 1996). The focus group enables the researcher to concentrate on the most important and complex variables dynamically. Since a focus group is semi-structured, it allows many directions to be explored (Gibson & Arnott, 2007). Focus groups can give feedback on a wide range of ideas and feelings that the individuals have on the subject (Rabiee, 2004).

In addition to the advantages of the semi-structured nature, the interaction between participants leads to participants asking questions to each other and explaining themselves in more detail (Morgan, 1996). This makes it also possible to highlight and observe the differences in perspective between the participants, and analyze the extent of agreement and disagreement (Morgan, 1996; Rabiee, 2004).

Besides the ability of focus groups to generate more information due to interaction, another strength lies in the lack of participation. The use of a group of people makes that participants often only speak when they feel than contribute something to the discussion (Gibson & Arnott, 2007). If interviewees are asked something directly, they will answer regardless of the strength of their knowledge and opinion. A focus group can make it easier to analyze which statements of participants have more value.

In the latter, also lies an important weakness. The group and especially the group dynamics can influence the results (Morgan, 1996). Therefore, it is important to analyze the group dynamics. If you can discover whether the group dynamics for example restrain people from expressing certain opinions, the moderator can mitigate this effect. However, the involvement of the moderator is in itself also a pitfall. The moderator can be a useful addition to focus the group on the right topics, but can also influence the data collection if not acting carefully (Morgan, 1996).

Next to the validity concerns, focus groups are also less effective in generating ideas than for example interviews (Morgan, 1996; Sutton & Arnold, 2013). Interviews generate more ideas per participant than focus groups. However, focus groups allow for a more detailed analysis of the opinions on these ideas than interviews.

3.2. Action research

Action research (AR) is a combination of action and research, or practice and theory (McKay & Marshall, 2001). It is an approach in which the acquisition of scientific knowledge is done by intervening to solve a problem in practice (Baskerville & Wood-Harper, 1998). Technical action research (TAR) is when an experimental artifact (e.g. a software application, possibly a beta version) is used to help a client and to learn about the effects (Wieringa, 2014). Wieringa (2014) describes it as “the last stage in the process of scaling up from the conditions of the laboratory to the unprotected conditions of practice”.

Coughlan and Coghlan (2002) describe four characteristics to define AR more clearly. First, it is focused on research *in* action rather than research *about* action. Next to this, it is participative. The objects of study are not just object of study but participate in the process of resolving problems. Third, the research is concurrent with action. The scientific knowledge is gained while improving the context. Finally, it is a sequence of events and an approach to problem solving.

The most widely used approach to AR is a five phase, cyclical process (Baskerville & Wood-Harper, 1998). After establishing the client-system infrastructure or research environment, it iterates through five phases: diagnosing, action planning, action taking, evaluation and specifying learning.

The largest advantage of action research is that it brings together research and practice, and as such provides a deeper understanding of the usefulness and usage of technology (or methodology) in practice (McKay & Marshall, 2001). In complex situations where objects do not stay the same over time, replicability as required in traditional scientific methods is not possible (Checkland & Holwell, 1998). It gives the researcher the possibility to intervene and research how and why actions can change the context (Coughlan & Coghlan, 2002). It is not possible to study new software, without doing an intervention in the target population (Baskerville & Wood-Harper, 1998). This makes (technical) action research especially useful for IS research.

Most weaknesses of action research are related to it not being a (traditional) scientific method. The three fundamental principles of reductionism, repeatability, and refutation, are hard to apply to action research (Checkland & Holwell, 1998). This is because it is context-bound and the context is ever-changing, making it difficult to identify cause and effect (Baskerville & Wood-Harper, 1998). This can also lead to threats to validity. An important threat is the lack of impartiality of the researcher (Baskerville & Wood-Harper, 1998; Coughlan & Coghlan, 2002). It is sometimes also seen as “consulting masquerading as research” (Baskerville & Wood-Harper, 1998; Coughlan & Coghlan, 2002). It is therefore important that action research is executed with rigor (Baskerville & Wood-Harper, 1998).

3.3. Choice

It is clear that focus groups and action research each have their own strengths. Focus groups are ideal to research a broad topic without a large time investment by the participants. It is ideal to explore multiple directions and the opinions of the participants on them. On the contrary, action research is good at exploring a specific direction in-depth with a rather large (time) investment by the participants, but also potentially larger rewards. As such focus groups are useful in exploratory phases, whereas action research might be more useful in a later phase. Especially for the testing of an artifact, also called technical action research, action research is more suited for one of the last stages before using an artifact widely in practice (Wieringa, 2014).

The weaknesses of both types of validation are mainly related to validity. In both focus groups and action research the researcher plays an important role in the process, and can therefore influence the results to quite some extent. Also, some other smaller threats to validity exist. In both cases it is most important to be aware of these validity threats and to mitigate them as much as possible.

The goal of this research is to develop a first design for Mobina. In that light, the focus group is most appropriate for several reasons. First, different functionality will be explored, and feedback is required on a broad range. Most importantly, this phase should leave options open to explore additional designs in other directions than the proposed artifact. Next to this, using the artifact in a company poses both the ‘customer’ and Mobina to higher risks. It will also take a much higher investment of Mobina to already develop a working prototype for action research. An initial evaluation and validation is more appropriate, so Mobina can use this for another iteration of the design cycle.

Kitzinger (1995) mentions that it can be useful to combine the focus group with other data collection techniques. It can for example be useful to go deeper into certain discussions of the

focus group with specific people. Therefore, after the focus group, one-on-one interviews can be used for specific topics. This way, we can ensure that every topic is discussed into enough detail to draw conclusions and make recommendations for the design.

3.4. Focus group set-up

This section explains more extensively the guidelines from literature for setting up a focus group. This literature can globally be divided into four areas. First, I will discuss the guidelines for selecting participants for the focus group. Next, the setting in which the focus group should take place is described. The third subsection describes how the focus group should be structured to ensure the best results. Last, the guidelines for analyzing the results of a focus group are given.

3.4.1. Group composition

Different guidelines for selecting focus groups exist. Morgan (1996) for example uses four to six groups as a rule of thumb, whereas Powell and Single (1996) mention the use of one to ten groups. Both are however focused on data collection in an early stage and not on validation. In validation for design science research one focus group is also deemed sufficient (Gibson & Arnott, 2007). All agree that the number of focus groups should make sure that enough information is collected for its purpose, and is therefore dependent on the goal, subject and participants.

The size of the group is also up for debate, and mentions both four to eight (J Kitzinger, 1995) and six to ten (Powell & Single, 1996) participants as the ideal size. Most useful is the guideline that the higher level of involvement of the participants, the smaller the group size should be (Morgan, 1996).

The last important aspect of group composition is the selection of participants. It is generally accepted to use theoretical sampling for the focus group, meaning that participants are selected to reflect a range of the study population, especially on the variables of interest for the study (J Kitzinger, 1995; Morgan, 1996; Powell & Single, 1996). A major decision is then whether to use homogenous or heterogenous groups. Homogeneity can facilitate discussion by having shared experiences or opinions, whereas heterogeneity gives more possibilities to explore different perspectives (J Kitzinger, 1995; Morgan, 1996).

3.4.2. Setting

Many guidelines are given for the setting in which the focus group takes place. Most importantly, it should be a comfortable setting. This includes providing enough refreshments, allowing for an informal meeting, seating in a circle and making sure all opinions are welcomed (Gibson & Arnott, 2007; J Kitzinger, 1995; Powell & Single, 1996). Some other guidelines can also be taken into account like using a neutral meeting place, but are aimed at more sensitive subjects.

3.4.3. Structure and moderator involvement

Many decisions on structure can be made. One session can be used as well as multiple sessions (Gibson & Arnott, 2007), and ranging from an hour to a whole afternoon (J Kitzinger, 1995; Powell & Single, 1996).

A session can have different levels of structure and moderator involvement. Many useful directions for the moderator are given in literature. According to Morgan (1996), two different kinds of structure should be taken into account. The focus group can be more structured to control the discussion topics, on the other hand the moderator can control the group dynamics for example by trying to get everyone to participate more equally.

When controlling the discussion topic, the moderator's involvement can especially be useful to take the discussion further, to for example make sure that disagreements are fully discussed (Jenny Kitzinger, 1994). It is important that the moderator makes sure that the group focuses on the areas of interest for the research and a more structure approach can prove more effective to answer research questions, but the moderator should leave enough space for the interactions that focus groups are useful for (Sutton & Arnold, 2013). A semi-structured interview schedule is expected to be most effective to both gain enough focus for the research topic, and provide enough flexibility to explore participants' answers and opinions (Powell & Single, 1996). The facilitator might also use group exercises, for example as a way to double check the assessment of the focus group results (Jenny Kitzinger, 1994).

A moderator's involvement can also be beneficial for the group dynamics. A moderator can encourage people to discuss with each other (Jenny Kitzinger, 1994). He can try to avoid over-domination of the group by certain participants, and make clear that all opinions are welcome (Gibson & Arnott, 2007). He should alleviate as much social pressure as possible (Sutton & Arnold, 2013).

3.4.4. Analysis

For a good analysis it is important to take into account the goals of the focus group, so the data can be effectively reduced (Rabiee, 2004). It is important to use a clear procedure and establish a trail of evidence to reduce bias. Therefore, a reflective diary and notes of the meeting can be very useful as well as recording the meeting.

When analyzing the focus group, it is especially important to pay attention to minority opinions and examples that do not fit with the researcher's theory (J Kitzinger, 1995). One should not use percentages, but distinguish individual opinions that defer from the group consensus. One should also evaluate whether agreement by participants has not resulted from coercion or self-censoring (Kidd & Parshall, 2000).

For analysis, often coded transcripts are used (Kidd & Parshall, 2000; Rabiee, 2004). A systematic process is used where categories, or codes, are assigned to the transcript. This coded transcript can then be used to analyze trends and also compare between focus groups. It also makes the data better searchable.

4. Current software Mobina

4.1. Introduction

Mobina is a web application that is developed to help industrial enterprises and especially SMEs innovate their processes. It provides a Knowledge-as-a-Service (KaaS) to its customers, which gives all customers access to vital and unique knowledge to innovate their processes and information landscape; knowledge which is not available widespread. This knowledge can be combined with the experience of employees through the collaboration environment to develop an agenda for innovation and change.

Knowledge is provided on the whole breadth of the company, but with a special focus on operational processes and information technology. Mobina believes the greatest opportunities and challenges lie at the edge of business and IT, and wants to help companies build an information landscape that enables their processes.

However, not every company is the same. Therefore, Mobina provides configurable knowledge so customers can find their own way. Based on specifics of their production typology, parts of the knowledge will be made accessible. Employees are involved in the application to translate and complement this knowledge into meaningful actions for the company.

Mobina provides a collaboration platform, so employees can develop the innovation roadmap together. It does not only help companies take advantage of its unique human resources. It makes sure the whole company is mobilized and the agenda is broadly supported by their own team.

The next subsection describes how the application looks and the functionality works. It mainly focuses on the most important functionality, and not on for example administrative functionality. The last subsection provides an overview of the implications of the current software for this research.

4.2. The application

Currently, Mobina focuses its support on the first phase of the innovation process: the identification of relevant issues and improvement possibilities, and generating ideas. It differentiates itself from for example idea management software by its focus on content and processes, instead of on ideas. As such, it is mainly suited for process innovation, which can be an enabler of product innovation.

Mobina provides KaaS through several content objects, to which functionality like discussion sections and ratings are linked. The most prominent part of the application is the reference model, which consists of processes and documents. Next to this, Mobina defined critical aspects, which are aspects that highly influence the needs for information technology, defined from a business perspective. Companies will consciously have to make these business decisions, to ensure a future-proof information landscape.

Last, Mobina provides more specific support for information systems. Companies can define their own applications and Mobina provides a database of (reviewed) information systems, currently only ERP systems, which allows for benchmarking and (pre-)selection. This is not further described, since it is very loosely linked to the rest of the functionality and not relevant for this research.

As mentioned, Mobina is a collaboration tool. The idea is that the software is used by a number of people from the company, who use Mobina’s knowledge as a steppingstone to stimulate

discussion, identify problems, and develop ideas. This can be done mainly through online communication, allowing teams to discuss with more people in a more efficient way. Everyone gets an equal voice, and removes planning constraints to bring working groups together.

The software was used in a pilot project in the first half of 2017. Based on this experience, and of progressive insights, Mobina decided to rebuild the application in a new technology to improve the interactive experience. Next to this, the lessons learned during the pilot were used to redesign the application to further cater to the needs of the users. At the start of the research, most functionality was thought out, but net yet developed. Parallel to this research, Mobina is developing the software. This chapter discusses the state of Mobina at the end of 2017, except for the designs from this research that were already included in the software (innovation ideas).

The data model in Figure 4, gives an overview of the objects in this functionality. It does not resemble the database structure, but functions as an illustration. Entities with a blue background are mainly created by users, whereas entities with a red background are mainly provided by Mobina. In the subsections, the functionality is discussed in more detail.

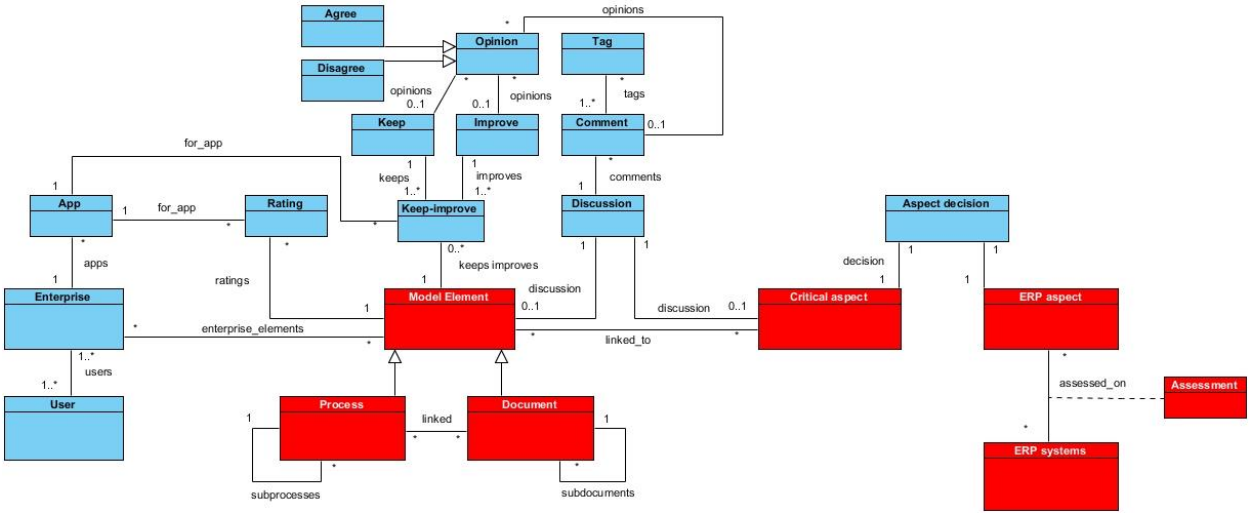


Figure 4 Data model current Mobina

4.2.1. Reference model

Most of the discussion in Mobina is structured around the reference model. Mobina developed a reference model that is configurable and usable by companies with multiple production typologies, e.g. Engineer-to-Order, Make-to-Order and Make-to-Stock.

The reference model consists of processes, which represent the tasks and actions, and documents, which represent the information exchanged (e.g. objects in a database, mails, or verbal communication). The documents connect processes from all parts of the reference model. In this way, people from multiple corners of the company are brought together on the overlapping areas, making sure the company functions as a team and not as a group of individuals. Both processes and documents have a breakdown to subprocesses and subdocuments, where processes are leading in the reference model.

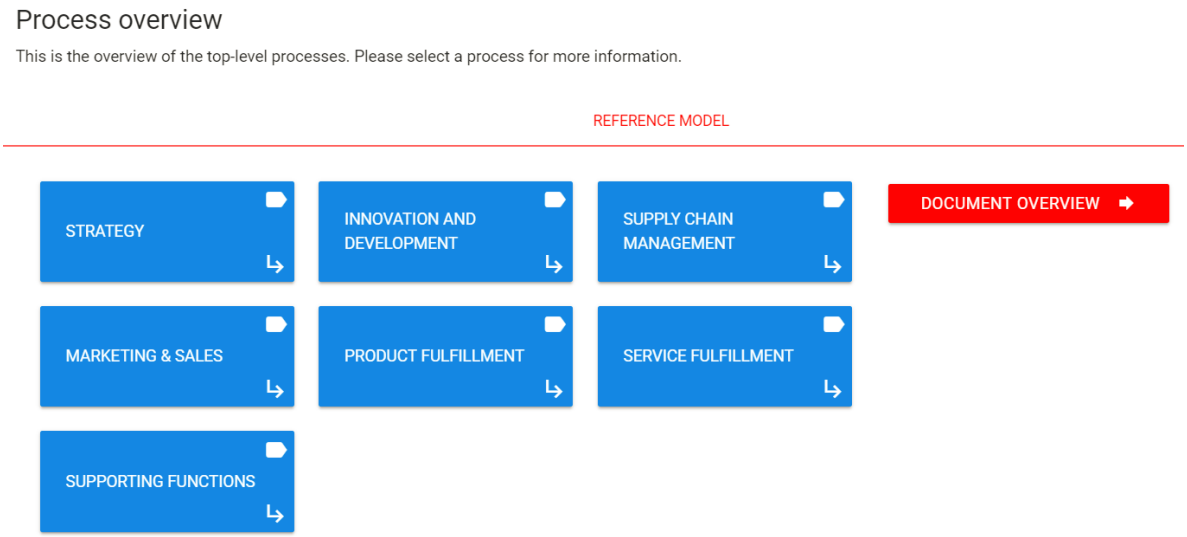


Figure 5 Top-level processes

Figure 6 A process has subprocesses and linked documents

This model consists of 7 top-level processes, see Figure 5. The breakdown structure can eventually go five or six levels deep. Each process is also linked to documents, which helps users not navigate only through their own processes but also see which information they (might) have to exchange with others, see Figure 6. This helps stimulate collaboration. Each document also has a breakdown structure, allowing for both detailed information and global data structures to be discussed.

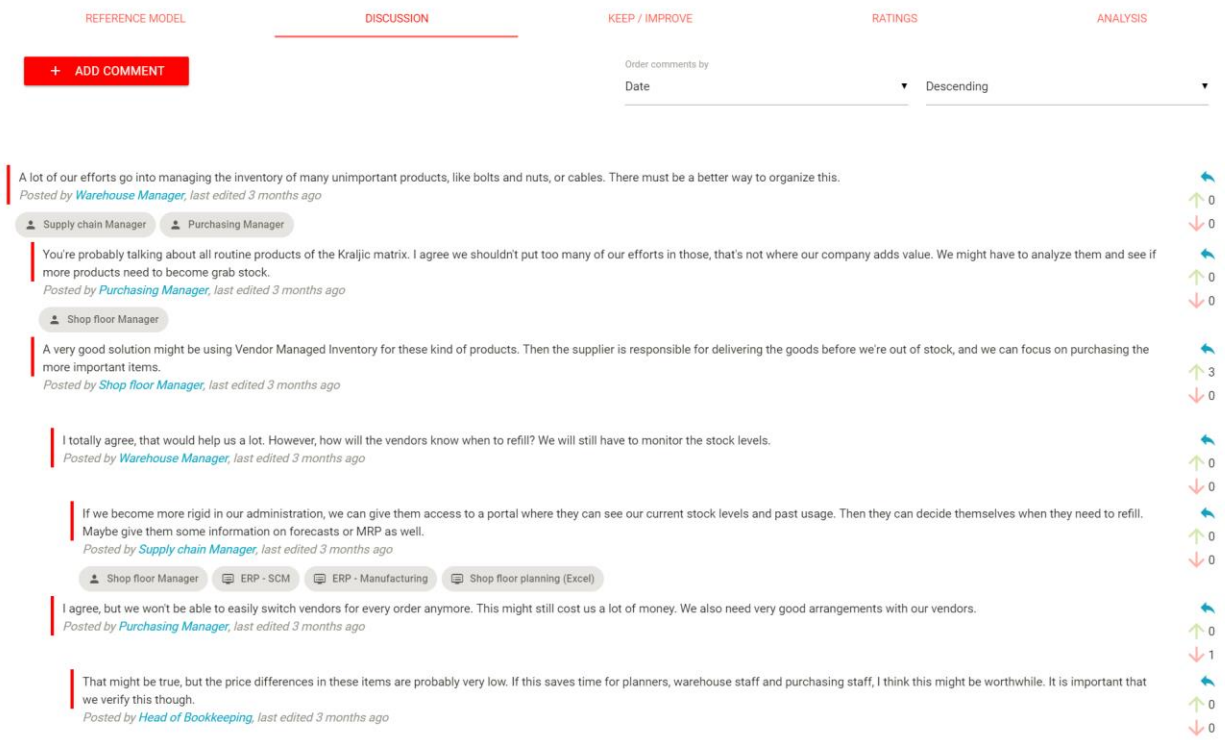


Figure 7 Example discussion in Mobina

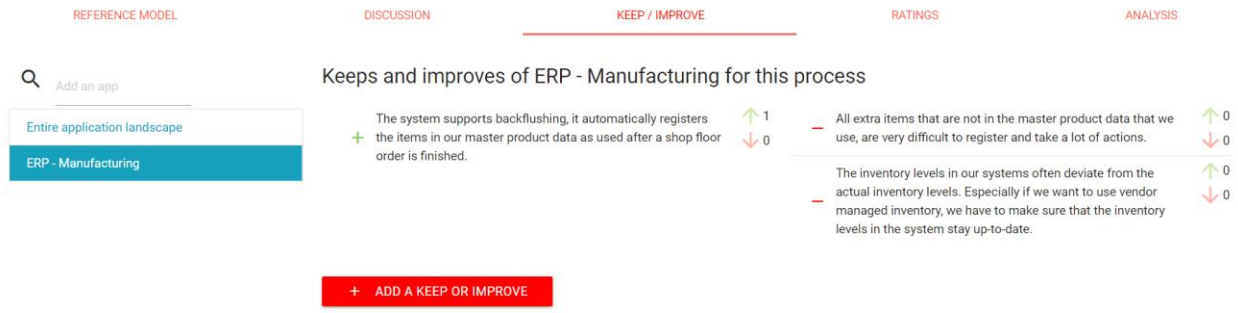


Figure 8 Keep/improve tab example

For each process and document the same kind of functionality is available. At the top, a description is shown which gives users more information on the element, best practices, and possible innovations. The reference model tab shows its child elements and linked processes or documents. The other tabs provide additional functionality.

An important aspect is the open discussion tab, which is re-used in many places in Mobina and therefore also in the design of this research as presented later. See Figure 7 for an example. This allows users to discuss all important issues with each other, which is stimulated by the provided information. They can tag users, systems and more to enrich searching and statistics. Next to this, they can agree or disagree with comments to easily show their opinion.

The next tab, Figure 8, allows users to make a list together of all aspects of the current information landscape they want to keep and all aspects to be improved in the future. The keeps and improves can be defined for the entire application landscape, as well as for a specific application that is used for that process or document. This allows a company to find out which systems are currently in use for which processes and documents, as well as how well they

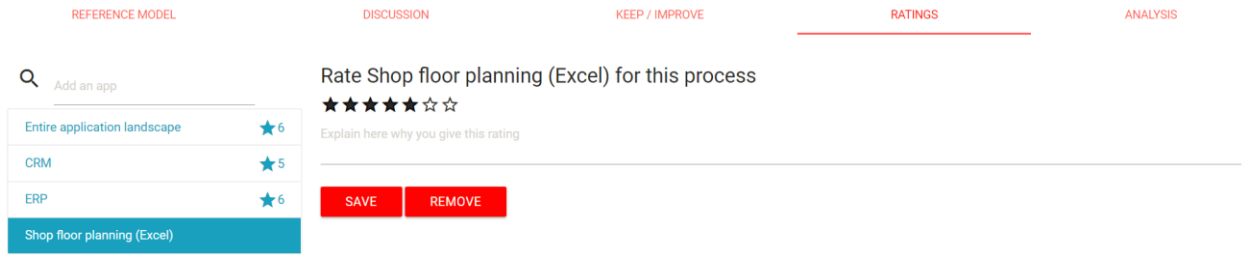


Figure 9 Ratings tab

perform. Recording both keeps and improves helps a company not throw away the baby with the bathwater.

The fourth tab allows users to individually rate each application or the entire application landscape, see Figure 9. They can add apps they use for that process or document from a pre-defined list of their company. Then they can rate how well they believe the support of those apps is. Since this is anonymous to the other users this gives a more objective view. Users also tend to list mainly negative points, and this forces them to pick a rating on the scale. The data helps a company to create a better and more statistical overview of the application landscape.

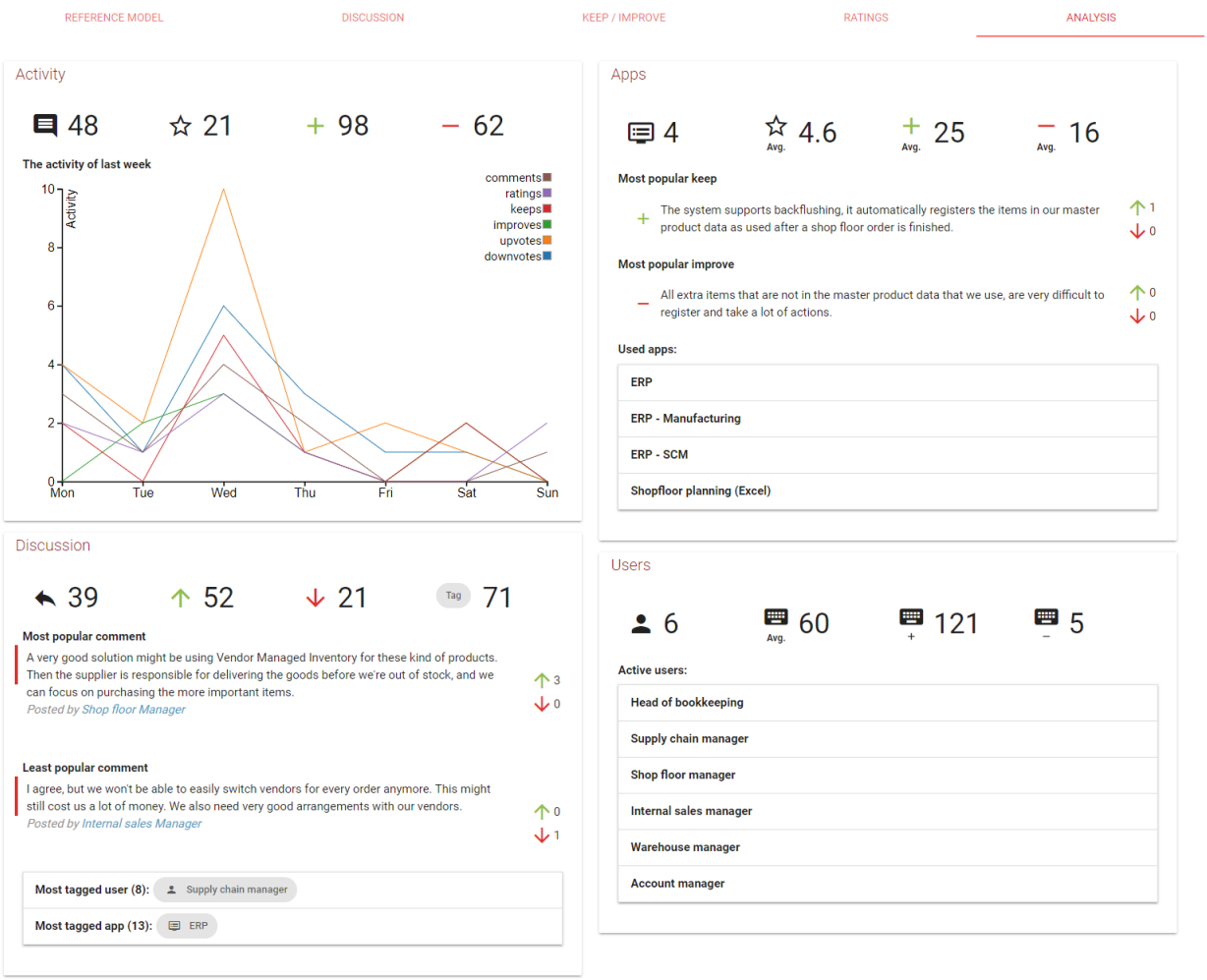


Figure 10 Analysis example

Of course, Mobina also offers possibilities for users to analyze the data. This is available per process, but of course also umbrella analysis is available to find out for example which process needs most attention. An example of an analysis for a process is shown in Figure 10.

4.2.2. Critical aspects

Another important part of Mobina are the critical aspects, defined by Mobina. These are aspects that companies will have to carefully consider before making decisions about the information landscape. Any expected changes on these aspects can have large influence on the company's information systems. If a company for example chooses to open a second production facility, this can have a lot of impact on all production-related information exchanges.

The admin can give specific users the possibility to join the discussion about these aspects, which are more high-level than processes or documents. Critical aspects can span the whole organization. Decisions therefore often have a more tactical or strategic nature, whereas the reference model covers many operational tasks.

To facilitate more insight in the consequences of a decision, critical aspects can be linked to processes and documents as shown in Figure 11. This way, people (with the necessary rights) can switch between critical aspects and operations. They could for example pose certain

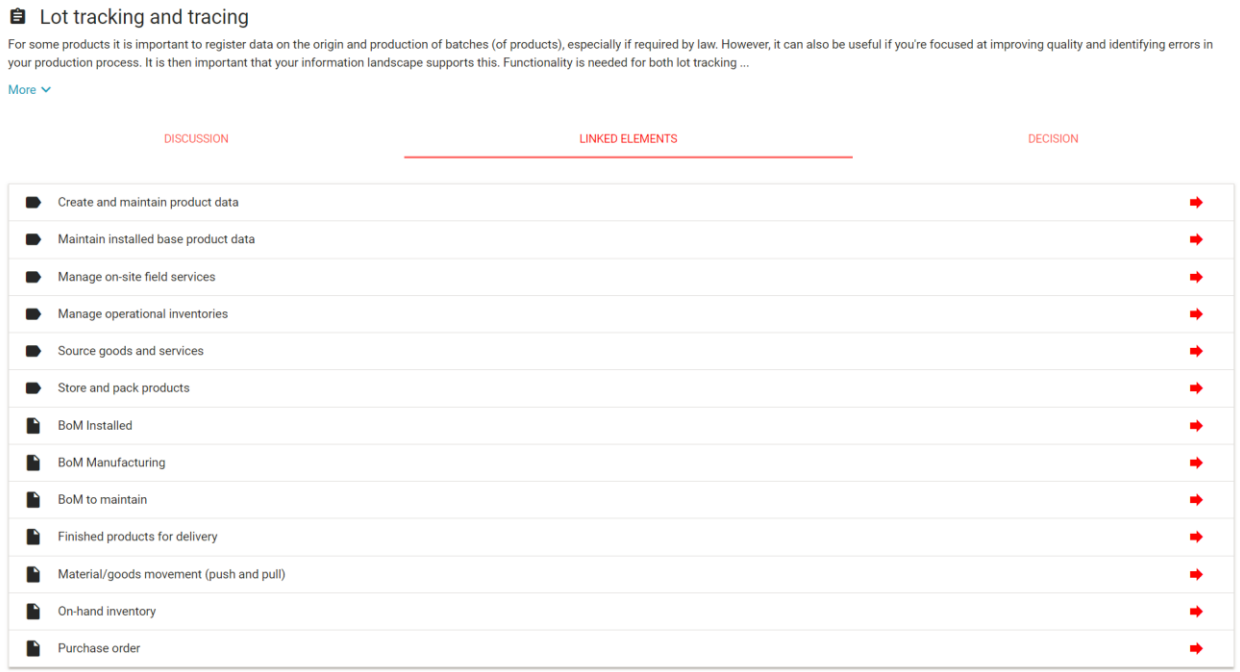


Figure 11 Linked elements critical aspect

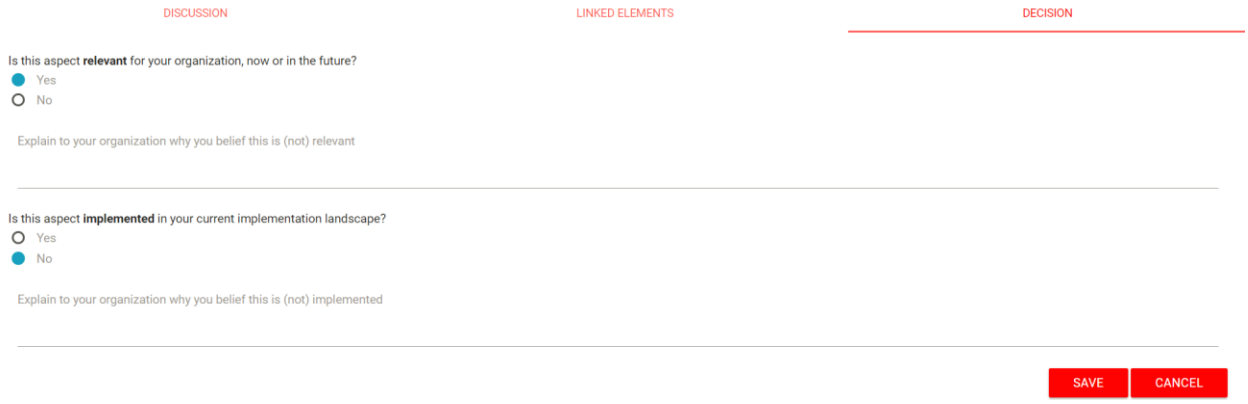


Figure 12 Decision critical aspect

questions about processes or documents, which can influence the aspect decision. Or they can see when browsing the processes and documents, which critical aspects have a large impact.

Decisions on these topics can provide guidelines to the usage of Mobina about the goals of the company. Therefore, the decision can also be communicated to the rest of the company, see Figure 12. Managers can communicate whether they believe the aspect is important for their company, either now or in the future. They can also give an idea of which information systems currently support the critical aspect. It can also be of great help to ensure due changes in the information landscape take into account the future situation. It helps create an overview of what information systems have to support in the long-term.

4.3. Implications for extension

Since the functionality to be designed in this research is intended as an extension to the existing software, the current software has some implications for the research. The target population is aligned with the target customers of Mobina. But there are also more specific consequences.

The software is still under development, which makes it more difficult to keep the designs aligned with the software. Therefore, it is important to make sure the designs are not dependent on details of the software, since they can easily change. There has to be some separation between the designs and the current software.

Because Mobina is still under development, there won't be much time available early on to start implement the designed extensions. However, this also makes it easier to adapt the software to the identified improvements since related parts are not yet taken into production.

The current software of Mobina is focused on the content and issues. All the functionality is linked to processes, documents, and critical aspects. However, the selection and management of innovations, and maybe also other parts, might need a more solution-oriented focus. This should be carefully considered during the design phase and discussed with Mobina stakeholders.

5. Global design

This chapter describes the global design of the artifact. It will give you an overview of the artifact and how it is designed to support the aspects described:

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);
Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

The first section discusses the generic design choices that are made. It will describe what requirements the artifact has to fulfill to be used for validation and how the artifact will be designed. The focus areas of the artifact and level of detail will be described.

The second section describes which functionality will be added globally and especially which major data objects will be added to the software to support these aspects. A metamodel of the software is designed without the details of the functionality areas. An explanation of why these functionality areas are chosen is given in the next chapters.

This chapter ends with a conclusion regarding the artifact design. It also answers the first research question:

RQ1. Which areas of functionality have to be added to Mobina to support industrial SMEs effectively on these aspects, being open innovation; assessing and selecting the best possibilities; and monitoring and controlling innovations?

5.1. Generic design

The goal of this research is to design functionality as an extension of Mobina to support industrial SMEs. In the end, fully functioning software should be available for users. However, this research is still the first iteration of the design cycle, and therefore a more global point of view is necessary. What kind of concepts and functionality is useful for users? Which support do they need? Which support can be incorporated in software and more specifically in Mobina? Most important is that this kind of questions are answered to allow further development to become more focused. The designed artifact should support answering these questions.

An important part of the research is to validate to what extent the designed functionality is useful. Therefore a validation model is needed to be able to answer these questions (Wieringa, 2014). The focus group represents the model of the context. However, the model of the artifact can take different shapes like simulations, prototypes, mockups, or role-play. This model should be applicable to the context model as well, the focus group.

Although most participants of the focus group, as well as the interviewees, have affinity for IT, for the purpose of validation they need to get a grasp of how the software could be used. It is important not to focus too much on details, like how you set up administration rights, or where a button is placed. It is all about the global elements that can be included in Mobina, and the related functionality.

To demonstrate this, a mockup is most suitable. This is a user interface design, that will not work beyond what the users see. This means that for the demonstration purpose, some actions will allow for useful changes of the user interface, but will not make a mutation in a database for example. The designer only designs the actions needed to demonstrate the usage of the software. It is useful for this research since it can make the design much more tangible, but

does not need to implement and review all functionality and edge cases yet. This aligns with the needs of ex ante evaluation. As such, it allows the users to focus more on the important aspects, rather than the details.

An important part of the designed functionality is the interaction with the existing Mobina software. To give a good feeling of how the new functionality builds on the existing functionality, it should be included in the mockup. To facilitate this, the mockup is designed as an extension to the existing software (in a separate branch). Mobina builds its backend in Django[2] and uses HTML, CSS (MaterializeCSS as a framework), and JavaScript for the frontend. The usage of the existing software and frameworks makes it possible to quickly and easily make a representative mockup.

Figure 13 for example shows how the menu for the artifact expands the menu of the current software. The already existing items are blended with new design. Figure 14 and Figure 15 show how this mockup can also show the link of new concepts, like innovation ideas and partner discussions, in the existing functionality like the reference model. This makes very clear how the new functionality might be integrated.

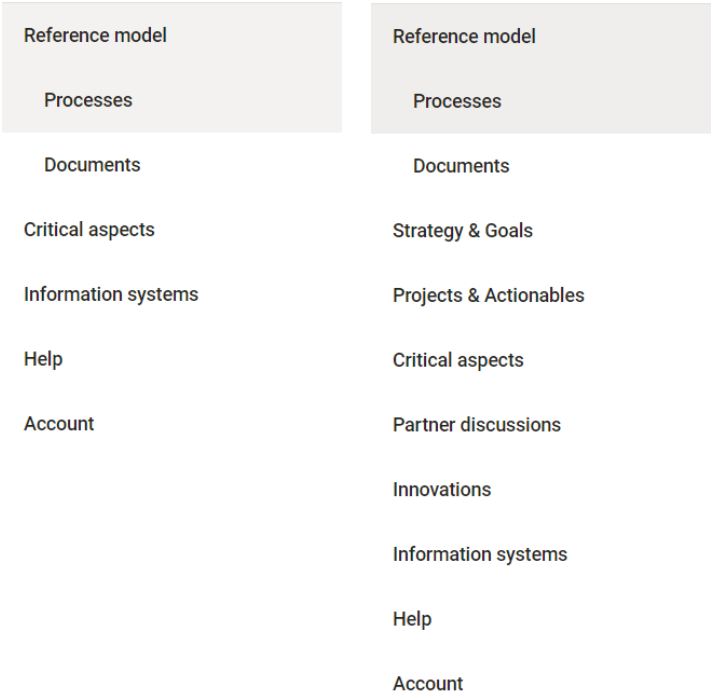


Figure 13 Screenshot menu current software versus designed artifact

[2] https://www.djangoproject.com/

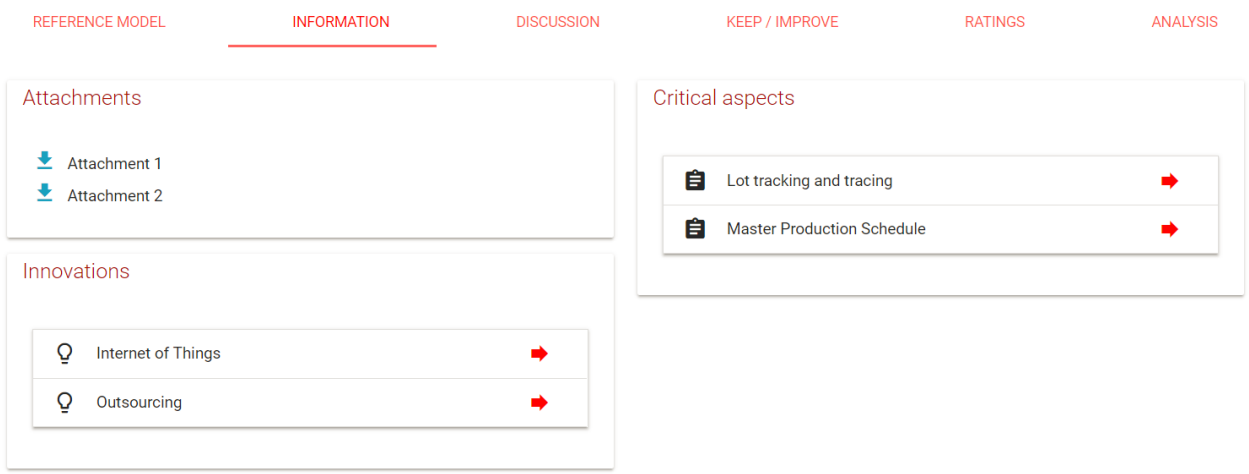


Figure 14 Integration of innovation ideas in the information tab of a process or document

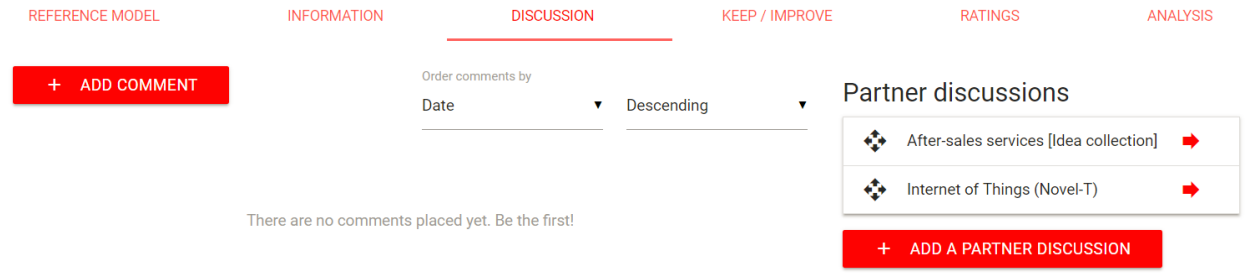


Figure 15 Integration of partner discussions in the discussion tab of a process or document

However, for Mobina in the end, it is most important which data is stored in the underlying databases. The interpretation of a mockup can be subjective, and the basis to build a good application is to understand the data model. Therefore, this report includes data models of the designed functionality to both show the important (knowledge) objects of the artifact, and the links between different parts. This gives a clear direction for future software design.

5.2. Global data model

Several areas of functionality are identified as useful for Mobina: partner discussions, innovation ideas, strategy & goals, actionables, and projects. Figure 16 shows which aspects these areas support. Especially aspect 2 and 3 are closely related, since those the assessment and selection criteria mentioned in aspect 2 are used as a baseline to monitor the innovations as mentioned in aspect 3. Therefore, the functionality related thereto mainly supports both aspects. For completeness, the aspects are repeated in this section.

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);
Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

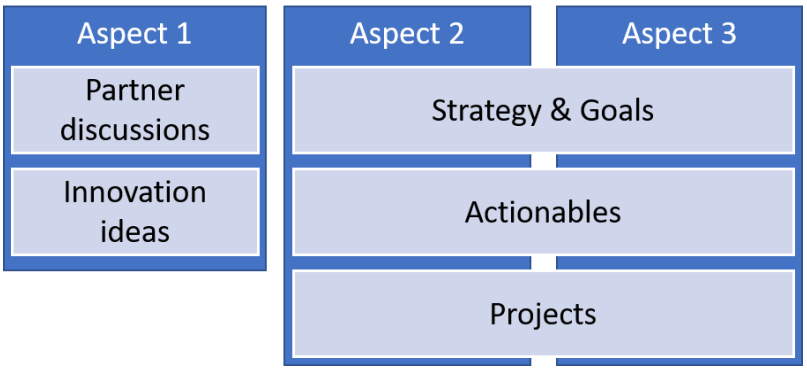


Figure 16 Relation between areas of functionality and the aspects to be supported

Open innovation can be useful for SMEs to generate more and better ideas. However, currently Mobina doesn't have any support for open innovation. Two ways to change this, that relate to the content of Mobina, are identified: partner discussions and innovation ideas. Figure 17 shows a global data model of both concepts. It shows the generic objects to be used in the designed functionality and how this relates to Mobina. They are described in more detail in chapter 6.

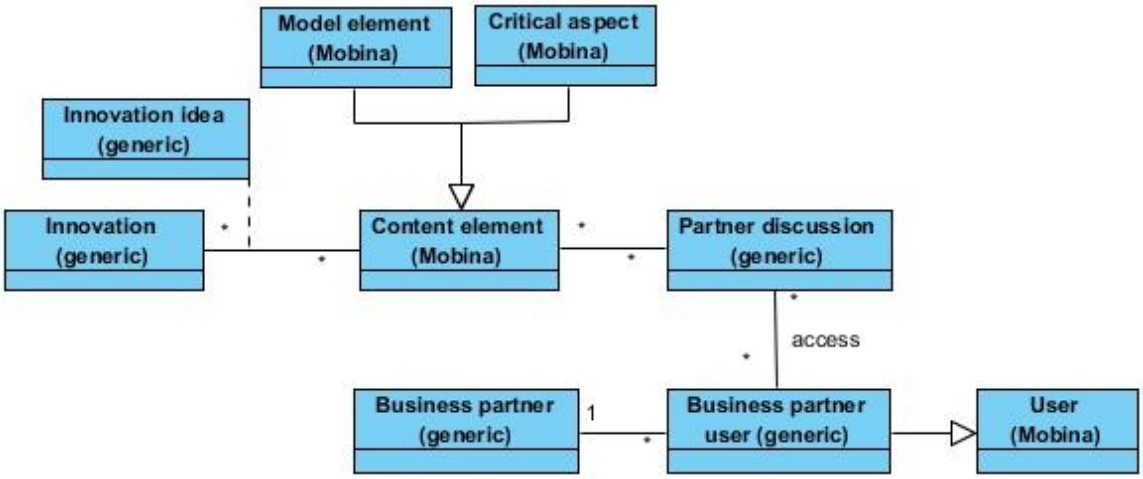


Figure 17 Global links of partner discussions and innovation ideas

The partner discussions give users the opportunity to collaborate with users from other organizations more easily. No mails outside of Mobina, but while using Mobina, discussion spaces with other companies can be set up. Users have control over what they share and with whom, while at the same being able to easily link discussions to their own environment. This allows users to enrich the data in Mobina, for example in the process reference model, because views from other stakeholders can be used.

Innovation ideas also enhance the idea generation process of companies, by providing them a view of the (technological) opportunities. Technological scanning is an important aspect of improving a company's operations, and the innovation ideas aid in this area. Users get an overview of useful innovations, and specific ideas of how these innovations can improve specific processes or data exchanges. This can stimulate the brainstorming process, and helps make global concepts, like smart manufacturing or big data, more concrete.

Next to this, support is needed in Mobina for the assessment of innovation possibilities and monitoring them afterwards. This should make Mobina a tool not only for providing an overview

for the change agenda, but also to prioritize the roadmap and make sure SMEs really get results.

An important aspect of both assessing possibilities and ensuring results, is establishing (concrete) goals. It is important that these are not only operational goals, but also strategic goals that contribute the long-term performance of the company. To really establish a good foundation for both assessing alternatives and measuring progress, (key) performance indicators are useful. Relating these goals to each other can give decision-makers and other people in the organization a lot of insight in the consequences of decisions and how the organization's performance is affected. More details about strategy and goals can be found in chapter 7.

To add support in Mobina for assessing and monitoring innovation, the ideas in the comment sections need to be analyzed. However, there can be duplicate ideas, similar ideas or comments that contain multiple ideas. Therefore, it is useful to have a separate entity that is linked to comments all over Mobina: actionables. These actionables can then be detailed, assessed, and monitored.

In a real-world scenario, actionables are not implemented one at a time. Rather, they are grouped in a project, in which related actionables are implemented together. This is also the level at which investment decisions are often made, and the level of detail that is known to people higher up in the organization or in other parts of the organization. It is therefore useful to support project management, where for example business cases can be monitored and the prioritization decisions will be made. Actionables and projects are very closely related, and are discussed in chapter 8.

Together, these areas should provide full support for aspects 2 and 3. Hence, it is useful to closely integrate them to make sure all areas contribute to the same goal. This also makes Mobina more navigable and leads to better insights into cause and effect for all users. Figure 18 shows the relation between these areas and to Mobina.

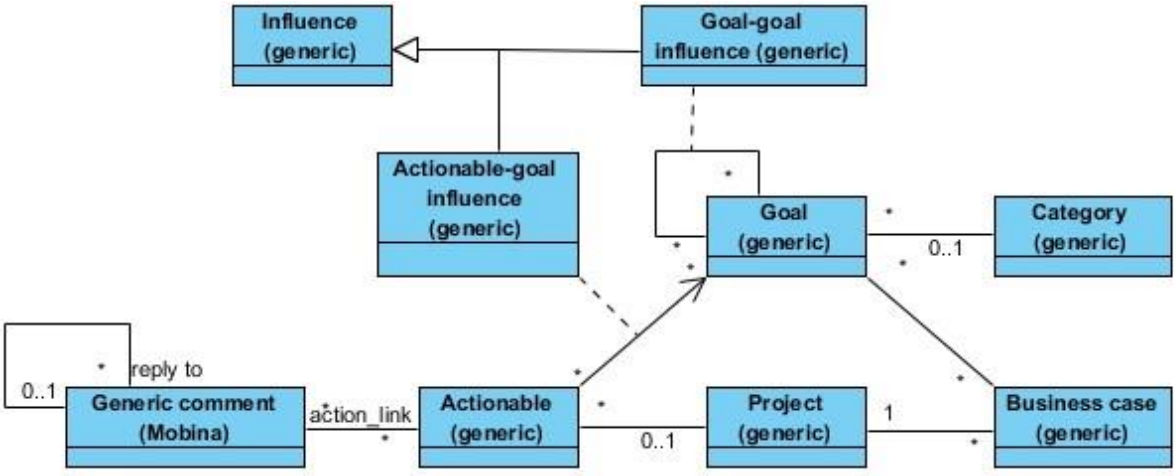


Figure 18 Global links between strategy/goals, actionables and projects

5.3. Conclusion

An important aspect of this research is how the design is presented. Artifacts could be plain text, paper prototypes or even fully functioning applications. It is important that the design is represented in such a way that the validation method delivers useful results. Therefore, a

mockup is built as an extension to Mobina, which provides the right balance to discuss potential usefulness and not focus too much on details. In addition, data models are created which provide a more objective representation and which provide a useful foundation for database design.

This chapter also answers research question 1. Several concepts have been defined to support SMEs on all three aspects. These areas of functionality should provide a solid foundation for SMEs to get better results out of the (process) innovation process.

First of all, Mobina can be extended with partner discussions and innovation ideas. SMEs can use this functionality to generate more and better ideas, by taking advantage of the opportunities of open innovation. They offer the opportunity to collaborate with business partners and to perform technological scanning in an efficient way.

Next to this, several concepts are useful for the assessment and monitoring of innovations: strategy & goals, actionables and projects. These are closely linked to each other and to Mobina, which leads to extensive support for aspects 2 and 3.

The next chapters provide more background for each of the areas. They describe the design choices, and also provide the detailed data models and mockup designs. Chapter 9 describes the functionality validation and chapter 10 describes some recommended improvements to the designs based on the validation.

6. Open innovation

6.1. Introduction

The first aspect to be supported regarding open innovation was described as follows:

Aspect 1. Discovering innovation and improvement possibilities through external search, intra- and inter-industry networking, and technological collaboration (also called open innovation);

Mobina already supports external search extensively through its process reference model. The reference model gives companies guidelines for their processes and innovation exchange and also hands them options for improving this. However, the current software doesn't really support any other open innovation (OI) extensively. Therefore, the designed artifact includes the possibility for collaborating with other companies through the partner discussion, and finding already developed products or other specific innovations through innovation ideas.

This chapter will first discuss the existing literature on the subject of open innovation. Section 6.3 describes the design choices to support open innovation in Mobina. The fourth section shows the mockup and data model that was designed to implement these design choices. This chapter ends with a conclusion.

6.2. Background and literature

The important factors identified related to this area are: external search breadth and external search depth; intra- and inter-industry networking; open innovation; and technological collaboration (Verburg, 2017).

External search breadth and depth focus on the importance of the external environment in the search of firms for new ideas and technologies for innovation (Laursen & Salter, 2006). External search breadth considers the number of sources used in innovative activities, whereas depth is about the extent to which these sources are used. External search depth is associated more with radical innovation, where companies need to draw deeply from some sources to develop new innovations. The most important external sources include suppliers and customers, but also standards. Both external search breadth and depth can positively influence a firm's innovation performance. However, it is important to keep in mind that it can also be time consuming, and 'over-search' should be avoided.

Meyers (1999) also describes how networking with other firms can be beneficial to adopt industrial process innovations. It can lead to a greater exposure to new innovations and in turn faster and more successful implementations. It might especially be useful to connect with adjacent industries, since changes there might also be relevant for a company's own industry.

Open innovation is not only practiced in large enterprises. SMEs also adopt OI practices more and more (van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Both medium and small enterprises are adopting open innovation, although the adoption rate in medium enterprises is higher.

Julien et al. (1999) show that the scanning of (technological) developments in SMEs is dependent on four important factors: the entrepreneur's profile, the information networks, the firm's characteristics, and the environmental uncertainty. These factors influence the dimensions of scanning: strategic orientation, types of information sought, sources of information used, and the scanning practices. Even though scanning is mostly done ad-hoc, it is often included in strategic management.

SMEs increasingly use customers, suppliers and partners as major sources of OI (Rahman & Ramos, 2011), especially on technological innovations it can be useful for SMEs to include an external technological infrastructure (Nieto & Santamaría, 2010). OI adoption in most SMEs starts with customer involvement, then employee involvement and networking, to finally use more advanced practices like venturing and licensing (van de Vrande et al., 2009). The most popular practices are informal and unstructured, especially in the early stages of OI adoption.

6.3. Design choices

Two kinds of support by Mobina are identified for involving others in the (process) innovation process: partner discussions and innovation ideas. Both especially increase search breadth, and to some extent search depth. This larger search breadth can especially lead to more search depth since the right partners can be found for implementation. However, real search depth will not be supported by Mobina since this has its own demands, like engineering or software development, which don't align with the expertise and focus of Mobina. The design choices underlying both concepts are discussed separately in this section.

6.3.1. Partner discussions

Designated space for collaboration with partners

SMEs use Mobina to discuss their own organization together, and generate ideas for operational excellence. It is therefore logical to provide them accessible means to collaborate not only inside the organization, but also with other companies. However, Mobina currently does not stimulate this and the only way others can collaborate with the company is by granting them access to their environment. The ability to create separate spaces for collaboration with partners can solve this. Other parties will not be able to automatically have access to the (strategic) information of the company.

These spaces are called partner discussions in the design. Companies can create multiple partner discussions. To each discussion partners can be added who can join the discussion. Next to this, each discussion can have its own, freely defined, topic.

Control over shared information and discussion partners

This format gives SMEs a lot of control over open innovation, while maintaining their flexibility. They're afraid to share all important knowledge with others. By giving them the freedom to create partner discussions that are separated from the internal discussions, e.g. in the reference model, they don't have to. Each discussion has its own set of participating partners, and its own topic which can be defined as narrow and broad as necessary. The partners can be part of the supply chain network of the user, e.g. customers or suppliers, but can also be partners for the purpose of improvement, e.g. Original Equipment Manufacturers (OEMs) or peer companies.

Close integration between partner discussions and Mobina

It is important that this functionality is not a separated module, but rather closely integrated with Mobina's main functionality. Otherwise, this kind of functionality can also be found in more generic collaboration tools. Its main power is that users can easily involve other organizations while using Mobina, and that all comments can be kept together in one tool.

Use cases

This functionality can especially be useful when a user identifies a problem or potential improvement in his process, and wants to get an outsider view on it. He might also know about a nice solution a business partner users, and ask them to find out more. He can easily start a

partner discussion to discuss this subject with partners, which makes sure that this discussion is not lost in someone's mailbox, but is available for all other users.

It can also be used to collaborate more top-down. Several users can be put in a partner discussion to find out how the collaboration between partners can be improved. This can then be linked to relevant areas in Mobina, like specific processes or critical aspects. Mobina is then not only a tool for improving intra-organizational information exchange, but also inter-organizational information exchange.

6.3.2. Innovation ideas

Support for technological scanning

Another important aspect of creating a better organization is technological scanning. Scanning for (technological) developments and opportunities gives entrepreneurs and employees a reference frame of the possibilities and potential best practices. Mobina supports this to a large extent, by providing a reference model which gives an indication of usual and best practices. This should trigger the thought process of users to improve their organization.

Innovation as an entity

The reference model is focused very much on the operational side. It gives an overview of how processes and information exchanges operate, and gives some examples of how they can be improved with the newest innovations. This text is free-format, and thus makes not clear where innovations are re-used. Next to this, only a few examples are currently used to stimulate the thought process, whereas many innovations might be applied in each process. Therefore, it is useful to make innovations a separate entity in Mobina. This makes it possible to give innovations a structured place in Mobina, and to link more examples to each process or document.

More information about innovations

Mobina will maintain the database of innovations. By making it a separate entity, users can quickly get an overview of all innovations available in the application. It also provides the opportunity to discuss the innovation concept as a whole, instead of specifically for one process. An investment decision might for example largely be influenced by the reusability of an innovation; multi-purpose temperature sensors are much more interesting to implement than single-purpose temperature sensors.

It also opens up possibilities for more information on each of the innovations. An indication can be given of the development status of the innovation, like the position on the Gartner Hype Cycle[3]. The most innovative companies might already want to adopt it in an early stage, whereas followers might want to wait till innovations become more mainstream.

Innovation partners

Mobina can also provide a list of innovation partners, like OEMs, who can help implement an innovation. Especially for process improvement or automation, most SMEs will often lack the knowledge and power to develop a new technology themselves. Nieto and Santamaría (2010) mention that SMEs for example need external infrastructure for technological innovations.

[3] The Gartner Hype Cycle gives an indication of which stage development technologies are in: https://www.gartner.com/smarterwithgartner/top-trends-in-the-gartner-hype-cycle-for-emerging-technologies-2017/

Innovation partners can give an indication of the investment, develop the technology, and support implementation.

Making innovations concrete

It is very important though that it is not just a discussion space for innovations. Most information is probably readily available. An important aspect of success for this functionality is linking innovation ideas to specific elements in Mobina, like processes and documents. Such an innovation idea explains how an innovation can improve specific processes and documents. This explanation, and possibly some examples, help users to make innovations concrete. Large concepts are often vague and difficult to understand, and these innovation ideas give users something to hold on. It might make the step to innovation adoption and implementation smaller.

Use cases

The innovation ideas can be used both top-down and bottom-up. In a top-down situation, a manager for example hears about the promises of Internet of Things (IoT). He has heard that it can deliver value to both products and services of the company in a cost-effective way. However, he does not know how he can use it in his company. He asks his organization to look for potential uses. The users use the innovation ideas that get an overview of how IoT can help them. The manager also contacts the innovation partners, to find out the investment scale he is looking at, and what the current possibilities are.

In a bottom-up situation, a user is busy in Mobina to analyze his process. He gets some information about how different innovations might improve his process. He sees that Internet of Things can for example improve the distribution process by using location sensors. He likes this idea and wants to find out more about it. He visits the IoT-innovation to find out more information and ask other users if they have more uses for location sensors. A manager is convinced of the potential and can use Mobina to find innovation partners for the implementation.

6.4. Design

This section describes the design of the functionality. It first provides screenshots of the mockup and at the end data models for each of the concepts. Section 6.4.1 describes globally how partner discussions might be implemented in Mobina, whereas section 6.4.2 describes how innovations can be used as a separate entity.

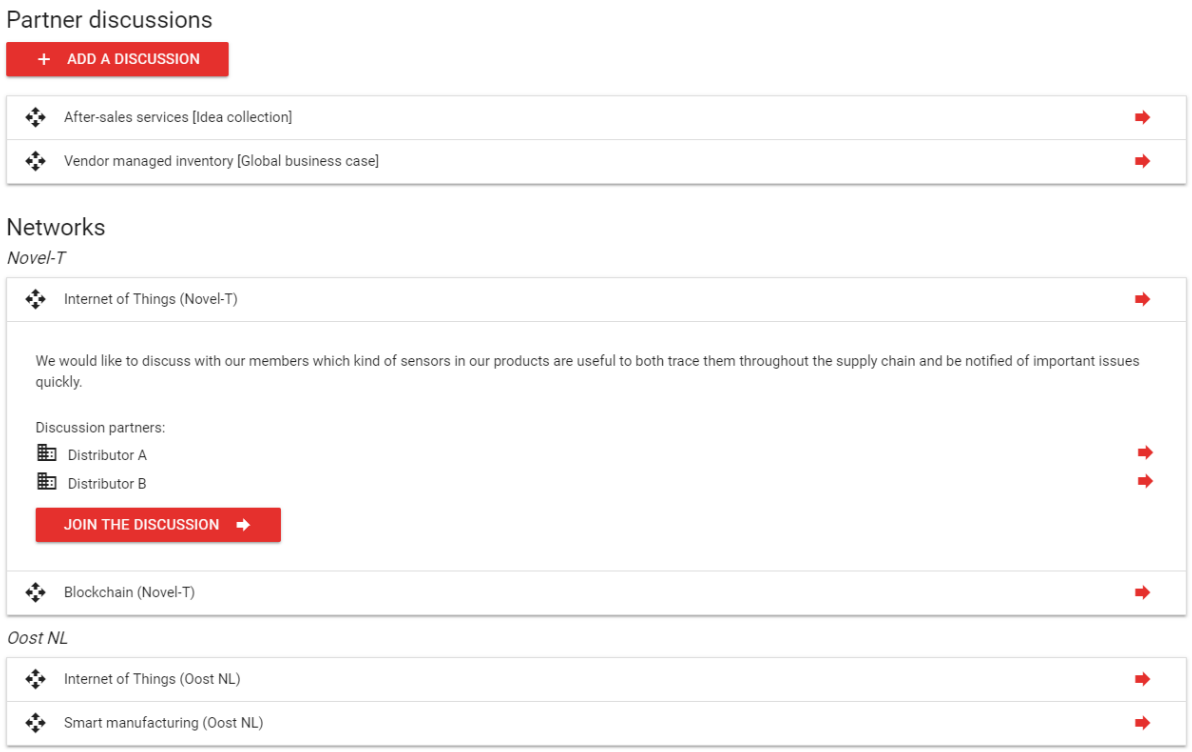


Figure 19 Partner discussions overview

6.4.1. Partner discussions

As explained users can create multiple partner discussions to collaborate. Therefore, an overview of all partner discussions is useful, as shown in Figure 19. This makes it for example easier for users who want to stay up-to-date on discussions with certain partners, as well as for people who need to check no confidential information is shared.

However, some SMEs might not have built a partner network yet. Or they might want to establish new partnerships for certain subjects. This overview shows how Mobina might also offer a platform to meet partners. They could for example allow organizations, like Novel-T and OostNL, to create open discussions which everyone, or all members, can join. Other possibilities are of course also possible, like a meet & match marketplace. The details can be worked out depending on the arising needs after implementing partner discussions.

The design uses an example where the company, Smart Crane, collaborates with its distributors about improving the after-sales services. Each partner discussion has several functionalities, which are separated into tabs in Mobina: discussion, linked elements, business partners, and settings.

Figure 20 shows the first tab: a free-format discussion space, like used in the rest of Mobina, where all participants of the partner discussion can collaborate. This includes tagging functionality to link comments to for example specific people or applications. The discussion provides the opportunity to users both inside and outside the organization to discuss the topic at hand. This can evolve around a specific problem of one of the company's, looking for opportunities to improve their joint value, or to just exchange some information and ideas.

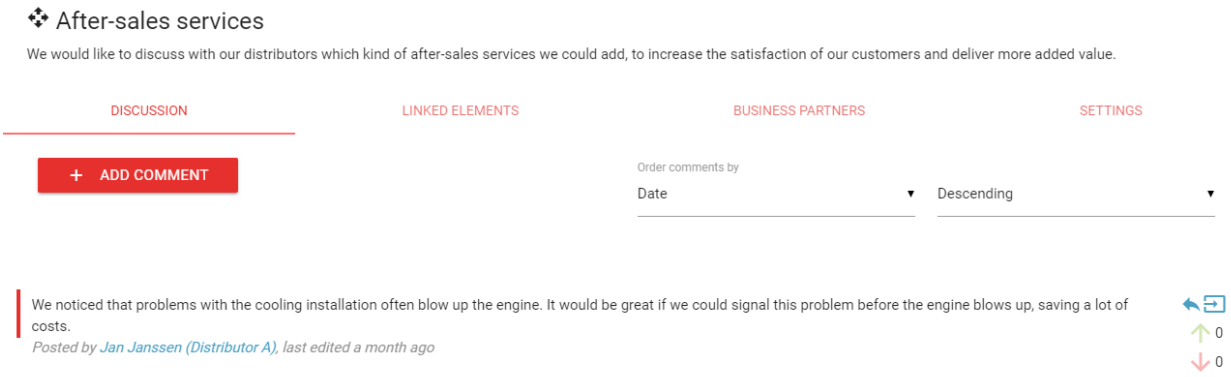


Figure 20 First tab partner discussions: Discussion

Figure 21 Second tab partner discussions: Linked elements

As explained, the partner discussions should be integrated with the rest of Mobina: to stimulate open innovation, to make sure every (relevant) user knows about their existence, and to make sure that the outcomes are used in the organization. Partner discussions can therefore be linked to all other content elements in Mobina (processes, documents, critical aspects and also the newly added innovations), as shown in Figure 21. Next to this, users can also see the linked partner discussions in the discussion area of each linked element as shown in Figure 22 for a process in the reference model. This stimulates users to start new or join existing partner discussions, and gives them an overview of the relevant partner discussions.

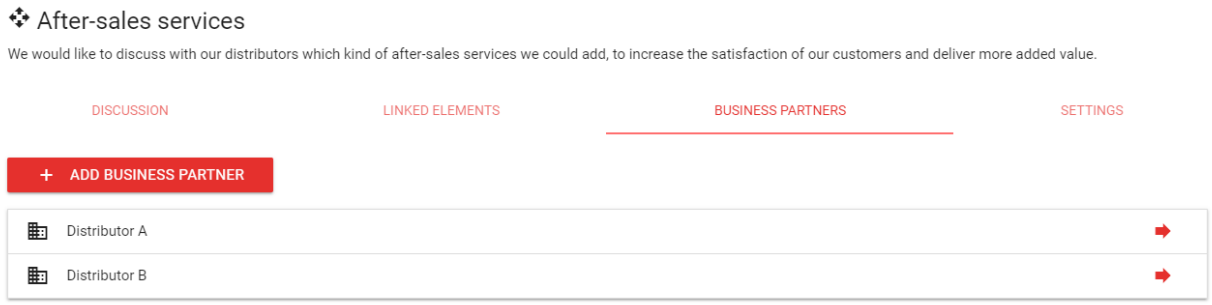


Figure 22 Example of how a process links to partner discussions

Figure 23 Third tab partner discussions: Business partners

It is important that the SMEs keep control over their environment. Therefore, they can choose which business partners, and potentially which users, are involved specifically for each discussion. An overview like Figure 23 should be provided to all users about which business partners are involved in the discussion. Additionally, some extra information of these business partners can be given. This way, everyone knows what they can share with whom.

A lot of options can of course be added to increase the user experience for this kind of functionality. Some examples are for example annotating the discussion with innovation phases, like idea collection or testing, and archiving the discussion. These are added to the data model to illustrate the possibilities.

Figure 24 illustrates the relations between different entities of partner discussions. This shows how a partner discussion is related to the business partners for example, and that for example a list of users can be maintained. It also proposes some attributes, but of course in implementation the attribute list can be extended.

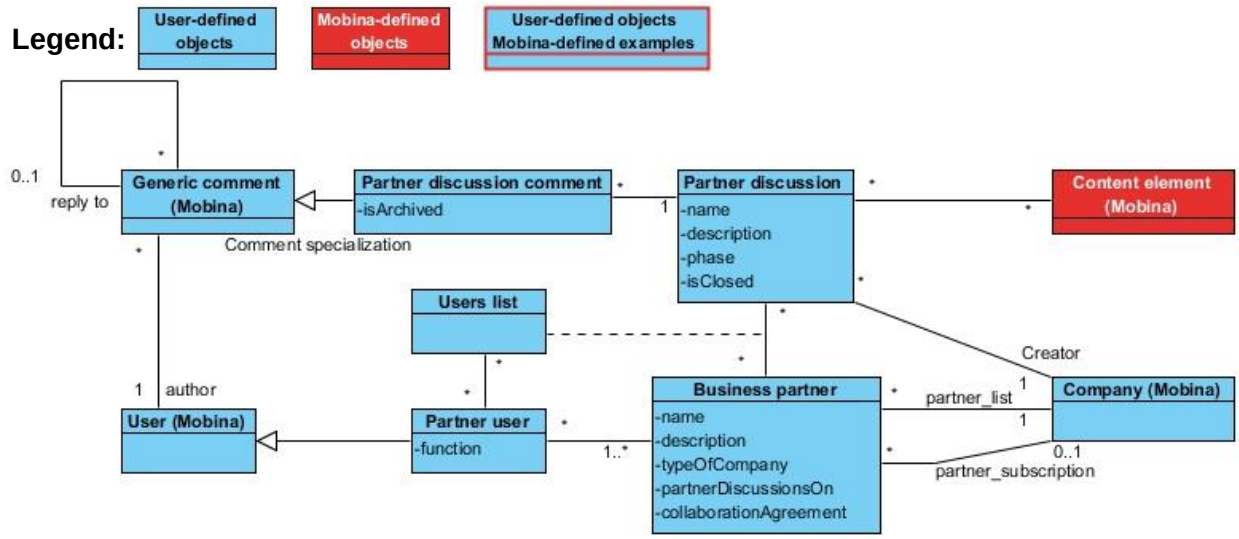


Figure 24 The data model of partner discussions

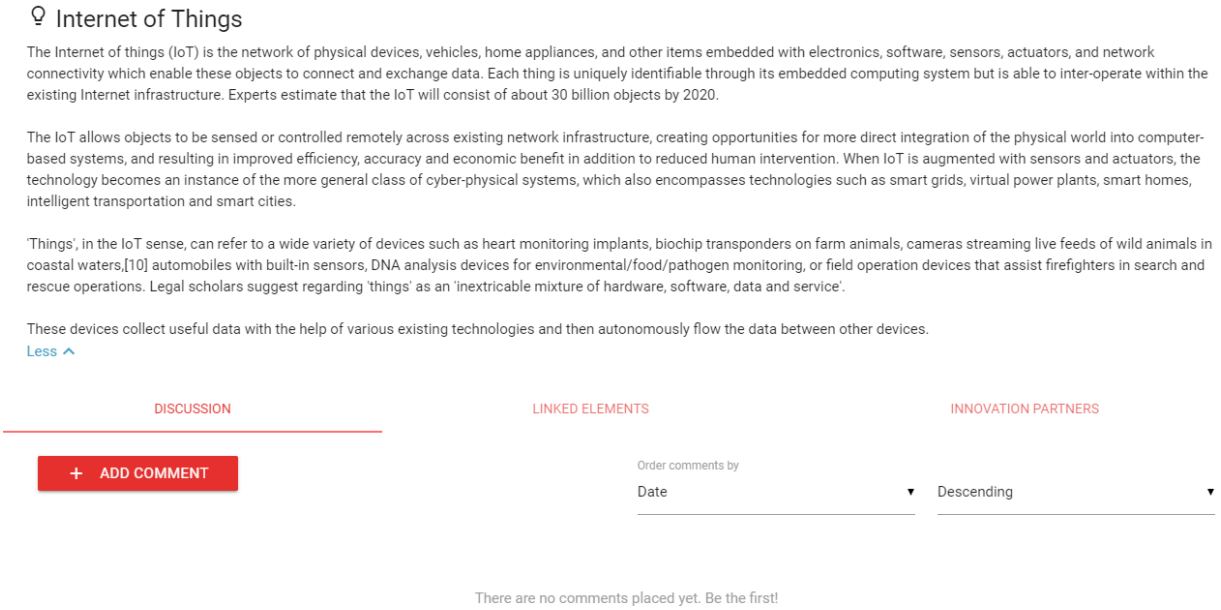


Figure 25 First tab innovations: Discussion

6.4.2. Innovation ideas

The innovation entity gives users the opportunity to find out more about innovations and to discuss this with the entire organization. Therefore, an extensive description should be given for each innovation. In Figure 25 an example for IoT is provided (example description from Wikipedia[4]). Next to this, the most prominent space is for discussion, where all users can discuss the usefulness of the innovation. This discussion has the same functionality as the discussion that is used in Mobina for content elements and partner discussions.

[4] https://en.wikipedia.org/wiki/Internet_of_things

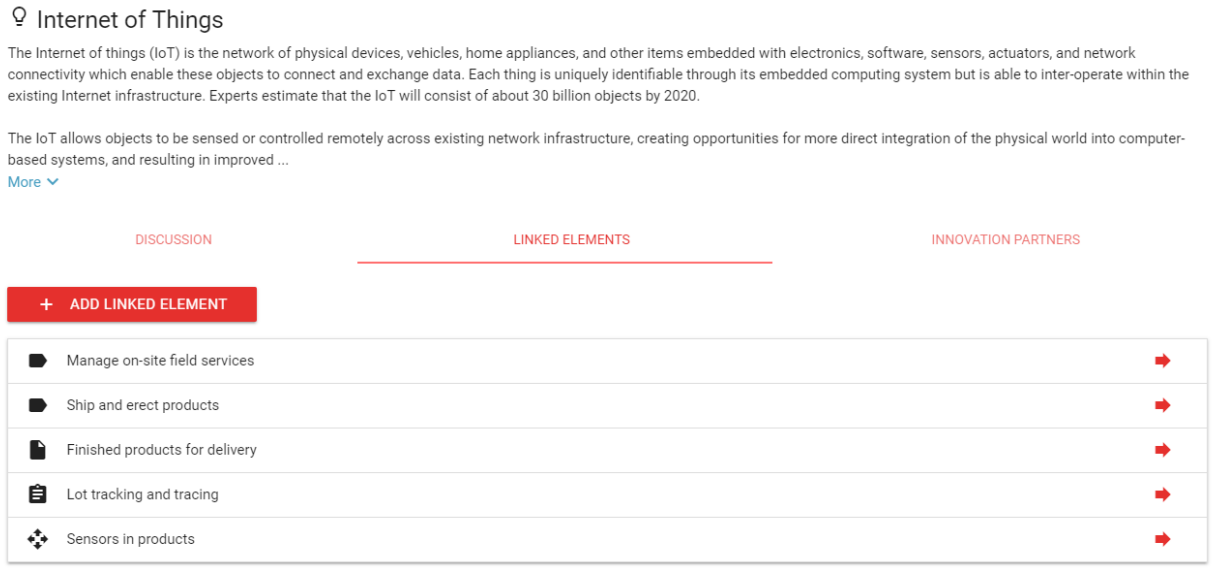


Figure 26 Second tab innovations: Linked elements

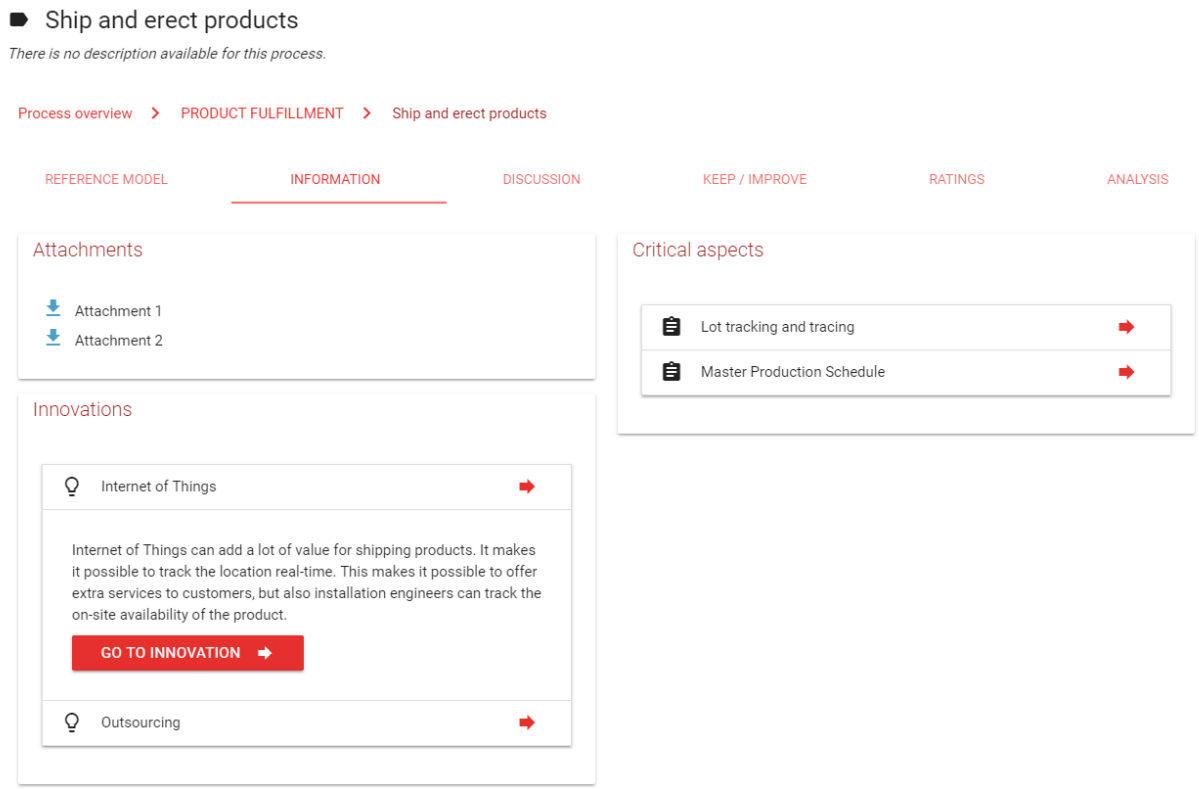


Figure 27 Example innovation ideas for a process

As with partner discussions, it is important that the innovations are linked to other elements of Mobina. In this case, this is not the user's effort, but Mobina pre-defines the link (although one can of course choose to allow users to change these links, or make their own links). Users can then quickly see where an innovation can add value, as shown in Figure 26.

It is not merely a simple link to elements. For every linked element a description is given of how the innovation can add value: the innovation ideas. This makes innovations much more

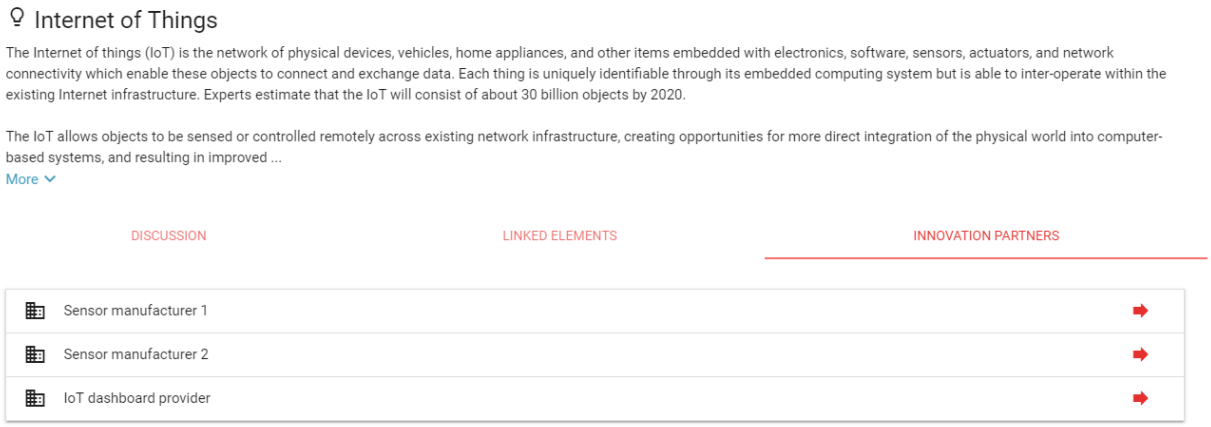


Figure 28 Third tab innovations: Innovation partners

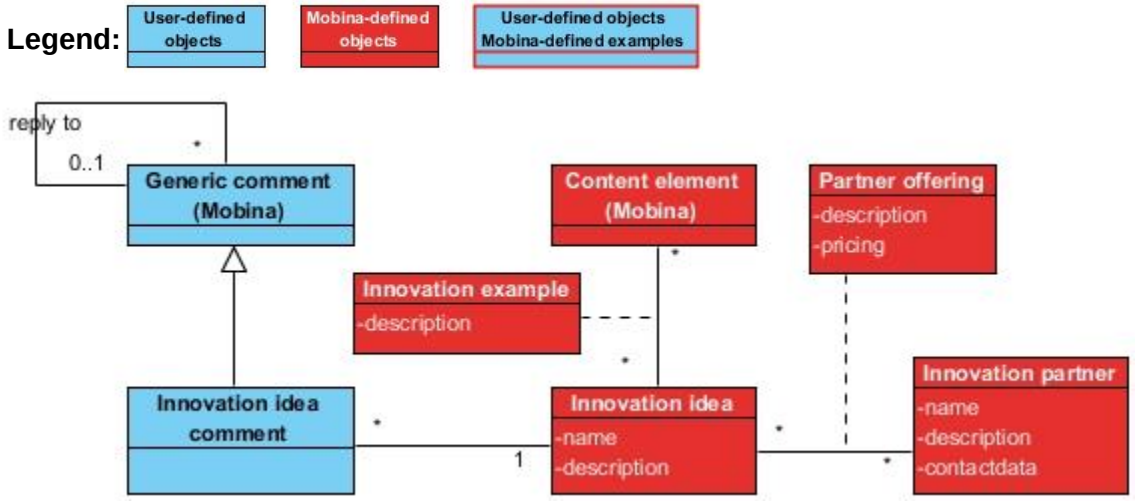


Figure 29 The data model of innovation ideas

concrete for users. This can also trigger the thought process to incorporate innovations to improve processes. A process can for example have multiple innovation ideas to help users improve the process, see Figure 27.

Last, Mobina can help companies find innovation partners like shown in Figure 28. This can be all kind of companies, like OEMs and advisors, who can help the users implement the innovation. They can provide a market-ready product, but can also be companies who can help transform an idea into a real innovation. This way, Mobina can offer a lot of added value to its users, by not only helping them with ideas, but also helping to bring these ideas into practice.

This option will also need a lot of effort from Mobina. Next to keeping the list of innovations updated and linking them to the other content, Mobina will also have to maintain the list of partners. They can choose to allow everyone, they might double-check companies before they get listed, or they might even rate each of the innovation partners. Mobina will have to decide how to handle this. Additionally, Mobina can help companies to generate a sort of check list with which they can test potential innovation partners themselves.

Figure 29 shows the entities and some of the attributes involved in implementing innovation ideas. It shows clearly that a lot of the effort will be in the hands of Mobina. This might have a

large start-up effort, but Mobina will also be able to offer more value to their users. The innovation ideas are really aligned with the Knowledge-as-a-Service concept of Mobina. It can help users more extensively without expecting a lot more effort from them.

6.5. Conclusion

Although a separate entity for partner discussions can be a threshold for users to collaborate with partners, this also offers a lot of advantages. It gives users and the company control over which partners join the discussion. Next to this, they can freely define their own topic (which can be smaller or larger than a process or document, but also use another dimension) and as such control which information they share with others. This helps support intra- and inter-industry networking.

However, to make sure that users really use partner discussions, it is important that there is a close relation to the other content of Mobina. This makes it both more accessible, and easier to use the comments from the partner discussion in the reference model and vice versa.

On the other hand, innovation ideas put the effort in the hands of Mobina. It can replace some of the descriptions of Mobina in the reference model, but a lot of start-up effort is needed to provide a large database of innovations and innovation ideas. However, Mobina can strengthen their position as KaaS-provider with this functionality.

This effort allows SMEs to do technological scanning very efficiently. It provides them an umbrella view of innovations, with links to the content of Mobina to make their usage more concrete. This can be overwhelming, so does call for good analysis of the most useful innovations. SMEs can get insight in the needed investment through getting in touch with the right innovation partners. They are not alone in bringing innovations into practice, but can be helped by partners with the right expertise.

7. Strategy & Goals

7.1. Introduction

As described in chapter 5, it might be useful to provide support for strategy & goals in Mobina. This should support mainly aspects 2 and 3:

Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

Currently, Mobina provides a lot of support to generate ideas and as such establish an innovation agenda for the future. However, these ideas are not related to the strategy of a company. Strategic alignment is an important aspect of ensuring long-term success for a company. Therefore, this chapter describes how including strategy and goals can support users to achieve this.

This chapter will first discuss the lessons from literature about the criticality of strategy, alignment, and strategic performance measurement systems. Then, the most important design choices based on this background information are highlighted. Afterwards, the mockups and data model are presented that shows how strategy and goals could be incorporated in Mobina. To conclude, the last section describes shortly the most important aspects and implications of this functionality.

7.2. Background and literature

The definition of objectives and strategy, both specifically for information systems and in general, is an important aspect of success (Verburg, 2017). Important IT governance practices for a successful ERP project in SMEs are for example defining an explicit IT strategy, pursuing strategic alignment, and using strategy to drive evaluation (Bernroider, 2008). This is however not only important for information systems. Using strategic goals and planning, and having a sense of strategic criticality is also important for the success of industrial process innovations (Meyers, 1999).

Alignment of IT, but also of the organization, with the strategy is an important factor for a company's performance. The Strategic Alignment Model for example looks at two axes; the external (strategy) vs. the internal domain (organizational infrastructure and processes); and business versus IT (Henderson & Venkatraman, 1993).

All axes should be aligned, respectively called strategic fit (external and internal) and functional integration (business and IT), to lead to superior business performance (Bergeron, Raymond, & Rivard, 2004). It is important that if a shift happens in any of the domains, internal or external, in business or IT, that all fours domains change in a systematic manner for a better performance. Alignment can be reached in different ways, four alignment perspectives have been identified (Henderson & Venkatraman, 1993):

- **Strategy execution** Business strategy is the driver and the organization is designed based on this. This organization design is the basis for the design of the IS infrastructure.
- **Technology transformation** Also takes business strategy as a starting point, and translates this into an IT strategy as the foundation of the IS infrastructure.

- **Competitive potential** This uses IT as an enabler, where IT opportunities and capabilities change the business strategy, which is then changed into an updated organizational infrastructure.
- **Service level** IT strategy is also used as a starting point, and then transformed into a world-class IS infrastructure, which can meet the needs of the IS customers. The business strategy only indirectly leads to customer demand.

To achieve a higher alignment, one first needs to analyze the current organization. Then, the effects of proposed projects on the current situation and strategy can be analyzed to make sure that the project portfolio moves the company towards its goals (Avison, Jones, Powell, & Wilson, 2004). Defining important business drivers is an important step, to make sure projects improve the right areas (Ward, Daniel, & Peppard, 2008).

Strategic performance measurement systems (SPMS) can help create and improve the strategy (Chenhall, 2005). An example of such a system is the balanced scorecard (BSC), which ensures that not only financial measures are taken into account but also other perspectives are taken (R. S. Kaplan & Norton, 1992). A SPMS can especially improve the strategic competitiveness of an organization, if they focus on integration between different aspects, e.g. between goals, strategies and operations (Chenhall, 2005). An example of a framework that supports this is the Benefits Dependency Network, which helps uncover how the goals are achieved and who is responsible for delivering benefits (Peppard, Ward, & Daniel, 2007).

Also the creators of the BSC identified an arising need to extend their framework (Robert S. Kaplan & Norton, 2001a). Although the four BSC perspectives (financial, customer, internal, and learning & growth) already implicitly contain a cause and effect, more support for a good strategy is needed. They defined the strategy map, which helps create and describe a strategy. This map defines the critical elements and their linkages. Next to this, they identified 5 important principles for a strategy-focused organization to achieve higher performance: make strategy operational; align organization and strategy; make it everyone's every day job; make it a continual process; and recognize that becoming strategy-focused is a change project (Robert S. Kaplan & Norton, 2001b).

7.3. Design choices

Strategy and goals in Mobina

As explained in the previous section, strategy can be very important to ensure projects contribute to a company in the long-term. By including functionality for goals and especially also strategic goals, users of Mobina take these as an endpoint, rather than the project. Strategy is included in Mobina by allowing the definition of (strategic) goals.

Define and monitor goals individually

Most companies have several goals, or dimensions (like in the BSC), which might sometimes even conflict. Therefore, it is useful to define and monitor goals individually. There should be a separate space with information on each of these goals, and especially the most important high-level goals should support monitoring by managers.

Define (multiple) KPIs

To become a strategy-focused organization, as described in section 7.2, one of the most important principles is to make strategy operational (Robert S. Kaplan & Norton, 2001b). The goals should be explicit, so they're easier to communicate and more understandable. Defining

Key Performance Indicators (KPIs) can help to make clear what the goal means and how they can be measured.

Measuring the goal is important to know the progress and status of the company. This can be done outside of Mobina, but it is important that the measurements can be related to the effort to improve. Next to this, the users of Mobina can be involved for more subjective measurements. By using and measuring KPIs, people can check both the effort and the results. Strategy becomes a continual process, one of the principles stressed by Kaplan & Norton (2001b).

It is important to allow goals to have multiple KPIs. If only one KPI is used, this might lead to a systematic measurement bias. In the end, the goal is to improve the goal and not the measurement representation. By allowing users to use multiple indicators, a more balanced measurement and representation of the intended goal can be achieved.

Influence relations

Multiple goals at different levels can exist. These goals also influence each other. It is for example difficult to achieve both the highest product quality and the lowest product price, a balance often has to be found. Goals can influence each other and therefore insight should be given in the influence relations between goals, like in the Benefits Dependency Network (Peppard et al., 2007). Also other aspects, like the means, should be linked like the means to achieve the goals (Chenhall, 2005).

These influence relations don't necessarily have to be quantifiable. It will often be difficult to put a specific percentage or other number on the influence. However, it is important to get an insight into whether the relations are positive or negative. Next to this, it is important that one can navigate through the relations, to get a very good insight in cause and effect. This can for example make sure that organization and strategy are aligned, but also that the whole organization can be involved by showing them how they influence the company's goals. These are both important principles for a strategy-focused organization (Robert S. Kaplan & Norton, 2001b).

Implicit support for alignment of IT and business

Although alignment of business and IT strategy is important, most SMEs will not have a strategic IT manager, or CIO, or a separate strategic IT agenda. Therefore, providing a separate space for IT strategy is probably abundant. More important is that IT projects will be used to contribute to the overall strategy, and that if necessary separate IT goals can be defined.

Mobina currently already supports the separate identification of the current situation of both business and IT, as well as generating ideas for improving each of them. In combination with the possibility to define goals on all levels, and for both business and IT, the design will support all alignment perspectives: strategy execution, technology transformation, competitive potential, and service level (Henderson & Venkatraman, 1993).

No (explicit) support for change management to become strategy-focused

Although it is important that companies that want to become strategy-focused recognize that this transition is a change project (Robert S. Kaplan & Norton, 2001b), Mobina will not explicitly support this change factor. The main focus is the usage of strategy and goals in the long-term. Of course, in a next design cycle some details might still be added to support the transition. These should however not be a prominent part of the strategy functionality, since after the transition has been completed, this would lead to a lot of overhead.

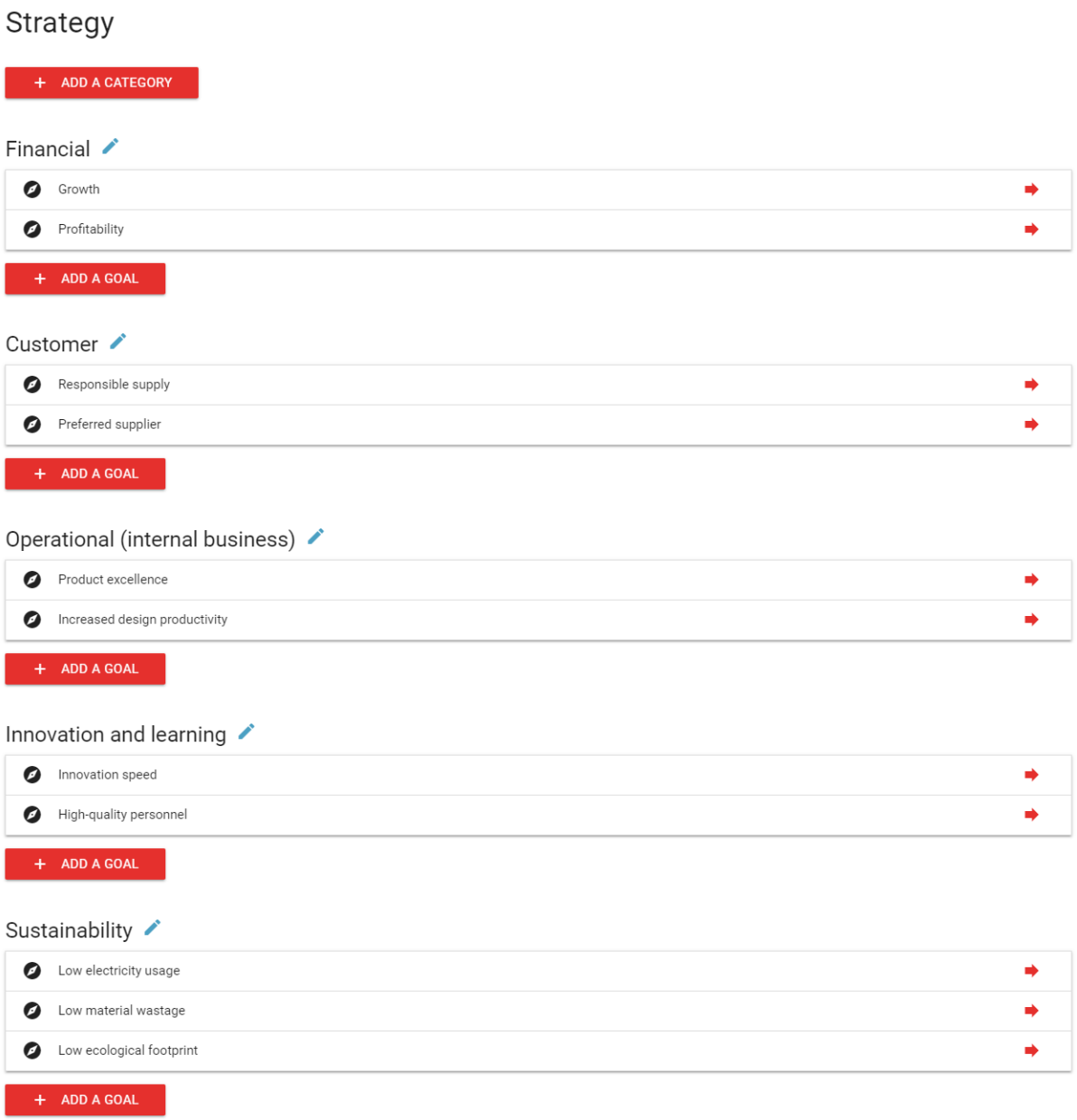


Figure 30 Overview of (strategic) goals

7.4. Designs

The user should define the goals, but Mobina can provide a lot of support. They can give examples of specific goals like profitability and product quality. In the design, strategy is defined by adding goals to a strategy overview. Next to this, as shown in Figure 30, goals can be categorized to provide a better overview of the strategy, and also to make sure all aspects of the strategy are taken into account. Here, an (extended) balanced scorecard is used as a framework, but Mobina can of course provide more examples to support users.

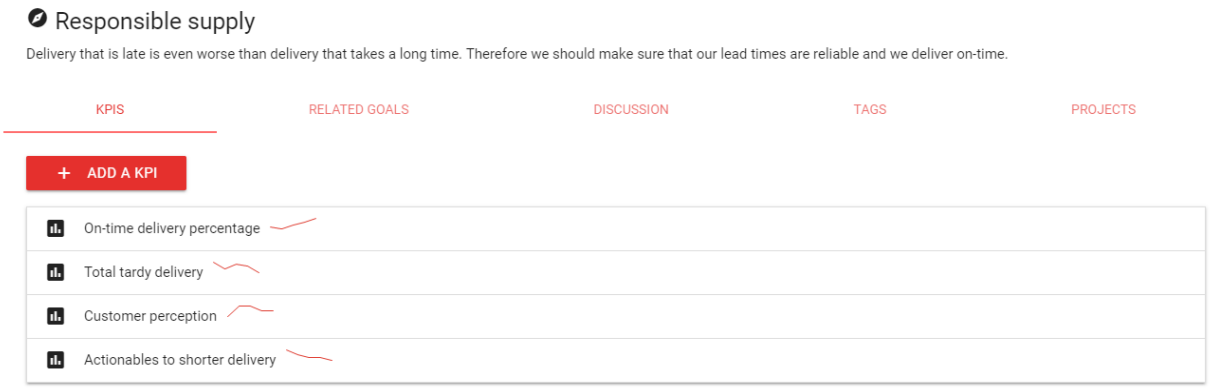


Figure 31 First tab goals: KPI overview

Figure 32 Detailed measurements for a KPI after opening a collapsed item

After opening a specific goal, here as an example responsible supply, a prominent place is given to the KPIs. These KPIs have to be defined by the user, but Mobina can help by providing examples. As mentioned, the KPIs fulfill both an important role for making the goals concrete, and as a way to monitor the goals. You can see in the mockup, Figure 31, that in one view you

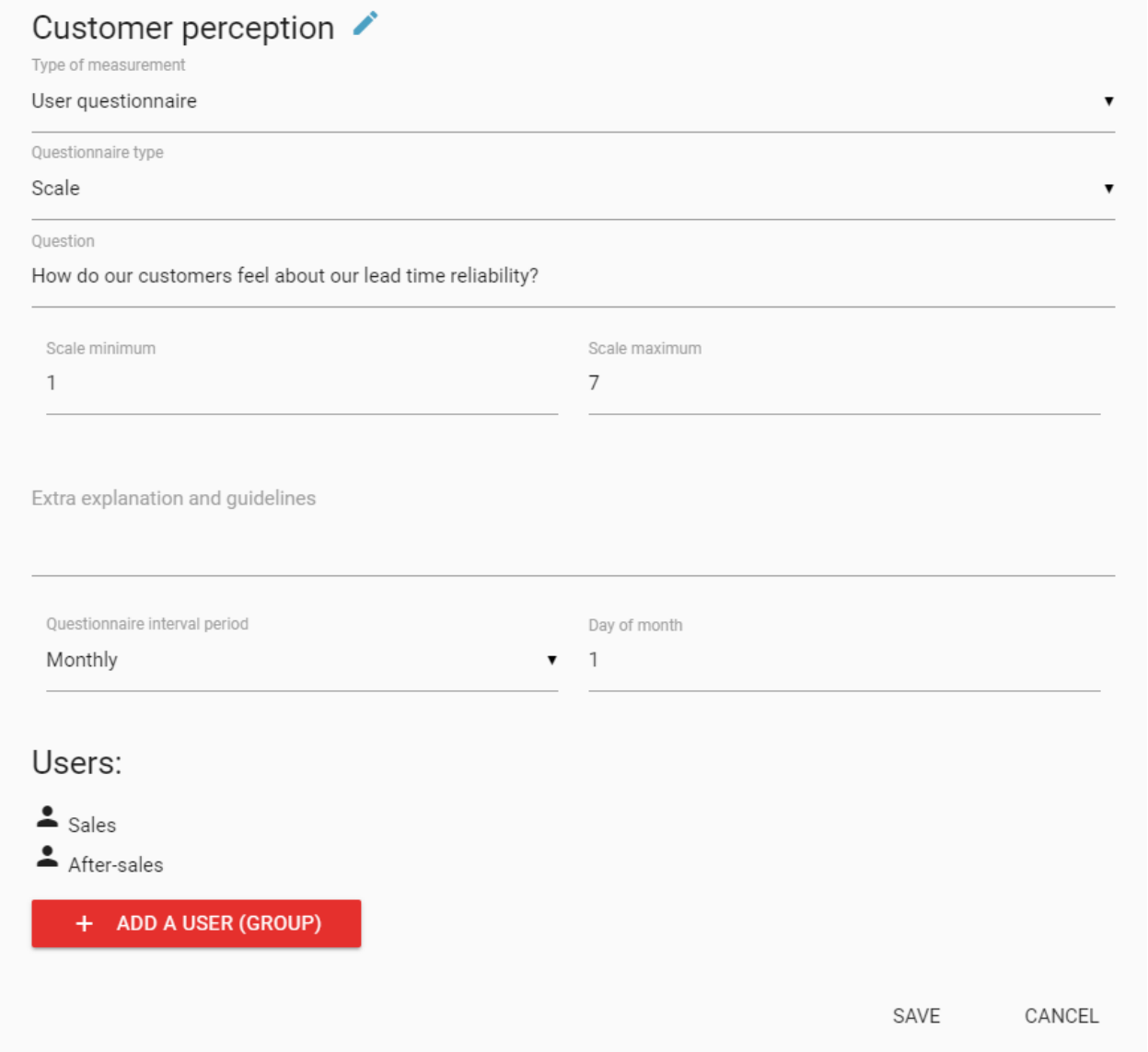


Figure 33 Example to set up a measurement questionnaire for users of Mobina

can see the trend of last periods for each KPI. Opening a specific KPI, Figure 32, you can also see the detailed measurements to help managers monitor the progress of the goal.

These KPIs can be measured using different ways. Mobina can provide support to make sure decision-makers get an overview of the progress. It is for example interesting to make a user questionnaire in which the users of the application are asked to give input. As an example, in the mockup, Figure 33, the customer-facing users are asked to provide feedback of the perceived customer opinion. These users are already thinking about improving their processes, and they can then easily be involved in measuring the progress of the company. Next to this, it might be interesting to provide measurements inside the software, for example in the area of innovation & learning: are users generating enough ideas for improving responsible supply or should they be stimulated to do more? Of course, most data is not available in Mobina. To fill this gap, this data could be entered by hand by designated users, or filled through interfaces with information systems like ERP.

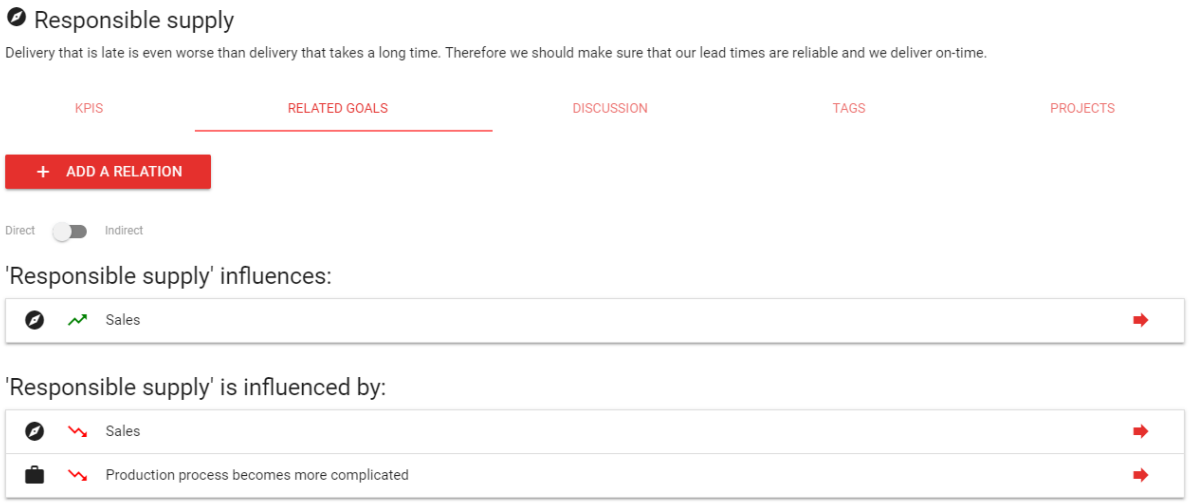


Figure 34 The (directly) related goals are easily visible

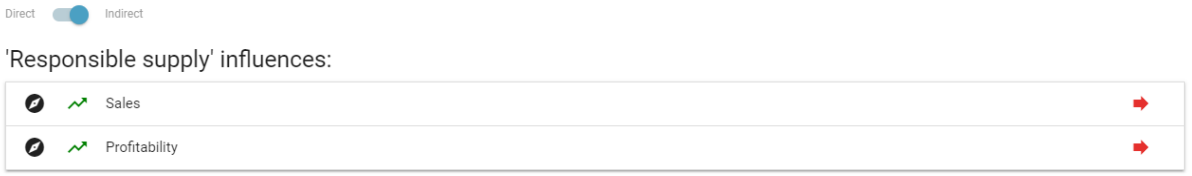


Figure 35 A user can toggle to also see indirect relations

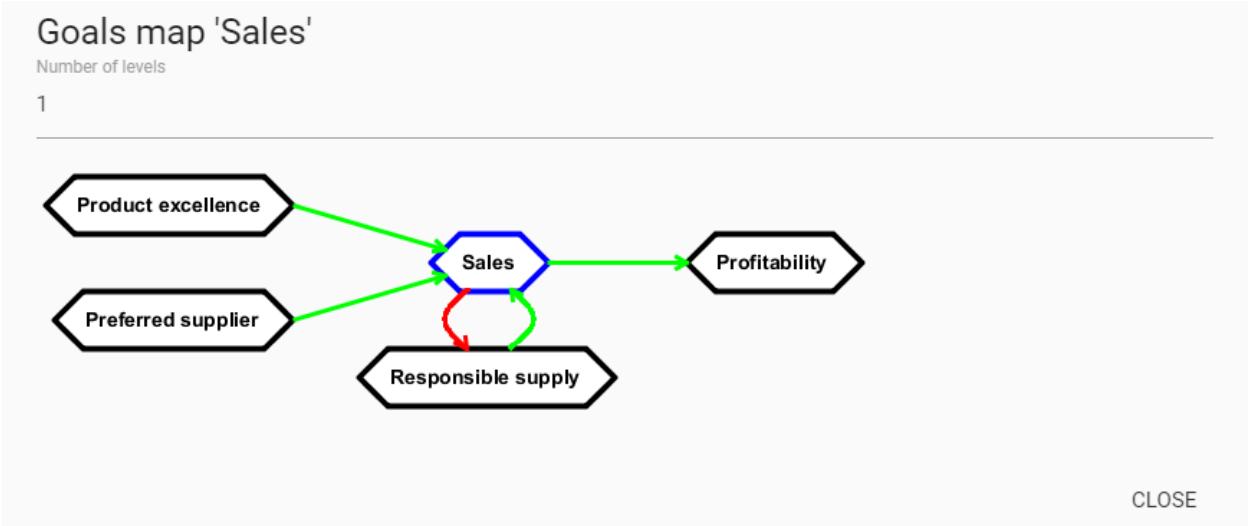


Figure 36 A goals map can provide more overview of all relations

Another important aspect is linking goals to each other. Multiple options exist to make sure that users get a clear insight in the influence relations. Figure 34 for example shows how users can see a goal's direct relations. However, it might also be useful to see all indirect relations. One option would be for users to navigate to the related goals to see the indirect causality. It is however easier if one can immediately see that in the end a goal can for example positively influence profitability. Therefore, users should be able to also show the indirect relations as in Figure 35. To create more overview, one could also provide a goals map like Figure 36, which shows all relations around a goal to a certain number of degrees.

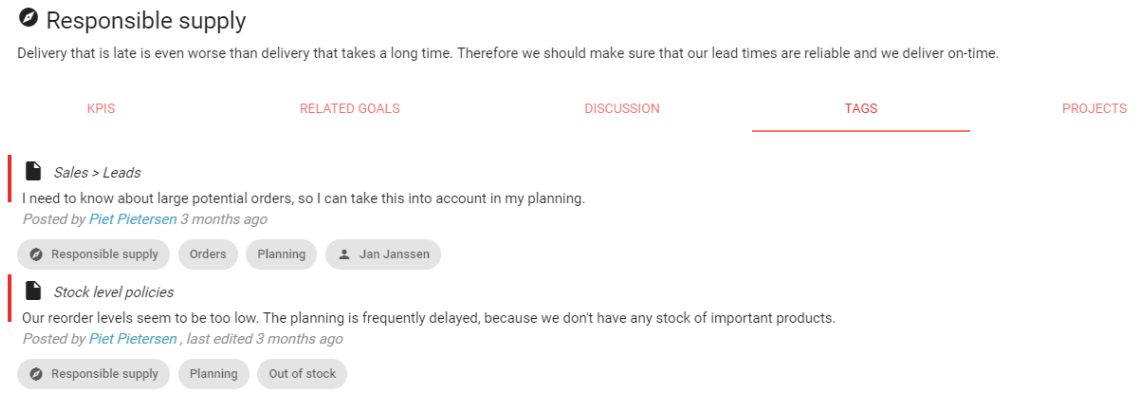


Figure 37 An example of extra functionality: Overview of all comments in which the goal is tagged

As discussed, these relations are not easily quantifiable. Therefore, only positive and negative indicators are given. This makes sure that users are aware that one should not always aim to improve every goal since this can have negative consequences, but that often a balance has to be struck. Goals don't only have to be related to each other, but the (strategic) goals can also be linked to operations or projects. One of the negative consequences of a project in this example, Figure 34, is the complexity of the production process; this example shows that users can also get an insight in how a goal is affected by projects.

Of course, also this functionality can be extended with more possibilities. Last section described the most important design choices, but additional possibilities can be offered. An example is shown in Figure 37. Users can tag goals in their comments, so managers can get an overview of which ideas can contribute to a specific goal. As such, certain good ideas that would contribute to the strategy might be managed on a higher level than other more operational improvements.

Next to this, users can of course be provided a discussion space like in other functionality of Mobina. Here users might discuss the importance of a certain goal, how they believe the goal should be measured, potential improvements and much more. Users might also add projects directly (and not through related goals) to be able to monitor these projects from higher up. This might for example be useful if certain projects are expected to have a high impact on the goal. More functionality can be added after needs arise when users start using the functionality or when a more in-depth design is created. Mobina might also actively look for more possibilities to strengthen the KaaS-concept.

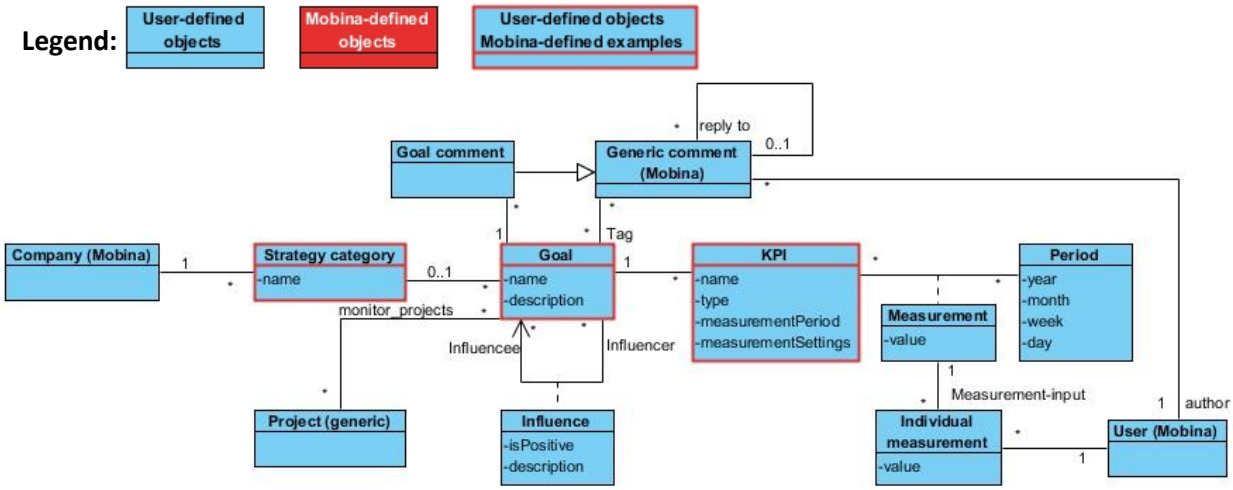


Figure 38 Data model of strategy & goals

The data model in Figure 38 illustrates how all entities relate to each other. It also provides an initial overview of potential attributes. This diagram is merely illustrative and does not have to be representative of the actual database or object model.

The diagram shows for example that a goal can be part of a category, but not necessarily (operational goals will not be shown in the strategy overview). Next to this, each goal can have multiple KPIs. Although KPIs might be re-used, to avoid unwanted effects every KPI can only be linked to one goal. Otherwise, a change to a KPI could influence other goals unknowingly.

7.5. Conclusion

Using strategy as a driver for change ensures a long-term future for companies. Operations, IT, and projects should be aligned with the strategy of an organization. It is thus logical to include the definition of (strategic) goals in Mobina. This can create extra overhead for users, but in the end, ensures a better alignment of the actions in Mobina with the strategy of the organization.

The goals are defined and monitored individually. To communicate them clearly with other users, and to measure them, multiple KPIs can be defined for each goal. This allows users to monitor the progress of the organization.

Next to this, it is important that insight is created in cause and effect within the organizations. Therefore, a proposal is made for showing the relations between different goals, and potentially also means (like projects). These relations are not easily quantifiable and therefore merely positive or negative.

Many opportunities exist to make the functionality even more user-friendly and effective. For example, linking comments to goals, and creating an overview of these comments. But also providing a discussion space for goals, or linking goals to specific important projects. To become a strategy-oriented organization, a company will have to undergo a (cultural) transition. As such support for this change factor might also be added.

8. Actionables & Projects

8.1. Introduction

As described in chapter 5, it might be useful to add actionables and projects to Mobina. Since these two entities are intertwined, they're discussed together in this chapter. They should mainly support aspects 2 and 3:

Aspect 2. Assessing and selecting those possibilities that are best for the organization;
Aspect 3. Monitoring and controlling the innovations to make sure that costs and risks are controlled, and all aspects of the company stay aligned.

Currently, many ideas in Mobina exist that can be used as an improvement agenda for the future. However, the management tools handed to them to create this improvement agenda from the comments are minimal. Now users can only prioritize comments through analyses. By adding actionables and projects, users can get more support for analyzing separate ideas, prioritizing them, and combining them to make them more controllable.

This chapter will first discuss the literature regarding projects and project management. It discusses both the success criteria and important success factors. Afterwards, the most important design choices for these actionables are discussed. The fourth section presents the designed mockup and data model. The last section contains a conclusion.

8.2. Background and literature

Project management is critical for the success of innovation and implementation of new systems (Fui- Hoon Nah, Lee- Shang Lau, & Kuang, 2001; Meyers, 1999). Two major barriers for innovation are that the cost is difficult to control and that it leads to excessive risk (Madrid-Guijarro, Garcia, & Van Auken, 2009). Therefore, both risk management and cost management are important tasks of project management (Cooke-Davies, 2002).

To analyze what is critical for successful projects, it is important to clearly define success. It is important to distinguish project success (the overall objectives of the project) from project management success (the performance of project management in terms of cost, time and quality), and to distinguish between success criteria (measures for success, explored in section 8.2.1) and success factors (factors that influence the success, explored in section 8.2.2) (Cooke-Davies, 2002; de Wit, 1988).

The main task of the project management unit is usually planning (Söderlund, 2004). Next to this, they're often responsible for handling different knowledge bases, differences in rates of time, setting priorities and deadlines, making decisions and the information process (Söderlund, 2004).

Mostly people involved in executing the project have another viewpoint, the micro viewpoint, than the customers and board who have a macro viewpoint on project success (Lim & Mohamed, 1999). The macro viewpoint looks at whether the original project concept was achieved, whereas people using the micro viewpoint look at success on a more detailed level. Project management is mostly responsible to bridge this gap.

8.2.1. Success criteria

To describe which factors are critical for project and project management success, we need to know what success is and how we can measure it. The distinction between project and project management success is often made, where project management success is often measured

after the project is ended and project success is also dependent on the second order control after the project is finished (Cooke-Davies, 2002).

Traditionally project management success is mainly measured by on-time performance and on-cost performance (Cooke-Davies, 2002), often extended with quality to form 'The Iron Triangle' (Atkinson, 1999). However, many scholars argue that it is important to also look at the delivery of benefits, for both the organization and other stakeholders (Atkinson, 1999; Cooke-Davies, 2002; Shenhar, Dvir, Levy, & Maltz, 2001; White & Fortune, 2002). The latter is often seen as project success, since they can usually not be delivered by the project manager or project team, but have to be delivered by the operations of an organization (Cooke-Davies, 2002).

To summarize, project management success is mainly measured by time, cost and quality. The latter is often also measured by checking whether the project meets the (client's) requirements (Shenhar et al., 2001; White & Fortune, 2002). More specifically the project manager's performance can be measured on the following criteria (Belassi & Tukel, 1996):

- Effective planning & scheduling
- Effective coordination & communication
- Effective use of managerial skills
- Effective control & monitoring
- Effective use of technology

The goal in the end is to deliver the planned benefits. So project management should therefore not be judged merely on these success criteria, but the strategic concept should also be used to drive evaluation (Bernroider, 2008). Project management does not have direct influence on the delivery of the benefits, but co-operation between project management, or R&D, and operations can ensure an optimal situation for benefits delivery (Cooke-Davies, 2002; Olson, Walker, Ruekert, & Bonner, 2001).

Benefits can be delivered to the organization, but also to other stakeholders like the customer (Atkinson, 1999; Shenhar et al., 2001). The type and amount of benefit expected from a project is highly dependent on the risk factor. The benefits expected from low-tech projects are mainly reasonable profit, with low margins, whereas the more high-tech the project the more benefits are expected (Shenhar et al., 2001). A more high-tech project should help an organization prepare for the future, by in the long run leading to new generations of products or new product lines, as well as the possibility to enter new markets, developing new technologies, and gaining a better reputation.

8.2.2. Success factors

The most important success criteria for project management are the on-time and on-cost performance. Hence, it is logical that the most important factors are also related to this. To achieve this, effective planning and scheduling is important (Belassi & Tukel, 1996). To ensure that projects adhere to the planning, some more specific factors are important.

For on-cost performance it is important that both scope and the performance measurement baseline are carefully maintained (Cooke-Davies, 2002). If the scope changes, careful reconsideration of the expected costs has to be done. To ensure that projects run on-time, risk management practices play an important part (Cooke-Davies, 2002). This includes company-wide education and assigning ownership, but also carefully maintaining and communicating the risk register.

The risk management process consists of risk identification, risk assessment, risk response planning and risk monitoring (Taylor, Artman, & Woelfer, 2012). It is important to identify the

risks already in an early stage, and assess and prioritize them. Based on these assessments, the organization can decide what to do with these risks. Afterwards, it is important to monitor the risks and take corrective actions if for example the response plan seems insufficient.

Risk analysis can be done at a more basic level, by identifying the potential hazards and probabilities, or more extensively using for example failure mode and effects analysis (FMEA) (White & Fortune, 2002). The most common risks are related to not achieving the success criteria, together with a lack of top management commitment, good personnel, and managing project changes adequately (Tesch, Kloppenborg, & Frolick, 2007). It is also possible to get an overall view on the risk of a project by evaluating key dimensions, like criticality, uncertainty and complexity (Taylor et al., 2012). This gives companies an overview of the total amount of inherent risk related to a certain project.

A very important criterion of project success is the benefits delivery. Although not all of this is under control of project management, part of this still is. As said in section 8.2.1, collaboration between the project organization and operations is an important aspect (Cooke-Davies, 2002; Olson et al., 2001). Other important factors are using effective communication and defining clear objectives (Pinto & Slevin, 1987; White & Fortune, 2002).

An important part of ensuring the delivery of benefits, is using objective prioritization techniques (Kirkham, Garza-Reyes, Kumar, & Antony, 2014). Currently, most SMEs use subjective approaches like experience, judgement and/or feeling, but a major disadvantage is that decision-makers often don't know enough details to make an informed decision. Using a more systematic approach, ensures that decision-makers can make informed decisions based on metrics, instead of personal interpretation and this leads to better results.

It can therefore be useful to use methods like a benefits dependency network that links together the means, ways, and ends to make more informed decisions (Peppard et al., 2007). Another useful tool is to make a business case, which can help set priorities, identify the changes that deliver benefits, ensure commitment from business, and provides a basis for review of cost, time and quality (Ward et al., 2008).

Many companies use project management methodologies like PRINCE or its successor PRINCE2[5] to ensure better outcomes using a more structured approach (White & Fortune, 2002). Although innovation projects should allow for flexibility at the execution level, formality and structure for the project can be useful to ensure better performance (Tatikonda & Rosenthal, 2000). Lessons can be learned from project management methodologies. PRINCE2 for example has a prominent place for many of the mentioned aspects, like benefits, business cases, and risks. This kind of project management methodology can provide structure to ensure positive results. It contains several principles, deliverables, and processes to guide project management.

8.3. Design choices

Transform comments into actionables

Currently, Mobina provides space to a lot of arising ideas, in the form of comments. The support for analyzing the usability and execution of these ideas is limited to analysis of the text, text, and (dis)agrees. Companies will have to make an effort themselves to prioritize these ideas and only implement the right ideas.

[5] https://www.axelos.com/best-practice-solutions/prince2

To do so, Mobina can support companies by providing them tools to analyze and prioritize these ideas more extensively. This way, companies can make more well-founded decisions on which ideas to use. The problem is that comments by users are necessarily not at the right level to be analyzed. They can for example include multiple aspects that should be analyzed separately, and multiple users might have repeated approximately the same idea or problem in other places.

That is why an extra entity is needed, the 'actionable'. An actionable should be made for ideas that a company wants to act on. This provides extra functionality for analyzing the idea and tracking its progress. These actionables can be linked to the comments that provided useful input for it. This ensures for example that the link between the operations, where the comments came from, and projects is clearer.

Combine actionables in projects

The list of actionables will quickly expand to an uncontrollably large list. It is therefore important to add an extra layer to allow for better prioritization and dividing the effort. In the real-world, projects are often bundles of ideas that are implemented together. By combining actionables in projects, the actionables are organized better.

Next to this, it gives companies tools to better control the scope of their projects, which is important to ensure success (Belassi & Tukel, 1996; Cooke-Davies, 2002). Through the link of actionables with comments, it also links the project organization to the operations. Interaction between the two is an important success factor (Cooke-Davies, 2002; Olson et al., 2001).

Link actionables and projects to goals

An important part of projects is the business case, to ensure the project delivers positive results (Ward et al., 2008). The go/no-go decision and budget is usually made for a whole project. Therefore, it is important that the project has a business case. The focus should be on linking to qualitative goals. For financial business cases other great tools exist, but Mobina can help to ensure that projects fit in the overall strategy and picture for traceability. The business case will not be stand-alone, but connected to the rest of the project. This is important for the long-term success of a project (Bernroider, 2008; Peppard et al., 2007; Shenhar et al., 2001).

Not only should goals be linked to the project as a whole, but also to its actionables. If a decision-maker has a complete overview of information, he can make better prioritization decisions (Kirkham et al., 2014). By linking goals to actionables, the project manager can get a good overview of the consequences of prioritization, both before and during the project. He sees both the ends to be reached and the means that reach them. Such a dependency network leads to more informed and better decisions (Peppard et al., 2007).

Support risk and issue management for projects

For successful project management, it is important take into account deviations from the expectation: risks and issues (Cooke-Davies, 2002; Taylor et al., 2012). Project managers should make an overview of the potential risks, and which actions should be taken to either prevent or solve them.

The contingencies and mitigations would be implemented in Mobina through actionables. To make sure project management have all information at their disposal when making prioritization decisions, it is useful to support risk management in Mobina. Actionables can then be linked, and therefore decision-makers can take into account their importance for risk avoidance or mitigation. For risk assessment different levels of detail can be used (White & Fortune, 2002), but most complete and clear seems to be FMEA.

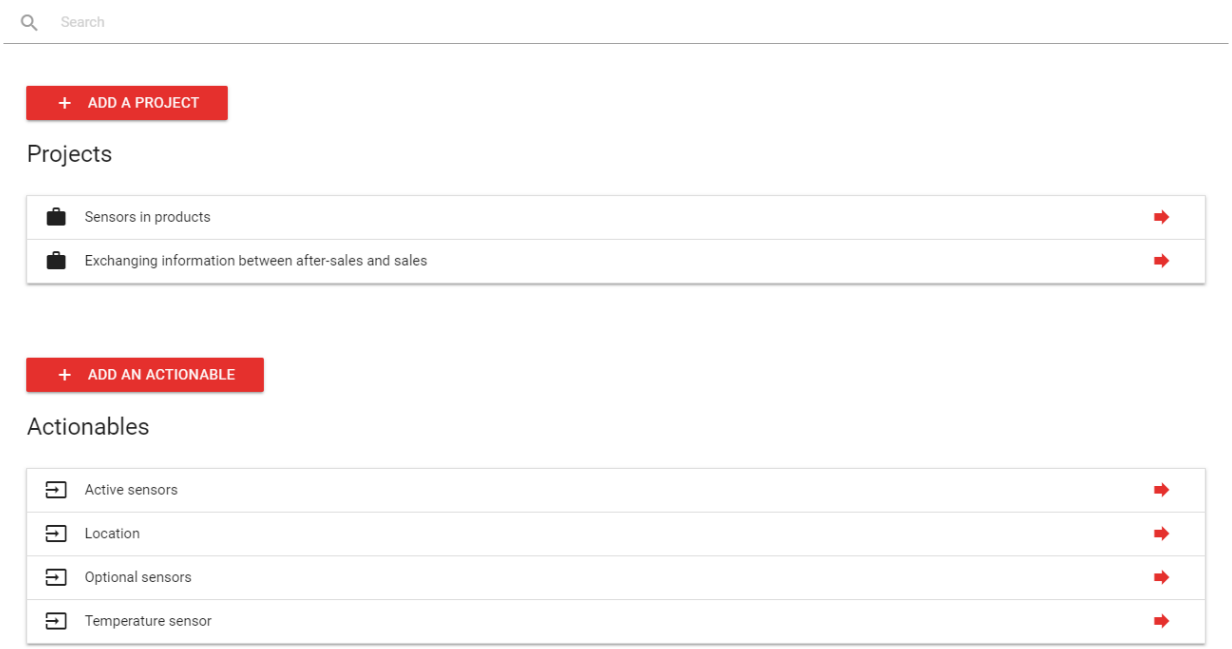


Figure 39 Overview of projects and actionables

Next to this, adding issue management in Mobina can help solve problems. If many users in the line organization use Mobina, each with their own expertise, they can easily be involved to handle issues. They don't have to be in the project permanently. By supporting issue management in Mobina, the right people with the right expertise can easily be involved at the moment they are needed. This might for example lead to smaller project teams, who are mainly responsible for coordination, since people from the line organization can conveniently be consulted when needed.

8.4. Designs

Of course, Mobina should provide an overview for projects and actionables. You can see in Figure 39 that with just a very small amount of projects and actionables, you will already get a lot more actionables. This shows that it is useful to group actionables into projects. If people still want to look for a specific actionable; this kind of search functionality can of course be added easily.

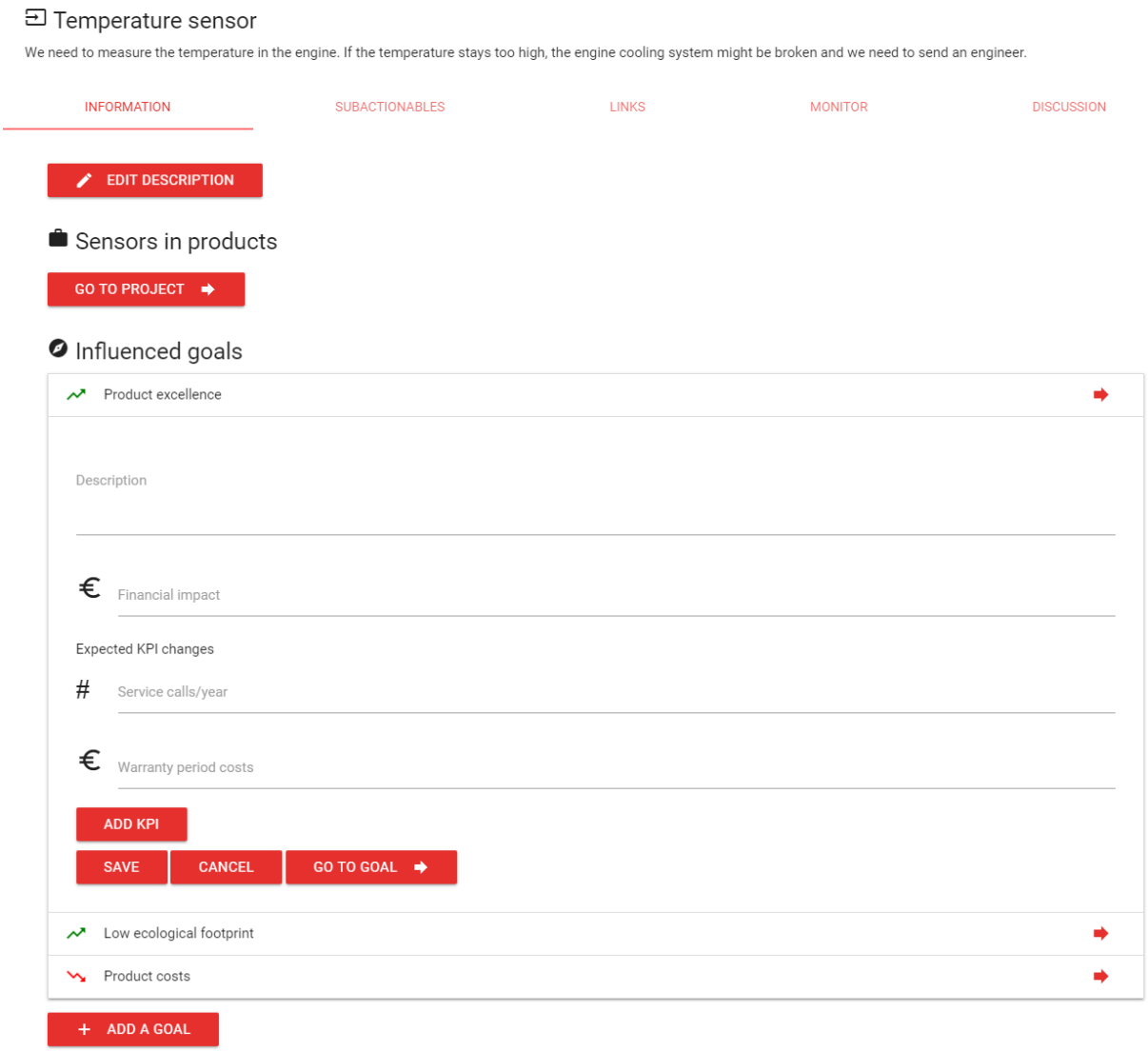


Figure 40 First tab of actionables: linked project and goals overview

If an actionable is selected, e.g. 'Temperature sensor' in Figure 40, then this should provide a prominent place for the linked project. Next to this, the first screen has a prominent place for the linked goals. For project managers this is an important aspect for prioritization decisions between actionables. It also helps tracking the effectiveness of an actionable. Users can describe how they expect to influence the goal, but can also quantify this influence to make measuring performance even easier.

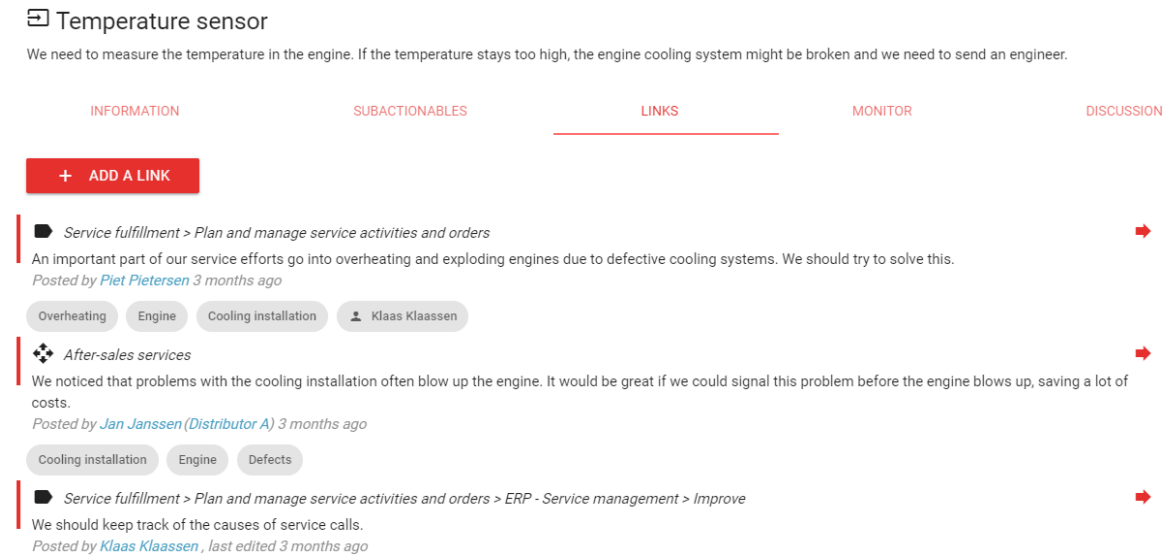


Figure 41 Links of the actionable to comments

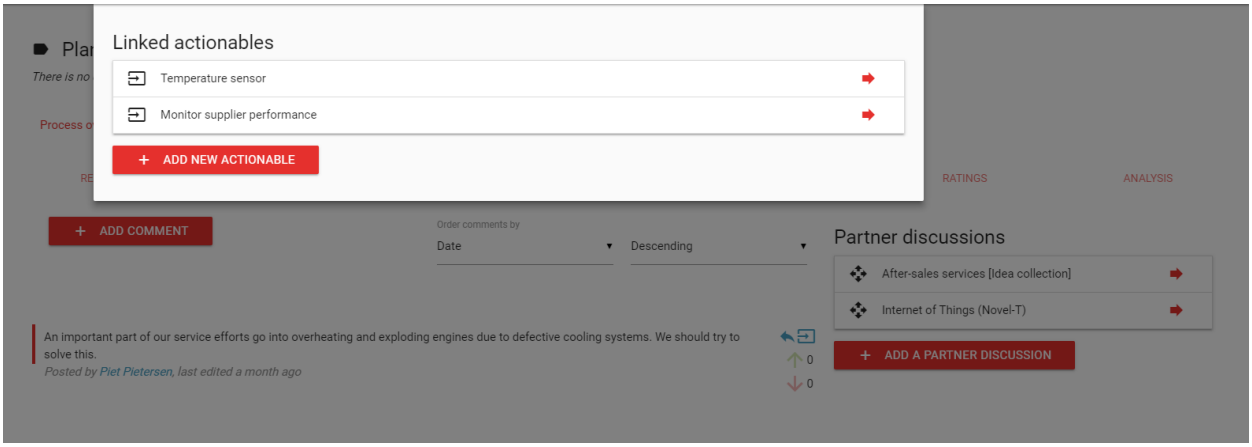


Figure 42 A popup to show a comment's linked actionables

As explained, a very important role of the actionable is to link to comments. These links can be made for all kinds of reasons, but the main reasons will be that the original idea or ideas come from these comments, or that the comment identifies a problem or improvement opportunity that the actionable solves. A bi-directional link has to be offered to ensure that it's both easy to add actionables to comments and vice versa, and to ensure traceability so the match between the implemented actionable and the needs of the organization can easily be analyzed. Therefore, actionables link to comments, Figure 41, and comments also show a list of linked actionables, Figure 42.

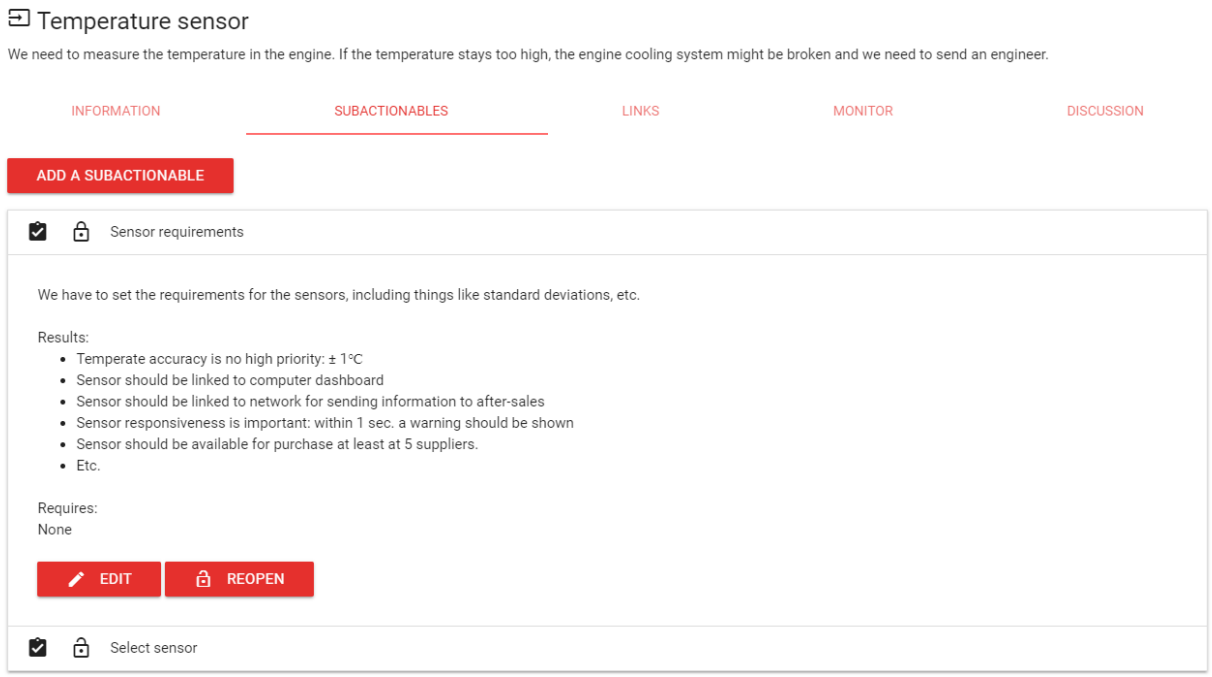


Figure 43 An example of how subactionables, or tasks, might be implemented

Another important aspect is to support the controlling of the scope of actionables. It can for example be useful to define subactionables, or tasks, that have to be completed so the progress can be monitored. This might not be essential, since many task managers exist, but can easily be added to provide more usefulness. These subactionables can for example be closed, and describe the results to all interested parties. Next to it, a sequence relation might be added to allow insight into the planning of the actionables. Figure 43 gives just an example of the implementation. Of course, much more advanced task and planning functionality can also be added; this can be done in the final implementatio. The actionables will probably also still be very effective even without this functionality, but users will probably need to use other tools to still support this.

Next to this, the management of actionables' implementations is important. They have been defined to solve a certain problem or reach a certain goal. Management tools to improve the actionables or review the implementation could be useful. One such tool, that is related to the usage of Mobina, might be linking user questionnaires, as shown for KPI measurements in section 7.4, to actionables.

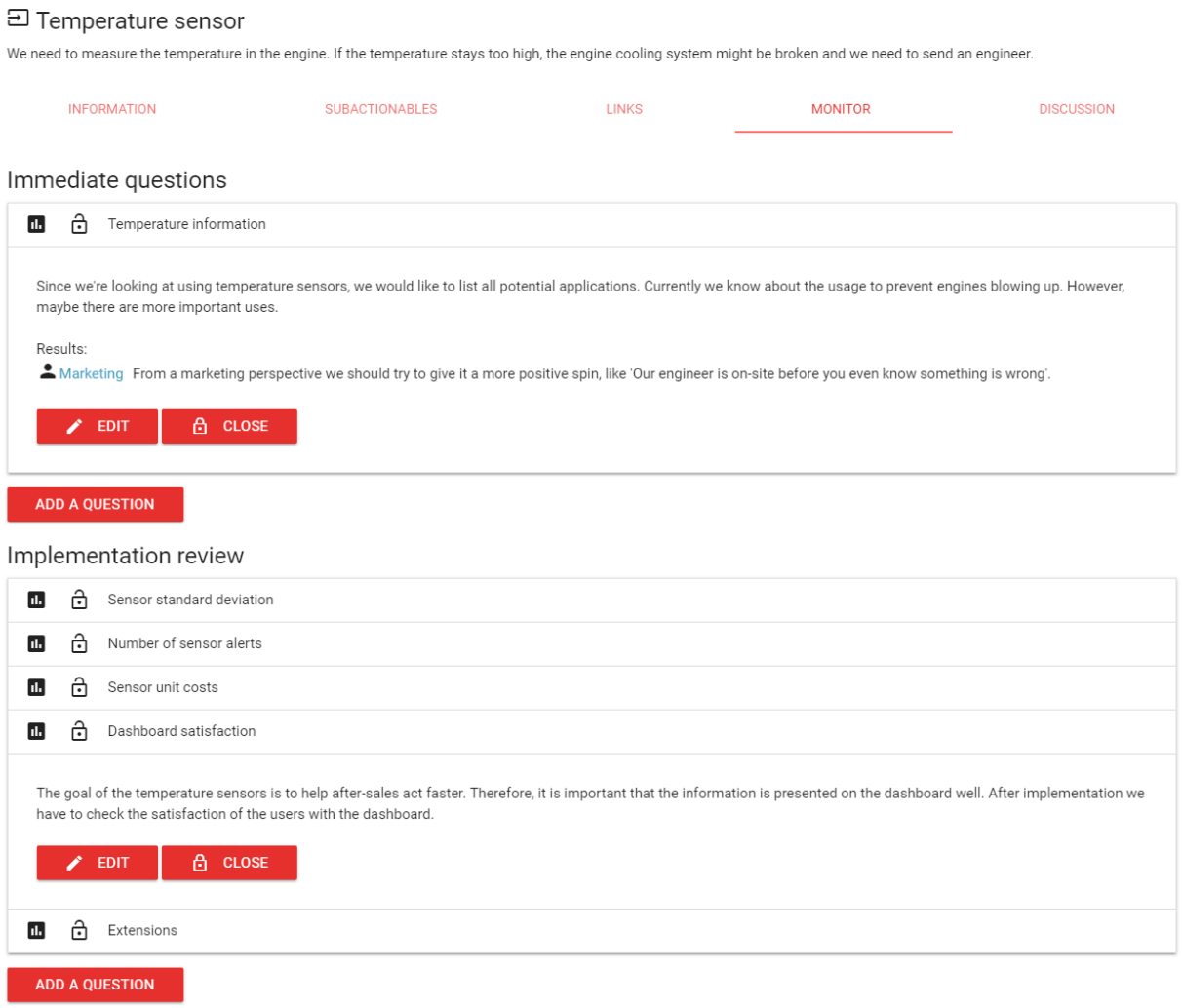


Figure 44 Using questionnaires to improve and review actionables

Shown in Figure 44 is using such review questions both immediately, and for an extensive implementation review that is automatically done after completion. Especially for implementation review also other options for measurements can be used, like using APIs to calculate statistics or having a user manually entering results. This can be useful for organizational learning and continuous improvement. Of course, this design is flexible and other options exist to accomplish the same result, like using discussions. One could also add reviews for multiple phases of a project, and maybe even provide review templates.

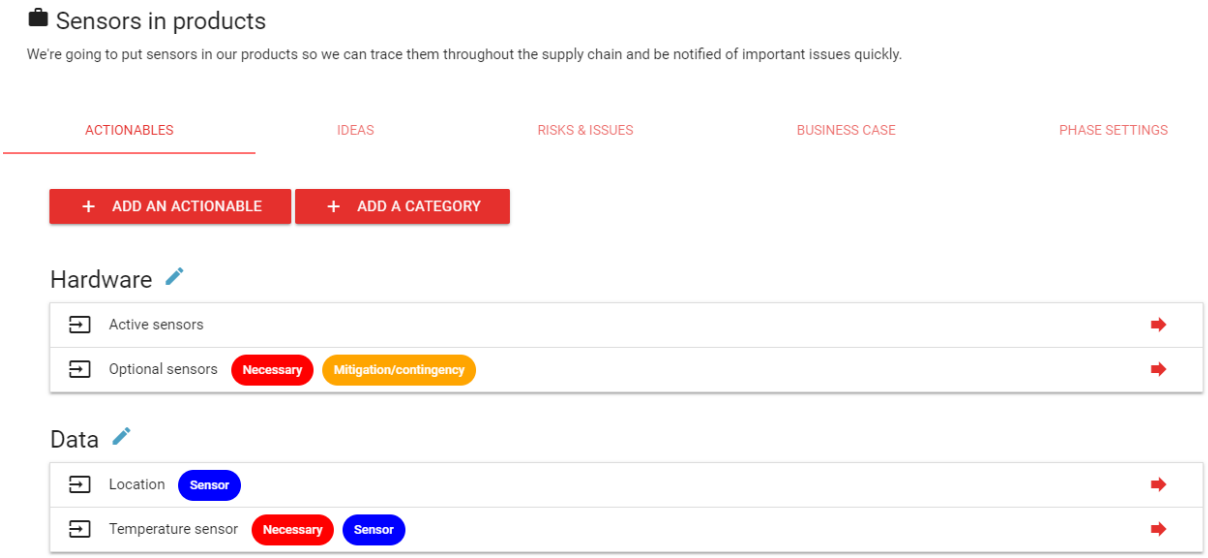


Figure 45 The first tab of a project shows the actionables

If you go to the project, the actionables should have a prominent place. These are important to monitor and prioritize to complete the project. Therefore, these are shown on the first tab in Figure 45. Multiple options to create a good overview exist, like using categories or labels to add meta-information to the actionables.

The next important part is the business case. This is only added to projects, since people probably don't want to make an extensive business case for every actionable. Next to this, the go/no-go decision and budget is usually made for the whole project. For users it will be important therefore to be able to get an overview. For financial business cases other great tools, exist. Therefore, Mobina focuses more on the qualitative side of the business case, ensuring that projects fit in the overall strategy and helping create traceability.

This business case can be partly generated through the linked goals of actionables. However, users can also individually add overall goals, so less overhead is needed in maintaining the business case. It might be useful to give guidelines for the business case to ensure completeness. The example in Figure 46 shows for example that users are stimulated to think about the drivers of the project, as well as about financial and non-financial consequences. If these are linked through a network of influence relations, the strategic impact could automatically be calculated.

Like for goals linked to actionables, multiple indicators can be used to measure the targets. Next to this, a quantified non-financial consequence might automatically be added to the financial business case. Financials can be limited to totals only, but could also implemented using a lot of difficult calculations to for example use regression over time. For this mockup, a compromise has been designed in which totals can be used, as well as some simple calculations with an amount of money/period for x periods.

It might be useful to freeze business cases. This allows for business cases to be continually maintained while also having traceability to business cases that were the foundation of important decisions. As such, users can continue to keep the original goals in mind, even if the project has changed.

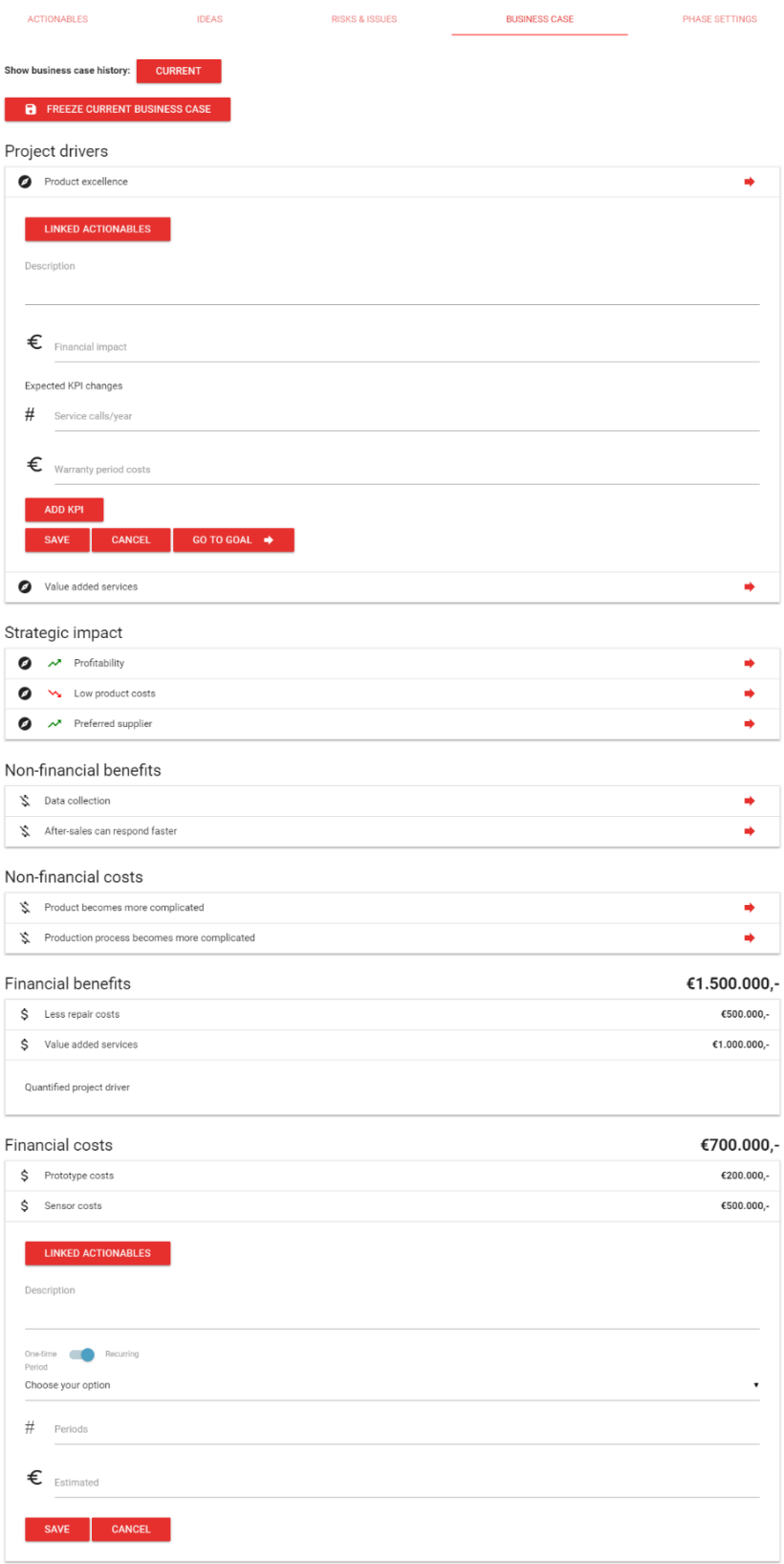


Figure 46 An example business case for a project

Next to business cases, an important aspect of project management is risk and issue management. As explained in last section FMEA provides a solid basis for risk management. It allows users to estimate the risks easily and effectively through three dimensions: the potential severity (or impact), the probability the risk manifests oneself, and the likelihood this can be detected in a timely manner. These can be used to calculate the Risk Priority Number (RPN).

In the mockup, Figure 47, each of the dimensions is scored on a scale from 1 to 5 (Very Low – Very High). The RPN can be automatically calculated and used to flag risks, for this example > 15 is orange and > 30 is red but more experience with scores from 1 to 5 might be needed to establish a good baseline. The flag thresholds could also be adjusted by admins in the organization.

Based on the scores, project managers can prioritize the risks, as well as decide on potential mitigations and contingencies. These mitigations and contingencies should be actionables, to make sure that the project also implements them. This gives decision-makers a clear overview of why actionables should be implemented, maybe not because of high reward, but because they fulfill an important role in risk management. To analyze the impact of these actionables, it might be useful to score both the initial and final risk (where the latter is important for further prioritization). This link between risks and actionables can be very useful.

Next to this, issues can arise in the organization. This might be based on a risk, like in Figure 47 the research on customers' privacy concerns, but might also be unforeseen events. The possibility to open discussions for specific issues, with specific participants, makes sure that the right expertise can always be involved in the project.

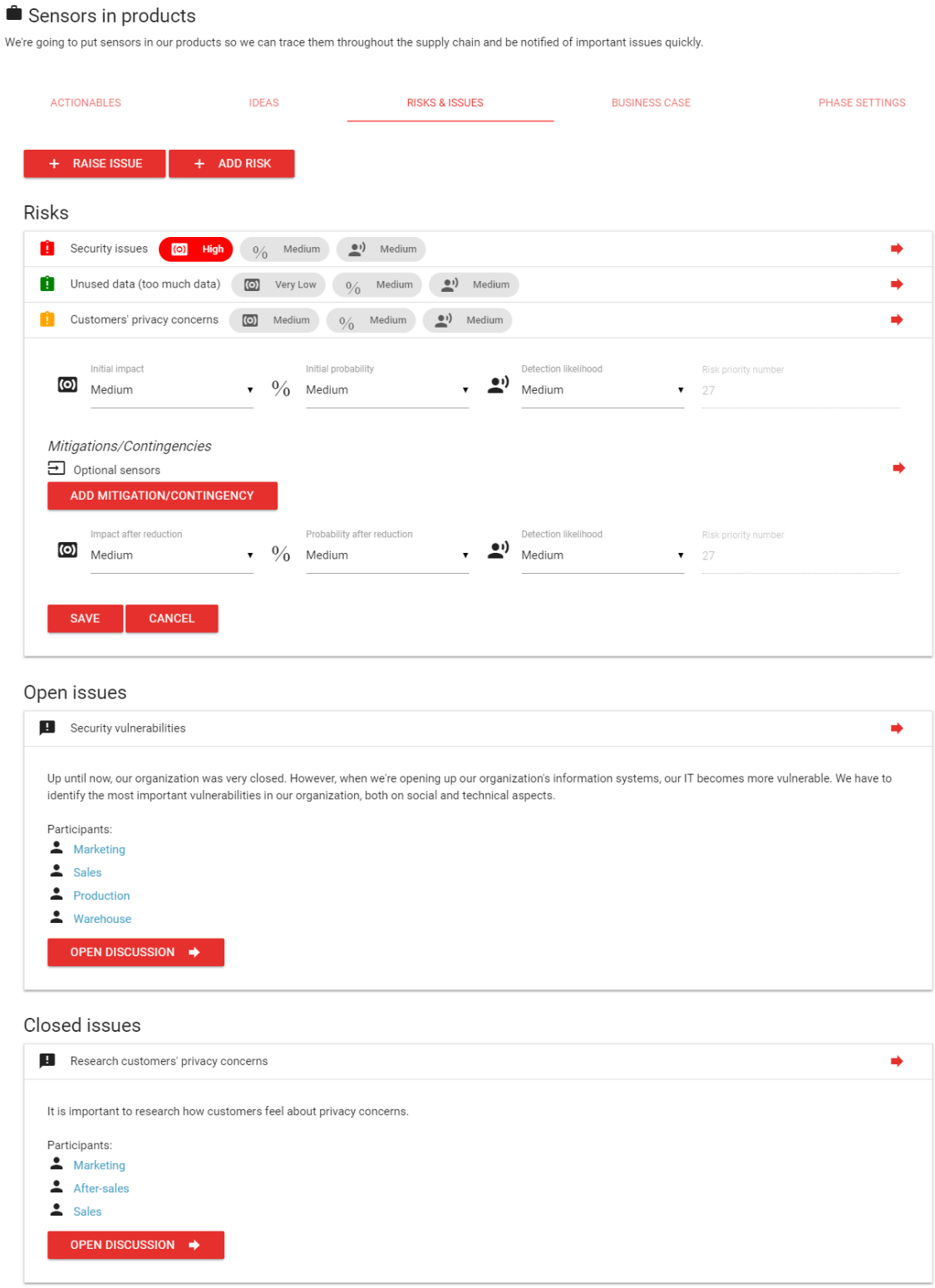


Figure 47 Risk & issue management for projects

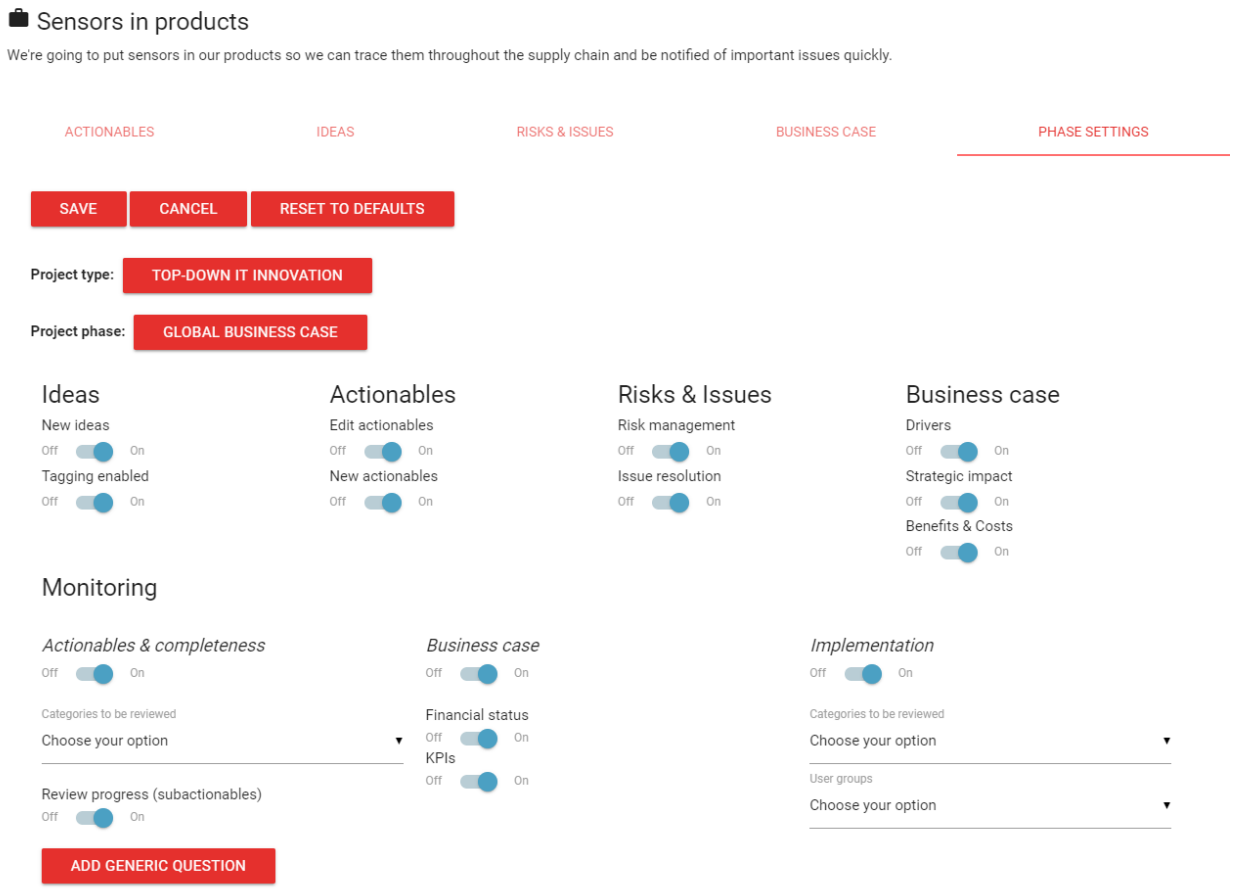


Figure 48 An example tab for project setting

For project managers, it might be useful to have a lot of settings to control the project environment. An example is shown in Figure 48. Settings could include for example whether users are allowed to add issues, or change the business case. This could work especially well in combination with some project phases, as used in project management methods like PRINCE2. For each phase, different functionality might be needed.

Next to this, no administrative functionality like rights management has been added to the mockups. This is an essential phase in software development and will therefore probably not be overlooked. It is often mainly a usability issue, as well as a business or sales decision. Mobina can for example base rights management on its licensing structures.

Some other extra functionality might be useful, which should be relatively easy to implement. For example, a tab for collecting ideas in the early stages of the process might be useful like in Figure 49. Next to this a generic discussion space could for example be added.

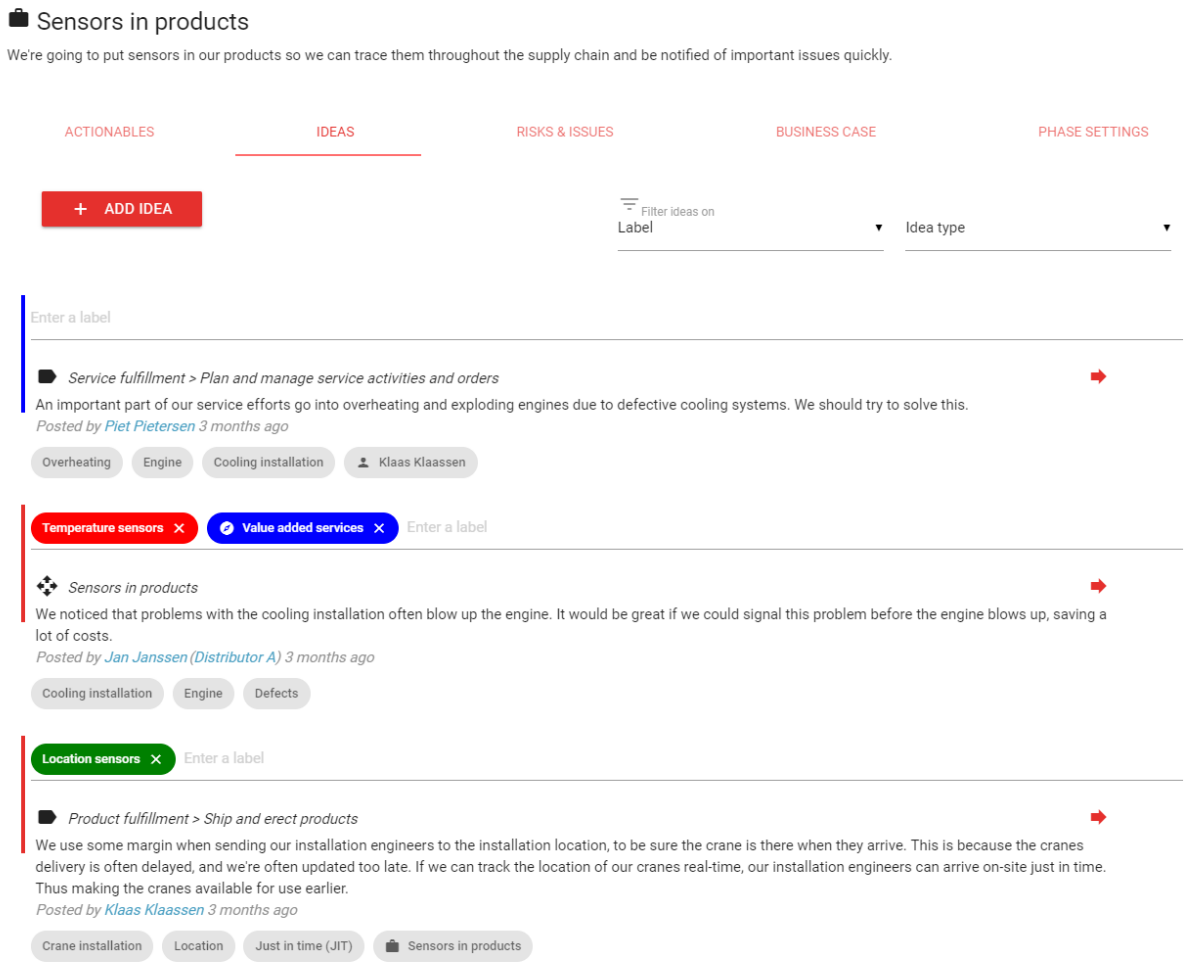


Figure 49 Support for the idea collection phase of a project

The data model in Figure 50 shows the amount of entities involved and how they're related. The goals and KPIs, of chapter 7, are reused. Next to this, projects and actionables are closely related; directly, through the business case and risks. This gives an indication of what needs to be implemented.

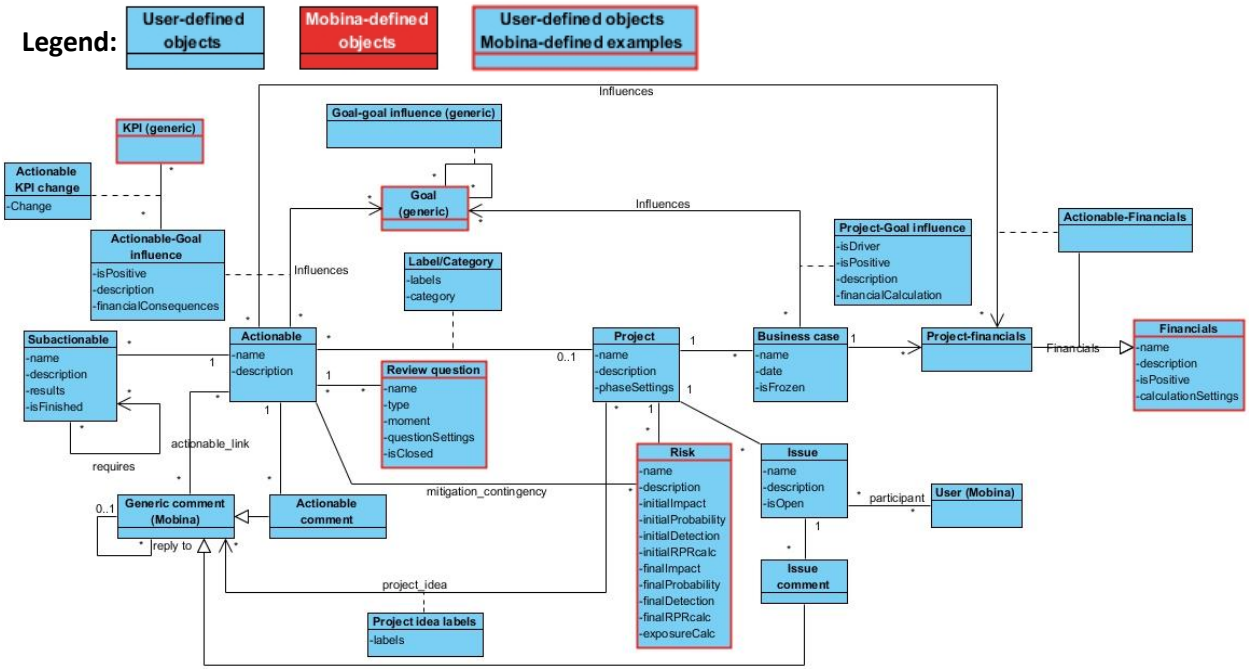


Figure 50 Data model of projects & actionables (larger size in Appendix C)

8.5. Conclusion

Mobina can effectively add support for project management and prioritization. This helps achieve higher project management success and project success. Different criteria exist, but in the end, both should lead to the same goals, and aim to deliver benefits to the organization or customer.

This can be supported on the one hand by adding an extra dimension to Mobina, actionables. Comments can be linked to these actionables to establish a link to the idea generation phase. Next to this, the actionables should be linked to goals to deliver a lot of information for prioritization. More functionality can be added like subactionables and monitoring functions.

However, actionables are small and a lot of them will be created. It will therefore be useful to use projects to combine these actionables. On the level of projects, a lot of extra support can be added, like business cases, risk management, and issue management. These aspects are important to ensure project management success and project success.

This functionality can help link projects to the line organization. That is an import factor for the delivery of benefits. A project team is still useful for coordination, but responsible for actionables can be assigned to specific people. Next to this, the right expertise can be involved in issues. The main task of the project team will be to coordinate the project, ensuring a smooth and correct progress, as well as making prioritization decisions.

9. Validation results

This chapter describes how the results of the validation. The first section discusses the choices made for setting up the focus group. Then, the results are described in the same order as the focus group. After the focus group, the decision was made to use the results to collect some extra information through interviews with people who complement the group. The interview results are summarized in the last section.

9.1. Focus group set-up

This section describes the set-up of the focus group. It first describes the composition of the group, and why this composition is chosen. Then the setting in which the focus group met is described, after which the structure and agenda is discussed. The last subsection describes how the analysis of the focus group was executed. The guidelines and background from literature can be found in section 3.4.

9.1.1. Group composition

For this study, the industrial SMEs are the target population for which the artifact should work. An important task for the software is to guide and improve the innovation process of these SMEs. We assume that the potential users of the artifact are not yet aware of the possibilities to improve the innovation process or do not know yet how to improve this process. The designed artifact is still in the initial stage of the design cycle, limiting it to global concepts to be discussed and developed. Therefore, it will be difficult for the target population to identify the usefulness of the software themselves. Using the knowledge and experience of a group of subject experts to validate the usefulness of the functionalities presented in the artifact for the target population is most useful.

These subject matter experts should be very familiar with the target population and the innovation process. Two major dimensions differentiate these subject experts. Their experience in the innovation process might lay very much on the side of the innovation development, while also experience from the operational side, the user and customer of the innovation, can provide useful insights to improve the innovation process. Another important dimension that can also be differentiated is the origin of the expertise. Knowledge can have a scientific foundation, whereas others derive their knowledge from practical experience. It is important to make sure that the participants cover both dimensions.

For the validation of the artifact, a heterogenous group is useful: more data can be collected, because the differences in opinion can be enlarged and discussed. This interaction can give more complex insights in the background of certain opinions and give the possibility to analyze how reliable the results of the focus group are.

Multiple people are contacted, to ensure a complete focus group. Due to planning constraints, not all people could participate (eventually some did participate in interviews). Five subject experts, see Table 2, participated in the focus group, selected through the network of Mobina and the University of Twente. This group represents the different angles on the target population and process. The expected involvement is high, since all participants have an interest in the subject. Therefore, a rather small group is chosen, to give more space for a good discussion and for everyone to participate in the discussion. We feel confident this group can provide enough information to provide a reliable indication of the usefulness and to give directions for the future development. If any topics have to be explored in more detail, ‘focused’ interviews can be held to solve this as discussed in section 3.3.

Table 2 Participants focus group

Prof. Jos van Hillegersberg	First supervisor of this research. He is head of the Department Industrial Engineering and Business Information Systems at the University of Twente. His interest and experience are in business information systems.
Marlène Hol	Vice President of Mobina, background in Computer Science. Also fulfilled the role of secretary at the focus group.
René Hol	President of Mobina, originally graduated in Mechanical Engineering. A lot of experience in consultancy in the manufacturing industry, especially on the edge of business and information systems.
Dr. Matthias de Visser	Assistant professor in the department Technology Management & Supply at the University of Twente. His key interest is in managing innovation in manufacturing organizations. Absent during the part 'Strategy & Goals'.
Bram de Vries	Managing Consultant at Leap – The Innovation Agency – in Enschede. Industrial SMEs are an important target group of Leap, both for subsidy advice and innovation consultancy.
Prof. dr. ir. Hans Wortmann	Chair professor Information Management at the University of Groningen. He has a lot of experience in the manufacturing industry, and focuses on both information management and innovation processes.

9.1.2. Setting

The focus group was kept at a meeting room at the University of Twente, RA3411, which is easily reachable for most participants. This room provides several large screens for a presentation and demonstration, and offers the possibility for participants to be seated in a (semi-)circle. Before starting, the participants had time to meet each other informally. During the focus group plenty of coffee (all participants drink coffee) and water was available, and the participants were provided with some snacks. The participants also got a small gift as a thank-you for the participation and were invited for a drink.

During the meeting the goals of the focus group were explained, and I stressed that discussion is important and all opinions are welcomed. They were also explained that the role of the moderator is to make sure the discussion is in line with the research goal and everyone is included. To make sure that the moderator did not influence the discussion too much due to his involvement and commitment in the artifact, they were encouraged to point out when this happens.

9.1.3. Structure

It was most difficult to find a day and time all participants were available than it was to clear their schedule for a bit longer. Therefore, we used only one session which was a bit longer.

Some structure is very important for the focus group, since there is a lot to discuss and a non-structured discussion would only diverge. Therefore, the agenda for the focus group was structured, with designated timeslots for open discussion. See Appendix C for the agenda. During these time slots the 'real' focus group took place, and questions were only used to stimulate the discussion and to ensure the group stayed within the area of interest for the

validation, as well as to make sure everyone was allowed to speak. By using this structure, I, as both researcher and designer of the to be validated artifact, could fulfill the role as presenter of the design and the role of moderator as researcher.

First, there was some space for an informal introduction and getting some refreshments. Then, the focus group was introduced to the research and the goals. They got an explanation of what a focus group is, of the role of the moderator and of the importance of different opinions. They were encouraged to highlight when the moderator steered the discussion too much, or was participating in the discussion.

Next, they got a short overview of the global design and the session was split up into three parts: open innovation; strategy & goals; and projects & actionables. This gave the opportunity to focus each discussion more on each of these parts. In the end, some space was given for a generic discussion, especially since the parts strategy & goals and projects & actionables could be intertwined too much. Between each part there was enough space for a short break.

Each part contained three different modes: a demonstration of the prototype, including a short introduction and overview of the key functionality; space for an open discussion (about 20 minutes per part); and a short questionnaire to collect more quantitative data and force people to take a stand on specific points. At the end, also a questionnaire to assess the whole prototype was held. The questions can be found in Appendix E. The questionnaire was held digitally.

9.1.4. Analysis

Since this study consists of only one focus group, the amount of rigor described in section 3.4.4 does not provide any advantages. The coding process takes very long, and the amount of data is not large enough to find any patterns. It is also not needed to find similar arguments or discussions in different focus groups. Rather, this rationalization might make it more difficult to analyze the data and the relative importance, which can be better analyzed through the overall tone and non-verbal communication.

Therefore, the focus group is summarized to key discussion points and arguments for each part. This summary is verified with the secretary of the focus group, Marlène Hol, and the research supervisor, to ensure a complete and correct representation of the focus group.

To ensure the possibility to verify these results, an audio recording is made during the focus group. An audio recording is used since it is less intrusive than a video recording and can provide enough context to review the summary. Next to this, extensive notes of the focus group are made including important aspects of e.g. non-verbal communication. These are not included in this report, to protect the privacy of the participants, but are used for analysis of the results.

9.2. Results

This section summarizes the results of the focus group. This is done in the same structure order the focus group. For every part of functionality, first a presentation was held after which some time was reserved for open discussion (the focus group). After this open discussion, a questionnaire was held to get an overview of the opinions on the usefulness. At the end, a global questionnaire was held to get an overview of the general opinion on the designs, and an idea of the relative usefulness. This section describes the summarized results, which have been anonymized and translated from Dutch. The raw results of the questionnaires can be found in Appendix F.

9.2.1. Open innovation

Discussion

In general, companies that want to explore open innovation will welcome this kind of functionality. Allowing them to collaborate with partners provides useful support, as well as providing users with innovation ideas to give them a grasp of the possibilities. However, there are many different phases and innovation subjects, which might each need other support.

In the orientation phase companies will probably still be looking for what is possible, and ask for example peers about their experiences. After this phase, companies know what they want and will mainly be on the look-out for partners that can help develop the innovation or that can deliver a solution. Especially SMEs are not sure where to find these partners, and lists of potential partners like for the innovation entity can especially be useful. Mobina might also provide links to external lists to help them.

Next to this, it might be necessary to differentiate the support for three different kinds of (product) innovation discussed in literature (Enkel, Gassmann, & Chesbrough, 2009): inside-out, outside-in and coupled. It might for example be useful to give examples to users of which kind of options they have for partner discussions.

For organizations that are ready for open innovation, the proposed functionality can easily be used. However, companies who are not using open innovation yet might need help to effectively use the functionality, especially partner discussions.

These companies might need help on the decision of whether open innovation is useful for them, and which practices they can use. A decision tree can be useful (Pellegrino, 2017). Next to this, the organization has to think about how they use partner discussions. They might for example lead to legal consequences, e.g. regarding intellectual property. Users could also share confidential information easily. Next to this, partner discussions might sometimes lead to a giving and a receiving organization, which might not be desired behavior. Companies should therefore make sure they know which guidelines they should use, as well as potentially making agreements with their partners.

Finally, Mobina currently uses mainly text for its descriptions. These are also used for the innovations. However, users of industrial SMEs, and people in general, don’t like reading (too) large texts. Therefore, it might be useful to include images, graphs, and other visual representations.

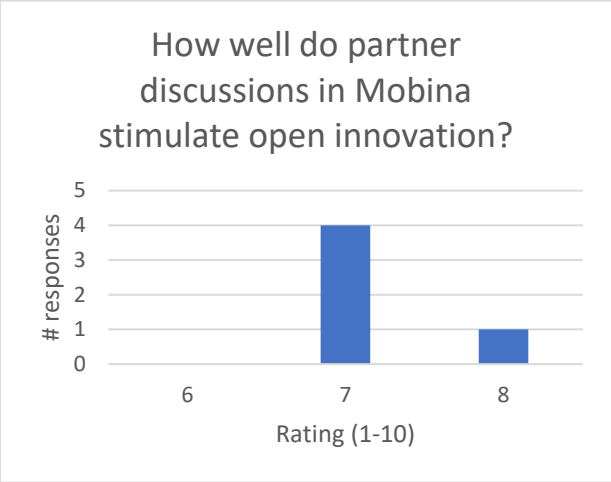


Figure 51 Ratings partner discussions

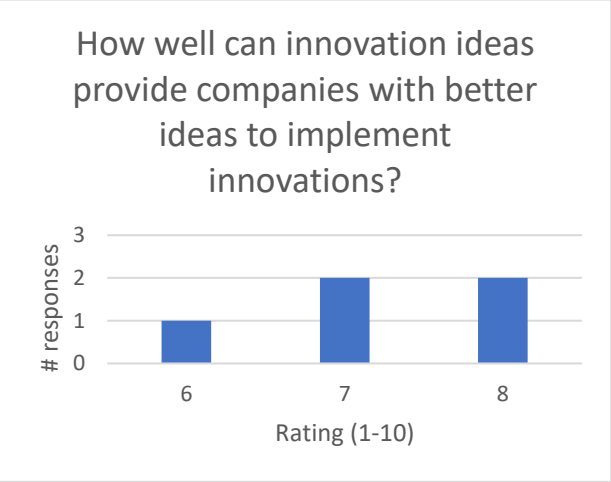


Figure 52 Ratings innovation ideas

#	Options
1	Link with content (reference model, critical aspects, etc.)
2	Subjects free to define
3	Closed group
4	Platform for open discussions (e.g. network organizations)

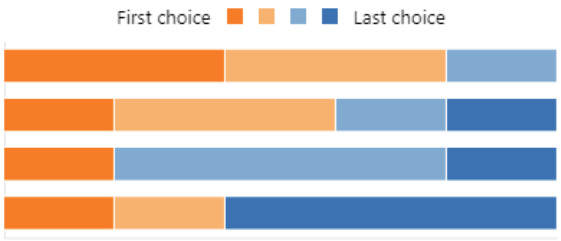


Figure 53 Ranking partner discussions

Questionnaire

Overall the ratings for both partner discussion and innovation ideas are positive, both averaging 7.2, see Figure 51 and Figure 52. Only some small extra attention points are given, but in general the answers to the questionnaire reflect points from the discussion.

For partner discussions, the link with Mobina content and the free definition of subjects are seen as relatively most important, see Figure 53. However, opinions differ a lot. Also, that the group is closed and the platform for open discussions score high in some answers. Anonymous posts could help users to share ideas easier. Next to this, it might be useful to give users insight into the supply chain of the company.

Innovation ideas should stimulate the user to think about innovation. Both companies that have already decided for open innovation, and 'closed' companies should be stimulated. It might be useful to include 'conversation starters' so users start talking, these can also provide a basis for partner discussions.

9.2.2. Strategy & Goals

Discussion

During this discussion, one participant, Matthias de Visser, was absent due to other obligations. Therefore, he also didn't answer this questionnaire.

The first discussion was regarding the concept strategy, and how strategy usually is formulated. The participants agreed that strategy is usually defined on a higher-level than the functionality presented, defining a few important pillars. The functionality makes this high-level strategy more

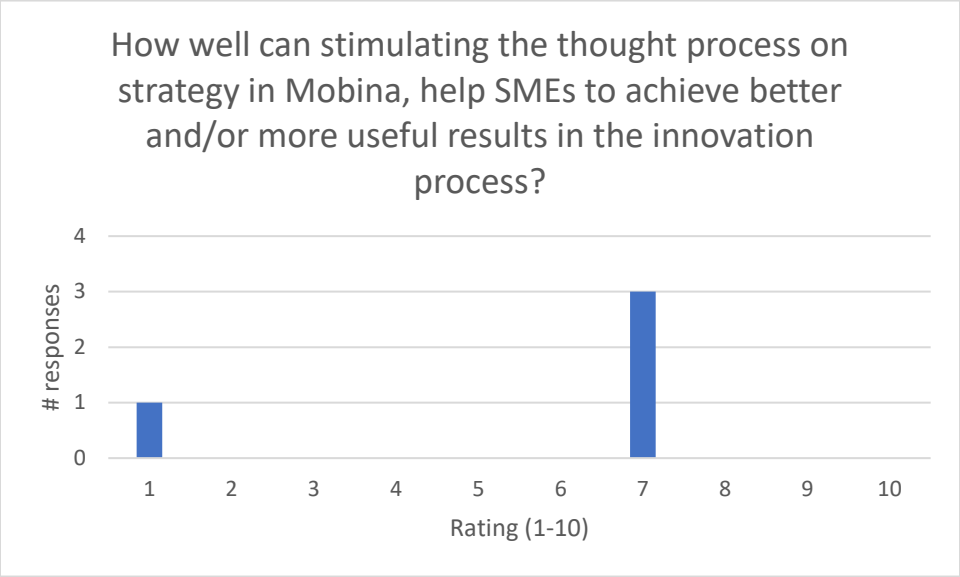


Figure 54 Ratings strategy & goals

operational, it is a tactical strategy. This is useful, since it helps communicate the strategy to the company and makes it more concrete for users. However, it might be useful to provide top-level management also with a way to communicate the strategy at the highest level.

Next to this, Mobina could really help companies define the right goals, by giving examples. However, for most 'ongoing concerns' like financial goals better tools are available, like BI tools or dashboards integrated into systems like ERP. Interfaces with these tools might be useful to improve usability. Therefore, Mobina should focus on showing thought leadership on the areas they excel at, e.g. 'innovation and learning' on the balanced scorecard. Mobina could for example provide a list of goals and KPIs that represent an organization's innovation capabilities.

It is important to keep in mind that SMEs often don't explicitly use strategy in their decision-making. Engineers for example mostly decide in a pragmatic way, where they use the tools they saw and liked the most. It can be good to facilitate users that recognize the importance of strategy, so they can think about it. However, the functionality of strategy should not be forced onto users. The current design adequately takes this into account, by providing a separate menu-item for strategy.

Some smaller discussions, or rather statements have also been made. It might for example be useful to check whether different types of companies have different needs and demands. A family business is probably a different, and less formalized, company than a SME that is owned by a corporate investor. Next to this, although KPIs is a correct term, it might be confusing for users since they often already use these for measuring performance in operations, for example to assess individual employees.

Questionnaire

Most ratings for this functionality are positive (three times a 7), but one rating was very negative (a 1), see Figure 54. During the discussion this division already became clear. The basis for negative feedback on the functionality was mainly whether SMEs use strategy as a criterion for investment decisions, and in that light whether this functionality is useful.

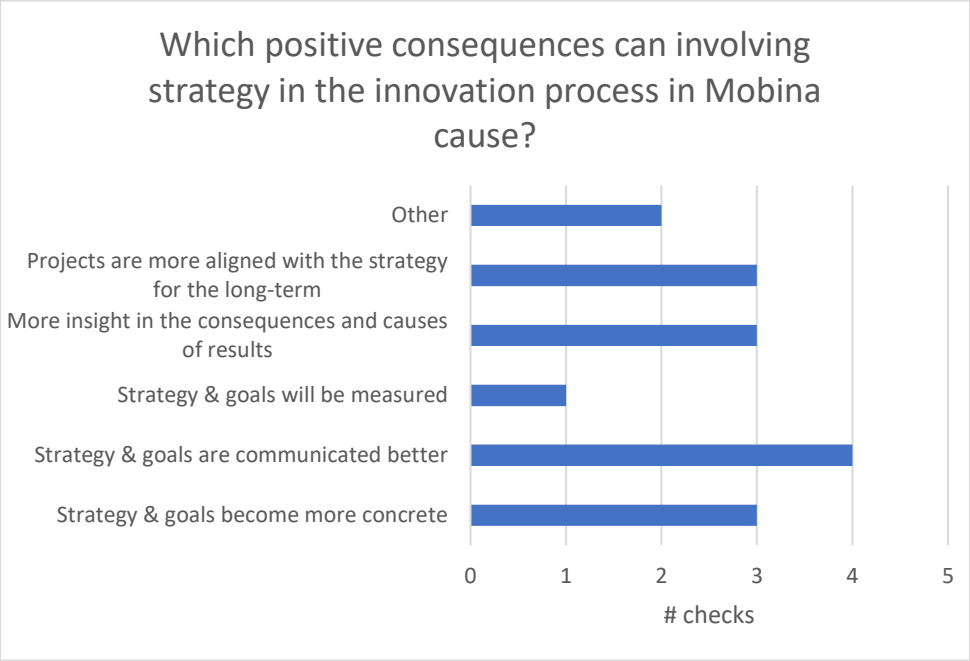


Figure 55 Consequences strategy & goals

#	Options
1	Defining goals
2	Monitoring KPIs
2	Relations between goals (insight in cause and effect)
3	Defining KPIS

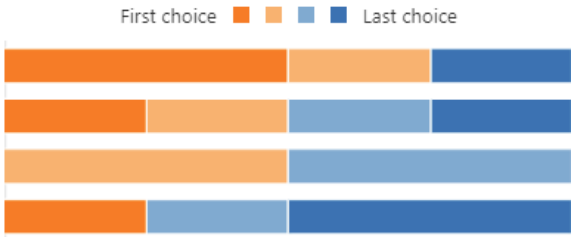


Figure 56 Ranking strategy & goals

The most positive potential consequence, see Figure 55, of the functionality is that it provides a mean to communicate strategy to the organization. Next to this the functionality is also expected to positively influence that: goals become more tangible; it provides more insight in causes and consequences; and projects will align with the strategy better. The measurement of goals is by most of the participants not seen as a positive consequence of this functionality.

The definition of goals is seen as the important part of the design, followed by the monitoring of KPIs and the relation between goals (see Figure 56). Last is the definition of KPIs, which is probably since it is a precursor of monitoring, but not in itself useful. The results on the open answers mainly reflect the discussion.

9.2.3. Actionables & Projects

Discussion

Actionables can play an important role in the pre-project phase. There is often a void between the idea generation phase, where there are lot of ideas, and the project phase where these ideas are developed further and implemented. Actionables can fill this void, by offering ways to filter and prioritize these ideas. For prioritization it might be useful to look at roadmap software. To make sure someone feels responsible to support these decisions, assigning ownership to actionables might be crucial.

Actionables are linked to projects. This might be a difficult job; the people who do this need a clear overview of all actionables and projects. Otherwise, actionables might be duplicated. Companies will probably need a way to create this overview. However, not everyone believes this is a large issue. Whether in Mobina, or outside of Mobina, always someone needs to have an overview to make good decisions.

Project (management) support is also useful, but the line between what to support in Mobina and in other tools is vague. Most companies will for example use Excel or project management software for extensive business cases, especially for financial calculations. Users probably don't want to use this functionality in Mobina, but rather want to focus in Mobina on qualitative business cases and traceability. To make sure an entrepreneur or manager does not have to maintain two lists in parallel, integrations with other tools should be offered. These could for example link actionables and goals in Mobina to financials in other tools.

Risk and issue management on the other hand is something which might be perfect for Mobina. The number of dimensions and involvement of multiple actors make it difficult to use simple tools like Excel. Other more advanced tools might also not provide as much support as Mobina can, for example the link to actionables and the line organization. As for actionables, it is important that ownership is assigned to make sure someone manages the risks and issues.

This functionality all leads to traceability throughout the whole chain, from comments to goals. It can be useful to offer a visual representation of all links, so people can see how everything is related. An example was given of a company that had a 'part of the week' where everyone could use sticky notes to provide improvement suggestions. In Mobina these comments can be saved, and a trace can be created to ensure that these ideas are acted upon and implemented correctly.

An important strength of SMEs is their flexibility. It is therefore important that the functionality mainly supports SMEs through dialogue and traceability, but does not restrict them. This is well presented in this case, since users are not obligated to enter anything. They can use whatever they believe is useful. Mobina will need to constantly monitor the usage to analyze whether users need additional support, possibly even through channels outside the software.

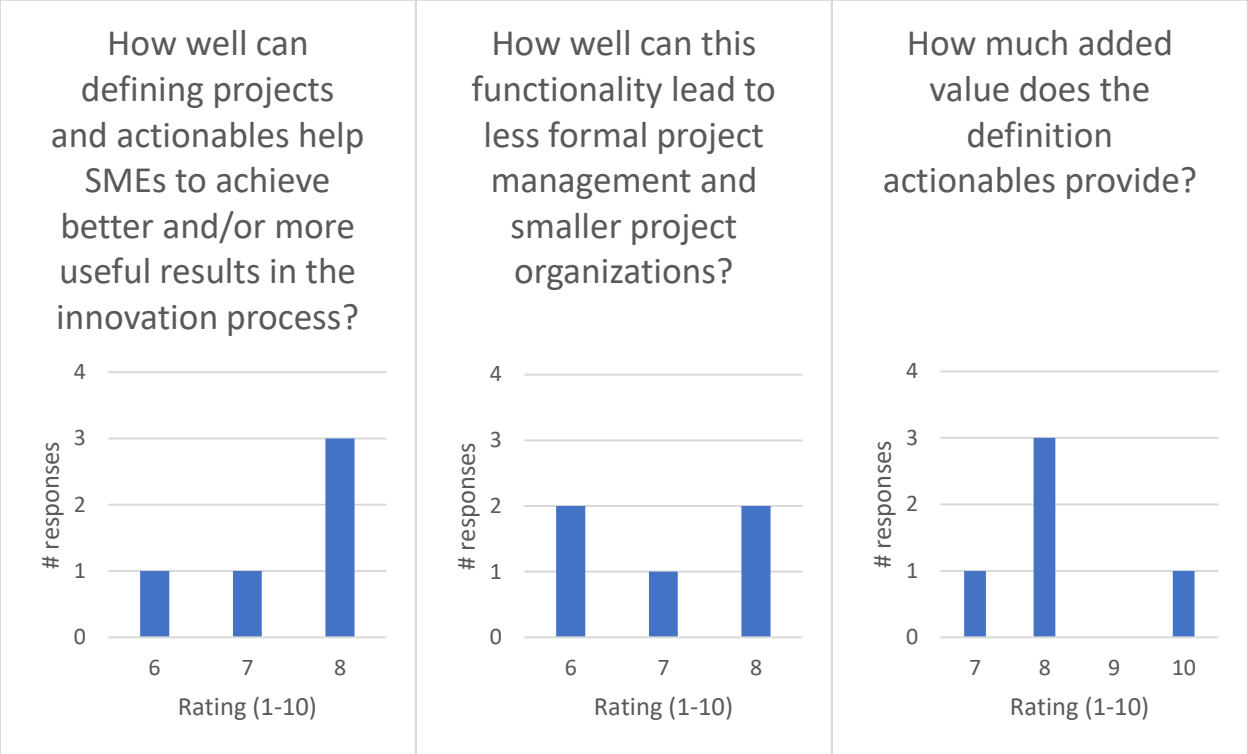


Figure 57 Ratings actionables & projects

#	Options
1	Defining actionables
2	Monitor actionables and actionable goals
3	Business case – Relation with strategy
4	Issue management (involving line organization)
5	Risk management
6	Business case – Benefits and costs analysis
7	Support for project phases

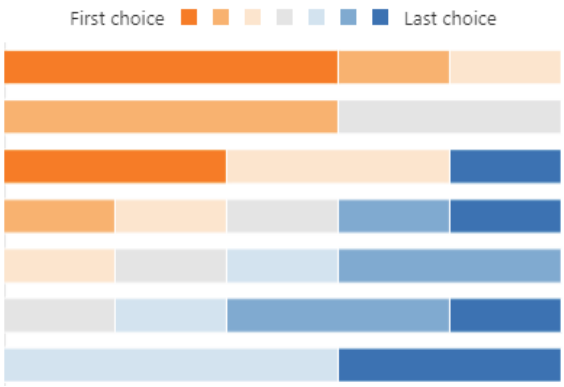


Figure 58 Ranking actionables & projects

Questionnaire

In general, the projects and actionables are very well received, see Figure 57, with averages of 7.4, 7.0 and 8.2. The participants believe these can help SMEs to get better and/or more useful results from the innovation process. Next to this, it might reduce the need for formal project management, and large project organizations. Last, actionables provide a lot of value to detail projects and link them to comments.

All participants agree that the definition of actionables is very important (relatively), as well as monitoring the actionables and their goals, see Figure 58. Next to this, the relation of projects with strategy through the business case is an important aspect of the design. Least important are support for the financial aspect of the business case and for project phases. Regarding issue and risk management, the results are mixed.

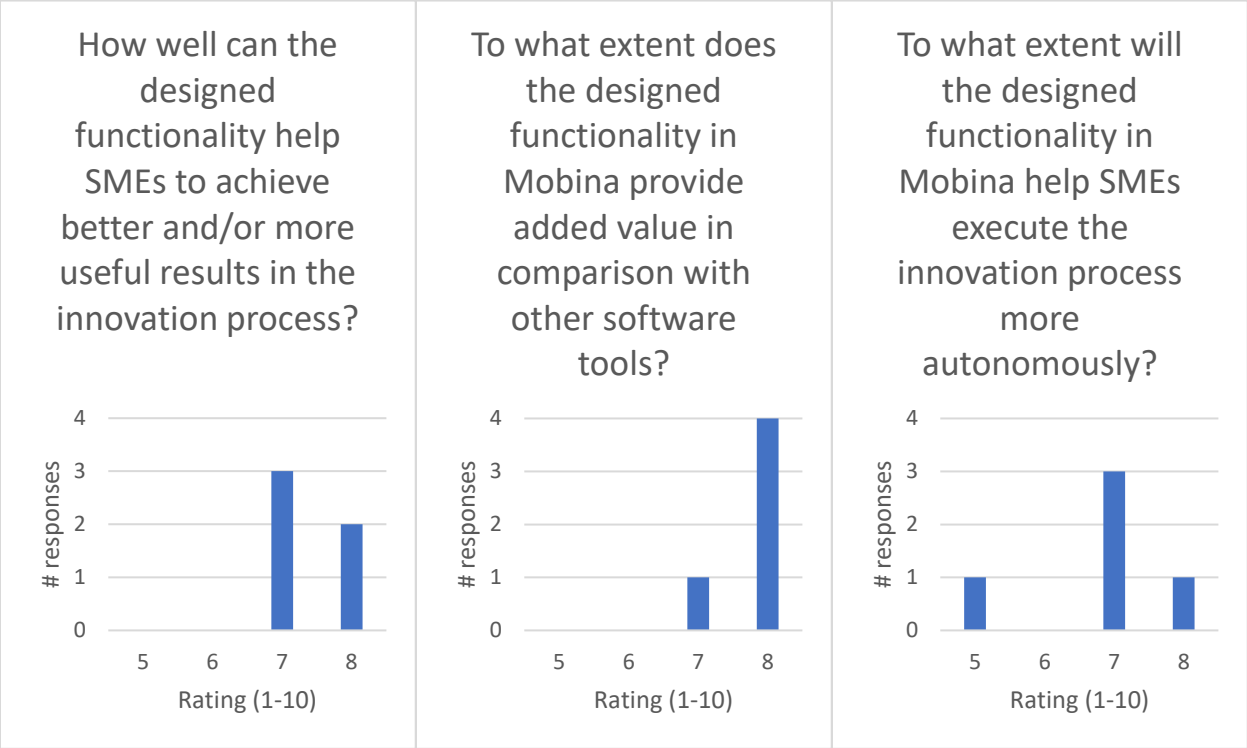


Figure 59 Global ratings

An important problem with the functionality is that the relation to project and portfolio management is not clear. It might also be useful to import or export projects. Next to this, the results mainly reflect the open discussion.

9.2.4. Global questionnaire

In general, the functionality is very well-received. This can also be concluded from the answers of the focus group on several questions, see Figure 59. It is expected to lead to better and more results, and it could offer a lot of added value in comparison with other tools. It probably also helps SMEs to perform the innovation process more autonomously.

Both concepts for open innovation, partner discussions and innovation ideas, score very well relatively to the other proposed functionality. See Figure 60. Behind these, opinions are divided. Actionables score highest, strategy & goals are next, and projects last. This is the relative importance, so it does not say anything about the absolute values (which are described in last sections). All results can be found in Appendix F, but generally reflect the findings in the discussions.

#	Options
1	Innovation ideas
1	Partner discussions
2	Actionables
3	Strategy & Goals
4	Projects

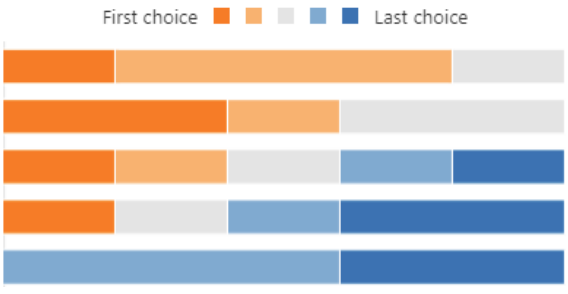


Figure 60 Results functionality ranking focus group

9.3. Interviews

The results of the focus group were described in last section. After analysis of the focus group, several important points are identified and discussed further using three interviews to ensure a more complete result. For this, candidate focus group participants were asked. They could not join the focus group due to planning constraints, but do provide insights from other viewpoints and are also not influenced by the dynamics of the focus group. The interviewees can be found in Table 3.

The most important discussion point is to what extent strategy is or should be used by industrial SMEs in their selection process. This is discussed during all interviews, since all three interviewees have different viewpoints on the matter.

Another important part to discuss is the usage of open innovation, and especially how industrial SMEs currently perceive this. This is discussed with Bart Jansen, since he is responsible for business innovation consultancy at Leap and therefore knows from a top-down perspective how different SMEs perceive the usefulness of open innovation. The last important discussion is to what extent project functionality should be included in Mobina. This is discussed with Marc Droste, who has a lot of experience with small and large projects in the manufacturing industry in both smaller and larger companies.

All interviews were semi-structured and about one to one and a half hour. John Stevens was interviewed in person, whereas Marc Droste and Bart Jansen were interviewed through Skype. A short presentation was given on the functionality to be discussed, after which their opinion was asked in general and on specific discussion topics. This chapter describes the summarized results, which have been anonymized.

Table 3 Interviewees

Marc Droste	Shareholder and partner of Mobina, and self-employed consultant at different companies. He has a lot of experience in managing small and large projects in the manufacturing industry, especially on the edge of business and IT.
Bart Jansen	Business Innovation Strategist at Leap – The Innovation Agency – and in that context responsible for the business innovation consultancy. Leap has a special focus on industrial SMEs, and Bart helps these companies to set up and control their innovation process.
John Stevens	Operations Director at Vanderlande, responsible for improving the logistics of Vanderlande's international projects. He is responsible for finding and choosing the right improvements.

9.3.1. Open innovation

Regarding open innovation some additional feedback has been collected, as well as some strengthening of existing information. Partner discussions are useful, so users are stimulated to talk with partners in their supply chain. However, other tools like Slack might be better suited for discussions. The usage of partner discussions in Mobina will heavily depend on usability, and is probably not a key selling point for Mobina. It is rather a useful addition to the core, and can be useful since users come up with ideas for partner discussions while using Mobina.

Innovation ideas on the other hand seem to offer Mobina more competitive advantage. Mobina focuses on providing Knowledge-as-a-Service, and these innovation ideas can really expand

Mobina's knowledge base. Next to this, a lot of people and especially entrepreneurs think in certain themes, like Internet of Things or Smart Manufacturing, and might want to discuss the topic at that level instead of the reference model. They can then use the theme to dive into the reference model.

9.3.2. Strategy & Goals

The interviews support that strategy is often not explicitly considered in project prioritization. An example was given on a customer-driven project in a company that has a large strategic focus on its customers. This project was not started because of its low-level goals, but really because of the customer orientation of the company.

Although projects are often not explicitly linked to company goals, this might be very important. A company should always keep in mind long-term results to establish continuity. The larger the project, the more strategic goals are expected to be a key part of decision-making. A positive financial business case is then often less important than for smaller bottom-up projects. The design presented could help SMEs to get more insight into the link between strategy and projects.

However, it is good to take into account that the usage of the functionality will also depend heavily on the users. What is their personal agenda? And to what extent do they have the big picture in the back of their mind? Some people might not want to take into account strategic goals, since this doesn't serve them well. On the other hand, the functionality can help managers to ensure the company's strategic agenda gets a more prominent place.

The level of goals used in the design can be very useful to communicate the company agenda. Mobina should not try to compete with tools like BI dashboards, but focus on their expertise, especially innovation, operational excellence, and the information landscape. These areas are also where Mobina could provide a lot of knowledge, in the form of examples. It can be useful, especially for other areas, to provide APIs to make sure the right data can be presented, but only if users will need this integration on a regular basis.

9.3.3. Actionables & Projects

The extension of actionables and projects can be very useful to support the whole lifecycle of innovation and continuous improvement. The set-up effort has already been done in Mobina, through entering all comments. It can therefore be beneficial for both Mobina and the customer to re-use these comments. Actionables can especially be useful for this bottom-up definition, where users posted a lot of ideas and these are used to create a project.

For prioritization the actionables and business cases can be useful. Alternative for this functionality are decision trees and benefit logic. Risk management can also be useful for establishing prioritization, especially regarding the sequence of implementation. An example project was discussed, which first tried to improve parts of the logistics process that had the least impact on the customer; if something went wrong, the impact was minimal since alternative options existed to still deliver on time. On the other hand, exposure in these parts had to be as large as possible to generate support in the whole organization. Improvements were made in the full breadth of the logistics process. In next phases, the lessons from this phase can be used and potential impact can be enlarged.

During one interview, the separation between project functionality in Mobina and in other tools was extensively discussed. Project management is often closely intertwined, and therefore companies are expected to want one tool for everything. Mobina will have to make a choice,

either completely support project management, possibly by close interfacing with tools for advanced functionality, or offer no project support at all.

It can be very useful for Mobina to completely support project management. This can be provided using close integration with another tool like MS Project[6]. Next to this, some support for portfolio and program management might be useful, since larger SMEs need support for this. Project management is within the expertise area of Mobina, and closely related to existing functionality. Mobina can add a lot of knowledge to project management using its KaaS-concept. Next to this, the collaboration focus in Mobina can really help improve projects. This functionality can make Mobina the tool to reach operational and business excellence, from idea generation to implementation and monitoring.

[6] https://products.office.com/en-us/project/project-and-portfolio-management-software

10. Recommended improvements

This chapter describes the problems and improvement opportunities identified in the validation results. It describes how the issues can be solved through improvements in the designed functionality. Although the improvements are based on the results of the validation, the improvements themselves have not been validated. Therefore, if any of the recommendations are added to a new version of the artifact, it is important to validate these with additional care. The sections describe for each part of functionality first the identified issues and improvement opportunities, and then some ideas on how to improve the design.

Each section contains an effort-impact quadrant, like Figure 61, that shows an estimate of how much effort the ideas will cost to implement and how much (positive) impact it can have on customers. The size of the bubbles show to what extent this functionality can differ, e.g. whether more or less functionality can be implemented for the same idea. In general, te more the functionality to be implemented changes, the more influence this can have on both effort and impact.

The left-bottom corner are incremental improvements, that can easily be implemented but will also provide small gains. The left-top corner, green colored, on the other hand are the low hanging fruits or easy wins. The right-top corner are big bets, they can lead to big wins, but need careful strategic consideration and planning. Ideas in the right-bottom corner will be money pits, and should be forgotten. They need a lot of effort, while they won't lead to a lot of gains.

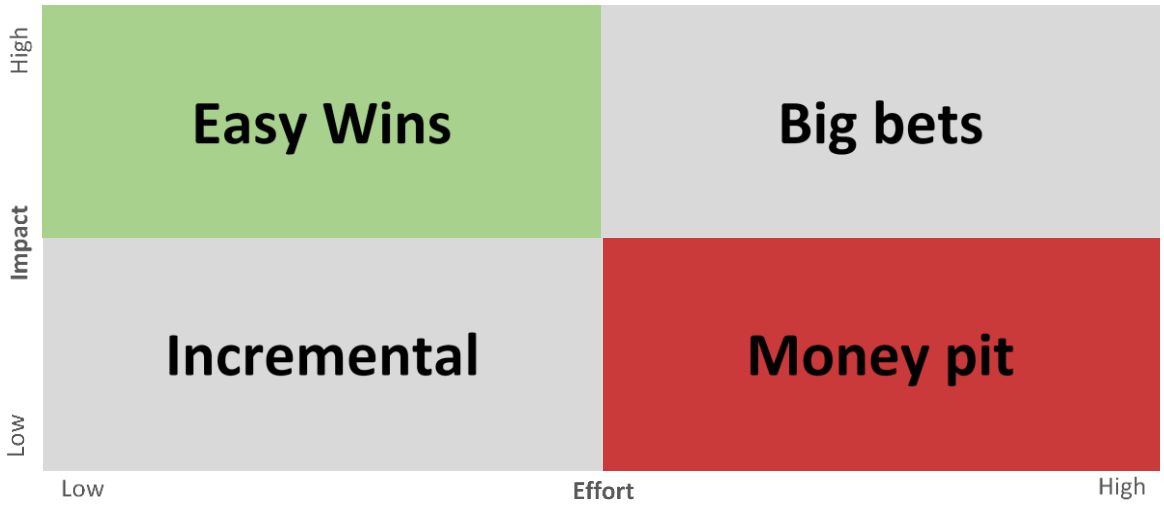


Figure 61 The effort-impact quadrant

10.1. Open innovation

For open innovation, several more specific issues were discussed. The following list of problems and improvement possibilities is identified:

- A SME has to be ready both legally and as an organization to use OI, and especially partner discussions. The latter can lead to problems like legal conflicts about intellectual property (IP) or sharing of confidential information by employees.
- Organizations might need guidelines and examples for partner discussions to make sure that users use them correctly and reach their full potential.

- Users might want differentiation between different types of innovation, e.g. for types like inside-out, outside-in, and coupled, or for product, process and service innovation. Few ideas for this issue have been provided. Partner discussions are largely unstructured, and therefore can already support a lot of different types of innovation. For innovation ideas, it is difficult to make the distinction, since IoT for example might provide possibilities to one company for product innovation whereas another company can use it for process innovation.
- It can be useful to provide SMEs with a decision tree that helps them to decide whether OI is useful and which practices they can use.
- To stimulate OI even more, anonymous comments might be added. This way, users are not afraid to share their ideas.
- For users to know which partner discussions are possible, it might be useful to give them insight into the supply chain and partner network of the company.

Next, the ideas to support these issues are described. All improvement ideas are also plotted on an effort-impact quadrant to show their usefulness, see Figure 62. The 'support in extended partner discussions' however is more like a guideline or attention point for Mobina, so isn't included. The quadrant gives an indication of how interesting the ideas are to implement. It shows that most of the improvements can be implemented with relatively little effort, and some provide easy wins.

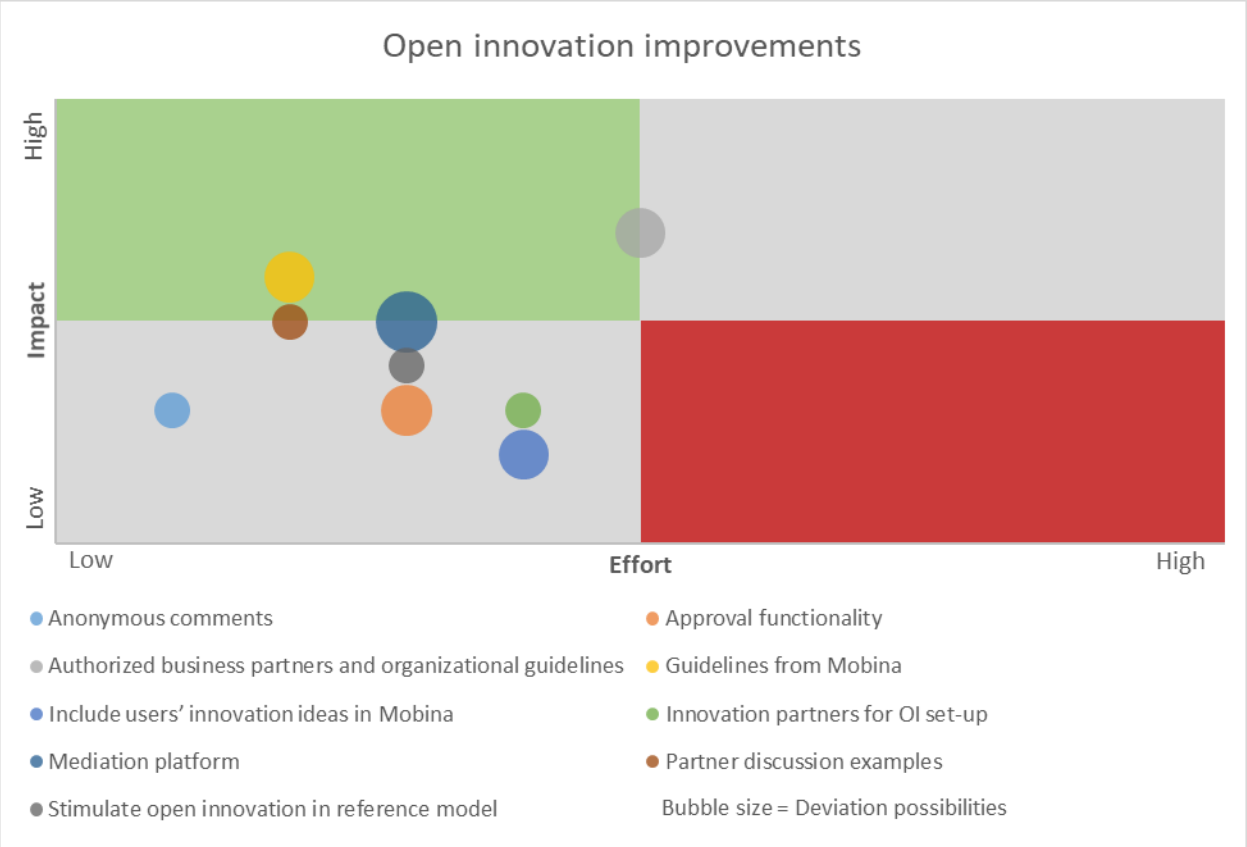


Figure 62 Effort-impact quadrant open innovation

Anonymous comments

During the focus group anonymous comments were mentioned as a way to stimulate open innovation even more. Users would feel more confident sharing their ideas. However, this might provide problems for traceability, e.g. regarding intellectual property.

This possibility will probably be very easy to add. Mobina can use for example a simple boolean field to indicate anonymity, still knowing the user's name. However, it can lead to problems for the customer. Therefore, this should probably be an option which the admin of the company can enable and disable, where he has a clear disclaimer with the risks.

Approval functionality

Another option to give managers more control about what users share is to use approvals. Approval from specific admins can be asked for creating partner discussions, but also for individual comments. However, this should be easily turned off and SMEs will have to watch they don't restrict their users too much. This might lead to worse results, as well as that users will share information outside of Mobina, where admins don't have any control about it. Additional to this functionality might be automated scanning of comments through rules or a blacklist, where the users gets a warning if it looks like his comment is not allowed.

Approval functionality takes some effort to implement, since many double checks must be added. This won't however change the code and databases fundamentally. However, for users this will also create a lot of overhead and might feel restrictive. This should therefore probably only be added if SMEs really feel they need to have more control about what is shared.

Authorized business partners and organizational guidelines

A useful way to make sure SMEs don't walk into unforeseen problems, is by adding functionality that allows specific users, e.g. admins, to maintain a list of authorized business partners. Users can then start partner discussions only with authorized partners. This list can also contain extra information about the agreements with these partners, to make sure users know what they're allowed to share and what not as soon as they add them to the partner discussion. These guidelines can also be provided generically for all partner discussions, to create less overhead.

Furthermore, this list of partners, can provide users additional insight into the partner network of the company. Insight into the supply chain regarding partner discussions is only useful if these partners can be involved in the discussion. To improve the insight, the partners can also be categorized or additional information can be given so all users can easily find the right discussion partners. However, categorization will only be worthwhile if the list becomes very long, so Mobina can first monitor the usage and add this functionality if the need arises.

This (administrative) functionality is probably not very difficult to add, and makes the partner discussions much more controllable. It allows for a structured approach to prevent large problems. It can also help users to get better insight into the possibilities for partner discussions.

Guidelines from Mobina

Mobina should make sure it provides at least a warning to users, that when they use partner discussions they should keep in mind the potential legal and organizational issues. They could also provide guidelines for using the partner discussions, possibly in the shape of a checklist. Another possibility is to provide a decision tree (Pellegrino, 2017), which helps SMEs decide whether they want to use open innovation and which practices are useful. Obviously, this also means they should be able to turn off partner discussions if they don't want to use it.

This functionality can be added relatively easy. In its simplest form it can be a warning icon, with some plain text. In a more advanced format, the user can get a checklist or a decision tree to help them decide on which functionality to use and to alert them of potential issues. SMEs probably won't immediately recognize the added value of this functionality, but it can help them prevent long-term problems.

Include users' innovation ideas in Mobina

The innovation concept and linked innovation ideas are a perfect example of inside-out innovation, where the company actively shares its knowledge and ideas outside the organization. To give customers more possibilities to execute inside-out innovation it might be useful to allow users to easily add innovation ideas in Mobina. This way they can show their solutions to other customers, and Mobina can extend the database of innovation ideas. The company can then be contacted by interested parties.

This idea might take some effort from Mobina to implement. The functionality itself will not be so difficult, but it might lead to a lot of content that Mobina has to moderate. On the other hand, it can really extend their database of innovation ideas. Next to this, it provides customers with inside-out innovation opportunities and on the other hand also with ideas from their peers, rather than only from OEMs.

Innovation partners for OI set-up

Mobina can also help SMEs get ready for open innovation, by providing a list of innovation partners who can help them. Like for innovation ideas, this can be all different kinds of partners. For example, lawyers with expertise in drafting a collaboration agreement, or a company that specializes in training for employees.

This functionality is easy to add, but it will cost Mobina some effort to create and maintain a list of partners. Especially if Mobina wants to ensure the expertise of these partners, some effort is needed. It can add some value to SMEs, since they find it difficult to find the right partners. However, a lot of the effort still lays with the SMEs themselves.

Mediation platform

The partner discussions depend largely on the partner network of the customer. Especially if they want to discuss with partners from outside the supply chain, it might be difficult to find these. Therefore, Mobina can provide a mediation platform, on which companies can find each other. A company can place a sort of personal ad, where they describe what kind of company they are and what they are interested in. Other companies can then contact them if they're interested in a partnership.

This needs some extra functionality in Mobina. However, this doesn't need to be very difficult to implement. The easiest format can be just plain text with some contact data, and maybe an option to immediately send a message through Mobina. Some rights will also have to be included, who can make and see them, but this can be set in parallel with for example the list of authorized business partners. It can help companies to build really useful partnerships, since it enables them to look into other circles than they usually do. The value increases as the customer base of Mobina increases. The question is to what extent these companies would build more partnerships using this functionality than through existing channels like network organizations.

Partner discussion examples

To ensure maximum results from using partner discussions, it can be useful to give examples. This way, users know how they can use partner discussions and what it can bring to them. These examples should include all kind of innovations, so involving inside-out, outside-in and coupled as well as for product, process and service innovation.

They can be provided in several different ways, e.g. prominently every time they add a partner discussion. For a better user experience, it might however be better to make it less obtrusive. Examples can for example be given in the support environment or with a help-button next to partner discussions. Another possibility is to give examples in a 'quick tour' of all functionality.

This functionality will be easy to add for Mobina, especially in the support environment. The examples will probably not need a lot of effort, and next to this the examples don't have to cover everything from the first release. The example base can easily be extended. This can help ensure partner discussions really provide additional value to customers.

Stimulate open innovation in reference model

The partner discussions in Mobina are expected to be especially useful due to its link with the content. The main part of Mobina is the reference model, but also critical aspects and other content will often provide the foundation for partner discussions. Therefore, it is important that the descriptions stimulate open innovation. The content contributors of Mobina can for example add questions that stimulate different discussions, including the different types of (open) innovation.

Adding this in one effort to all descriptions will be a large effort in Mobina. However, when taking this into account during the writing or updating of the descriptions, this effort can largely be reduced. Most content will usually already be written, it will mostly be a question of rephrasing or adding just a few sentences. This effort can make sure open innovation is used much more effectively, as well as stimulating a better discussion inside the organization.

Support in extended partner discussions

Partner discussions as presented are still unstructured. Therefore, it currently supports all kind of innovations and all phases. However, if Mobina would consider extending this with more structured functionality, it is important to look at the different kinds of innovation and how to support them. Especially if this spans multiple phases, for example product and process innovations have very different trajectories. This idea is not included in the effort-impact quadrant, since it would be implemented on possible future functionality and therefore an estimate is difficult to make.

10.2. Strategy & Goals

During the focus group and interviews, regarding strategy & goals the focus was mainly on the high-level discussion whether SMEs use strategy in their decision-making. Therefore, only some more specific problems and improvement possibilities have been identified:

- The implemented functionality seems to focus on a more tactical level than a high-level strategy, especially due to the amount of goals and the operationalization in KPIs. Although this has a lot of advantages, it might be useful to also take into account high-level strategy.
- For many ongoing concerns like financials, better tools are available. Mobina should take this into account and focus its knowledge.

- SMEs should not be forced to use strategy & goals. This has already been solved through providing a separate tab, and not making it an intrusive part.
- Different types of companies might have different needs regarding strategy. For example, a family-owned SME might act differently and more pragmatically than SMEs that are owned by a corporate investors.
- KPIs might be a confusing term since this is often already used in operations for other measures.

Next, the ideas to improve strategy and goals are described. These are also plotted on an effort-impact quadrant to show their usefulness, see Figure 63. It gives an indication of how interesting the ideas are to implement. The 'focus support' and 'support different types of companies' are both guidelines or future directions and are not specific improvements, so they aren't included.

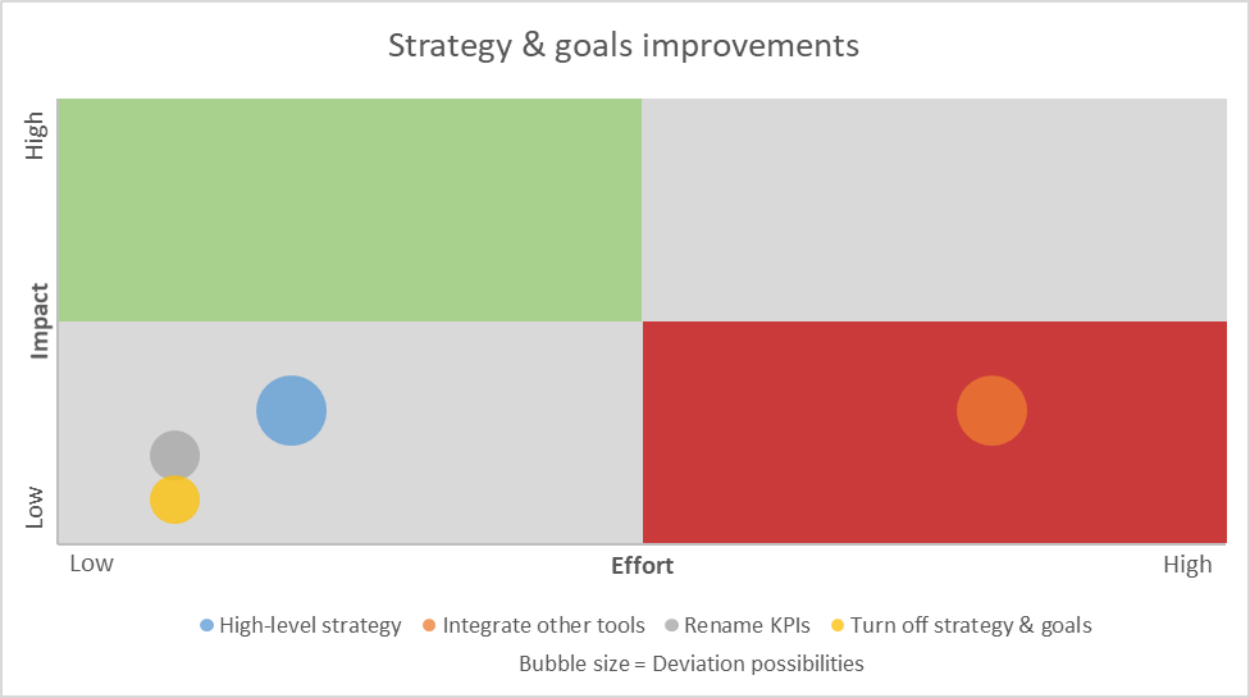


Figure 63 Effort-impact quadrant strategy & goals

Focus support

As explained, better tools are available for ongoing concerns. Therefore, Mobina should focus its Knowledge-as-a-Service on those goals that are closest to the core of Mobina. Mobina can focus on goals and categories for e.g. operation excellence, innovation & learning, and other categories they want to establish themselves as thought leader. This is not included in the quadrant, since this is mainly a guideline for Mobina and not so much a change to the existing design.

High-level strategy

The presented design seems to focus on a more tactical level of strategy. Although this has its advantages, users might also want to share a high-level strategy. Multiple options to implement this exist. Mobina can for example choose for a free-format description of the strategy, that is

potentially shown in multiple places. Next to this, there could be a fixed category for the most important strategy items, which provides the option to link all goals to these items.

Both options are easy to implement, it's just a small adjustment of the current concept. However, this can help companies well to communicate their (high-level) strategy to all users.

Integrate other tools for goals and measurements

For many ongoing concerns better tools are available, like business intelligence or measures in systems like ERP. Mobina should not focus for example on financial goals or operational measurements. Rather, it could be useful for Mobina to integrate with these other tools to show the progress.

These integrations can take quite an effort for Mobina. An API is easy to provide, but if users are really going to use it, out-of-the-box integrations need to be available. Mobina will therefore have to put lot of effort in creating a sufficient amount of integrations to support the majority of customers. Next to this, these integrations also have to be maintained. This can make sure that users monitor their progress more and better, but the real impact depends on how much users will look at the results at a daily basis. Therefore, after implementation the position on the quadrant has to be revisited. Mobina could for example analyze usage data to find out the effectiveness of integrations.

Rename KPIs

KPIs can be a confusing term since they will often be already used by companies for operational measures. Mobina should check whether the term KPIs can be used, or whether terms like measures or operationalization are better. This renaming is very easy to implement and can make sure the functionality is used much better.

Support different types of companies

It might be useful to look at supporting different types of companies specifically. As said, family-owned businesses might have different needs than companies in the hands of a corporate investor. This is mainly a way to improve support for different types of customers, for example by including other examples or providing different integrations. Especially for larger companies or corporate investors it might be interesting to have more integration support. They might also want to have more extensive rights management.

However, it is probably not necessary to provide this support immediately. It can therefore be useful to first implement the proposed functionality, so the usage can be analyzed. Machine learning methods like clustering could then for example be used to analyze differences between customers. Since this is an idea that still has to become more concrete, it is excluded from the quadrant.

Turn off strategy & goals

As explained SMEs should not be forced to use strategy & goals. If they don't want to use it, the functionality shouldn't be too intrusive. Although this is already largely supported by providing a separate menu item, some customers might still prefer an option to turn off the functionality completely. The question is whether Mobina should do this, since it will motivate users even less to look at the long-term.

10.3. Actionables & Projects

During the focus group and interviews, the main discussion points regarding actionables and projects were very high-level. The following concrete problems and improvement possibilities have been identified:

- The most important discussion is where the line between project management in Mobina and other software should be. This should be considered in the next design.
- Ownership was deliberately not included in the design, since administrative functionality was expected to always be included in software. However, during the focus group it became clear that ownership of actionables and projects can be a very important success factor.
- During the focus group it was questioned whether Mobina should support a financial business case, since many other tools for this exist. Users will often use other tools for this, and involving it in Mobina could lead to duplicates.
- The traceability is an important aspect of the designed functionality, and future designs should make sure that they're user friendly and support traceability at an optimum.

Next, the ideas to solve or improve these points are described. These are also plotted on an effort-impact quadrant to show their usefulness, see Figure 64. This shows the expected effort and impact of the improvements. It is clear that the functionality for actionables and projects can have a large impact, but also takes some effort. Most of them will therefore need careful consideration.

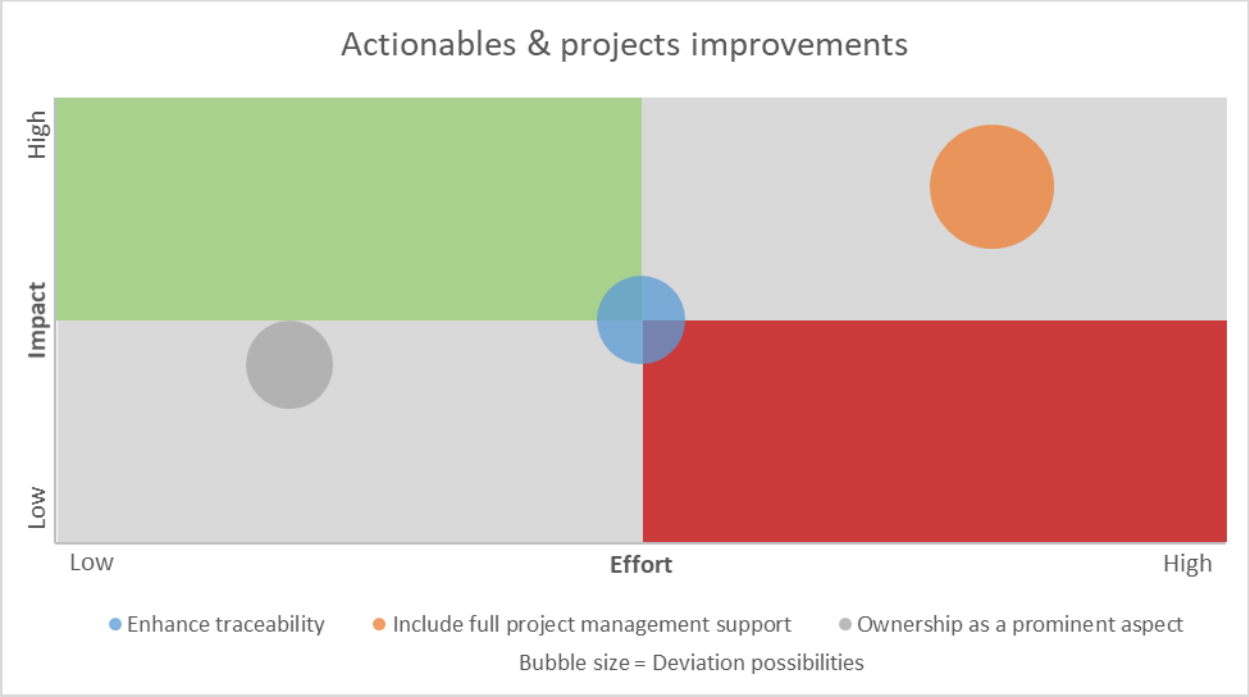


Figure 64 Effort-impact quadrant actionables & projects

Enhance traceability

The traceability is an important part of projects. The functionality can provide users a lot of insight into the causes and consequences of projects. Therefore it is important that Mobina looks constantly how to enhance user friendliness to support this traceability. A visual

representation could be very useful, in which the network from comments to goals is shown and can be navigated. This can be done in a lot of ways, where everything is shown in one view, or where navigation can be done one step at a time.

This functionality will be difficult to implement. Designers need to take into account a lot of edge cases and look at how this can be shown in a clear and efficient way. However, this can also add a lot of value to users. Good traceability leads to better decisions and also more understanding of the choices.

Include full project management support

As described the division of project management functionality is an important discussion. From the results of the focus group and later the interviews, it seems the best option is to choose between either full project management support or no project management.

It can be very useful to support project management fully. Project management is within the expertise of Mobina and Mobina can add a lot of knowledge to the organization of the customer. Collaboration in Mobina can also improve project management. This functionality would provide customers with a tool that involves everything for operational and business excellence, not only idea generation, but also implementation and monitoring.

This means that the discussion about including financial business cases in Mobina is also solved. To provide full project management support, Mobina will have to include financial business cases as well. However, to support more advanced features of project management, tight integrations with other tools like MS Project or MS Office can be provided. These integrations should be in such a way, that it still provides enough traceability like linking costs to actionables. It might also have to include some portfolio and program management.

This functionality is a textbook example of a strategic decision. There is a lot to gain, but it will also take a lot of effort and risk. Careful consideration is therefore crucial.

Ownership as a prominent aspect

Ownership was not included in the design, but is expected to be an important success factor. Therefore, it should get a prominent place, so everyone knows who is responsible, and possibly also accountable or credible. Every actionable and project should have an owner, and maybe this should be even more detailed. This ownership can for example get a prominent place by including the name of the owner on the overview of every object. Next to this, they should possibly be provided with reminders and get automatic notifications if anything important for them happens.

Owners can be added easily, since most software will already need administrative functionality. Therefore, it would probably usually already be added to the implementation. This functionality will have a relatively large impact, since ownership can be an important part to get things going. A lot of different possibilities exist to implement this.

11. Discussion

11.1. Open innovation

In general, the open innovation concepts are well-received. Both supporting the discussion of industrial SMEs with their partners and supporting technological scanning through innovation ideas are expected to positively influence the results of the innovation process. Many SMEs are currently looking into open innovation, and they will probably welcome functionality to help them with it.

The functionality for open innovation is most ready for implementation and, possibly because of this, also most well-received. Both partner discussions and innovation ideas can be implemented independently from each other and the other proposed functionality. Mobina can especially extend its Knowledge-as-a-Service by implementing innovation ideas.

The partner discussions are a useful way to stimulate the usage of open innovation in Mobina. It can help companies to collaborate with their partners, and not just in a single project but potentially on all aspects of the organization. The design of the partner discussions also gives industrial SMEs grip on what they share with whom. It is important for them that they don't have to share all company secrets, but have control over this. This should also be considered account by researchers and practitioners other than Mobina.

As with the already available functionality in Mobina, most of the effort will still have to come from the users themselves. They will have to establish the partnerships themselves and make sure the right information is shared. Without this, the partner discussions will not be effective. This effort will always exist if a company wants to use open innovation. A collaboration attitude at the core of the company will probably be a key determinant of the successful adoption of this functionality.

Innovation ideas also offer a lot of potential advantages to the users of Mobina. It gives them a better grasp of which possibilities are out there, while also making the innovations tangible. This support for so-called 'technological scanning' can be very useful for companies to get more innovation ideas.

Next to this, especially SMEs are always looking for help for implementation. They often do not have the financial power to develop a lot of new technologies alone, and therefore look for technological collaboration. This 'match-making' is something SMEs are looking for, and which for example network organizations like OostNL and Novel-T help with. This is supported in the design by linking innovation partners to an innovation. Researchers and other practitioners can also provide help, e.g. by providing assessment or assessment criteria to make sure that SMEs find the right partner (Mobina for example already helps companies find the right ERP system by assessing multiple systems).

The advantage of both concepts is that they're very generic and broad, and therefore can be used for a large amount of purposes. However, this is also a weakness. SMEs might need more specific support for different types of innovation, like inside-out, outside-in and mutual innovation, or process and product innovation. This might be benefit from additional support such as a decision tree or examples.

This OI functionality provides SMEs support for open innovation, but it is important that SMEs are not thrown in at the deep end. They should be guided in the process of using open innovation, not to get surprised by negative consequences of for example partner discussions. These consequences can be legal (e.g. no agreement with partners leading to legal conflicts

regarding intellectual property), not getting the most out of OI (by for example using the wrong OI practices for the wrong ends) and more. This implication has been taken into account by Mobina, but also by practitioners and researchers. It is important to hand entrepreneurs the right information to make a well-founded decision about whether to use OI, and which practices and partners to use.

Both concepts are very useful for industrial SMEs. Especially innovation ideas can really strengthen Mobina's position as a Knowledge-as-a-Service provider. The knowledge and experience in Mobina's network can well be shared through this concept of innovation ideas. However, it is very important for Mobina and all others to realize that not all SMEs will be ready for open innovation and that clear guidelines have to be given to minimize the risks, especially to make sure that no disputes arise between companies in a partner discussion. The functionality will thrive most in companies that have an open culture and strive for collaboration with other companies.

11.2. Strategy & Goals

The opinions on strategy differed. One person in the focus group especially feels like industrial SMEs don't use strategy when making decisions a lot. In the manufacturing industry, people usually want better solutions and will not put this into an organizational perspective. Although other people do agree that not every project will usually be related to strategy, to some extent this will always be in their minds. The interviews reflected this as well, an example project was for example customer-driven, an important strategic goal for the company.

In general, the consensus is that industrial SMEs will need to choose projects that enforce their strategy, or otherwise will go bankrupt in the end. So even though SMEs currently might lack a clear link between projects and strategy, it might be useful to help them doing this. It is important for practitioners in SMEs to keep their strategy and high-level goals in mind when making decisions. There is already a lot of literature available on this subject, but it might be useful to research how specifically SMEs can be supported in a pragmatic way, if not through the designed functionality in this research.

The functionality in Mobina can help communicate the strategy better to the whole organization. Even if they do not make the link to strategy explicitly, users can then keep the strategy in mind. The functionality shown focused more on an operationalized level of strategy which can help to make strategy tangible for users. However, it might be useful to also include the high-level strategy in some way.

For strategy, and goals, an important question is to what extent goals should be defined in Mobina. For most 'ongoing concerns' and financial goals, better tools will be available to both measure and monitor KPIs. When including goal functionality, it is easy to support the definition of all goals in Mobina, but when delivering extra knowledge, it is important to focus on those goals related to the software's topics and which need more support. This is mainly in the areas of innovation, operational excellence, and the information landscape. In general, examples of goals and KPIs can be useful especially for SMEs who don't have their own large knowledge base yet.

An important aspect of the strategy functionality is that users are not forced to use it. It is useful to support this functionality, and an important question for Mobina, and in general, is to what extent they want to stimulate SMEs to think about their strategy. This functionality will work especially well in a strategy-focused company, or a company that strives to become strategy-focused. However, if users have a personal agenda and don't want to use it, forcing doesn't work. Engineers often decide more pragmatically and don't want to be forced to link strategy. In

the design this is already represented well, since a separate menu-item is offered and the goals are not obligatory.

Overall, it is useful to allow top management to communicate the strategy with the rest of the organization, since this can enhance results of the idea generation and selection. Users will have the right information to make well-founded decisions. However, the usefulness of more functionality like explicitly defining separate goals and KPIs is really dependent on what it is linked to, like actionables. It is probably good for Mobina to use a very lean form of goals when needed for other functionality (like actionables or projects) to find out to what extent users define (strategic) goals and would like support for monitoring them.

11.3. Actionables & Projects

Both actionables and projects functionality can enhance traceability throughout projects. The functionality helps companies to trace back the origin of project decisions, and also trace forward to their goals. Throughout the whole innovation process, this can support decisions. The usability might be enhanced by using visual representations for traceability showing the whole network of for example comments, actionables and goals. It is also logical for users who have already put a lot of effort in Mobina, to profit even more of this by using their content in the total innovation process.

The most important functionality is the actionables, which can play an important role in both the ‘pre-project’ phase and further in the innovation process. Their link to goals can be very useful to decide which ideas to pick up and execute. Especially for the bottom-up process, this can make sure that the right actions are taken. It is crucial though, that actionables get a clear owner, who feels responsible for making the decision and to follow-through the actionables. A culture of improvement will probably lead to the best results, stimulating and rewarding owners and other stakeholders to make sure the goals are actually achieved.

The importance of ownership on some aspects might have been underestimated in the first design. A clear decision was made not to involve administrative functionality in the designs, since this is a must-have for software. However, in some cases, like in this research the actionables and in other research or software possibly other aspects, ownership is more important and should get a prominent place in the software (design) or project.

A major problem with the actionables might be, that users are not sure what level of detail to use for defining the actionables. Different users might also have different preferences. However, by allowing them to define and re-define the actionables themselves, companies will stay in control and this should not become a major problem. This problem exists not only for this research, but in general where breakdown structures are involved, this might lead to ambiguity.

Goals can’t only be linked to actionables, but also to projects in the proposal. This might confuse users. However, joining together the goals of the actionables in the business case for a project makes this less redundant. The link to (strategy) goals at projects is also seen as useful by the focus group. As described in section 11.2 about strategy & goals, SMEs can benefit from linking the project portfolio to a strategy or long-term vision.

Risk and issue management is also found useful for companies, although alternative tools might exist. The close relation with the rest of the application, users in the line organization, and actionables, make that it is useful to include this functionality in Mobina. In every project, practitioners should assess risks and monitor them, to ensure on-time performance of the project.

This kind of project functionality also makes it very difficult to maintain a clear separation between Mobina and other project (management) tools. Most companies will for example use other tools, like Excel or more formal project management tools, to make a (financial) business case. They don't want to keep duplicate lists which have to stay synchronized. A business case focused on qualitative goals might be more logical in Mobina. However, this makes it very difficult to make clear to users, what they should do in Mobina.

Therefore, it is very important in the development of project functionality in Mobina, to make a very clear decision on what Mobina wants to support and where the distinction and overlap with other tools is. There was a consensus during the focus group that this needs exploration.

During the interviews, the same kind of feedback was given. Companies don't want to maintain data in two different applications. Another conclusion was drawn, companies want one tool for everything related to project management, and therefore Mobina should either support projects completely, potentially using integrations with specialist tools, or stay away from project functionality. This also makes sense, since during the focus group it already became very clear how difficult it is to make a clear distinction in what to support. Based on this conclusion, Mobina has an important decision to make: either support project management fully (possibly by making an integration with other tools, which leads to a coherent user experience) or stop at supporting actionables.

This is a problem that might be true in other domains as well. On the one hand, people are increasingly used to using many single-purpose apps and switching apps easily. On the other hand we also like to have a convenient and seamless user experience which can often be provided by APIs. Different users and companies will have different preferences and policies, and it is useful to analyze the target audience before making a decision.

Next to this, it can be useful to build software (and other kind of products and services) in such a way that both can be served: on the one hand the users that want to use Mobina for example only for idea generation and use other project management tools for the follow-up should be able to integrate these; and on the other hand the users that wants one application for everything should be able to easily transfer data from one module to the other and should be fully supported.

Mobina should probably want to support project management fully since the collaboration focus of the product can really improve projects in SMEs. Mobina can also use its knowledge, experience, and network to provide users with more knowledge and support. The combination of actionables, projects, and possibly also strategy & goals, with the existing functionality like reference models and critical aspects, can provide a full suite for companies to innovate and improve their processes.

Although this discussion was not held during the focus group, the results of the focus group indicate the same. As described, they believe users are not waiting for overlap with other products, but on the other hand do need a clear distinction between tools. This can be provided by either including project management in Mobina fully or not. Since all participants agreed that most of the functionality regarding projects is useful, and the discussions mainly focused on what users would do with other tools, I advise Mobina to really consider including full project management in the future.

Regarding this functionality, the actionables should have the highest priority. By including actionables and linking these to goals, users can first prioritize and monitor them. Compared to projects this is relatively easy to implement, and can provide a first step for industrial SMEs better prioritize ideas. Building on this basis, projects will be easier to implement as well. The

actionable-functionality can also be used to analyze the needs of industrial SMEs better before expanding the application even further.

11.4. Validity

This research only provides a first design and validation for the software. Still, a lot of work is needed to make it ready for use. Although it provides good directions for the future, for both research, practitioners and Mobina, more research and design is needed to guarantee positive results. The validation model used is based on assumptions and expert reviews and not on a real-world case. An important next step is therefore developing a prototype that is ready for usage in case studies, after which the software might be used in a larger sample of the population.

The used validation method provides a qualitative review of the usefulness of the software. It has many strengths as described in chapter 3, but also its weaknesses. These are related to the participants of the focus group and interviews, the moderator, the analysis, and the design (method).

It is important to keep these weaknesses in mind, and it might be useful to build in an extra step where the software is not immediately used by the target population, but first thoroughly reviewed. This has to be in a phase where the software is as good as ready for use, so they can pay attention to both the global aspects and the details.

11.4.1. The group composition

Regarding the group there are several aspects to keep into account. Of course, an important decision is not to involve people from the target population in the focus group. Although this is a deliberate decision, this might lead to a bias. The participants are expected to be experts on the target population, but their opinions might not reflect the actual usefulness for the target population nor reflect the opinions of experts in general. This issue is partly resolved by interviewing John Stevens on important topics after the focus group, since Vanderlande is at the border of being just inside or outside the target population. However, it is no guarantee that the results are a good reflection of the usefulness for the whole target population.

Another important aspect is the group dynamics (Morgan, 1996). On the one hand, the group might be dominated by certain people. This is for example reflected in the focus group by a few people being more to the point, while others talk a bit lengthier. This leads to the latter speaking more in terms of time. During the analysis this is taken into account by summarizing all opinions, therefore trying to avoid a bias. This bias towards the lengthier people is also addressed during the focus group, by explicitly asking others for their opinion.

On the other hand, people might feel restrained to express certain opinions (Kidd & Parshall, 2000; J Kitzinger, 1995). The moderator made it very clear at the start of the focus group that all opinions are welcomed, even very negative ones. The topic and group also lead to less barriers to express opinions freely, the topic is not very emotional and all participants value a critical point of view. This is also supported by the fact that although in the end everyone agreed on certain topics, several differences in opinion arose during the focus group. However, there is always a risk that one or multiple people have refrained from expressing certain concerns or opinions.

Of course, also other aspects might be of influence for the focus group. People might for example express different opinions and ideas depending of their state of mind on the specific moment, possibly even influenced by events in someone's personal life. The specific group composition can also influence this, since the participants might steer each other into a certain

direction, not discussing other important opinions. The moderator can make sure that all topics of interest are addressed, but especially more out-of-the-box ideas might have been left unaddressed.

Another important circumstance to address is that Matthias de Visser left the room for one topic, strategy & goals, due to another obligation. This different group composition might influence the results, as well as the lack of the insights of Matthias de Visser on strategy & goals.

It is also good to consider that some of the results were obtained through interviews. The reason for these interviews was two-fold. On the one hand contact with multiple people was established to participate in the focus group, but it was impossible to let them all participate both due to planning constraints and establishing a convenient group size. On the other hand, the interviews gave the possibility to dive further into certain topics after analyzing the focus group. Still, it's important to know that the division between focus group participants and interviewees was largely created by planning constraints. This might have influenced the results of the research.

11.4.2. The moderator

During the focus group, the moderator tries to remove validity threats by ensuring everyone is heard and has the opportunity to speak freely and by making sure all topics of interest are discussed. However, this can also influence data collection a lot (Morgan, 1996). Different moderators might lead to a very different result of a focus group (Kidd & Parshall, 2000) and this makes replicability very difficult. The same kind of problems exist for the role of interviewer in the post-focus group interviews.

This bias is mainly addressed by explicitly explaining the role of the moderator at the start of the focus group and ensuring everyone feels comfortable to address a deviation from the moderator role (e.g. the moderator trying to give arguments for the artifact during the focus group, or steering away from an important topic). This doesn't ensure that the moderator had no influence at all, and at certain points this might have influenced the results. The critical attitude of all participants does help to make sure they're not influenced by any bias in the moderator's views too much.

The moderator also tried to steer questions to him, back to the group as much as possible. For example, at a certain point the question was asked whether a version with open innovation would lead to better results than without open innovation. The moderator steered this question back into the group by explaining that this is an important discussion and asking whether anyone had any opinions on this. During certain discussions, the moderator also asked certain people specifically, who hadn't said something for a longer time.

11.4.3. Focus group analysis

Another aspect is that, especially in qualitative research, some extent of subjectivity exists (Rabiee, 2004). Different people might interpret the results differently and come to different assessments of what is important and what not. Aspects other than speech might also influence the point of view, for example body language. It is important to make sure that the analysis of the focus group correctly represents the actual discussion.

The risk of bias is decreased as much as possible by asking questions during the focus group to clarify. The moderator for example tried to summarize several opinions and ask for feedback to make sure the correct conclusions are drawn. Additional data was collected through the questionnaires. Next to this, the summary of the focus group is reviewed with several attendants to make sure that this reflects not only the point of view of one person.

In addition, the focus group was (audio) recorded and extensive notes were made during the focus group. This makes sure that the summary is not purely based on memory, and that people can verify both the completeness and correctness of the results.

11.4.4. The prototype and content

The research itself also brings about very specific validity threats to the focus group. The design of socio-technical artifacts always leaves space for difference of opinion, since design is personal. This research is in a rudimentary stage of design for the software. Therefore, the prototype and discussions are meant to focus on the core concepts and discuss which kind of global functionality is useful and which not. However, what level of detail is expected is subject to discussion and different people might discuss on differing levels of detail. An example is to what extent the user interface design or user rights are important in this phase.

Although it is not preferable in this stage to go into too much detail, in the end ‘the devil is in the detail’. A great example of this is the perceived importance of assigning an owner to an actionable. Assigning someone who is responsible is seen as crucial, even though for me as a designer the details of administrative seemed too operational for this phase. If the final design misses a small, but significant, item this can highly influence the results. Even though this might not be difficult to develop, attention has to be paid to it. Therefore, it is important that throughout the next design cycles the product is constantly reviewed and improved.

Another problem is that the prototype is an extension to Mobina. This is useful to show the relation to the existing content, but this makes it more difficult to analyze the difference between the artifact and Mobina. An example is the comment in the focus group of ‘our people are no readers’, that is used to explain that the users might not want to read a lot on different subjects. However, this is mainly applicable to the general design of Mobina, which is now using descriptions where for example also the choice may be made to use more pictures and videos. The designed artifact builds on top of this design, and the choice to use more multimedia content is more a generic design choice than specifically for the designed artifact.

Furthermore, the border between prescriptive, what should industrial SMEs do, and descriptive, what would SMEs need, is vague. The link with strategic goals for example is combination of the two, on the one hand people describe that SMEs really need this link to be successful, on the other hand the question is whether SMEs would use this. This places the developers of such functionality, in this case Mobina, in a dilemma: do you develop functionality which you really believe would benefit your users but which users might not want to buy, or do you develop functionality that users would like to buy but that is not essential for their success?

Finally, the design is mainly in the hands of one person. Although it was developed with background information in mind and in close collaboration with multiple stakeholders of Mobina and supervisors, it might still be possible that other designers would have come up with other, and potentially better, ideas.

The demonstration of the prototype in the focus group and interviews was focused at validating the design, for usability but also for completeness. However, the demonstration of the prototype in the focus group and interviews could have highly influenced the thoughts and opinions. Specific details, even though not a crucial part of the design, like categories or buttons, might have influenced the opinions of participants on the functionality. Next to this, the thinking of participants is especially triggered on elements in the prototype, therefore possibly not stimulating more out-of-the-box ideas.

This issue has mostly been addressed by summarizing the key functionality of each part, and steering the discussion on which aspects are really important and which not. As little attention to

detail as possible for a good demonstration was used. Participants were also stimulated to think about other ideas and explicitly asked whether any functionality is missing, or whether other aspects should also be supported.

11.4.5. Validity conclusion

Even though the nature of the research and of a focus group leads to a lot of potential validity threats, I believe the focus group in combination with interviews has led to representative results. Most threats have been identified, considered, and addressed in an early stage, taking away most problems as much as possible.

In the end, I believe the group dynamics itself and the separation between participants of the focus group and the interviewees did not influence the results in a large extent. All participants were experienced enough both in general and on the discussed topics to not be influenced by the dynamics, state-of-mind, or the absence of a person during one part. This is also reflected by the results of the interviews, that did not weaken any conclusions but rather reinforced them. I believe that with these people the same results conclusions can be drawn in broad terms.

The same holds regarding the representativeness of the participants for the target population. We can't be sure that the opinions of the participants are in line with the target population, but I believe that the conclusions will sufficiently represent the usefulness of the designed functionality. Of course, this global design still needs to be detailed and those details can lead to other conclusions, but that different conclusions might have been drawn in this phase is probably not caused by the group compositions.

Although it is important to keep in mind that the moderator has influence on the outcome, I believe every other moderator (of course taking into account the same guidelines, and not steering the discussion negatively) would lead to approximately the same outcomes. The combination of communicating the role of the moderator to the focus group, the attitude of participants, and the awareness of the moderator about the pitfalls of his role, have largely minimized the moderator's influence.

Extracting results from qualitative research can be subjective. Interpreting the results of the focus group and interviews can lead to a bias introduced by the analysis. This bias is reduced by providing a trail of evidence. However, one has to be careful if specific details of this report are used for a future design decision; it might be useful to study the context in which certain statements have been made.

Design in this early phase should focus on high-level concepts and not on details. I believe this has been adequately achieved, and that broad outlines can be given for the next phase. Of course, one should not forget to still pay attention to details in the next phases. Next to this, it is good to keep an eye out for any additional design possibilities, since the influence of having a single designer instead of a team might be large. People involved in the next design phases, like designers or developers, should definitely be stimulated to propose their ideas.

In conclusion, I believe this research provides sufficient guidelines to build on. However, there is also still a lot of work to do. Further development of the artifact is needed to be able to test the real usefulness of the functionality; for this, more details should be added to the design. This research can help set priorities, but does not provide conclusive evidence about the actual results. Special attention has to be given to the target population itself. This design cycle was still too early to test the artifact on a subset of the target population, this however also provides most reason to doubt the results of this research.

12. Conclusions & Implications

12.1. Summary answers research questions

RQ1. Which areas of functionality have to be added to Mobina to support industrial SMEs effectively on these aspects, being open innovation; assessing and selecting the best possibilities; and monitoring and controlling innovations?

The modules that have been identified for research question 1 in chapter 5 are: open innovation (partner discussions and innovation ideas); strategy & goals; and actionables & projects. These three modules can cover most of the possible useful support in Mobina for industrial SMEs to stimulate open innovation, assess and select innovation projects, and monitor and control them.

RQ2. How can these areas of functionality be included in these modules to support industrial SMEs effectively?

Mockups were created for each of the modules, where especially attention was paid to the most important objects. For open innovation the most important aspects identified are to stimulate technology push, as well as to give SMEs control over the topics of open innovation in partner discussions. Goals, in general and strategic, have to be operationalized and linked to each other to create an overview of influence relations. Last, for actionables and projects it is important that the link with the line organization and the original comments is maintained, a qualitative business case is made and managed, and that risks are assessed and observed. More details can be read in the respective chapters 6, 7, and 8.

RQ3. Do experts believe this functionality can help industrial SMEs on these aspects?

Using this mock-up, research question 3 was answered using a focus group and interviews. In general, the functionality was well-received, with scores for usefulness, added value and more independent SMEs of respectively 7.4, 7.8, and 6.8. The most important discussions were to what extent SMEs use strategy in their decisions, and whether support for project management should be included in Mobina. More useful discussions on the details of the functionality are described in chapter 9.

RQ4. How should the next version of this artifact look?

These discussions have led to recommendations for Mobina to take into account for the next stages of development for these modules. Very important is the decision whether to include project management fully in the application. Mobina has to make a decision on this subject in the future. Next to this, designers and developers should carefully look at whether they can support users on the decision to use open innovation in their company. More recommendations are given in chapter 10.

12.2. Conclusion

This research provides a design that can help Mobina to make a roadmap for its software. Several building blocks are designed and validated to allow a path towards a tool that can be used continuously. This report can be used by Mobina to make decisions on the future of the product and company.

The functionality regarding open innovation, partner discussions and innovation ideas, is most well-received and also most ready for implementation. They can be implemented on top of the current software, and independently from each other. This allows industrial SMEs to take advantage of the strengths of OI, and will have to be extended with support to avoid pitfalls.

Actionables support the pre-project phase in companies as well as the project phase. This extension to Mobina helps users transform from the content- and issue-oriented current software to an idea- and solution-oriented dimension. It provides a steppingstone for developing and managing the innovation agenda of companies.

An important aspect of long-term success of companies is strategy, and aligning the company with it. Therefore, it's useful to provide functionality that allows for re-using and monitoring goals, as well as a separate space where the strategy is managed. It is important that strategy is communicated through the organization and this can help.

Mobina has to make a crucial strategic decision about supporting project management. Since most companies are expected to choose for an integral solution, Mobina should aim for either full or no support. It can provide a lot of added value to customers with project management, due to the organization's expertise, the link with existing functionality, and the collaboration focus.

The design and validation method used proved very effective for this type of research. Using scientific literature and mock-ups for the first design cycle was effective to develop and present the needed results. Next to this, a focus group is a useful method to validate a first concept, since the synergy of participants can create a lot of insight in this early stage. Many lessons were learned and described on both the design and validation method.

The next sections describe in more detail the implications and recommendations arising from this research. First, the results for Mobina are described in section 12.3. The next sections describe the most important consequences for scientists and researchers, section 12.4, and for practitioners in general, section 12.5.

12.3. Implications and recommendations for Mobina

The designed functionality can lead to continuous usage

In general, the functionality is well-received. Using the proposed modules, Mobina can support most of the customers' (process) innovation process effectively. This can help Mobina to extend the usage of users to a more continuous basis. It will create a continuous revenue model and more customer intimacy. Both Mobina and customers can benefit from this, since the prolonged usage and customer intimacy will allow Mobina to create more adequate service models and sophisticated set-up tools. This can help customers get the most out of the application and their innovation process.

Next design phase for further development and validation

This research provides a solid basis for the next design phase. In the next phase the artifact should be developed further and the details have to be worked out. This research does not provide conclusive evidence of the consequences of the artifact; the design has to be tested in practice. The target population has not been involved in this phase, and therefore it is important to involve potential users when the design progress allows it.

Open innovation well-received and most ready for implementation

The functionality for open innovation is most ready for implementation and, possibly because of this, also most well-received. Both partner discussions and innovation ideas can be implemented independently from each other and the other proposed functionality. Mobina can especially extend its Knowledge-as-a-Service using innovation ideas, and let companies advertise on or contribute to the platform. Most importantly, Mobina will have to make sure

SMEs are guided in the process of using open innovation, and that their organizational context will facilitate partner discussions.

Actionables creates an idea-oriented dimension as a leg up to more functionality

For the other functionality, I would advise to implement actionables first, which allow to transform comments into a new dimension (where multiple comments can be joined and comments can also be split across multiple actionables). A separate dimension is needed to transform from the issue-oriented reference model to the idea-oriented implementation. It will also allow importing ideas like product improvements from other tools. The actionables give companies more grip to develop their improvement agenda and prioritize, especially in the pre-project phase. It is perceived as very useful functionality, and also easiest to add to the current application, since it can be directly linked to the already existing comments. However, it will also need a lot of tools to keep an overview of this separate dimension.

Actionables combined with goals helps companies in the pre-project phase

To make sure actionables are not only a new dimension, but also help companies in the pre-project phase in the void between idea generation and the project, it is essential that some goals functionality is developed. To make actionables comparable and goals reusable, it will be useful to implement a goal concept that is linked to the actionable. Mobina might already provide pre-defined goals, including examples of strategy goals, extending its KaaS However, it is not necessary to immediately provide a separate space for strategy. By first implementing actionables and linking goals, Mobina might use data to analyze the usage of strategic goals, and confront users with their needs for monitoring the goals.

Strategy functionality can help companies build towards the future

If further analysis points out this is useful, it will be easy to extend the software with a separate space for monitoring goals and linking strategy. This can help the management of companies communicate the long-term vision with the users. Users can focus their actions and align with the strategy. However, it is important that this is not an obligatory part for users. Often, the strategy will not be linked explicitly to projects.

Project management should be supported fully or not at all

A last step for Mobina to support the whole (process) innovation process would be the project functionality. An important decision for Mobina is whether they want to fully support project management. If only partly implemented, it will be very difficult to explain the distinction between Mobina and other (project management) tools. Therefore, all or nothing is probably the best way to go. More research whether all or nothing is the only way to go might be useful, this can be scientific but also more practical market research.

Project management functionality in Mobina is a logical step

Functionality where Mobina can add value relative to other tools is by adding knowledge of the industry and allowing companies to collaborate well. The relation with (the comments in) the reference model provides a lot of value, but also involving the rest of the organization during the project with risk and issue management is useful. The relation with strategy and goals, to provide insight in the consequences and relations, helps a company to ensure an effective agenda.

For both Mobina and industrial SMEs it is very interesting if the application supports project management completely, potentially by integrating closely with specialist tools. For users this would provide one tool for everything related to innovating processes, and therefore create a lot

of synergy. More users will use the tool, and therefore it can create even more support in the organization for (innovation) projects. It will also reduce overhead, since all efforts put in generating ideas (comments), can be reused throughout the process. The company can both set goals, generate ideas, follow-through on them, and monitor the progress. This way, companies can use the tool for continuous improvement.

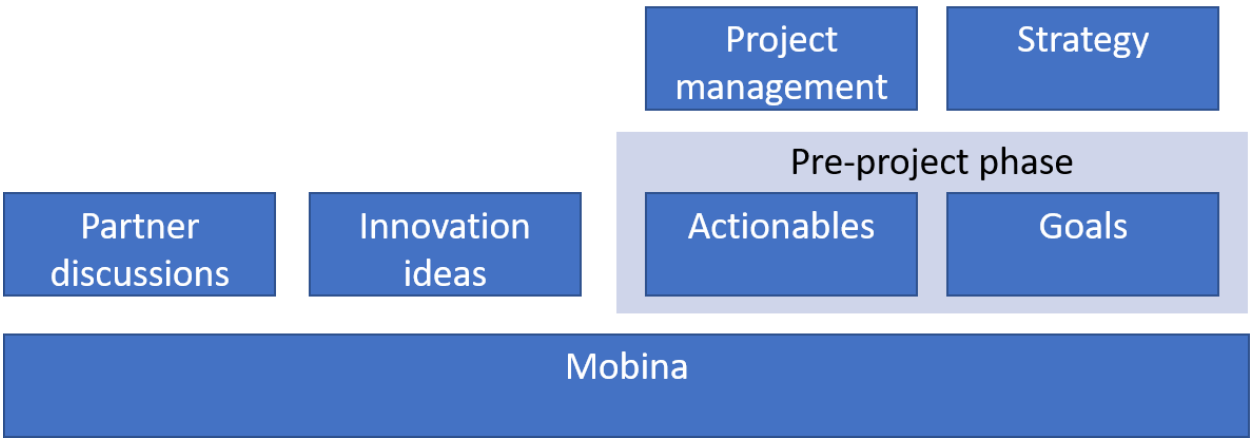


Figure 65 The proposed building blocks for Mobina

12.4. Implications and recommendations for science

Of course, this design leads to possibilities for further research, on this and subsequent designs. However, researchers can learn more lessons from this research than just the usefulness of this design. The design leads to discussions for several areas of research. All conclusions can be researched further, and next to this, some gaps were stated that researchers could solve. This might be using a literature review, but maybe also more data collection has to be done. Next to this, lessons can be learned from this research for both designing and validating (similar) functionality.

SMEs need support for open innovation on selecting practices, identifying pitfalls and finding partners

First, open innovation can be food for thought. An important conclusion was that industrial SMEs need support tools for open innovation. They need to know which kind of practices are useful for them, and how they should select these. Next to this, it is important that researchers identify and clearly communicate pitfalls of open innovation for SMEs, e.g. the legal implications. There also is a need for innovation partners that can help them implement innovations, but finding them and selecting the right partner can be difficult. Future research can for example point out the most important selection criteria and operationalize them.

More research on the usage of strategy in SMEs is needed

Although plenty of research has demonstrated the importance of strategy, it seems that not all SMEs are aware of this. Can these SMEs still survive, and is this because strategy is not important or because they implicitly implement their strategy? Or should they use strategy more, and is it important that researchers and practitioners communicate this more clearly and to a wider audience? Future research can focus on the current practices regarding strategy in (industrial) SMEs to get answers on these questions. Maybe other tools than Mobina can be handed to them to adequately support strategic decision-making.

Provide guidelines for the decision between one integral system or several best-of-breed apps

Regarding actionables and projects, the most important discussion point is whether project management functionality is separable, as well as whether this is desirable. This can be subject to further research, but probably not only in this area. In general, companies have to make decisions to what extent using one integral system, e.g. ERP, is useful or whether functionality can better be cut into pieces in several best-of-breed apps. Of course, for every piece of functionality and every company different factors play a role.

Future research could really help to provide generic guidelines for this decision, in which cases to use multiple apps for related functionality and in which cases one, potentially larger, application. This can be both descriptive, what do users and companies do, and prescriptive, what leads to the best results. Many factors could play an important role, like the type of company, the strategic importance of IT, the degree of integration between information, but also aspects like the average age inside a company.

The design and validation method are useful for the first design iteration

I can advise other researchers the same design and validation method. Especially when no clear idea and specific need for development exists, a first (iterated) iteration of the design cycle that contains only a high-level design or mock-up and is validated using expert reviews can be useful. This can give a first and clear idea of which directions to explore further, and which not. Many useful improvements were given, and many important discussion points arose, which make sure the global concept stands well before exposing users to the product. It would for example be horrible if the legal implications would have been found out only after using the product.

A focus group is useful for validation and many lessons have been learned

Existing literature can help a lot in making this design. It provides initial background information and especially provides many details to refine the design. However, in the end a large part of the design effort is dependent on the designer's experience and inspiration. Therefore, it's important to iteratively improve the design with other stakeholders and validate it before putting in a lot of effort to develop it completely.

This validation was done using a focus group, in which all experts discuss together about the usefulness of the design. This proved very valuable. The interaction between experts gave a lot more information on the relative importance of certain aspects and the degree of differences in opinion. A disadvantage is that it seems that people will mainly focus on the negative aspects and potential improvements, making it difficult to completely analyze their opinion on the usefulness. It is helpful to explicitly ask for these, and the short questionnaires used in this research for example really helped to force them to take a stand. More information and detailed tips on the focus group can be found in the corresponding chapters 3 and 9, and in the additional paper in Appendix G.

It is difficult to plan a focus group, especially because you can only start planning if you know the exact needs of the research and that the validation will be done using a focus group. Then it's often too late to still get everyone together. Making the decision to use a focus group should therefore be made as early as possible. In that stage it is useful to develop a vision about how this focus group is set up already before the details of the design are available. The set-up of this focus group was successful and can provide a useful example for using focus groups as a validation method for other kind of supporting applications.

12.5. Implications and recommendations for (other) practitioners

This research is not only useful for Mobina, but also for other practitioners like employees of (industrial) SMEs and in some occasions large enterprises, consultants, and software companies. Many lessons can be drawn from the design, the discussions about the design, and the used methods.

OI is useful for industrial SMEs; several aspects are important to effectively adopt OI

Open innovation can be effective to improve innovation results of industrial SMEs. These companies are looking into the possibilities, but are looking for help which can come from both advisors and software companies. They have to set up procedures and decide which practices to use. Next to this, SMEs generally want to keep grip on the shared information, they don't want to share all company secrets. In the end, the ideas have to be developed and implemented. However, often both the financial power and expertise lack to do this alone. They are looking for the right innovation partners to help, but don't know where to find them. Therefore, they look at trusted advisors to bring them into contact with the right people.

Strategy in decision-making can help achieve long-term success

Next to this, strategy plays an important role. To build and maintain a sustainable company it is important that (long-term) decisions are based on a strategy or vision for the future. The project portfolio should not only deliver short-term benefits, but also support long-term goals. However, it seems not all industrial SMEs do this. Although further research into the consequences might be necessary, it is useful for entrepreneurs and employees to make well-founded decisions with the strategy in mind. To do this, it is important that the strategy is communicated and in many cases also operationalized in order to clearly communicate it. The strategy should not be forced onto people. Some people have their own agenda and won't accept this. Therefore, it's better to make sure the people that do look for support, can get it.

Traceability and monitoring functionality leads to a more successful innovation process

It is important that decision-makers have enough information to make the right decisions. To support this, projects and the project portfolio should be linked to the strategy, to give insight into the consequences. Throughout the projects traceability should be provided, both to the goals and to the original problems and ideas. Next to this, a lot of attention should be given to managing and monitoring risk to ensure a successful project (management).

Administrative functionality in software might be more than the necessary evil

For software developers, and designers, administrative functionality might be seen as a necessity and as such not the most important design aspect. However, in some cases ownership is essential. Therefore, it is good to always consider the importance of administrative functionality for the success of certain functionality.

Software companies and users have to carefully consider their position on the scale from best-of-breed to integral support

Next to this, software companies have to carefully consider where the border of their application lays. Some customers might prefer one product that covers a whole range of needed functionality, whereas other look more at best-of-breed applications and mix and match the apps they need. It is important to analyze the target group to make the right decisions, and potentially try to support both groups of customers. This can for example be done by providing APIs, out-of-the-box integrations, and modular software that help users with multiple apps to create a better user experience.

Users of these software products should also consider what serves them best. Do for example the advantages of using different, potentially better suited, applications outweigh the additional overhead? Or might one broader application provide synergy that leads to better results? Both options have their advantages and weaknesses, but should be carefully considered to avoid naturally growing application spaghetti.

Scientific literature can provide a solid foundation for software design

Although this design phase was conducted through scientific research, and might contain overhead that software companies and other designers want to avoid, some useful lessons can still be drawn from the design and validation method. Scientific literature can for example provide a lot of background information for the initial design phase and also provide good ideas for design. It might not lead to radical new ideas. The designer's influence is still very important, but it can make sure that no details are overlooked, and the right decisions are made.

Focus groups are useful to validate (initial) software designs

Next to this, focus groups can also be useful for practitioners. It provides a lot of insight from experts on, in this case, an initial high-level design. The interaction between different experts provides a lot of additional insights. To deliver good results, it is however important the focus group is planned carefully. This means that the design presented has the right level of detail for the design phase, as well as the discussion. And even though it might be tempting for the designers to steer to certain conclusions and defend the design, the most useful and representative results are received when a moderator mainly facilitates and doesn't steer the discussion.

References

Abee, E. (2014). Hoe werkt organisatie advies aan kleine MKB ondernemers. Retrieved July 29, 2017, from https://www.managementsite.nl/organisatieadvies-mkb-ondernemers

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, *17*(6), 337–342. https://doi.org/10.1016/S0263-7863(98)00069-6

Avison, D., Jones, J., Powell, P., & Wilson, D. (2004). Using and validating the strategic alignment model. *Journal of Strategic Information Systems*. https://doi.org/10.1016/j.jsis.2004.08.002

Barisic, A. F., & Bozicevic, M. (2013). Role of management consulting in a process of professionalization of SME management. *Učenje Za Poduzetništvo*, *3*(2), 144–160.

Baskerville, R., & Wood-Harper, A. T. (1998). Diversity in information systems action research methods. *European Journal of Information Systems*, *7*(2), 90–107. https://doi.org/10.1057/palgrave.ejis.3000298

Belassi, W., & Tukel, O. I. (1996). A new framework for determining critical success/failure factors in projects. *International Journal of Project Management*, *14*(3), 141–151. https://doi.org/10.1016/0263-7863(95)00064-X

Bergeron, F., Raymond, L., & Rivard, S. (2004). Ideal patterns of strategic alignment and business performance. *Information & Management*, *41*(8), 1003–1020. https://doi.org/10.1016/j.im.2003.10.004

Bernroider, E. W. N. (2008). IT governance for enterprise resource planning supported by the DeLone-McLean model of information systems success. *Information and Management*, *45*(5). https://doi.org/10.1016/j.im.2007.11.004

Calantone, R. J., Cavusgil, S. T., & Zhao, Y. (2002). Learning orientation, firm innovation capability, and firm performance. *Industrial Marketing Management*, *31*(6). https://doi.org/10.1016/S0019-8501(01)00203-6

Calantone, R. J., Harmancioglu, N., & Droge, C. (2010). Inconclusive Innovation "Returns": A Meta-Analysis of Research on Innovation in New Product Development*. *Journal of Product Innovation Management*, *27*(7), 1065–1081. https://doi.org/10.1111/j.1540-5885.2010.00771.x

Chan, Y. E., & Reich, B. H. (2007). IT alignment: What have we learned? *Journal of Information Technology*, *22*(4). https://doi.org/10.1057/palgrave.jit.2000109

Checkland, P., & Holwell, S. (1998). Action research: Its nature and validity. *Systemic Practice and Action Research*, *11*(1), 9–21. https://doi.org/10.1023/A:1022908820784

Chenhall, R. H. (2005). Integrative strategic performance measurement systems, strategic alignment of manufacturing, learning and strategic outcomes: An exploratory study. *Accounting, Organizations and Society*, *30*(5), 395–422. https://doi.org/10.1016/j.aos.2004.08.001

Consultancy.nl. (2014). 72% MKB bedrijven gaat externe adviseurs inschakelen. Retrieved July 29, 2017, from http://www.consultancy.nl/nieuws/8648/72-procent-mkb-bedrijven-gaat-externe-adviseurs-inschakelen

Cooke-Davies, T. (2002). The "real" success factors on projects. *International Journal of Project*

Management, *20*(3), 185–190. https://doi.org/10.1016/S0263-7863(01)00067-9

Coughlan, P., & Coghlan, D. (2002). Action research for operations management. *International Journal of Operations & Production Management*, *22*(2), 220–240. https://doi.org/10.1108/01443570210417515

Cragg, P., King, M., & Hussin, H. (2002). IT alignment and firm performance in small manufacturing firms. *Journal of Strategic Information Systems*, *11*(2). https://doi.org/10.1016/S0963-8687(02)00007-0

de Wit, A. (1988). Measurement of project success. *International Journal of Project Management*, *6*(3), 164–170. https://doi.org/10.1016/0263-7863(88)90043-9

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&D Management*, *39*(4), 311–316. https://doi.org/10.1111/j.1467-9310.2009.00570.x

Europe INNOVA. (2012). *IMP^{3}rove: HIGH-IMPACT INNOVATION MANAGEMENT*. https://doi.org/10.2769/3826

Fui-Hoon Nah, F., Lee-Shang Lau, J., & Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal*, *7*(3), 285–296. https://doi.org/10.1108/14637150110392782

Gibson, M., & Arnott, D. (2007). The Use of Focus Groups in Design Science Research. In *Proceedings of the 18th Australasian Conference on Information Systems* (Vol. Paper 14, pp. 327–337). https://doi.org/10.1007/978-1-4419-5653-8_10

Gupta, Y. P., Karimi, J., & Somers, T. M. (1997). Alignment of a firm's competitive strategy and information technology management sophistication: The missing link. *IEEE Transactions on Engineering Management*, *44*(4), 399–413. https://doi.org/10.1109/17.649870

Henderson, J. C., & Venkatraman, H. (1993). Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal*, *32*(1), 472–484. https://doi.org/10.1147/sj.382.0472

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*(1), 75–105. https://doi.org/10.2307/25148625

Hong, K. K., & Kim, Y. G. (2002). The critical success factors for ERP implementation: An organizational fit perspective, *40*(1), 25–40. https://doi.org/10.1016/S0378-7206(01)00134-3

Johannessen, J.-A., Olaisen, J., & Olsen, B. (2001). Mismanagement of tacit knowledge: The importance of tacit knowledge, the danger of information technology, and what to do about it. *International Journal of Information Management*, *21*(1). https://doi.org/10.1016/S0268-4012(00)00047-5

Julien, P.-A., Raymond, L., Jacob, R., & Ramangalahy, C. (1999). Types of technological scanning in manufacturing SMEs: An empirical analysis of patterns and determinants. *Entrepreneurship and Regional Development*, *11*(4). https://doi.org/10.1080/089856299283119

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard--measures that drive performance. *Harvard Business Review*, *70*(1), 71–79. https://doi.org/00178012

Kaplan, R. S., & Norton, D. P. (2001a). Transforming the balanced scorecard from performance measurement to strategic management: Part 1. *Accounting Horizons*, *March*(1), 87–104. https://doi.org/10.2308/acch.2001.15.1.87

Kaplan, R. S., & Norton, D. P. (2001b). Transforming the balanced scorecard from performance measurement to strategic management: Part II. *Accounting Horizons*. https://doi.org/10.2308/acch.2001.15.2.147

Kaufmann, A., & Tödtling, F. (2002). How effective is innovation support for SMEs? An analysis of the region of Upper Austria. *Technovation*, *22*(3), 147–159. https://doi.org/10.1016/S0166-4972(00)00081-X

Kettinger, W. J., Teng, J. T. C., & Guha, S. (1997). Business Process Change: A Study of Methodologies, Techniques, and Tools. *MIS Quarterly*, *21*(1), 55–80. https://doi.org/10.2307/249742

Kidd, P. S., & Parshall, M. B. (2000). Getting the Focus and the Group: Enhancing Analytical Rigor in Focus Group Research. *Qualitative Health Research*, *10*(3), 293–308. https://doi.org/10.1177/104973200129118453

Kirkham, L., Garza-Reyes, J. A., Kumar, V., & Antony, J. (2014). Prioritisation of operations improvement projects in the European manufacturing industry. *International Journal of Production Research*, *52*(18), 5323–5345. https://doi.org/10.1080/00207543.2014.903345

Kitzinger, J. (1994). The methodology of Focus Groups: the importance of interaction between research participants. *Sociology of Health and Illness*, *16*(1), 103–121. https://doi.org/10.1111/1467-9566.ep11347023

Kitzinger, J. (1995). Qualitative research. Introducing focus groups. *BMJ (Clinical Research Ed.)*, *311*(7000), 299–302. https://doi.org/10.1136/BMJ.311.7000.299

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, *27*(2), 131–150. https://doi.org/10.1002/smj.507

Lim, C. ., & Mohamed, M. Z. (1999). Criteria of project success: an exploratory re-examination. *International Journal of Project Management*, *17*(4), 243–248. https://doi.org/10.1016/S0263-7863(98)00040-4

Madrid-Guijarro, A., Garcia, D., & Van Auken, H. (2009). Barriers to innovation among spanish manufacturing SMEs. *Journal of Small Business Management*, *47*(4), 465–488. https://doi.org/10.1111/j.1540-627X.2009.00279.x

McKay, J., & Marshall, P. (2001). The dual imperatives of action research. *Information Technology & People*, *14*(1), 46–59. https://doi.org/10.1108/09593840110384771

Meyers, P. (1999). Implementation of industrial process innovations: factors, effects, and marketing implications. *Journal of Product Innovation Management*, *16*(3), 295–311. https://doi.org/10.1016/S0737-6782(98)00044-7

Mondragon, A. E. C., Lyons, A. C., & Kehoe, D. F. (2004). Assessing the value of information systems in supporting agility in high-tech manufacturing enterprises. *International Journal of Operations and Production Management*, *24*(12). https://doi.org/10.1108/01443570410569029

Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, *71*(3), 75–86.

Morgan, D. L. (1996). Focus Groups. *Annual Review of Sociology*, *22*(1), 129–152. https://doi.org/10.1146/annurev.soc.22.1.129

Nieto, M. J., & Santamaría, L. (2010). Technological collaboration: Bridging the innovation gap between small and large firms. *Journal of Small Business Management*, *48*(1). https://doi.org/10.1111/j.1540-627X.2009.00286.x

Olson, E. M., Walker, O. C., Ruekert, R. W., & Bonner, J. M. (2001). Patterns of cooperation during new product development among marketing, operations and R&D: Implications for project performance. *Journal of Product Innovation Management*, *18*(4), 258–271. https://doi.org/10.1016/S0737-6782(01)00091-1

Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. *A handbook for visionaries, game changers, and challengers*. https://doi.org/10.1523/JNEUROSCI.0307-10.2010

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–78. https://doi.org/10.2753/MIS0742-1222240302

Pellegrino, A. C. (2017). Open Innovation in SMEs: a Process Model for Successful Implementation. In *9th IBA Bachelor Thesis Conference*. Enschede, The Netherlands.

Peppard, J., Ward, J., & Daniel, E. (2007). Managing the realization of business benefits from IT investments. *MIS Quarterly Executive*, *6*(1), 1–11. https://doi.org/0657

Pinto, J. K., & Slevin, D. P. (1987). Critical factors in successful project implementation. *IEEE Transactions on Engineering Management*, *EM-34*(1), 22–27. https://doi.org/10.1109/TEM.1987.6498856

Powell, R. A., & Single, H. M. (1996). Focus Groups. *International Journal for Quality in Health Care*, *8*(5), 499–504. https://doi.org/10.1093/intqhc/8.5.499

Rabiee, F. (2004). Focus-group interview and data analysis. *Proceedings of the Nutrition Society*, *63*(4), 655–660. https://doi.org/10.1079/PNS2004399

Rahman, H. (University of M., & Ramos, I. (University of M. (2011). Is Open innovation imperative to small and medium enterprises?: A comparative study. *7th Americas Conference on Information Systems 2011, AMCIS 2011*, *3*, 2078–2084.

Ross, J. W., & Vitale, M. R. (2000). The ERP Revolution: Surviving vs. Thriving. *Information Systems Frontiers*, *2*(2), 233–241. https://doi.org/http://dx.doi.org/10.1023/A:1026500224101

Shang, S., & Seddon, P. B. (2002, October). Assessing and managing the benefits of enterprise systems: The business manager's perspective. https://doi.org/10.1046/j.1365-2575.2002.00132.x

Shenhar, A. J., Dvir, D., Levy, O., & Maltz, A. C. (2001). Project success: A multidimensional strategic concept. *Long Range Planning*, *34*(6), 699–725. https://doi.org/10.1016/S0024-6301(01)00097-8

Shin, I. (2006). Adoption of enterprise application software and firm performance. *Small Business Economics*, *26*(3). https://doi.org/10.1007/s11187-005-0215-9

Söderlund, J. (2004). Building theories of project management: Past research, questions for the future. *International Journal of Project Management*, *22*(3), 183–191. https://doi.org/10.1016/S0263-7863(03)00070-X

Sutton, S. G., & Arnold, V. (2013). Focus group methods: Using interactive and nominal groups to explore emerging technology-driven phenomena in accounting and information systems. *International Journal of Accounting Information Systems*, *14*(2), 81–88.

https://doi.org/10.1016/j.accinf.2011.10.001

Tatikonda, M. V., & Rosenthal, S. R. (2000). Successful execution of product development projects: Balancing firmness and flexibility in the innovation process. *Journal of Operations Management*, *18*(4), 401–425. https://doi.org/10.1016/S0272-6963(00)00028-0

Taylor, H., Artman, E., & Woelfer, J. P. (2012). Information technology project risk management: Bridging the gap between research and practice. *Journal of Information Technology*, *27*(1), 17–34. https://doi.org/10.1057/jit.2011.29

Tesch, D., Kloppenborg, T. J., & Frolick, M. N. (2007). IT Project risk factors: The project management professionals perspective. *Journal of Computer Information Systems*, *47*(4), 61–70. https://doi.org/10.1080/08874417.2007.11645981

Urîtu, D., & Ștefan-Florin, C. (2016). The Usage of Consulting Services Among Romanian SMES between 2011-2015. *Management of Sustainable Development*. https://doi.org/10.1515/msd-2016-0004

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. *Omega*, *3*(6), 639–656. https://doi.org/10.1016/0305-0483(75)90068-7

van de Vrande, V., de Jong, J. P. J., Vanhaverbeke, W., & de Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, *29*(6–7), 423–437. https://doi.org/10.1016/j.technovation.2008.10.001

Venable, J., Pries-Heje, J., & Baskerville, R. (2012). A Comprehensive Framework for Evaluation in Design Science Research. *Design Science Research in Information Systems. Advances in Theory and Practice*, *7286*(2012), 423–438. https://doi.org/10.1007/978-3-642-29863-9_31

Verburg, J. G. J. (2017). *Research topics Jochem Verburg - Identifying design objectives for an extension to Mobina*. Enschede.

Voigt, M., Ortbach, K., Plattfaut, R., & Niehaves, B. (2013). IT Support for Business Process Innovation -- Architectural Choices and Design Challenges. In *2013 46th Hawaii International Conference on System Sciences* (pp. 3737–3746). IEEE. https://doi.org/10.1109/HICSS.2013.371

von Hippel, E., Thomke, S., & Sonnack, M. (1999). Creating breakthroughs at 3M. *Harvard Business Review*, *77*(5). https://doi.org/10.1038/nbt1001-921

Ward, J., Daniel, E., & Peppard, J. (2008). Building Better Business Cases for IT Investments. *MIS Quarterly Executive*, *7*(1), 67–78. https://doi.org/10.1109/HICSS.2008.37

White, D., & Fortune, J. (2002). Current practice in project management — an empirical study. *International Journal of Project Management*, *20*(1), 1–11. https://doi.org/http://dx.doi.org/10.1016/S0263-7863(00)00029-6

Wieringa, R. J. (2014). *Design Science Methodology: For Information Systems and Software Engineering*. Springer Heidelberg New York Dordrecht London. https://doi.org/10.1007/978-3-662-43839-8

Appendix A. List of competitor tools and applications

Accessed 21-08-2017

Tools were searched for by using Google with combinations of the following words:

1. Application/Apps/Tool/Software
2. Help/Support
3. Business process reengineering/Continuous improvement/Innovation/Process improvement

'Analog' tools

https://www.forumforthefuture.org/sites/default/files/images/Forum/Projects/E21C/Innovation_infrastructure/1.%20Toolbox%20A5%20Cards%20updated.pdf

https://www.slideshare.net/ramonvullings/27-creativity-innovation-tools-final

https://www.boardofinnovation.com/tools/

http://implementconsultinggroup.com/media/1961/20-innovation-tools.pdf

http://idea-sandbox.com/innovation-tools/

http://www.businessballs.com/dtiresources/TQM_process_improvement_tools.pdf

http://www.captio.com/blog/5-tools-for-process-improvement

http://www.qualitymag.com/blogs/14-quality-blog/post/92040-five-tools-for-process-improvement-and-lean-six-sigma

https://www.bizmanualz.com/improve-quality/what-quality-tools-are-for-process-improvement.html

http://asq.org/learn-about-quality/six-sigma/tools.html

https://tallyfy.com/continuous-improvement-tools-growth/

http://www.quality-assurance-solutions.com/basic-tools-for-process-improvement.html

https://www.linkedin.com/pulse/tools-techniques-process-improvement-assi-mba-dph-mph-mfm

https://www.codot.gov/business/process-improvement/tools-and-techniques

http://www.radio-electronics.com/info/electronics-design/process-improvement/quality-tools-techniques-list.php

https://www.probuilder.com/blog/5w2h-simple-process-improvement-tool

https://centricconsulting.com/business-consulting/improve-operational-performance/business-process-improvement-lean-six-sigma/

http://www.systems2win.com/

Applications for specific usage

http://www.techrepublic.com/blog/five-apps/five-free-tools-to-help-brainstorm-solutions-and-spark-innovation/ - Mind mapping

https://www.collectivecampus.com.au/blog/14-apps-to-support-corporate-innovation - Landing pages, task management, video makers, etc.

https://www.planisware.com/ - Project portfolio management

http://rzsoftware.com/ - For analyzing manufacturing performance and quality assurance management

Idea management software

http://crowdicity.com

https://www.ideasmine.net/en

http://www.cotunity.com

https://www.receptive.io/

https://ideanote.io

https://www.wazoku.com/products/idea-spotlight/

https://www.spigit.com/

https://www.sap.com/products/innovation-management.html

Innovation (management) software

http://www.orchideainnovations.com

http://www.brightidea.com/

https://www.sopheon.com/

https://www.kainexus.com/

https://www.phase5group.com/

Appendix B. Research topics Jochem Verburg

Starts next page

Research topics Jochem Verburg

Identifying design objectives for an extension to Mobina

1. Introduction

Mobina is a software tool by ERP Index B.V. to support innovation in industrial companies and more specifically SMEs. It offers a tailormade process reference model with a collaboration environment for users to discuss all kind of subjects. Next to this, it has deeply integrated possibilities for aligning the information landscape with the processes. As such it has extensive support for IT-driven innovation.

This tool has several strengths. First of all, it offers a lot of content to help companies in their innovation trajectory and makes sure IT is given an appropriate and important place in the trajectory. Next to this, the collaboration environment has a mobilizing effect and helps create a culture of innovation and continuous improvement in companies.

Mobina is not a pure top-down or bottom-up tool. Rather it positions itself at the edge to connect the two. It helps management to make high-level plans more specific and identify the impact of changes in the organization. The knowledge of the whole organization is then used to transform the organization.

Currently, Mobina is mainly suited for usage on a project basis. Companies can use the tool with a specific goal, like identifying the improvement potential of the ERP system or standardizing the product assortment. Support to really implement ideas and monitor progress is not yet extensively present.

Mobina would like to further extend their support for industrial SMEs and therefore wants to identify areas that are essential for innovation in industrial SMEs which might benefit from extra functionality in the software. ERP Index B.V. has a preference for areas which might prolong the usage of Mobina from a project basis to continuous usage.

2. Research approach

Mobina currently already has a software tool aiming to improve company's success by helping them to effectively and efficiently innovate and improve their processes. A strong focus in the product is on achieving this by making sure the information landscape is well-aligned. However, Mobina wants to improve this product. The goal of the research is to design an extension to Mobina that improves the innovation and improvement process of industrial SMEs. As such, this is a design problem.

Peffers et al. (2007) presented the Design Science Research Methodology for executing design science, presented in Figure 1. This methodology can be used to structure the design science process, even though part of the process of transforming objectives to an artifact might seem intangible.

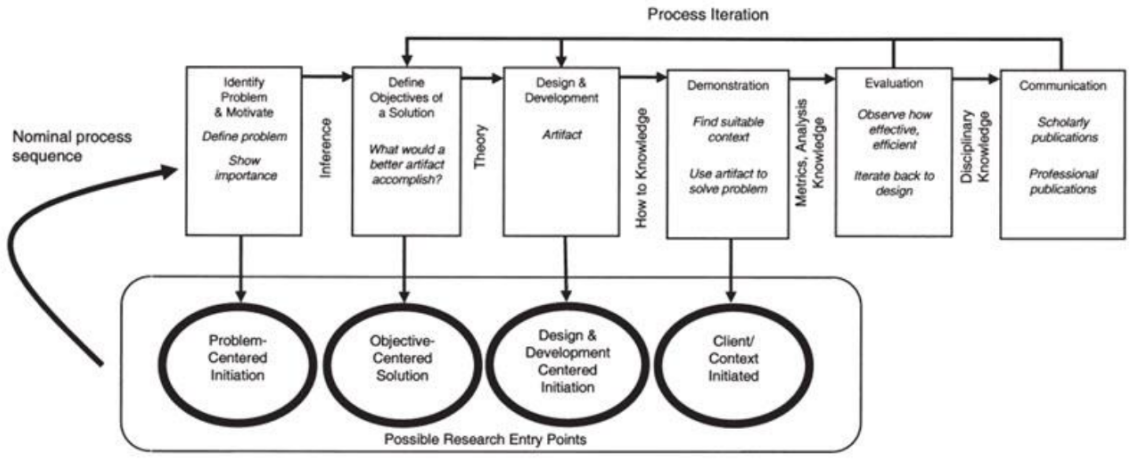


Figure 1 The Design Science Research Methodology (DSRM) Process Model (Peffers et al., 2007)

Research can be started in different phases (Peffers et al., 2007). In this case, the final goal (or the problem to be solved) has already been set by Mobina and thus the research will be entered as an objective-centered solution. This report for research topics will focus on identifying the global (design) objectives.

To establish the most important areas to improve, a literature search is used to identify critical success factors for innovation projects in industrial SMEs. To support this literature search, initially a framework is developed to ensure completeness and comprehension of the different aspects. Then, critical success factors from literature need to be identified to help the decision.

This research has to answer the following main question: Which factors should Mobina focus on to extend its support for the innovation process of industrial SMEs?

This question can be answered by answering the following questions:

1. Which aspects are involved in the innovation process of industrial SMEs?
2. Which factors are critical for success of the innovation process of industrial SMEs?
3. What determines the usefulness of factors for extending functionality in Mobina?
4. How useful are the critical success factors for extending functionality in Mobina?

The relation between these research questions is shown in Figure 2.

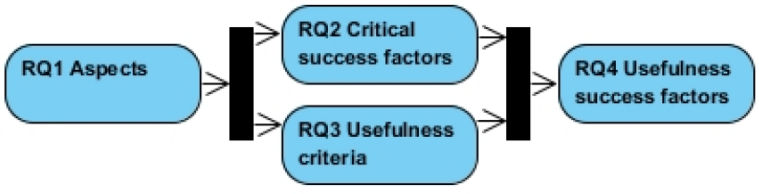


Figure 2 Visual representation of the research questions

3. Framework innovation process aspects

A framework is developed to identify the different aspects influencing the success of industrial SMEs, especially related to the (process) innovation and improvement process with a large focus on IT. This framework makes sure the list of success factors takes into account all aspects, and can also be used to guide the development efforts of Mobina at a higher level. A first version is made and then reviewed to create the final version.

3.1. First version

A first framework is developed based on top-level papers in the Information Systems and Innovation field (and as an extension the ERP field, being one of the systems used a lot in industrial enterprises), see Figure 3. How these aspects are identified can be found in Table 1.

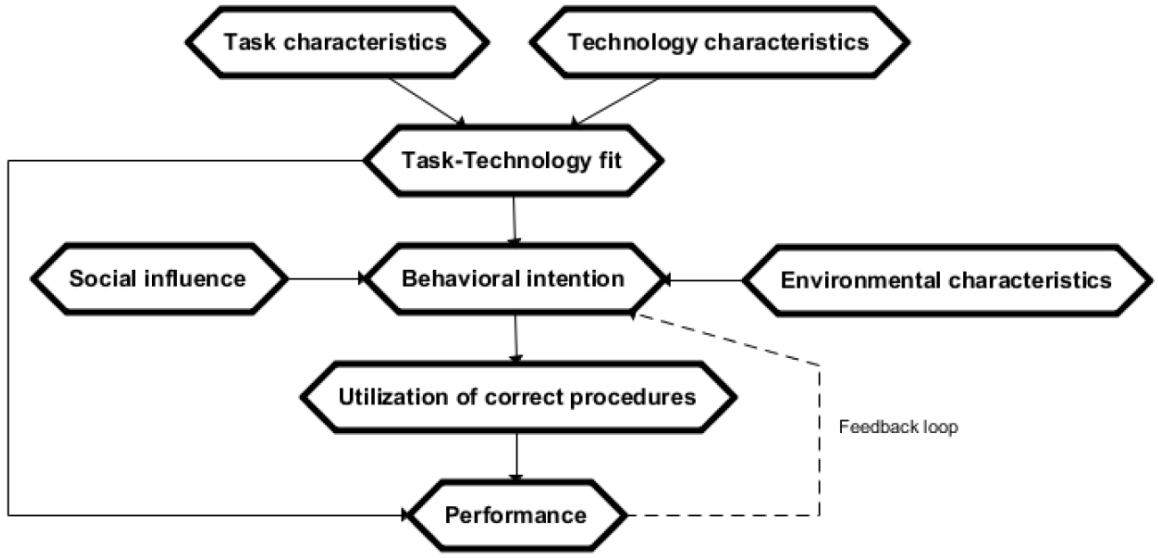


Figure 3 First version of framework of the innovation and improvement process

Aspect	Based on
Task characteristics	(D. L. Goodhue, 1995)
Technology characteristics	(Agarwal & Prasad, 1997; DeLone & Mclean, 2003; D. L. Goodhue, 1995; Zhang, Lee, Huang, Zhang, & Huang, 2005)
Task-Technology fit	(Agarwal & Prasad, 1997; D. L. Goodhue, 1995)
Social influence	(M. Bradford & Florin, 2003; Venkatesh, Morris, Davis, & Davis, 2003)
Behavioral intention	(Agarwal & Prasad, 1997; DeLone & Mclean, 2003; Venkatesh et al., 2003)
Environmental characteristics	(M. Bradford & Florin, 2003; DeLone & Mclean, 2003; Venkatesh et al., 2003; Zhang et al., 2005)
Utilization of correct procedures	(Agarwal & Prasad, 1997; DeLone & Mclean, 2003; Venkatesh et al., 2003)

Performance	(M. Bradford & Florin, 2003; DeLone & Mclean, 2003; D. L. Goodhue, 1995; Zhang et al., 2005)

Table 1 Basis on which the (first version) aspects were identified

3.2. Validation first version

This framework is improved through an expert review with Jos van Hillegersberg (supervisor and head of the department Industrial Engineering and Business Information Systems (IEBIS) at the University of Twente) and René Hol (supervisor and President of ERP Index B.V. and many years of experience in consulting in the manufacturing industry). The findings of this review are described next.

The first version of the framework seems to represent two different phases in an enterprise. For measuring the performance or success of a company in a static state, and for the transition of an enterprise from a current to a future state. This makes the framework very difficult to comprehend and not completely representative of reality. To solve this, a framework with multiple phases is proposed.

Next to this, the level of analysis of the framework is not clear. The different aspects can take place at different levels in an organization, and can also be measured at different levels like enterprise-level, business unit-level or process-level. Therefore, the reviewers advise to make a distinction between the aspects on different levels.

3.3. Second framework version

Based on the feedback a second version of the framework is made. It includes several phases and levels in the framework. It is extended to include past influence on new projects, and include the end performance at multiple levels. Next to this, social influence is split up into beliefs (of an individual), the social influences (on that individual) and the influence of management and strategy. An important part to be added is identified in the innovation search for critical success factors: the capabilities of a company to identify (good) improvement opportunities.

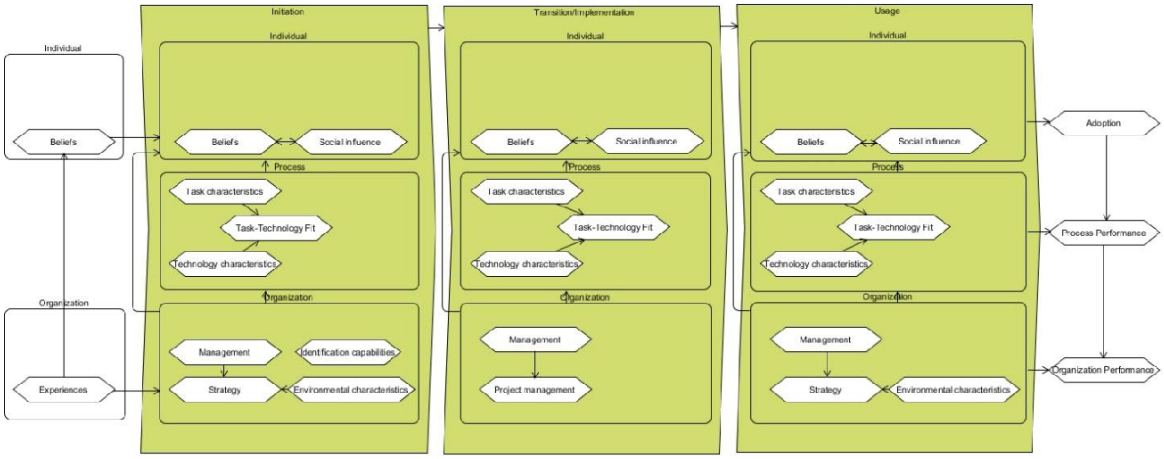


Figure 4 Second framework version (full image in Appendix A)

Phases

The framework presents several phases, since the success of process (or IT) improvements can't be seen only as a consequence of several characteristics of e.g. the system. Rather, the process from the current situation to the future situation can also have a lot of influence. Examples of such factors are project

management and user involvement. The result of a phase, can highly influence next phases. If for example earlier phases already led to a lot of opposition to a project, the implementation results can not only be explained by aspects related to the implementation.

The need for a combination of both process and variance model was also established for the IS Success model (DeLone & Mclean, 2003). This combination is also a good addition to a model trying to explain drivers and critical success factors for process improvements. DeLone and McLean explained the need for this combination:

"This process model has just three components: the creation of a system, the use of the system, and the consequences of this system use. Each of these steps is a necessary, but not sufficient, condition for the resultant outcome(s). For instance, without system use, there can be no consequences or benefits. However, with system use, even extensive use, which is inappropriate or ill-informed, there may also be no benefits. Thus, to understand fully the dimensions of IS success, a variance model is also needed."

Other examples of phases exist in ERP literature, a specific type of innovation process. These especially also recognize an initiation or design phase and have multiple phases after implementation or adoption (Ross & Vitale, 2000; Somers & Nelson, 2004). This phase preceding the development of the system is a useful addition, since factors like establishing goals of a project and involvement of employees in an early usage can be important for later phases. However, although from a project management perspective there might be a longer phase after adoption to really realize benefits, these phases will probably not introduce more different constructs. Besides this, attempts in these phases to improve e.g. the process or system design, can be seen as an improvement project in themselves. Thus, the model consists of three phases: initiation, transition/implementation and usage.

Level of analysis

A lot of IS adoption models have a specific level of analysis. Models related to IS adoption like UTAUT (Venkatesh et al., 2003) mainly look at the individual level to predict usage. Task-technology fit often takes a more organizational view where the fit between task and technology can predict organizational performance (Dale L Goodhue & Thompson, 1995). The original IS Success model (DeLone & McLean, 1992) has a main focus on the individual, however translating the individual impact to organizational impact in the end.

Although the dependent variable in this research is organizational performance, factors at several levels may play an important role. The fit of task and technology at an organizational level might be perfect and thus be expected to influence performance positively. If individuals in the organization are opposed to any changes in their process and continue working the way they did, then organizational performance might be unaffected. The need to look at both the individual and organizational level has also been identified in literature (Grover, Seung Ryul Jeong, & Segars, 1996). Since this research looks at process improvements, which in the end should affect organizational performance, three levels of analysis can be identified: individual, process and organizational.

4. Identified critical success factors

Using this framework, a literature search is executed to analyze critical success factors of the innovation and improvement process of industrial SMEs. The literature is searched specifically for information

systems and innovation in industrial SMEs. The identified critical success factors are based on these papers, an overview can be found in Critical success factorsAppendix B.

The critical success factors are classified on aspects in the framework. Mostly, they are linked to multiple aspects of the framework, with some alternative interpretations in different aspects. The list contains 94 critical success factors. Therefore, it is obvious that it's impossible to focus on the entire process. Rather, it's important to focus on identifying the most interesting critical success factors and most interesting parts of the process.

The list of critical success factors is not completely exhaustive. However, it does lead to a good validation of the framework. A new aspect of the process is identified (the capabilities of a company to identify innovation/improvement opportunities). Next to this, the critical success factors help to fill in what exactly is important for each of the aspects in the framework. It is also a good starting point for the development of Mobina.

Each of the success factors have differing amount of detail. This is mainly dependent on the literature found. Some papers describe into detail what the factors contain, others don't even have a description and leave us guessing for the exact definition. The list therefore forms a good starting point, but each part of the process might need some detailing.

For this research, the identified critical success factors serve its purpose. It was needed to get a complete, and more detailed, overview of the innovation and improvement process. Next to this, it can serve as a solid basis to identify the design objectives. It can also serve as a good basis for other research, which might benefit from both the framework and the critical success factors.

5. Usefulness of critical success factors

To identify the design objectives, first the success factors are analyzed. Mobina wants to extend their application's support and therefore five aspects have an important influence on what extend Mobina finds the critical success factors useful to include:

- The success factor is very important for the success of industrial SMEs in (IS-related) innovation projects. Of course, most important are those factors that influence success most.
- The success factor comprises variables that can be influenced to some extent. Success factors like the economy or government regulations are success factors that are very hard to influence by most companies and are therefore more like limitations with which companies have to work.
- In extension to being influenced by the companies, the software of Mobina should also be able to at some extent influence the factor. For example, it will be difficult for Mobina to influence top management support.
- The success factor has not yet been researched in-depth (for the target population). Some success factors, like top management support, have already been researched in-depth, or their criticality is straightforward, thus making them less useful to research.

Appendix C contains a brief overview of how each critical success factor scores on these aspects. The identified success factors that fulfill the first four requirements are discussed within Mobina. These success factors were scored on a fifth criterion, which is whether Mobina has not yet incorporated (full) support for them or wants a more in-depth look at the needed support. On the basis of this criterion Mobina concludes that they want to look into the possibilities for the following success factors:

18. Cost difficult to control
23. Definition of IS/IT objectives
28. Excessive risk
30. Explicit IT/IS strategy
32. External search breadth and external search depth
43. Intra and inter-industry networking
56. Open innovation
63. Prioritization methods used
77. Strategic alignment
78. Strategic concept drive evaluation
79. Strategic criticality
80. Strategic goals and planning (broad goals, not operational/tactical)
83. Technological collaboration

6. Conclusion

This research into the critical success factors of the innovation process of industrial SMEs provides a solid basis for Mobina to base development decisions for their software on. It provides a list of 13 factors that Mobina would like to expand its support on.

The factors identified has a strong focus on several areas. First, on discovering innovation possibilities through external search, intra and inter-industry networking, and technological collaboration that can all be seen as open innovation. Next to this, on selecting innovations to support the IT objectives and the strategy. Last, it is important to control the innovations to make sure cost and risks don't get out of hand, and that the organization keeps supporting the strategy.

Even though this research was conducted specifically for Mobina, it can also be useful for many other parties. The framework used to identify the global aspects involved in the innovation process, can help others to direct their efforts. Next to this, the success factors identified can also be used in other contexts. Although the research was focused on industrial SMEs, the success factors can in general also be important for other companies. Many factors have not made the cut for Mobina, but might be useful in another situation.

References

Agarwal, R., & Prasad, J. (1997). The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies. *Decision Sciences*, *28*(3), 557–582. https://doi.org/10.1111/j.1540-5915.1997.tb01322.x

Bernroider, E. W. N. (2008). IT governance for enterprise resource planning supported by the DeLone-McLean model of information systems success. *Information and Management*, *45*(5). https://doi.org/10.1016/j.im.2007.11.004

Bradford, J., & Childe, S. J. (2002). A non-linear redesign methodology for manufacturing systems in SMEs. *Computers in Industry*, *49*(1). https://doi.org/10.1016/S0166-3615(02)00055-6

Bradford, M., & Florin, J. (2003). Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems. *International Journal of Accounting Information Systems*, *4*(3), 205–225. https://doi.org/10.1016/S1467-0895(03)00026-5

Caldeira, M. M., & Ward, J. M. (2003). Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium-sized enterprises. *European Journal of Information Systems*, *12*(2). https://doi.org/10.1057/palgrave.ejis.3000454

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

DeLone, W. H., & Mclean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *Journal of Management Information Systems / Spring*, *19*(4), 9–30. https://doi.org/10.1073/pnas.0914199107

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*, *3*(1), 60–95. https://doi.org/10.1287/isre.3.1.60

Fries, V., Wiesche, M., Pfluegler, C., & Krcmar, H. (2016). The hateful six - Factors hindering Adoption of innovation at small and medium sized enterprises. In *AMCIS 2016: Surfing the IT Innovation Wave - 22nd Americas Conference on Information Systems*.

Goodhue, D. L. (1995). Understanding User Evaluations of Information Systems. *Management Science*, *41*(12), 1827–1844. https://doi.org/10.1287/mnsc.41.12.1827

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly*, *19*(2), 213–236. https://doi.org/10.2307/249689

Grover, V., Seung Ryul Jeong, & Segars, A. H. (1996). Information systems effectiveness: The construct space and patters of application. *Information & Management*, *31*(4), 177–191. https://doi.org/10.1016/S0378-7206(96)01079-8

Julien, P.-A., Raymond, L., Jacob, R., & Ramangalahy, C. (1999). Types of technological scanning in manufacturing SMEs: An empirical analysis of patterns and determinants. *Entrepreneurship and Regional Development*, *11*(4).

Kirkham, L., Garza-Reyes, J. A., Kumar, V., & Antony, J. (2014). Prioritisation of operations improvement projects in the European manufacturing industry. *International Journal of Production Research*, *52*(18), 5323–5345. https://doi.org/10.1080/00207543.2014.903345

Klein, K. J., & Sorra, J. S. (1996). The challenge of innovation implementation. *Academy of Management Review*, *21*(4), 1055–1080. https://doi.org/10.1109/EMR.2008.921802

Koh, S. C. L., & Simpson, M. (2005). Change and uncertainty in SME manufacturing environments using ERP. *Journal of Manufacturing Technology Management*, *16*(6). https://doi.org/10.1108/17410380510609483

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, *27*(2), 131–150. https://doi.org/10.1002/smj.507

Madrid-Guijarro, A., Garcia, D., & Van Auken, H. (2009). Barriers to innovation among spanish manufacturing SMEs. *Journal of Small Business Management*, *47*(4), 465–488. https://doi.org/10.1111/j.1540-627X.2009.00279.x

Meyers, P. (1999). Implementation of industrial process innovations: factors, effects, and marketing implications. *Journal of Product Innovation Management*, *16*(3), 295–311. https://doi.org/10.1016/S0737-6782(98)00044-7

Mondragon, A. E. C., Lyons, A. C., & Kehoe, D. F. (2004). Assessing the value of information systems in supporting agility in high-tech manufacturing enterprises. *International Journal of Operations and Production Management*, *24*(12). https://doi.org/10.1108/01443570410569029

Nieto, M. J., & Santamaría, L. (2010). Technological collaboration: Bridging the innovation gap between small and large firms. *Journal of Small Business Management*, *48*(1). https://doi.org/10.1111/j.1540-627X.2009.00286.x

Panizzolo, R. (1998). Managing Innovation in SMEs: A Multiple Case Analysis of the Adoption and Implementation of Product and Process Design Technologies. *Small Business Economics*, *11*(1), 25–42. https://doi.org/10.1023/A:1007941228765

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45–78. https://doi.org/10.2753/MIS0742-1222240302

Perez-Freije, J., & Enkel, E. (2007). Creative Tension in the Innovation Process: How to Support the Right Capabilities. *European Management Journal*, *25*(1), 11–24. https://doi.org/10.1016/j.emj.2006.11.005

Poba-Nzaou, P., Raymond, L., & Fabi, B. (2008). Adoption and risk of ERP systems in manufacturing SMEs: A positivist case study. *Business Process Management Journal*, *14*(4). https://doi.org/10.1108/14637150810888064

Rahman, H. (University of M., & Ramos, I. (University of M. (2011). Is Open innovation imperative to small and medium enterprises?: A comparative study. *7th Americas Conference on Information Systems 2011, AMCIS 2011*, *3*, 2078–2084.

Ross, J. W., & Vitale, M. R. (2000). The ERP Revolution: Surviving vs. Thriving. *Information Systems Frontiers*, *2*(2), 233–241. https://doi.org/http://dx.doi.org/10.1023/A:1026500224101

Singh, L. P., Singh, S., & Pereira, N. M. (2010). Human risk factors in post-implementation phase of ERP in SMEs in India. In *PICMET '10 - Portland International Center for Management of Engineering and Technology, Proceedings - Technology Management for Global Economic Growth*.

Snider, B., DA Silveira, G. J. C., & Balakrishnan, J. (2009). ERP implementation at SMEs: Analysis of five Canadian cases. *International Journal of Operations and Production Management*, *29*(1). https://doi.org/10.1108/01443570910925343

Somers, T. M., & Nelson, K. G. (2004). A taxonomy of players and activities across the ERP project life cycle, *41*(3), 257–278. https://doi.org/10.1016/S0378-7206(03)00023-5

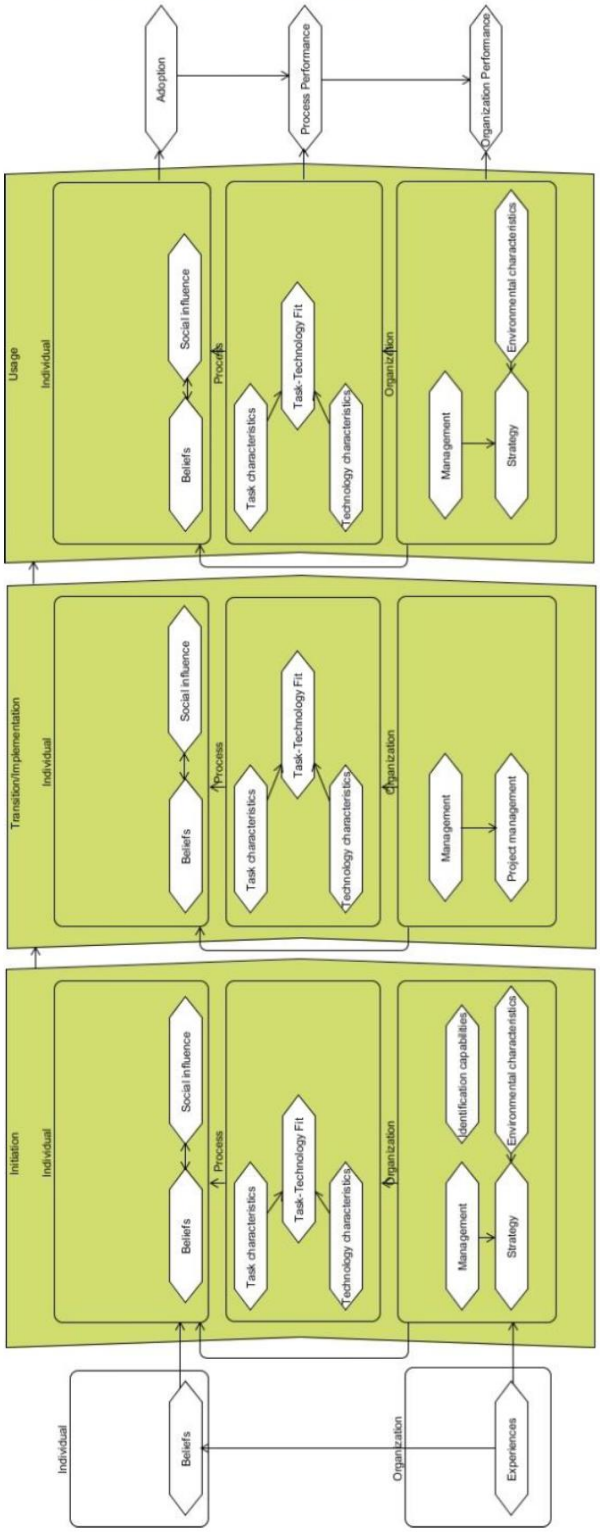
Tornatzky, L., & Klein, K. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, *29*(1), 28–43. https://doi.org/10.1109/TEM.1982.6447463

van de Vrande, V., de Jong, J. P. J., Vanhaverbeke, W., & de Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, *29*(6–7), 423–437. https://doi.org/10.1016/j.technovation.2008.10.001

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.1017/CBO9781107415324.004

Zhang, Z., Lee, M. K. O., Huang, P., Zhang, L., & Huang, X. (2005). A framework of ERP systems implementation success in China: An empirical study. *International Journal of Production Economics*, *98*(1), 56–80. https://doi.org/10.1016/j.ijpe.2004.09.004

Appendix A. Framework for innovation process



Appendix B. Critical success factors

Success factor	Paper	Classification
1. Accurate data entry	(Singh, Singh, & Pereira, 2010)	Adoption
2. Adjust the system to the organization	(Poba-Nzaou, Raymond, & Fabi, 2008)	Task-Technology Fit (all phases)
3. Authorization to access data	(Dale L Goodhue & Thompson, 1995)	Task-Technology Fit (all phases)
4. Availability and quality of human resources; Make do with existing skills; Acquire new professional skills; Presence of qualified personnel; Management of human resources	(Caldeira & Ward, 2003) (Madrid-Guijarro, Garcia, & Van Auken, 2009) (Panizzolo, 1998) (Poba-Nzaou et al., 2008) (Singh et al., 2010)	Environmental characteristics (initiation) Management (all phases)
5. Business pressure to adopt	(Caldeira & Ward, 2003)	Management (all phases)
6. Changes in organizational structure	(Panizzolo, 1998) (Singh et al., 2010)	Project management
7. Commitment/motivation	(Klein & Sorra, 1996) (Meyers, 1999)	Beliefs (all phases) Social influence (all phases) or management (all phases)
8. Communicability	(Tornatzky & Klein, 1982)	Social influence (all phases)
9. Communication intensity	(Meyers, 1999)	Social influence (all phases)
10. Communication skills seller	(Meyers, 1999)	Environmental characteristics (all phases)
11. Compatibility (normative or cognitive)	(Agarwal & Prasad, 1997) (Tornatzky & Klein, 1982)	Beliefs (all phases)
12. Compatibility, with daily work routine; and lacking fit in individual business processes	(Fries, Wiesche, Pfluegler, & Krcmar, 2016) (Tornatzky & Klein, 1982)	Task-Technology Fit (all phases)
13. Complexity	(Tornatzky & Klein, 1982)	Technology (all phases) Task (all phases)
14. Complexity in infrastructure investments	(Fries et al., 2016)	Technology (all phases)
15. Confidence in the system	(Singh et al., 2010)	Beliefs (all phases)
16. Core elements of the environment and whether this is resource-efficient or creativity-enhancing	(Perez-Freije & Enkel, 2007)	Identification capabilities
17. Cost (for setup)	(Fries et al., 2016) (Madrid-Guijarro et al., 2009) (Panizzolo, 1998) (Tornatzky & Klein, 1982)	Management (all phases)
18. Cost difficult to control	(Madrid-Guijarro et al., 2009)	Management (all phases)

19. Cross-functional coordination	(Singh et al., 2010)	Management (usage)
20. Data compatibility (between systems), and integration with existing systems	(Dale L Goodhue & Thompson, 1995) (Panizzolo, 1998)	Technology (all phases)
21. Database development (no explanation given)	(Panizzolo, 1998)	Technology (implementation)
22. Deal with a single interlocutor	(Poba-Nzaou et al., 2008)	Project management
23. Definition of IS/IT objectives	(Caldeira & Ward, 2003) (Singh et al., 2010)	Strategy (all phases)
24. (Dis)incentives	(Klein & Sorra, 1996)	Social influence (all phases)
25. Divisibility	(Tornatzky & Klein, 1982)	Technology (all phases) Task (all phases)
26. Ease of use	(Agarwal & Prasad, 1997) (Dale L Goodhue & Thompson, 1995)	Technology (all phases)
27. Economy	(Madrid-Guijarro et al., 2009)	Environmental characteristics (all phases)
28. Excessive risk	(Madrid-Guijarro et al., 2009)	Management (all phases)
29. Expertise (seller); Qualified consultant	(Meyers, 1999) (Snider, DA Silveira, & Balakrishnan, 2009)	Project management
30. Explicit IT/IS strategy	(Bernroider, 2008)	Strategy (all phases)
31. External end-user training	(Snider et al., 2009)	Project management
32. External search breadth and external search depth	(Laursen & Salter, 2006)	Identification capabilities
33. Facilitating conditions	(Venkatesh et al., 2003)	Environmental characteristics (all phases) Project management
34. Financial resources	(Caldeira & Ward, 2003) (Madrid-Guijarro et al., 2009)	Environmental characteristics (all phases)
35. Flexibility/Agility	(Koh & Simpson, 2005) (Meyers, 1999) (Mondragon, Lyons, & Kehoe, 2004)	TTF (all phases) or environmental characteristics (all phases)
36. Functional cooperation	(Meyers, 1999)	Project management
37. Generic project management capabilities	(Panizzolo, 1998) (Snider et al., 2009)	Project management
38. Government regulations	(Meyers, 1999)	Environmental characteristics (all phases)
39. Government support	(Madrid-Guijarro et al., 2009)	Environmental characteristics (all phases)
40. Image	(Agarwal & Prasad, 1997)	Social influence (all phases)
41. Information/data quality	(DeLone & McLean, 1992) (DeLone & Mclean, 2003)	Process performance

	(Dale L Goodhue & Thompson, 1995)	
42. Interdependence	(Dale L Goodhue & Thompson, 1995)	Task (all phases)
43. Intra and inter-industry networking	(Meyers, 1999)	Environmental characteristics (all phases)
44. IT know how	(Fries et al., 2016)	Technology (all phases)
45. IT vendors' support	(Caldeira & Ward, 2003)	Project management
46. Joint product development buyer-seller/implementation cooperation	(Meyers, 1999)	Project management
47. Lack of information about technologies	(Madrid-Guijarro et al., 2009)	Identification capabilities
48. (Lack of) market information	(Madrid-Guijarro et al., 2009)	Strategy (initiation)
49. Lack of regional infrastructure	(Madrid-Guijarro et al., 2009)	Environmental characteristics (all phases)
50. Locatability of data	(Dale L Goodhue & Thompson, 1995)	Process performance
51. Management perspectives and attitudes towards IT	(Caldeira & Ward, 2003) (Madrid-Guijarro et al., 2009)	Management (all phases)
52. Management support: a. Financial support b. Motivation c. Reduction in functional duties d. Resource allocation e. Follow-up actions	(Panizzolo, 1998) (Snider et al., 2009)	Management (all phases)
53. No domination by business mgmt. in project team	(Bernroider, 2008)	Project management
54. Non-routineness	(Dale L Goodhue & Thompson, 1995)	Task (all phases)
55. Observability/visibility	(Agarwal & Prasad, 1997) (Tornatzky & Klein, 1982)	Social influence (all phases)
56. Open innovation	(Rahman & Ramos, 2011) (van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009)	Identification capabilities
57. Operational process discipline	(Snider et al., 2009)	Adoption Process performance
58. Perceived ease of use (effort expectancy)	(Davis, Bagozzi, & Warshaw, 1989) (Venkatesh et al., 2003)	Beliefs (all phases)
59. Perceived unbalance of risks and chances	(Fries et al., 2016)	Beliefs (all phases) Management (all phases)

60. Perceived usefulness (performance expectancy)	(Davis et al., 1989) (Venkatesh et al., 2003)	Beliefs (all phases)
61. Phased implementation	(Meyers, 1999)	Project management
62. Power relationships	(Caldeira & Ward, 2003)	Social influence (all phases)
63. Prioritization methods used	(Kirkham, Garza-Reyes, Kumar, & Antony, 2014)	Strategy (all phases)
64. Production timeliness (IS meeting scheduled operations)	(Dale L Goodhue & Thompson, 1995)	Task-Technology Fit (all phases)
65. Profitability	(Tornatzky & Klein, 1982)	Management (all phases)
66. Quality of external (IT) expertise/services available in the market; lack of external partners opportunities	(Caldeira & Ward, 2003) (Madrid-Guijarro et al., 2009)	Environmental characteristics (initiation)
67. Quality of software available (in the market)	(Caldeira & Ward, 2003)	Technology (initiation)
68. Relationship IS and users	(DeLone & McLean, 1992)	Environmental characteristics (all phases)
69. Relative advantage	(Agarwal & Prasad, 1997) (Tornatzky & Klein, 1982)	Technology (all phases) Task (all phases)
70. Reliability	(Dale L Goodhue & Thompson, 1995)	Technology (all phases)
71. Resistance to change	(Madrid-Guijarro et al., 2009) (Panizzolo, 1998)	Beliefs (all phases) and/or project management (transition)
72. Result demonstrability	(Agarwal & Prasad, 1997)	Technology (all phases) Task (all phases)
73. Service quality	(DeLone & Mclean, 2003)	Environmental characteristics (all phases) Project management
74. Skills/familiarity, and IS/IT competences	(Caldeira & Ward, 2003) (Klein & Sorra, 1996) (Meyers, 1999) (Poba-Nzaou et al., 2008)	Technology (all phases) Task (all phases)
75. Small internal team	(Snider et al., 2009)	Project management
76. Social Approval	(Tornatzky & Klein, 1982)	Social influence (all phases)
77. Strategic alignment	(Bernroider, 2008)	Strategy (all phases) Organization performance
78. Strategic concept drive evaluation	(Bernroider, 2008)	Project management Strategy (all phases)
79. Strategic criticality	(Meyers, 1999)	Strategy (all phases)
80. Strategic goals and planning (broad goals, not operational/tactical)	(Meyers, 1999)	Strategy (all phases)
81. System quality	(DeLone & McLean, 1992) (DeLone & Mclean, 2003)	Technology (all phases)

82. Technical capability seller	(Meyers, 1999)	Environmental characteristics (all phases)
83. Technological collaboration	(Nieto & Santamaría, 2010)	Identification capabilities
84. Technological scanning – Fit with firm characteristics	(Julien, Raymond, Jacob, & Ramangalahy, 1999)	Identification capabilities
85. Technology standards (fit)	(Panizzolo, 1998)	Technology (all phases)
86. Time of IT adoption	(Caldeira & Ward, 2003)	Technology (all phases)
87. Top management support and championing	(Bernroider, 2008) (Meyers, 1999) (Singh et al., 2010)	Social influence (all phases)
88. Training/education/knowledge transfer	(Caldeira & Ward, 2003) (Dale L Goodhue & Thompson, 1995) (Madrid-Guijarro et al., 2009) (Meyers, 1999) (Panizzolo, 1998) (Singh et al., 2010)	Project management
89. Trialability	(Agarwal & Prasad, 1997) (Tornatzky & Klein, 1982)	Technology (all phases) Task (all phases)
90. Type of IT to be implemented	(Caldeira & Ward, 2003)	Technology (all phases)
91. User satisfaction	(DeLone & McLean, 1992)	Beliefs (transition and usage)
92. Using iterative methodology	(J. Bradford & Childe, 2002)	Project management
93. Voluntariness	(Agarwal & Prasad, 1997)	Adoption
94. Workforce involvement (in development), and participative form of decision making	(Bernroider, 2008) (Caldeira & Ward, 2003) (Meyers, 1999) (Panizzolo, 1998) (Singh et al., 2010)	Beliefs (all phases)

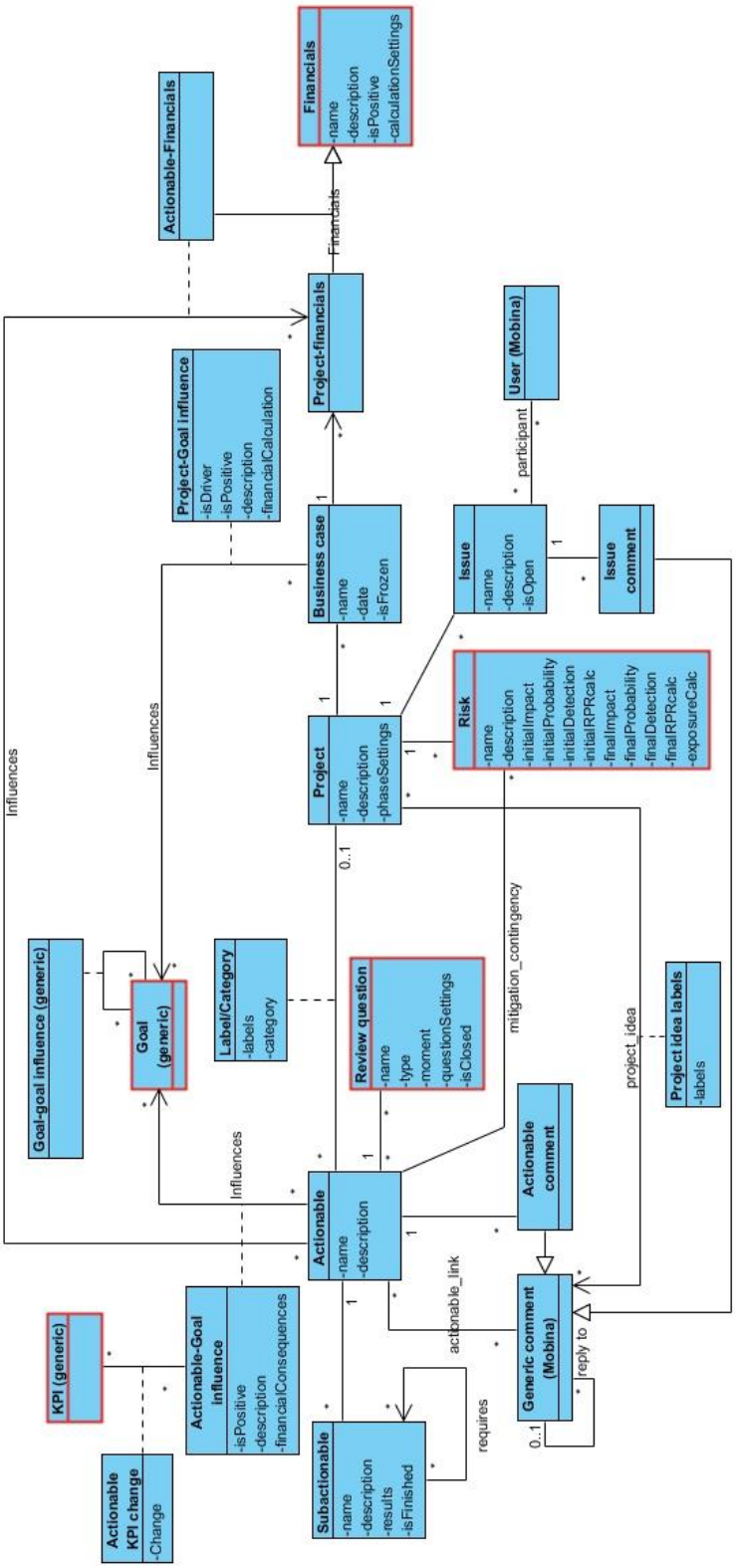
Appendix C. Criteria scores critical success factors

Success factor	Important	Company can influence it	More research useful	Mobina can (easily) influence it
1	X	X		
2	X	X	X	X
3	X	X		X
4	X			
5	X			X
6	X	X		
7	X	X		
8	X	X		
9	X	X		X
10	X			
11	X	X		X
12	X	X	X	X
13	X			
14	X			X
15	X	X		
16	X	X	X	
17	X			
18	X	X	X	X
19	X	X	X	X
20	X	X		X
21	X	X		
22	X	X		
23	X	X	X	X
24	X	X		
25	X			
26	X	X		
27	X			
28	X	X	X	X
29	X	X		
30	X	X	X	X
31	X	X		
32	X	X	X	X
33	X	X		
34	X			
35	X	X	X	
36	X	X	X	X
37	X	X		
38	X			
39	X			
40	X			

41	X	X		
42	X			
43	X	X	X	X
44	X	X	X	X
45	X	X		
46	X	X		
47	X	X	X	X
48	X			X
49	X			
50	X	X		
51	X	X		
52	X	X		
53	X	X		
54	X	X		X
55	X			
56	X	X	X	X
57	X	X		
58	X	X		
59	X	X		X
60	X	X		
61	X	X		X
62	X	X		
63	X	X	X	X
64	X	X		
65	X	X		
66	X			
67	X		X	
68	X	X	X	X
69	X			
70	X	X		
71	X	X		X
72	X			
73	X	X		
74	X	X		
75	X	X		
76	X	X		
77	X	X	X	X
78	X	X	X	X
79	X	X	X	X
80	X	X	X	X
81	X	X		X
82	X	X		
83	X	X	X	X
84	X	X	X	X

85	X	X		X
86	X	X		
87	X	X		
88	X	X		
89	X			
90	X	X		
91	X	X		
92	X	X		
93	X	X		
94	X	X		X

Appendix C. Data model of projects & actionables (large)



Appendix D. Agenda focus group

1. Introduction
2. Recap Mobina
3. Global design
4. Open innovation
    a. Demonstration
    b. Discussion
    c. Questionnaire

Break

5. Strategy & Goals
    a. Demonstration
    b. Discussion
    c. Questionnaire

Break

6. Projects & Actionables
    a. Demonstration
    b. Discussion
    c. Questionnaire

Break

7. Global discussion
    a. Discussion
    b. Questionnaire
8. Conclusion

Appendix E. Questionnaire forms (Dutch)

Open innovation

1. Hoe goed stimuleren partner discussies in Mobina open innovatie?
    a. Scale 1 – 10
2. Kun je de volgende elementen van partner discussies sorteren in volgorde van belang (1 is meest belangrijk)?
    a. Gesloten groep
    b. Zelf te definiëren onderwerpen
    c. Koppeling met inhoud (referentiemodel, kritische aspecten, enz.)
    d. Platform voor open discussies (bijv. netwerkorganisaties)
3. Hoe goed kan het concept innovatie in Mobina bedrijven betere ideeën geven om innovaties toe te passen?
    a. Scale 1 – 10
4. Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om open innovatie in Mobina te stimuleren?
    a. Free-format text field
5. Overige opmerkingen
    a. Free-format text field

Stategy & Goals

1. Hoe goed kan stimulans in Mobina om na te denken over strategie MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen? Bijvoorbeeld doordat projecten meer vanuit een bredere visie op de toekomst geselecteerd worden.
    a. Scale 1 – 10
2. Welke positieve gevolgen kan het betrekken van strategie bij het (innovatie)proces in Mobina teweegbrengen? (multiple checks possible)
    a. Strategie & doelstellingen worden concreet gemaakt
    b. Strategie & doelstellingen worden beter gecommuniceerd
    c. Strategie & doelstellingen worden gemeten
    d. Meer inzicht in de gevolgen en oorzaken van resultaten
    e. Projecten sluiten meer aan bij de strategie op langere termijn
    f. Other
3. Kun je de volgende elementen van strategie en doelstellingen sorteren in volgorde van belang om MKBs in Mobina te helpen bij het innovatieproces (1 is meest belangrijk)?
    a. Definiëren van doelstellingen
    b. Definiëren van KPIs
    c. Monitoren van KPIs
    d. Relaties tussen doelstellingen (en dus inzicht in gevolgen en oorzaken)
4. Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om strategie en doelstellingen in Mobina te ondersteunen?
    a. Free-format text field
5. Overige opmerkingen
    a. Free-format text field

Projects & Actionables

1. Hoe goed kan het definiëren van projecten en actionables in Mobina MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen? Bijvoorbeeld doordat meer gekeken wordt naar de toegevoegde waarde, risico's en het daadwerkelijk realiseren van de doelstellingen.
    a. Scale 1 – 10
2. Hoe goed kan deze functionaliteit ervoor zorgen dat minder formeel projectmanagement en minder grote projectorganisaties nodig zijn, doordat het makkelijker is de lijnorganisatie bij (belangrijke punten van) het project te betrekken?
    a. Scale 1 – 10
3. Hoe groot is de toegevoegde waarde van het definiëren van actionables, waardoor het mogelijk is projecten beter te detailleren en de link met opmerkingen uit de rest van de applicatie duidelijker is?
    a. Scale 1 – 10
4. Kun je de volgende elementen om MKBs in Mobina te helpen bij hun (innovatie)projecten en actionables sorteren op volgorde van belang (1 is meest belangrijk)?
    a. Definiëren van actionables
    b. Actionables (en actionable-doelstellingen monitoren)
    c. Business case - Baten en kostenanalyse
    d. Business case - Relatie met strategie
    e. Risicomanagement
    f. Issue management (betrekken lijnorganisatie)
    g. Ondersteuning voor projectfases
5. Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om projecten (en actionables) in Mobina te ondersteunen?
    a. Free-format text field
6. Overige opmerkingen
    a. Free-format text field

Generic

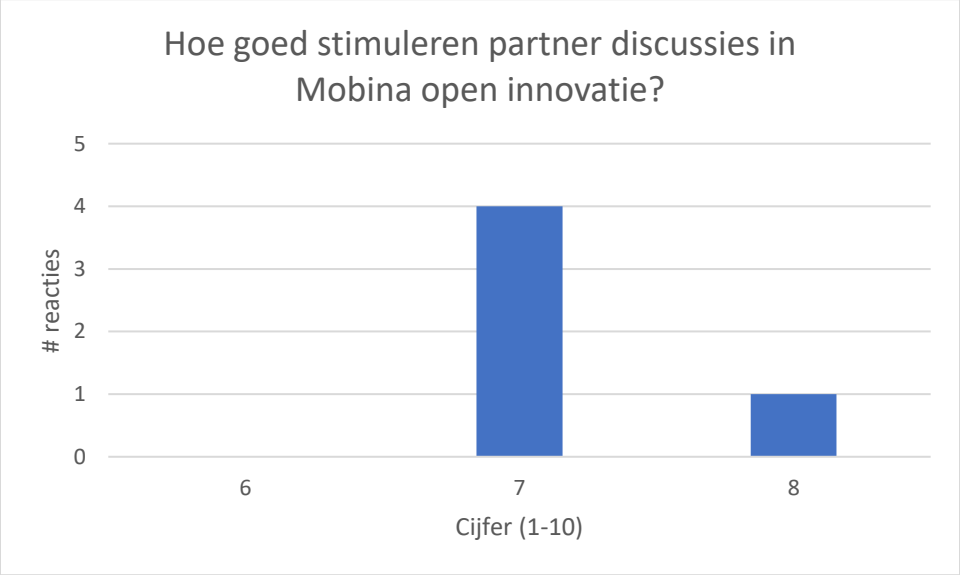
1. Hoe goed kan de ontworpen functionaliteit in Mobina MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen?
    a. Scale 1 – 10
2. In welke mate heeft de ontworpen functionaliteit in Mobina toegevoegde waarde ten opzichte van functionaliteit in andere software tools (zoals project management of idea management software)?
    a. Scale 1 – 10
3. In welke mate zorgt de ontworpen functionaliteit in Mobina ervoor dat MKBs meer zelfstandig hun innovatieproces kunnen uitvoeren?
    a. Scale 1 – 10
4. Kun je de functionaliteit rangschikken op toegevoegde waarde voor het ondersteunen van het innovatieproces in Mobina?
    a. Partnerdiscussie
    b. Innovatie concept
    c. Strategie & Doelstellingen
    d. Projecten
    e. Actionables

5. Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om het beoordelen, selecteren en monitoren van innovaties in Mobina te ondersteunen?
    a. Free-format text field
6. Overige opmerkingen
    a. Free-format text field

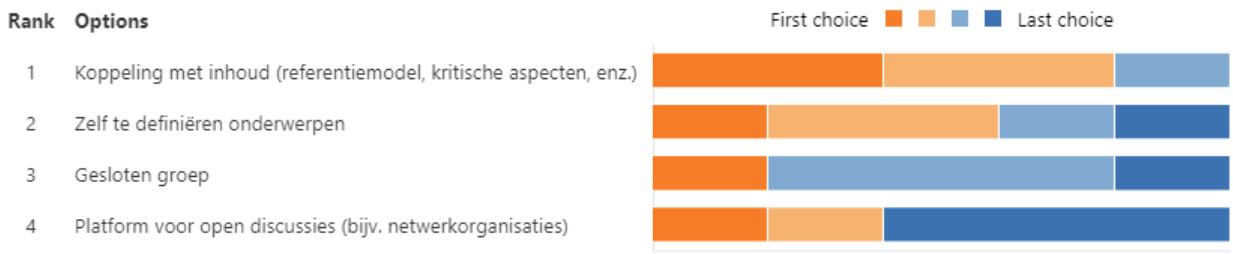
Appendix F. Raw results questionnaires (Dutch)

Open innovation

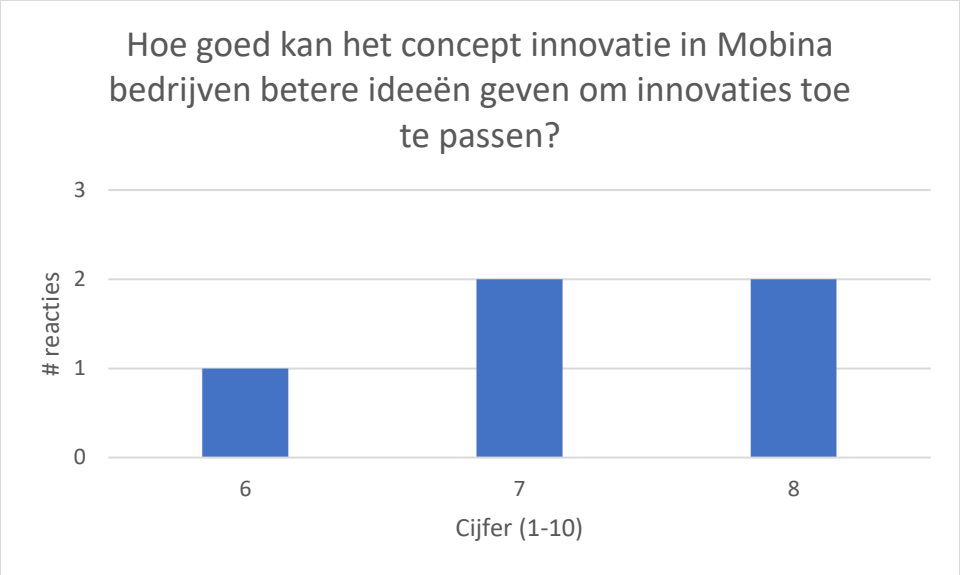
1. *Hoe goed stimuleren partner discussies in Mobina open innovatie?*



2. *Kun je de volgende elementen van partner discussies sorteren in volgorde van belang (1 is meest belangrijk)?*



3. *Hoe goed kan het concept innovatie in Mobina bedrijven betere ideeën geven om innovaties toe te passen?*



4. *Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om open innovatie in Mobina te stimuleren?*

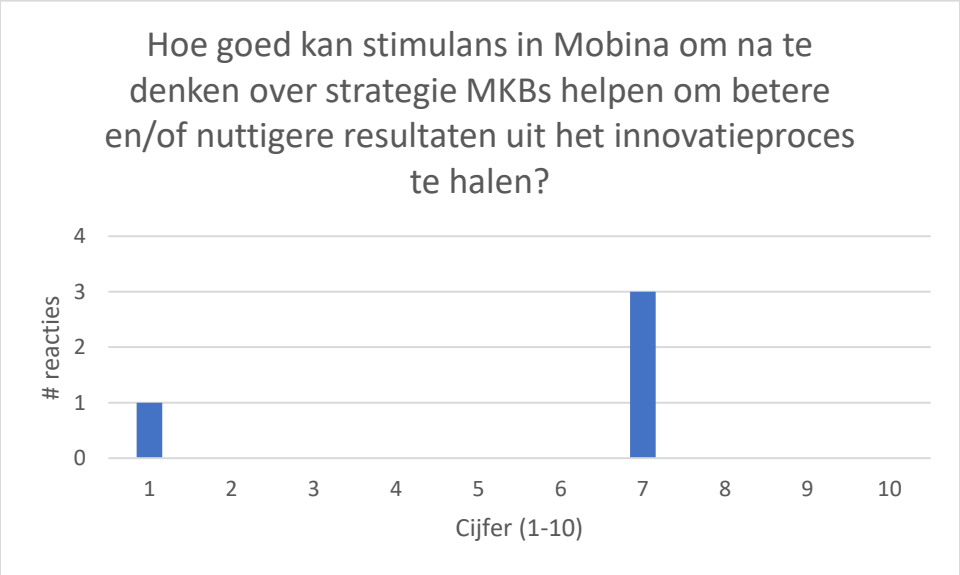
- "Overzicht aanbieders. Prikkelende content"
- "zichtbaarheid partnernetwerk Incentives voor toevoegen van bijdrages mogelijkheid ok zowel anoniem als op naam te posten Conversation starters"
- "Hoe stimuleer je gesloten bedrijven om na te denken over open innovatie? Als wetenschappelijk is aangetoond dat open innovatie een belangrijle driver is, wil je wellicht vastgeroeste bedrijven ook stimuleren meer open te gaan denken (en vervolgens hebben jullie weer mooie tooling om hier mee om te gaan)"
- "Onderscheid fasen en typen innovatie"
- "Om open innovatie te stimuleren zou een overzicht van soorten + stereotypische voorbeelden nuttig zijn. bekijk bv. BSc thesis van Anna Pellegrino (zie doc.utwente.nl). Voor bedrijfsbrede discussie over samenwerking met leveranciers en klanten zou het inzichtelijk maken van de waardeketen / supply chain praktisch zijn."

5. *Overige opmerkingen*

- "Chessborrough"
- "Onderscheid product innovatie van proces innovatie"

Strategy & Goals

1. *Hoe goed kan stimulans in Mobina om na te denken over strategie MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen? Bijvoorbeeld doordat projecten meer vanuit een bredere visie op de toekomst geselecteerd worden.*



2. *Welke positieve gevolgen kan het betrekken van strategie bij het (innovatie)proces in Mobina teweegbrengen?*

Other:

- "Innovatie en leren beter zichtbaar en meetbaar maken"
- "Het bovenstaande KAN, maar hoeft niet"

3. *Kun je de volgende elementen van strategie en doelstellingen sorteren in volgorde van belang om MKBs in Mobina te helpen bij het innovatieproces (1 is meest belangrijk)?*

4. *Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om strategie en doelstellingen in Mobina te ondersteunen?*

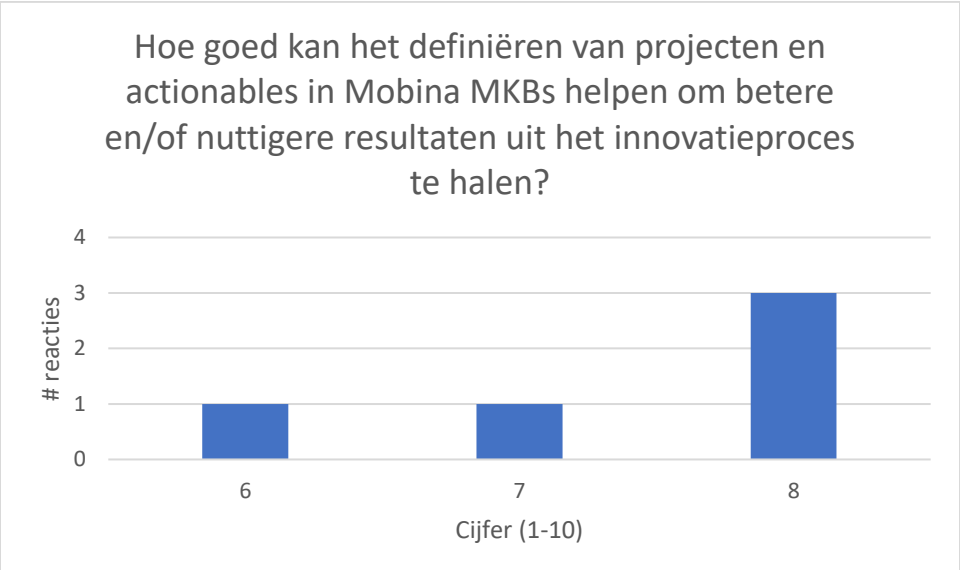
- "Breder strategie uitdragen. Templates aanbieden, voorbeeld Hans innovatie-kennis Eigedomstrategie"
- "Strategie omschrijven en visualiseren en concreet maken. Koppelen projecten op het gebied van innovatie en leren aan strategie"
- "Kijk ook naar typologie van MKB (familiebedrijf, in handen investeringsmaatschappij etc.)"
- "Dieper ingaan op processen van innovatie en leren"

5. *Overige opmerkingen*

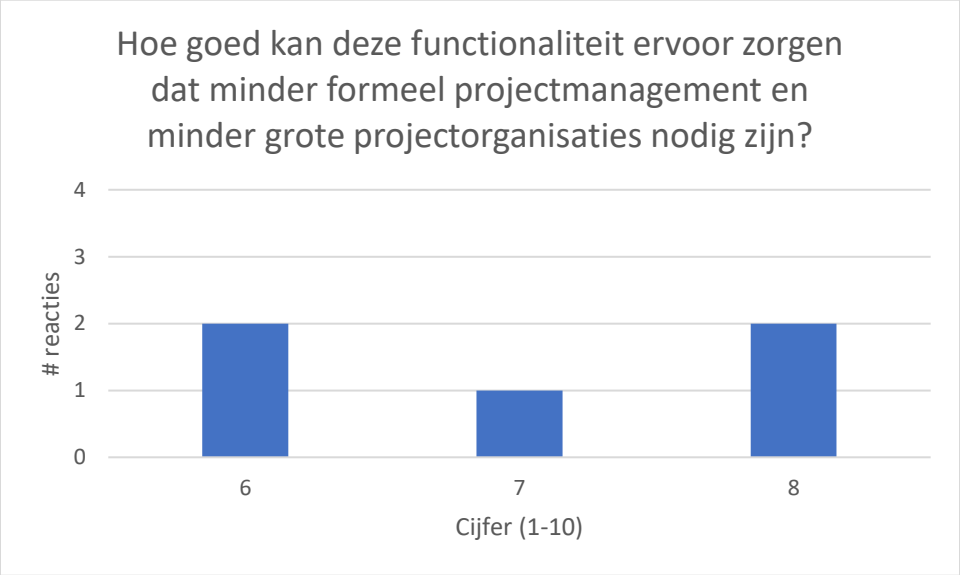
- "Mooi dat monitoren maar waar komt de data vandaan? Kan je kpi definiëren die vanuit minima discussies worden gevoed?"
- "Wel relateren aan strategie tav finance en commerce, en operations, maar meer niet om verwarring met reguliere KPIs te vermijden"

Actionables & Projects

1. *Hoe goed kan het definiëren van projecten en actionables in Mobina MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen? Bijvoorbeeld doordat meer gekeken wordt naar de toegevoegde waarde, risico's en het daadwerkelijk realiseren van de doelstellingen.*

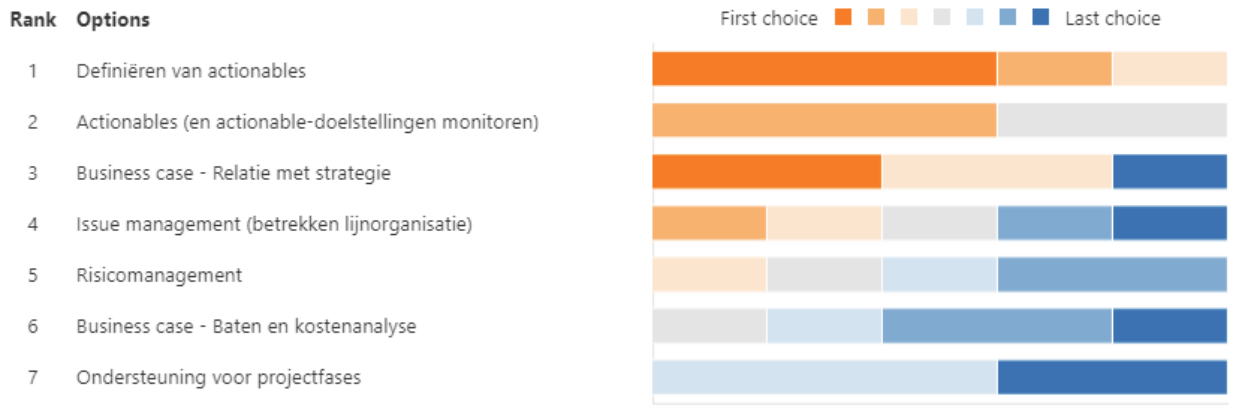


2. *Hoe goed kan deze functionaliteit ervoor zorgen dat minder formeel projectmanagement en minder grote projectorganisaties nodig zijn, doordat het makkelijker is de lijnorganisatie bij (belangrijke punten van) het project te betrekken?*



3. *Hoe groot is de toegevoegde waarde van het definiëren van actionables, waardoor het mogelijk is projecten beter te detailleren en de link met opmerkingen uit de rest van de applicatie duidelijker is?*

4. *Kun je de volgende elementen om MKBs in Mobina te helpen bij hun (innovatie)projecten en actionables sorteren op volgorde van belang (1 is meest belangrijk)?*



5. *Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om projecten (en actionables) in Mobina te ondersteunen?*

- “Visueel overzicht alle componenten en samenhang Comments sorteren, ondersteuning bij ordenen Verwachtingsmanagement tools”
- “Overzicht met samenhang projecten / actionables, portfolio en strategisch planningsniveau”
- “Ondersteuning bij vertaling baar actionables en projecten Eenvoudige import en export van huidige projecten (voor de gevallen waarin dit bestaat)”
- “Ownership - zowel voor het kunnen toewijzen als voor het houden van actionnables”

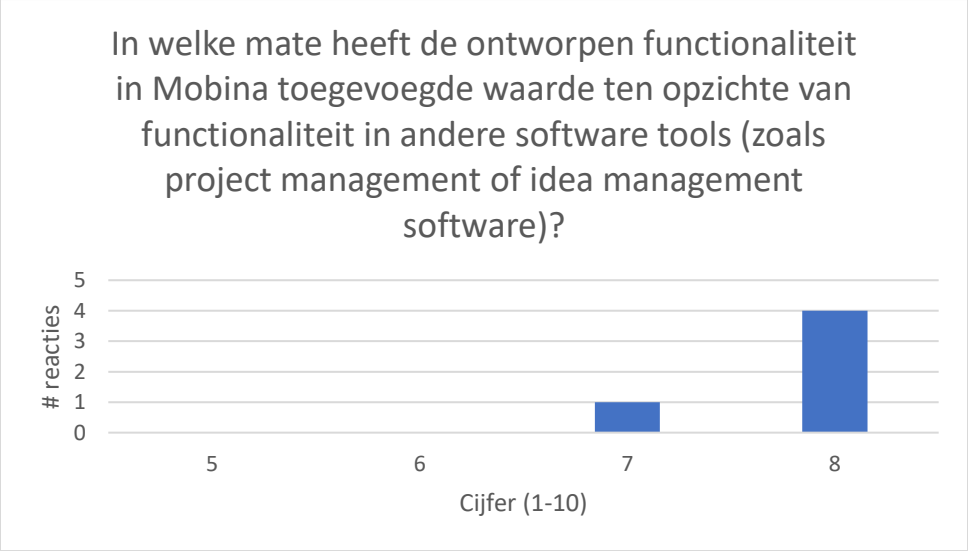
6. *Overige opmerkingen*

- “Nadenken over manieren gebruiker te verleiden terug te komen, bv. door updates over trends in industrie”
- “Visueel overzicht op hoger niveau Duidelijk positionering tov portfolio en project management”
- “Bij vraag 2: het MKB doet niet zoveel aan formeel PM, maar het tool kan wel de lijn onlasten”

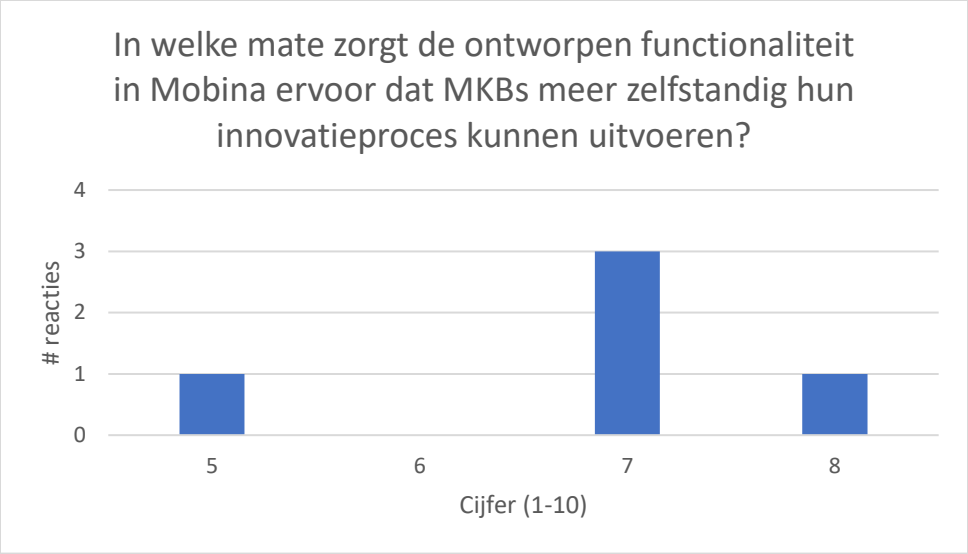
Global questionnaire

1. *Hoe goed kan de ontworpen functionaliteit in Mobina MKBs helpen om betere en/of nuttigere resultaten uit het innovatieproces te halen?*

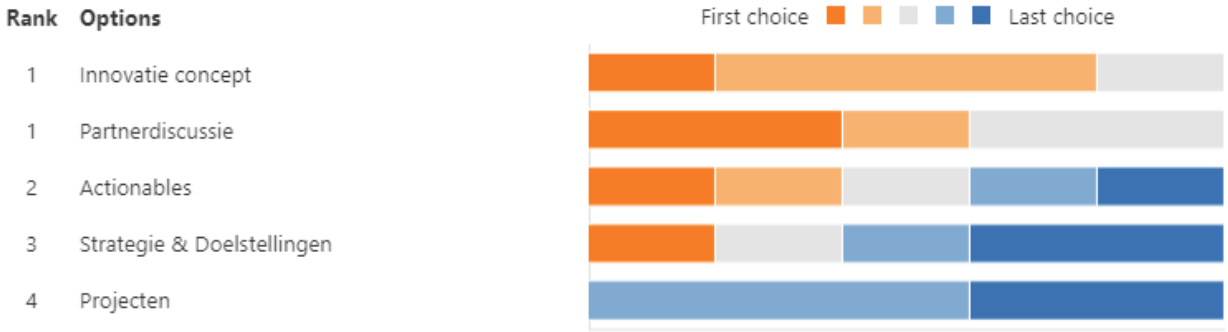
2. *In welke mate heeft de ontworpen functionaliteit in Mobina toegevoegde waarde ten opzichte van functionaliteit in andere software tools (zoals project management of idea management software)?*



3. *In welke mate zorgt de ontworpen functionaliteit in Mobina ervoor dat MKBs meer zelfstandig hun innovatieproces kunnen uitvoeren?*



4. *Kun je de functionaliteit rangschikken op toegevoegde waarde voor het ondersteunen van het innovatieproces in Mobina?*



5. *Is er volgens jou nog andere kernfunctionaliteit (gerelateerd aan de inhoud van Mobina) nodig om het beoordelen, selecteren en monitoren van innovaties in Mobina te ondersteunen?*

- “Overzicht Aansluiting bij projectmanagement tool”
- “Functionaliteit om trends in externe omgeving te volgen (als input voor strategische doelstelling)”
- “Hoe gemakkelijk is in mobina vastgelegde informatie op een andere manier beschikbaar te maken? Ik kan mij voorstellen dat een bedrijf in het kader van continuïteit nooit het risico wil lopen bij onvoorziene omstandigheden niet zelf over haar data kan beschikken.”
- “Meer bottom up (ideeenbus 2.0) Aansluiting bij Lean”
- “Meer voorbeeld performance attributen meer voorbeeld best practices Multi language translation”

6. *Overige opmerkingen*

- “Boeiend!”

- “Maak een video over de software in gebruik ter verduidelijking”
- “Succes met de afronding!”
- “Ad 3: MKBs voeren nu het innovatieproces meestal zelfstandig uit.”
- “Een goede feature vergelijking met idea generation en Process Improvement forms”

Appendix G. Paper on usage of focus groups

Starts next page

Focus Groups as a Design Science Validation Method

Jochem Verburg[1], Jos van Hillegersberg[2] and Klaas Sikkel[3]

[1] Mobina, Dommelstraat 130, 7523 SE, Enschede, Netherlands
[2] Faculty of Behavioural and Management Sciences,
University of Twente, PO Box 217, Enschede, Netherlands
[3] Faculty of Electical Engineering, Mathematics and Computer Science,
University of Twente, PO Box 217, Enschede, Netherlands
jochem.verburg@mobina-it.com
{j.vanhillegersberg, k.sikkel}@utwente.nl

Abstract.
Focus groups have been used as a method to acquire feedback in a variety of contexts. In the Design Science literature there are a few hints that focus groups could be useful to validate naturalistic design artifacts *ex ante*, but there are no clear guidelines how to go about it.
In this paper we propose a framework for setting up and conducting a focus group for *ex ante* validation, discussing which parameters need to be decided upon and which choices are available.
The framework is based on a case study in software design, where a focus group was used to validate proposed extensions to an existing enterprise software product, Mobina. A global design with multiple extension options was validated using a focus groups of subject matter experts.
While the focus in the case study is on IT design in the orientation phase, we conjecture that the framework is more widely applicable.

Keywords: Focus groups, Validation, Design science, Software, Artifact, *ex ante* Validation

1 Introduction

Focus groups are a useful method to validate the usefulness and usability of artifacts in a variety of contexts, well-established in Marketing, Social Sciences and Health Sciences. Its use in Design Science has been limited so far. There is some literature stipulating that the use focus groups to validate a design could be useful. But the body of knowledge on 'validation focus groups' is small and little specific guidelines are given.

We conducted a case study [1], in which a focus group was used as a validation method for the design of an extension to a commercial packaged software system. The experience

was positive and calls for further application. However, in setting up and conducting the focus group we were confronted with a number of practical decisions for which the literature offers little help.

The results of the case study provide a basis for guidelines for the usage of validation focus groups. It helps determine when validation focus groups can add value as a design science validation method, and gives an overview of all important aspects of setting up a focus group. This paper provides a framework with a set of deciding variables, decision options and guidelines. We conjecture that the framework is more widely applicable than in the context of software design.

The paper first summarizes the existing body of literature on both traditional focus groups and validation focus groups. In section 3, the research questions and research set-up is described. This provides the foundation on which decisions for setting up the focus group have been based. The fourth section describes the results and experiences of this case study. In section 5, we discuss these results and propose a framework to guide design scientists in their usage of validation focus groups. The paper ends with the concluding remarks and recommendations for future research.

2 Background

2.1 What is a Focus Group?

A focus group is a method that validates designs through the interaction of participants in a group on a topic determined and guided by the researcher, the moderator [2-6]. The participants are selected to form a useful group focused on the given topic, not necessarily representative of the population [3]. The definition distinguishes focus groups from group meetings with another primary purpose (such as therapy), groups without interactions (nominal or Delphi groups), and groups without an interviewer [4]. Although focus groups are widely used in both social and health sciences, they can also be useful as a validation method in (IS) design science research [2].

A focus group is mainly useful when the subject is complex [5]. The focus group enables the researcher to concentrate on the most important and complex variables dynamically. Since a focus group is semi-structured, it allows many directions to be explored [2]. Focus groups can give feedback on a wide range of ideas and feelings that the individuals have on the subject [3].

In addition to the advantages of the semi-structured nature, the interaction between participants leads to participants asking questions to each other and explaining themselves in more detail [4]. This makes it also possible to highlight and observe the differences in perspective between the participants, and analyze the extent of agreement and disagreement [3, 4].

Besides the ability of focus groups to generate more information due to interaction, another strength lies in the lack of participation. The use of a group of people makes that participants often only speak when they feel than contribute something to the discussion [2]. If interviewees are asked something directly, they will answer regardless of the strength of their knowledge and opinion. A focus group can make it easier to analyze which statements of participants have more value.

In the latter, also lies an important weakness. The group and especially the group dynamics can influence the results [4]. Therefore, it is important to analyze the group dynamics as well. If you can discover whether the group dynamics for example restrain people from expressing certain opinions, the moderator can mitigate this effect. However, the involvement of the moderator is in itself also a pitfall. The moderator can be a useful addition to focus the group on the right topics, but can also influence the data collection if not acting carefully [4].

Next to the validity concerns, focus groups are also less effective in for example generating ideas than interviews [4, 6]. Interviews generate more ideas per participant than focus groups. However, focus groups allow for a more detailed analysis of the opinions on these ideas than interviews.

2.2 Focus Groups for Design Science Validation

Many overviews for design science validation methods exist, but clear guidelines about when to use focus groups are scarce. Hevner et al. [7] created an overview and categorized design validation methods into five categories: observational, analytical, experimental, testing and descriptive. An important validation method missing in this overview is the focus group [2].

Wieringa [8] mentions focus groups as one of the methods to validate artifacts through expert opinion. Expert opinions are seen as a useful method to weed out bad design ideas. It is especially useful to indicate whether an artifact will work in conditions of practice and whether it takes all conditions into account.

Another framework uses two dimensions: naturalistic vs. artificial and *ex ante* (before implementation) vs. ex post (after implementation) [9]. It describes which criteria guide to the most suitable validation methods, and for *ex ante* validation of naturalistic artifacts provides two options: action research and focus groups. This was adapted by Johannesson and Perjons [10] to include interviews. They also mention focus groups as a way to execute *ex post* validation.

Focus groups can thus mainly be useful in an early stage of design, so an artifact can be validated to ensure its usage in practice. Action research is described as “the last stage in the process of scaling up from the conditions of the laboratory to the unprotected conditions of practice” [8]. Action research is more comprehensive and focus groups can therefore be a useful method to choose the right solution direction, before executing more extensive research.

2.3 Guidelines for Validation Focus Groups

Although focus groups are mentioned as a useful validation method for design science research (DSR), only few guidelines for validation focus groups exist. Focus groups are traditionally used as a data collection method, specifically in social research. It is underutilized in for example Information Systems (IS) research [11]. Lessons from traditional focus groups should therefore be carefully reviewed and adapted to create guidelines for usage as a validation method in DSR [12].

Traditional Literature. The guidelines for traditional focus groups can be divided into roughly four areas. An important aspect is the focus group composition. Next to this, the importance of the setting is described. A third area regards the structure of the focus group and guidelines about the moderator involvement in maintaining this structure. Last, many papers describe how to analyze focus groups, especially for data collection.

Group Composition. Different guidelines for selecting focus groups exist. Morgan [4] for example uses four to six groups as a rule of thumb, whereas Powell and Single [5] mention the use of one to ten groups. All agree that the number of focus groups should make sure that enough information is collected for its purpose, and is therefore dependent on the goal, subject and participants.

The size of the group is also debated, and the literature mentions both four to eight [13] and six to ten [5] participants as the ideal size. A useful guideline is that the higher level of involvement of the participants, the smaller the group size should be [4].

The last important aspect of group composition is the selection of participants. It is generally accepted to use theoretical sampling for the focus group, meaning that participants are selected to reflect a range of the study population, especially on the variables of interest for the study [4, 5, 13]. A major decision is whether to use homogenous or heterogenous groups. Homogeneity can facilitate discussion by having shared experiences or opinions, whereas heterogeneity gives more possibilities to explore different perspectives [4, 13].

Setting. Many guidelines are given for the setting in which the focus group takes place. Most importantly, it should be a comfortable setting. This includes providing enough refreshments, allowing for an informal meeting, seating in a circle and making sure all opinions are welcomed [5, 13]. Some other guidelines can also be taken into account like using a neutral meeting place, but are aimed at more sensitive subjects.

Structure and Moderator Involvement. Many decisions on structure can be made. Both on the amount of sessions and the duration, ranging from an hour to a whole afternoon [5, 13].

A session can have different levels of structure and moderator involvement. Many useful directions for the moderator are given in literature. According to Morgan [4], two different kinds of structure should be taken into account. On the one hand the moderator can have

more influence on the discussion topics. On the other hand, the moderator can control the group dynamics for example by trying to get everyone to participate more equally.

When controlling the discussion topic, the moderator's involvement can especially be useful to take the discussion further, for example to make sure that disagreements are fully discussed [14]. It is important that the moderator makes sure that the group focuses on the areas of interest for the research and a more structured approach can prove more effective to answer research questions [6]. However, the moderator should leave enough space for the interactions that focus groups are useful for. A semi-structured interview schedule is expected to be most effective to both gain enough focus for the research topic, and provide enough flexibility to explore participants' answers and opinions [5]. The facilitator might also use group exercises, for example as a way to double check the assessment of the focus group results [14].

A moderator's involvement can also be beneficial for the group dynamics. A moderator can encourage people to discuss with each other [14]. He should alleviate as much social pressure as possible [6].

Analysis. For a good analysis it is important to take into account the goals of the focus group, so the data can be effectively reduced [3]. It is important to use a clear procedure and establish a trail of evidence to reduce bias. Therefore, a reflective diary and notes of the meeting can be very useful as well as recording the meeting.

When analyzing the focus group, it is especially important to pay attention to minority opinions and examples that do not fit with the researcher's theory [13]. One should not use percentages, but distinguish individual opinions that defer from the group consensus. One should also evaluate whether agreement by participants has not resulted from coercion or self-censoring [15].

For analysis, often coded transcripts are used [3, 15]. A systematic process is used where categories, or codes, are assigned to the transcript. This coded transcript can then be used to analyze trends and also compare between focus groups. It also makes the data better searchable.

Validation Focus Groups. Tremblay, Hevner, and Berndt [12] provide an example of a validation focus group in the health care context. The example was used to demonstrate the use of their guidelines. These guidelines were provided for each of the steps of a focus group, summarized from traditional literature: Formulate research question or problem; Identify sample frame (Number of groups, size of groups, source of participants); Identify moderator; Develop and pre-test a questioning route; Recruit participants; Conduct focus group; Analyze and interpret data; and Report results.

A case study used focus groups to validate a BI benefits management method, which was presented in the form of two documents [2]. This case study was used to develop six guidelines for using focus groups in DSR:

1. Maintain focus.
2. Be selective with participants and group size.
3. Be selective with facilitator.
4. Be prepared.
5. Allow flexibility.
6. Take a pragmatic approach to analysis.

It is important that all guidelines are tested in practice, to build knowledge on the usage of validation focus groups. However, only limited examples of case studies of using focus groups in DSR exist. Examples of focus groups used in DSR and more specifically IS research are using focus groups for data collection instead of validation [11].

Two studies reported on in the literature were just described. Another study used focus groups to validate a roadmap for DSR in IS [16]. This study uses the guidelines by Tremblay, Hevner, and Berndt [12]. It demonstrates the value of the focus group method for validation in DSR and provides an example of how to use validation focus groups. However, it does not include any additional guidelines or conclusions about how to use focus groups for DSR.

These examples have contributed to a basic understanding of focus groups in DSR. However, not enough case studies exist to give researchers using DSR clear and comprehensive guidelines for choosing focus groups as a validation method, as well as to set up a validation focus group. Next to this, few lessons have been drawn from validating a software artifact, which is a specific type of design artifact that might pose additional lessons.

3 Research Approach

3.1 Research Questions

We believe focus groups can be a very useful validation method for DSR, and more specifically for a software artifact. Therefore, we want to answer the following research questions:

1. When can or should focus groups be used for design science validation, and more specifically software design science?
2. How should a focus group for (software) design science validation be set up?

Literature has already provided some guidelines of when focus groups can be used. These point towards using them in *ex ante* validation for naturalistic artifacts. However, this is still very broad and it might be useful to develop knowledge about the specific situations in which focus groups can be used effectively.

The combination of traditional literature with additional guidelines specifically for validation focus groups has led to a good basis for the set-up of validation focus groups. However, we have little insight in the consequences of these guidelines for validation focus groups in practice due to the limited number of examples and case studies. We want to

contribute to the body of scientific knowledge by using focus groups for validation of a software design.

3.2 Research Set-up

To answer the research questions, we conduct a case study [1]. This provides additional information on validation focus groups in practice. The basis of this case study is the application of software design science research in an early stage. The researcher incrementally designed an extension to a software product, Mobina, in cooperation with stakeholders. The design was then validated using a focus group with experts. This validation was necessary to guide further software design efforts. The software developed is a sociotechnical artifact (naturalistic), and the moment of validation is during the product extension design before the extension gets implemented into the software product (*ex ante*). The focus group was set up based on existing literature both on traditional focus groups and validation focus groups.

The design was still in one of the earlier design cycles. Mobina had global design objectives, but did not yet have clear solution directions. Therefore, the research was started to create a first design and provide directions for future research. A mockup was made to demonstrate the design, which allows the researcher to show the potential of an application without having observers pay too much attention to detail. It allows thus for a high-level discussion that helps to decide the future directions of the software.

This need for high-level directions, in combination with specifics of the software, makes it useful to use subject matter experts for validation, instead of the target population. Potential users were expected not to be yet aware of potential improvements to their process and needing a fully functioning product to give feedback. Next to this, the existing software did not have a widespread user base yet.

Although many papers describe the need for homogeneous focus groups, especially for collecting more sensitive and personal data, we expected heterogeneous validation focus groups to provide superior results for validation. A group with experts from different angles can be used to complement each other and highlight and explore the differences in opinion.

Several important variables of the population were identified, and experts with knowledge of these different variables were selected. One group was expected to provide enough information for this design phase, since this can give clear directions about the usefulness of the designs and where uncertainty lies. Five experts were recruited in the researcher's network. This is a rather small number of participants, since experts are expected to have a lot to say and the participants are highly interested in the topic.

The focus group took place in a closed room at the researcher's university, that all participants were familiar with. Only one participant had to travel from far. They had some time to informally meet each other before the session, and got plenty of refreshments. The room was well suited for both presentation, demonstration, and discussion.

Since the focus group was used for validation of several possible extension modules, some structure was needed. Therefore, a time slot was reserved for each of the modules. At the beginning an introduction into the research, goals and focus groups was given. Then, for each of the modules a demonstration was given, including a short introduction and overview of the key functionality. Afterwards, there was time for discussion, the actual focus group. At the end of every module and after the whole session a questionnaire was held to force the participants to provide quantitative answers.

The researcher, and thus designer of the software, was chosen as the moderator. He knows the details of the design and the goals of the research, to be able to both present and moderate the focus group. He made sure he knew all potential pitfalls. He stressed that discussion is important, and all opinions are welcomed. He also explained his own role, and all participants were encouraged to directly interfere, if his involvement in the discussion becomes too large. For the open discussion, he also had a list of questions to potentially spark the group, but he intended to let the participants guide the discussion. Next to this, he had to look out whether everyone could equally participate.

Since this case study consisted of only one focus group, the prescribed rigor in literature is not expected to give any advantages. The goal of validation is not to collect a lot of data and find new connections, but to assess the usefulness of the software. Coding takes a lot of effort, and the details make it more difficult to analyze the overall picture [2]. Therefore, the focus group is summarized on key points, which is then verified together with several attendees. To support traceability, an audio recording and extensive notes were made.

Table 1. Summary of research set-up

Design representation	Mockups
Group composition	One heterogeneous group of five experts
Setting	Convenient room and place for presentation, demonstration and discussion.
Structure	Semi-structured, per module a demonstration, discussion, and questionnaire.
Moderator	Fulfilled by the researcher; aware of pitfalls; explanation to all participants of his role; and only necessary moderator involvement during discussion
Analysis	Summary on key points; traceability using audio recording and extensive notes

4 Results

The focus group proved very useful in this case study. Planning of the focus groups was difficult. Many experts did not have many moments available and especially in a short timeframe it proved impossible to find a moment when all candidate participants could

make it. In the end, still a full focus group was put together. Five experts easily filled the available time with discussion, and it was difficult to keep the discussion within the allotted time. More participants would probably have made it impossible to include everyone in the discussion.

However, some important validation points were identified during the focus group that needed more exploring to make recommendations. Therefore, the focus group was supplemented with interviews with targeted participants that could not join the focus group due to the planning constraints. These interviews focused on the important discussion points with the right experts.

The setting did not seem to influence the expert focus group. The group seemed comfortable to discuss with each other, even though several participants did not know each other yet. Some participants were a bit lengthier, but the moderator made sure everyone got time to express their opinions.

Differences in opinion were explicitly highlighted and the interaction of a focus group helped make clear which arguments they had and to what extent participants agreed with the arguments. The focus group therefore provided more information than separate interviews would, for example on the strength of opinions and reasoning.

The discussion itself tends to focus on the negative aspects of the design; which aspects have to be improved. To create a good overview of the usefulness of the software, the moderator therefore sometimes had to use follow-up questions to ask for positive points or absolute opinions about the usefulness. This was aided by the short (digital) questionnaires held after each discussion. In these questionnaires participants were forced to both rate the functionality on a scale from 1 to 10, and to provide an insight in the relative importance of the key functionality.

One of the major threats to validity in focus groups is the moderator. The moderator can have a lot of influence on the opinions and directions of the discussion. Especially when the moderator is highly invested in the topic, in this case since he designed all mockups, this can be a problem. To minimize the influence, the moderator's role was clearly explained at the beginning and all participants were encouraged to interfere if the involvement of the moderator became too high. In a setting with experts, constructive criticism is welcomed and therefore we expect that participants felt free to do so. Next to this, the participants are all confident to share their opinion, whether positive or negative. One attendee, not a participant, took notes and was also instructed to observe this.

Sometimes participants were looking for clarification or confirmation from the moderator. The moderator deliberately tried to steer this back to them, unless it was obviously a need for clarification of the design.

For presenting the design, mockups were used in combination with a short presentation describing the key functionality. This design was made by the researcher, who also fulfilled the role of moderator. This helped to establish the level of detail for the discussion and decide on which aspects are most important. The presentation of mockups made it clear that user interface design and details were not important. This design might have directed the

discussion, and therefore the participants were also stimulated to share ideas about which aspects are missing.

The analysis was executed as described. During the focus group, an audio recording was made and an additional attendee was responsible for taking extensive notes of the session. The focus group was summarized on key points. This was then verified with the secretary and a participant, the research supervisor. The most important points were identified for the interviews. The interviews were also summarized.

5 Proposed Guidelines for Focus Groups in DSR

One of the major issues for this focus group were the planning constraints. Therefore, a focus on the execution order like Tremblay, Hevner and Berndt [12] did not work. When recruiting participants, especially experts, only after finishing the design and thus the questioning route, this will delay research a lot. Next to this, it does not highlight all decisions that have to be made when setting up a focus group.

The guidelines from Gibson and Arnott [2] can be useful when setting up a validation focus group, but the set of guidelines is definitely not complete enough to provide direction for all aspects. It might therefore be useful to develop a set of decisions that have to be a made, which can partly be based on traditional literature, and provide directions for these decisions based on practice.

Hereby, we provide a first set-up, which can be used as a basis for further research to build on. This is based on traditional literature, additional guidelines, and own experience. It includes a set of variables that are important when making decisions on the set-up of focus groups. The next section further describes the decisions to be made, and gives guidelines for these decisions. Although this case study formed the basis, and the focus group performed well, it is important to note that the software is not yet implemented in practice, so the results are not sound.

Table 2. Decision dimensions of validation focus groups

Deciding variables	Phase Goals Type of artifact
Group composition	Number of groups and participants Homogenous vs. heterogenous Experts vs. target population
Setting	Location Duration Facilities
Structure	Type of (re)presentation Amount of structure

	Additional validation methods
Moderator selection and involvement	Be aware of pitfalls Communication of goals Involvement in determining topics Influence on group dynamics
Analysis	Traceability Coding Communication of results

5.1 Deciding Variables

It is important to define in which scenarios the focus group can best be used. This will also largely influence the decisions regarding the set-up of the focus group. Three important variables can be identified: the phase, the goals, and the type of artifact. These variables are of course also intertwined.

This research showed that a validation focus group can be very useful in the first phase of software development, where no clear direction was yet determined in advance of the design cycle. A validation focus group can help to validate the software designs, as well as provide an indication of the relative importance for future design.

This is a specific case of *ex ante* validation of a naturalistic artifact. Especially the need for future directions, made it a perfect fit. It is important to execute more case studies to find out whether focus groups can also be useful with different combinations of these variables.

In later phases, a need will probably arise to let users use the software itself. Maybe it can be useful to combine the usage with a focus group to validate it, but maybe it might be better to analyze the usage itself through for example a questionnaire. Focus groups might be more fruitful as long as the software is not yet functional.

Next to this, other types of artifacts might not be well suited for a focus group. Specifically, an artificial artifact can probably be better tested using different methods. However, also other naturalistic artifacts might not be as well suited for validation focus groups as software.

Finally, if the goals of validation are different, then focus groups might not provide the solution. If one wishes to fully support the whole population, it can be difficult to represent all demands through a limited group of experts. A survey would provide a larger sample of the population.

5.2 Group Composition

First of all, it is important to decide on the number of groups and participants. Literature proposes that you should continue until nothing new can be learned, but especially in design

science there will always be room for improvement. Therefore, it is better to look at the goals, and make sure valuable feedback is collected with relative certainty.

Traditionally, many homogenous focus groups are used to find out the experiences and opinions of people on a certain subject. Afterwards, researchers try to find correlation between these focus groups.

We believe after this case study that heterogenous groups can be much more effective in design science validation. The goal is not to collect data on opinions but to validate and improve the artifact. Therefore, it is important to find out not only the opinions but also the relative strength of these opinions to make tradeoff decisions. Especially on non-sensitive subjects in a group that stimulates constructive criticism, a heterogenous group might be the solution.

The number of groups is highly dependent on the goal of the research, especially the needed rigor, and the available resources. In this research, the goal was to eliminate major gaps in the design and get directions for future design. Since the design will be tested further, statistical relevance was not important. In later stages or for example for safety-critical applications, more focus groups should be used to ensure the results.

This research we decided to use experts, both because of the needed high-level view and the latent need of the target population. Especially in earlier phases, experts which represent different views on the target population can be very useful to get better answers. Potential users will focus more on details, whereas experts will be able to review the global design. In later phases, the focus can shift more to the target population as they can comment on the usefulness and usability of the artifact in detail. Experts can still be used to review whether the artifact has a positive impact on the target population.

The number of participants in each group is highly dependent on the involvement and interest of the participants. In this case study, five experts who were highly interested in the subject was a good amount to ensure everyone could express their opinions. However, when participants are mainly recruited using rewards and not on intrinsic motivation, more participants will be useful. These participants can then stimulate each other and spark responses from other participants.

5.3 Setting

It is always important to choose a location that is most convenient for the participants, this might be at their workplace or a location that is most central for all participants. However, most important is that the room allows for uninterrupted discussion and the right facilities for presentation and discussion. Seating should not be in rows, but in a square or circle to allow face-to-face contact.

Next to this, refreshments should be available throughout the whole session. Especially if a focus group focuses on a new artifact, a lot will be asked from the participants to understand everything. It is therefore important they stay fresh. The focus group in this case study was spread over three hours, since it was easier to get all participants together during

one longer session than multiple shorter sessions. However, this is a long period to stay fresh. Therefore, between every part a short break was given.

In this case, the setting was probably not an important determinant for the results. This has two main reasons. First, the subject was not very sensitive and emotion plays only a small role. Second, experts base their opinions mostly on experience and reasoning and are therefore less subject to the environment. In other situations, experimentation is necessary to find out how participants may be influenced by the setting.

5.4 Structure

The representation of the artifact is highly dependent on the set-up and goals of the focus group. In this case the focus was on getting and reviewing a high-level design, therefore it was not useful to completely implement the software. Mockups were most appropriate since not all experts have a lot of experience with software, and for example data models are too difficult to explain. Next to this, an overview was given of the key functionality, to aid in establishing the right level of detail.

It is important to decide on the representation based on the goals, but to also be aware of the potential pitfalls. In this case study for example, the results might have been influenced by the mockup being an extension to the existing software. It might have been difficult for the focus group to differentiate between new and existing design. Next to this, the details of the mockups might have influenced the opinions even though they were not the focus of the design. Providing them with an already designed artifact can also make participants less aware of other options.

It is also important to think about the structure of the focus group. The discussion tends to focus on negative points, on aspects that can improve. Therefore, it might be useful to separate discussion on positive and negative points. Next to this, it can be useful to structure discussions around certain parts of the artifact, in this case study per module. This helps keep the discussion together, but it is important to keep in mind that a more structured discussion can also limit the participants.

The amount of structure also depends on the goals and design phase. If you want to explore other possibilities, it is better to have an unstructured discussion. On the other hand, if you want feedback on very specific parts of the artifact, it might be useful to structure more around those parts.

Another way to collect more information from participants is by using short questionnaires. These can be used to spark the discussion, or to summarize the opinions afterwards. In this case, it helped to get a better idea of the overall opinions on the artifact, since the discussion focused mainly on negative aspects. Next to this, if the questions are closed it forces participants to decide. It might be useful to have a tested set of questions that can be used effectively in a validation focus group questionnaire.

Another important decision is whether the focus group will be combined with additional validation methods. In this case study, this decision was made based on results of the focus

group, and focused interviews were held to ensure the reliability of results on doubtful cases. This can especially be useful if it's difficult to include all targeted participants in the focus group. In later design phases, it might for example be useful to combine focus groups with usability testing methods.

5.5 Moderator Selection and Involvement

The moderator is of course one of the important differentiating factors, especially since the moderator's influence is difficult to control and replicate. Therefore, it is extremely important to analyze the pitfalls of the focus group to decide who will be the moderator. The moderator should be aware of these pitfalls.

The designer as moderator can be useful since he knows both the design motivation and research goals. However, the designer's involvement can also steer the focus group too much. Additional attendees who take notes or observe can help analyze the moderator's actions. Clearly communicating the goals and role of the moderator to all participants can also mitigate this influence.

It is important to consider two types of moderator involvement: influence on the discussion topics, and influence on group dynamics. For the former, it might be useful to have some backup questions, mainly to get the discussion going. However, it is also important that the moderator knows the research goals, and makes sure all important questions are answered during the focus group. The moderator can for example make sure that both negative and positive aspects are discussed.

Influence on group dynamics is important to make sure that everyone is able to share their opinion. The moderator should therefore analyze the group dynamics and if necessary ask specific participants questions to include them in the discussion. However, this can also influence the results. One of the advantages of a focus group is that participants might express themselves less if their opinion is not that strong. By actively involving them, this advantage is undone.

5.6 Analysis

An important aspect of analysis is that the results can be traced. This allows multiple people to review the correctness. Therefore, in advance of the focus group, researchers have to decide how to create this traceability. This can be done through an audio or video recording, while making sure this does not impact the group too much. Next to this, notes can be made during the focus group to also include details like body language. It is important to keep in mind the privacy of the participants, and explain clearly what will happen with these notes and recordings.

Afterwards, one can choose to transcribe and code the focus group. This can help to find more complex relations in opinions. This can lead to overanalyzing, so therefore this decision should be carefully considered. In this case study, coding was not useful. It will be

good to create guidelines in the future when to use coding. It will probably be more useful when multiple focus groups are used.

Last, the results will need to be communicated. If the results are coded, this can provide the basis, but otherwise another format has to be used. A summary on key points proved useful during this case study, this provided the basis for conclusions and could also easily be double checked with attendees. It can be anonymized and more compact than a whole transcript. However, it is important to keep in mind that the abstraction from the actual focus group to a summary can be very subjective. Therefore, it is important to check this summary with multiple people to ensure it accurately reflects the discussions.

6 Conclusion and Future Research

We can conclude that focus groups can especially be useful for naturalistic artifacts in *ex ante* validation, as proposed by literature. In this case, we tested it in the first design phase of a sociotechnical software application. We expect however that it can also be useful in other design phases, potentially in combination with other validation methods.

The design choices have been extensively explained. On the basis of the design choices which have been derived from literature, and the experience in this case study, in Table 2 we proposed a set of decisions that have to be made for every validation focus group. For these decisions we provide guidelines to help future design researchers to set up a validation focus group.

We conjecture that this framework is more widely applicable than to the IT context of the case study. Future research should focus on validating this set of design choices, This paper provides an extension and consolidation of existing literature, but more widespread usage in either the same or different situations can make more decision aspects surface.

Most potential decisions are similar to those in existing literature. In validation focus groups however, different decision criteria are needed. Therefore, an important contribution of this paper is providing guidelines for making these decisions. It proposes a set of variables that influence the decisions and provides guidelines for every decision.

These variables and guidelines are mainly based on this specific case study, and therefore more research into the validity of these guidelines both in similar and different cases is necessary. Therefore, it is important that this research is repeated in various contexts and larger numbers, so the framework can be refined. This can contribute to both verifying the completeness of decision aspects and validity of decision guidelines.

Next to this, the guidelines can be extended. The guidelines are currently at a high-level, but it might for example be useful to develop a validated questionnaire that can be used in specific cases. This makes it easier for researchers to set up a focus group.

Last, this case study only provides a one-sided view of the success of validation focus groups. The validation has only been executed using a focus group, and is not compared to

other validation methods. Next to this, the software has not yet been implemented and therefore the perceived success of this case study is only based on short-term results. In traditional literature, the usefulness of focus groups has extensively been compared to other methods like interviews. Such a comparison with other validation methods can also help researcher decide on when to use validation focus groups. A longitudinal study can also provide insight into the validity of the results.

References

1. Verburg, J.G.J.: Supporting the Innovation Process of Industrial SMEs Using Mobina: The First Design Cycle Using Mockups and a Validation Focus Group, M.Sc. Thesis, University of Twente (2018).
2. Gibson, M., Arnott, D.: The Use of Focus Groups in Design Science Research. In: Proceedings of the 18th Australasian Conference on Information Systems. pp. 327–337 (2007).
3. Rabiee, F.: Focus-group interview and data analysis. Proc. Nutr. Soc. 63, 655–660 (2004).
4. Morgan, D.L.: Focus Groups. Annu. Rev. Sociol. 22, 129–152 (1996).
5. Powell, R.A., Single, H.M.: Focus Groups. Int. J. Qual. Heal. Care. 8, 499–504 (1996).
6. Sutton, S.G., Arnold, V.: Focus group methods: Using interactive and nominal groups to explore emerging technology-driven phenomena in accounting and information systems. Int. J. Account. Inf. Syst. 14, 81–88 (2013).
7. Hevner, A.R., March, S.T., Park, J., Ram, S.: Design Science in Information Systems Research. MIS Q. 28, 75–105 (2004).
8. Wieringa, R.J.: Design Science Methodology: For Information Systems and Software Engineering. Springer Heidelberg New York Dordrecht London (2014).
9. Venable, J., Pries-Heje, J., Baskerville, R.: A Comprehensive Framework for Evaluation in Design Science Research. Des. Sci. Res. Inf. Syst. Adv. Theory Pract. 7286, 423–438 (2012).
10. Johannesson, P., Perjons, E.: An Introduction to Design Science. (2014).
11. O'hEocha, C., Wang, X., Conboy, K.: The use of focus groups in complex and pressurised IS studies and evaluation using Klein & Myers principles for interpretive research. Inf. Syst. J. 22, 235–256 (2012).
12. Tremblay, M.C., Hevner, A.R., Berndt, D.J.: The Use of Focus Groups in Design Science Research. In: Design Research in Information Systems. pp. 121–143 (2010).
13. Kitzinger, J.: Qualitative research. Introducing focus groups. BMJ. 311, 299–302 (1995).
14. Kitzinger, J.: The methodology of Focus Groups: the importance of interaction between research participants. Sociol. Heal. Illn. 16, 103–121 (1994).
15. Kidd, P.S., Parshall, M.B.: Getting the Focus and the Group: Enhancing Analytical Rigor in Focus Group Research. Qual. Health Res. 10, 293–308 (2000).
16. Alturki, A., Gable, G.G., Bandara, W.: The design science research roadmap : in progress evaluation. Sci. Eng. Fac. (2013).