Ecosystem for COllaborative Manufacturing PrOceSses – Intra- and Interfactory Integration and AutomaTION

(Grant Agreement No 723145)

D9.7 Cost, Benefit and Risk Evaluation

Date: 30.09.2018

Version 1.0

Published by the COMPOSITION Consortium

Dissemination Level: Public

Co-funded by the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement No 723145

Document control page

Document file: D9.7 Cost, Risks, and Benefit Analysis v1.0.docx
Document version: **1.0**
Document owner: FIT-WI

Work package: WP9 – Business Models, Dissemination and Exploitation
Task: T9.2 – Cost, Benefit and Risk Evaluation
Deliverable type: R

Document status: ☒ Approved by the document owner for internal review

☒ Approved for submission to the EC

Document history:

Version	Author(s)	Date	Summary of changes made
0.1	Martina Beer (FIT-WI)	2017-09-29	TOC and first content drafts
0.2	Thomas Kreuzer (FIT-WI)	2018-07-01	Structuring complete
0.3	Thomas Kreuzer (FIT-WI)	2018-08-01	Workshop Results
0.4	Thomas Kreuzer (FIT-WI)	2018-08-20	Analysis of all Workshop Results
0.5	Thomas Kreuzer (FIT-WI)	2018-09-14	Content and Structure update
0.6	Thomas Kreuzer (FIT-WI)	2018-09-19	90% status for Peer Review
0.7	Thomas Kreuzer (FIT-WI)	2018-09-26	Minor comments and changes after first review by Matteo Pardi (NXW)
0.8	Thomas Kreuzer (FIT-WI)	2018-09-27	Minor comments and changes after second review by Mathias Axling (CNET)
1.0	Thomas Kreuzer (FIT-WI)	2018-09-28	Finalisation

Internal review history:

Reviewed by	Date	Summary of comments
Matteo Pardi (NXW)	2018-09-26	Approved with minor comments
Mathias Axling (CNET)	2018-09-27	Approved with minor comments
Ifigeneia Metaxa (ATL)	2018-09-27	Approved with minor comments

Index:

1 Executive Summary

This deliverable aims to conduct a benefit, cost and risk analysis for the pilot partners in COMPOSITION to make a statement on whether the planned use case implementations are worthwhile from the point of view of the pilot partners. It will also be discussed whether the investments into the entire COMPOSITION project are economically reasonable. This will be accomplished by developing an approach for benefit, cost and risk analysis that meets requirements derived from the project's context, e.g. practicability or reusability. The approach is divided into two phases. First, the business models of the individual pilot partners, specifically the use cases, are visualized. These results have been presented in detail in D9.9. The next step is to evaluate the business models with a focus on the business value increase that occurs through the implementation of the use cases. This procedure is based on value-based management, a scientifically and practically recognized method of corporate management. Specifically, this is presented by the so-called Benefit Management, which aims to quantify all benefits and costs from an IT project and to determine a holistic project value. The implementation is carried out by Fraunhofer project members with the help of the BeneFIT-Method and the associated BeneFIT-Tool, scientifically and practically field-tested methods of Benefit Management.

The approach is applied holistically to every pilot partner and at least every use case that is to be implemented in the further course of the project. In order to determine the necessary values, workshops are conducted with experts from the pilot partners. The aim is to identify all benefits, costs and risks associated with the use cases and, afterwards, obtain meaningful estimates for the cash inflows and outflows of the benefits and costs. Based on these estimates, a modified form of the BeneFIT-Tool is used to determine an expected project value from the point of view of the pilot partner at hand. The expected project value gives an indication as to whether the implementation of the use cases will be worthwhile in the next few years from the pilot partner's point of view.

It was found that the implementation of all use cases will probably pay off in the next five years from the pilot partners' perspective. A comparison with COMPOSITION's overall budget also shows that the level of investment and the benefits of the project are already appropriate and in similar dimensions. If more companies join the ecosystem in the future and use COMPOSITION products and solutions, the overall added value of the project will increase even more.

From a risk perspective, technical risks are particularly important in order to ensure good performance of products and services. In the long run, this is relevant in order to reduce the extent of impact of market risks, e.g. a competing product to COMPOSITION.

For the next steps, the approach at hand will be enhanced and improved based on the results of this deliverable. For D9.11 a new benefit, cost and risk analysis will be carried out.

2 Abbreviations and Acronyms

Table 1: Abbreviations and Acronyms

Acronym	Meaning
BMC	Business Model Canvas
ELDIA	ELDIA SA
KLE	KLE Hellas ABEE
ATL	Atlantis Engineering SA
NXW	Nextworks
IIMS	Integrated Information Management Systems
WP	Work Package
D	Deliverable

3 Introduction

3.1 Purpose, Context and Scope of this Deliverable

COMPOSITION aims to create a digital automation framework (the COMPOSITION Integrated Information Management System - IIMS) that optimises the manufacturing processes by exploiting existing data. As an international project with twelve consortium partners, nine work packages, and a three years project duration, predicting and quantifying costs, risks and benefits is a necessity to ensure long-term project success. Therefore, WP9, more specifically task 9.2, is dedicated to assessing the benefits of COMPOSITION's business models, as well as to cover an ex ante benefit, cost and risk estimation for single projects, by means of use cases, and the whole COMPOSITION ecosystem. This should, at later project state, lead to an integrated decision support system that enables proper project management, more specifically Benefit Management. It can then be used, for example, by interested companies who want to evaluate whether COMPOSITION products and services are economically profitable for them.

For this purpose, this deliverable D9.7 provides a detailed analysis of benefits, costs and risks for every pilot partner and the currently most relevant use cases. Furthermore, an overall project-risk-report is delivered that aims to identify the most important overarching risks and to categorize and visualize their extent of impact and probability of occurrence.

This deliverable relates to several other deliverables:

- The identification of the COMPOSITION-related business models in deliverable *D9.9 Sustainable Business Models for IIMS in Manufacturing Industries* which is used as an input for this deliverable as the identified business models are the basis for the cost, risk, and benefit analysis. In D9.9 there were also some business cases and identification of revenue and cost streams for inter-factory use cases and the software marketplace.
- Several use cases have been defined in *D2.1 Industrial Use Cases for an Integrated Information Management System* and *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry*, which will eventually be developed and evaluated by the end users in the pilots. It is the intention to submit a final version of *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry* focusing on the industrial markets for intra-factory and inter-factory solutions. The updated deliverable will be submitted, when the results of the pilots are available, anticipated in M32 (April 2019). When the software components are stable, the proper pricing models and revenue streams will be selected and presented in *D9.11 Final Exploitation Strategy and Business Plans*. The stated deliverables and the updated versions might have a significant impact on the cost, risk, and benefit analysis, so that there should be another evaluation cycle regarding cost, risk, and benefits after the updated versions are published.
- The business models also form the basis for the partners' individual exploitation planning. The context is demonstrated in *D9.10 Exploitation Planning Framework and First Draft of Exploitation Plans.*
- This deliverable (D9.7) is also basis for a generic decision support system regarding the evaluation of business models in the context of COMPOSITION-similar industries and project in D7.4. The goal for future interested companies is to be able to evaluate the integration of COMPOSITION solutions into their business model.

3.2 Content and Structure of this Deliverable

Following the previous chapters 1 for the executive summary, 2 for abbreviation and acronyms and 3 for a short introduction, the main content begins in chapter 4.From then on this deliverable is structured as follows:

Chapter 4 deals with the analysis of the costs, benefits and risks of use cases. An approach is developed and presented that aims to identify benefits, costs and risks based on a visualization of the business models of the pilot partners, more specifically their individual use cases. Benefits, costs and risks are then quantified in order

to enable an evaluation based on the BeneFIT-Method and the associated BeneFIT-Tool. In addition, the scientific foundation behind the business model visualization by means of the Business Model Canvas (BMC) and the business model evaluation by means of the BeneFIT-Method is introduced. By using a showcase, UC-ELDIA-1, the analysis approach is demonstrated and discussed regarding its practicability. After that, the approach is applied to every pilot partner and at least every use case that will be implemented until the end of the project in August 2019. Thus, the Fraunhofer project members conduct workshops with experts from all pilot partners to estimate necessary figures for the benefits and costs of the use cases. Calculations are performed in the BeneFIT-Tool, an excel-based implementation of the BeneFIT-Method. First, the results are being discussed on an individual pilot partner level. Afterwards, the Fraunhofer project members aim to determine whether COMPOSITION is already economically profitable with the number of pilot partners currently available and how the addition of further companies will change this.

Chapter 5 extends the assessment from Chapter 4 by focusing specifically on the identified risks. On the basis of sound scientific articles, the importance of risk management in large IT projects is demonstrated. Afterwards, the Fraunhofer project members explain how risk has been taken into account in the BeneFIT-Method and determine the extent of impact and probability of occurrence. The results are visualized and discussed regarding their implications for COMPOSITION.

Chapter 6 summarizes and reports on the results of the benefits, costs & risk analysis. The limitations of the analysis approach are discussed and possible improvement outlined. The approach will be reused at a later stage in the project to follow the progress of the project. Hence it is inevitable to further develop and enhance the existing methods to get even better results.

4 Cost, Benefit and Risk Analysis – Methods and Approach

In the last decade, IT-projects are becoming increasingly more complex (Fridgen et al. 2015). One of the major drivers are dependencies that arise within and between projects, especially for large scale projects. This is compounded by an increase in uncertainty, not only due to intense competition, but also due to higher demands by customers. While there are many initiatives in research and practice to manage complexity and uncertainty in IT-projects, a significant portion of them still fails because of mismanagement of time, budget or goals. A study by the Project Management Institute even states that for 36% of projects there is an impactful difference between the results and the initially intended goals (PMI 2012). Against this backdrop, it is essential for a project to evaluate its value before, during and after the implementation. If deviations from target goals are identified, organizations can react directly (Beer et al. 2013).

The question is whether these project risks also apply to COMPOSITION or not. With regard to the complexity, COMPOSITION is an international project that will be carried out over a period of three years. Overall, there are twelve different organization involved in a wide variety of project roles. This leads to dependencies at an inter-organizational level that must be taken into account and managed. In addition, the benefits of COMPOSITION are particularly marked by uncertainty. In the context of Industry 4.0 projects, many qualitative factors are important that complicate and hinder a deterministic view. Therefore, COMPOSITION needs an integrated approach for the evaluation of its benefits, costs and risks that is applicable even for highly complex projects and accounts for uncertainty.

The analysis of costs, risks and benefits for COMPOSITION is the goal of this section. Since there is no commonly agreed on method as the best in practice or research, this deliverable develops its own multi-step approach based on the profound project and research experience of Fraunhofer project members. The prior course, status and intent of COMPOSITION lead to various requirements for the development of the approach. Thus, the following goals and specification can be derived.

On the one hand, there has been no detailed consideration of benefit, costs and risks up to this deliverable in COMPOSITION. That is why an analysis approach must be chosen, that is easily practicable, even during the project implementation. This also promotes reuse and subsequent evaluation. On the other hand, COMPOSITION is a project that works very closely with manufacturing companies from a variety of industries. Therefore, the analysis must be universally applicable to different organizational contexts, e.g. company size or customer target group.

Moreover, it is not intended to conduct this analysis only one time. Rather, it is important to design an approach that can also be carried out without great effort at later stages of the project. Each iteration of the benefit, cost and risk analysis should build on the findings of the previous one and improve the evaluation method. In order to include the costs (e.g. the budget) for COMPOSITION in the valuation, it is necessary to build a quantitative approach with, in the best case, monetary results. This may be an overall project value that enables a statement to be made about the economically profitability of the use cases. Note that although the project and the implementation of the use cases is on time, the projects still lack experience and many results for the use case implementation. It must therefore also be possible to carry out the analysis based on sophisticated estimates, while accounting for inaccuracies and fluctuations with these estimations.

Taking all these requirements into account, the Fraunhofer project members develop an approach for the benefit, cost and risk analysis as shown in Figure 1.

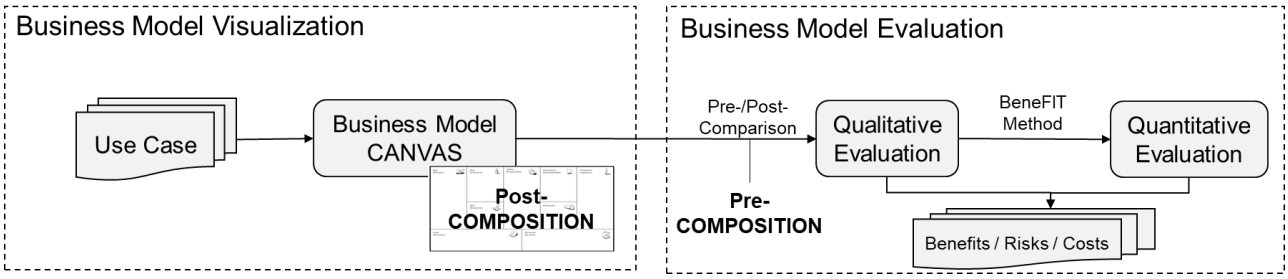

Figure 1: Approach for Benefit, Cost and Risk Analysis

The approach is divided into two steps. First, it aims to understand how COMPOSITION's solutions are changing existing processes of the pilot partners. This requires a visualization of the use cases before COMPOSTION (pre-COMPOSITION) and a comparison to the state after COMPOSITION (post-COMPOSITION). In previous deliverables (D9.9), the BMC was the chosen tool to describe and visualize use cases. Due to the fact that this is also appropriate for this evaluation, the BMC method can be applied as well.

On this basis, benefits, risks and costs are identified qualitatively by means of an evaluation of the BMC. For instance, cost drivers may be determined that are now positively influenced by COMPOSITION, i.e. cost savings. The quantitative evaluation is carried out based on the so-called Benefit Management, specifically the BeneFIT-Method and -Tool. Developed as an evaluation method for IT projects, Benefit Management was chosen after examining common methods used in the scientific literature.

The Fraunhofer project members combine different scientific methods and tools to build the approach for the analysis of benefits, costs and risks in COMPOSITION. In the following, the individual steps of the approach are explained regarding their procedures on the basis of current and recognised scientific literature. To make the explanations more tangible, one use case is selected as a showcase, for which the corresponding step is carried out directly after the theoretical explanation. Since it is a typical intra-factory use case, the Fraunhofer project members opt for UC-ELDIA-1. After that, the approach is applied to the remaining pilot partners and their use cases. This includes the inter-factory use cases from ATL and NXW as well in order to compare the results with the overall budget used for COMPOSITION. The aim is to obtain an indication as to whether the project meets its requirements and can also create value for additional companies in the future.

4.1 Business Model Visualization

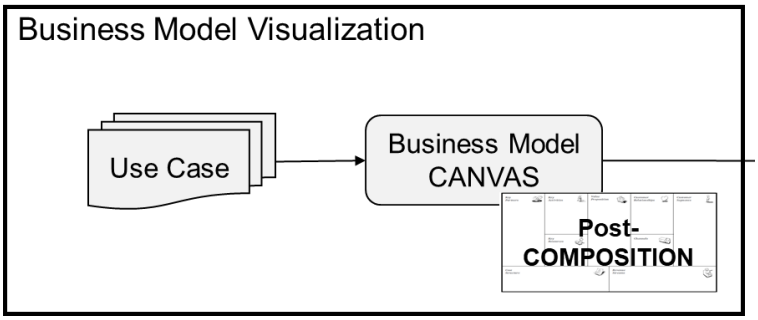

Figure 2: Business Model Visualization

This section aims to explain the first part of the analysis approach, the business model visualization. Hence, it introduces the concept of business models and how the BMC can be used in the context of COMPOSITION to visualize them. A lot of work about this topic has already been done in collaboration with deliverable 9.9., where the BMCs of the use cases were initially presented. In the following, this section provides insights into the scientific foundations and extend previous knowledge by specifically focusing on differences in the BMC between pre- and post-COMPOSITION.

4.1.1 Business Model

With the emergence of digital technologies and the ongoing globalization, the environment for businesses changes rapidly. Digitalization offers new possibilities of doing business and creating value with and for the customer. Therefore, a change in business logic and activities becomes evidential for every company. To successfully adapt the business to the volatile environment, the business model concept plays a significant role. It helps to understand how the company actually works, which is essential for the success of any business. The model also helps to realize the economic value of a company's products, services, business or technology. Because companies can realize competitive advantages with the support of the business model concept, the concept is gaining more and more popularity. Despite of the multitude of different approaches to define a business model, there is no commonly accepted business model definition. To get a glimpse of what people mean by the buzzword business model, two popular definitions provide a good foundation.

- In short, a business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits (Teece, 2010).
- A business model describes the rationale of how an organization creates, delivers and captures value (Osterwalder & Pigneur, 2010).

Business models are constantly facing innovation and therefore an ongoing process of adaption is needed within existing business models. Incumbent firms are forced to stay competitive and to adapt their current business model constantly. This process of innovation of the business model can be distinguished based on where the innovation affects the firm within the business model perspective. The literature describes mainly two different forms of business model innovation, the process innovation and the product/service innovation. The process innovation affects the inner view of the business model and encompasses innovations which can lead to more efficient processes. The product or service innovation affects the market side of the firm and encompasses for instance a better quality of products, or incremental improvements. For choosing the right business model, Osterwalder and Pigneur (2010) propose different questions a company has to think about their overall business plan:

- Who are the most important customers?
- Which values are offered to the customers and which problems do they solve?
- Which kind of relationship does the customer expect?
- Which channels are used to reach the customers?
- For which values the customers are willing to pay?
- Which key resources are needed for the value proposition?
- Which key activities are needed for the value proposition?
- Who are the key partners and suppliers?
- Which are the most important costs of the business?

The BMC by Osterwalder & Pigneur (2010) is a popular framework, which helps companies to answer these questions and to think about all relevant aspects of their business model.

4.1.2 Business Model Canvas

The BMC is a visualization of the key elements of a business model and their relationship. According to its inventors Osterwalder and Pigneur (2010) BMC is a concept that helps to describe and think about business models. Various enterprises have been - and still are - using the BMC to visualize their business model. Furthermore, there is an extensive body of knowledge in research and practice, which highlights the BMC as a proven driver of organizational success. One of its most important strengths is the simplicity of structuring a business model. The BMC consists of nine so called building blocks, which are arranged on a canvas. The tool can be used by writing directly on it or as an underlay for post-its. Figure 3 shows the building blocks in one of the most frequently used frameworks.

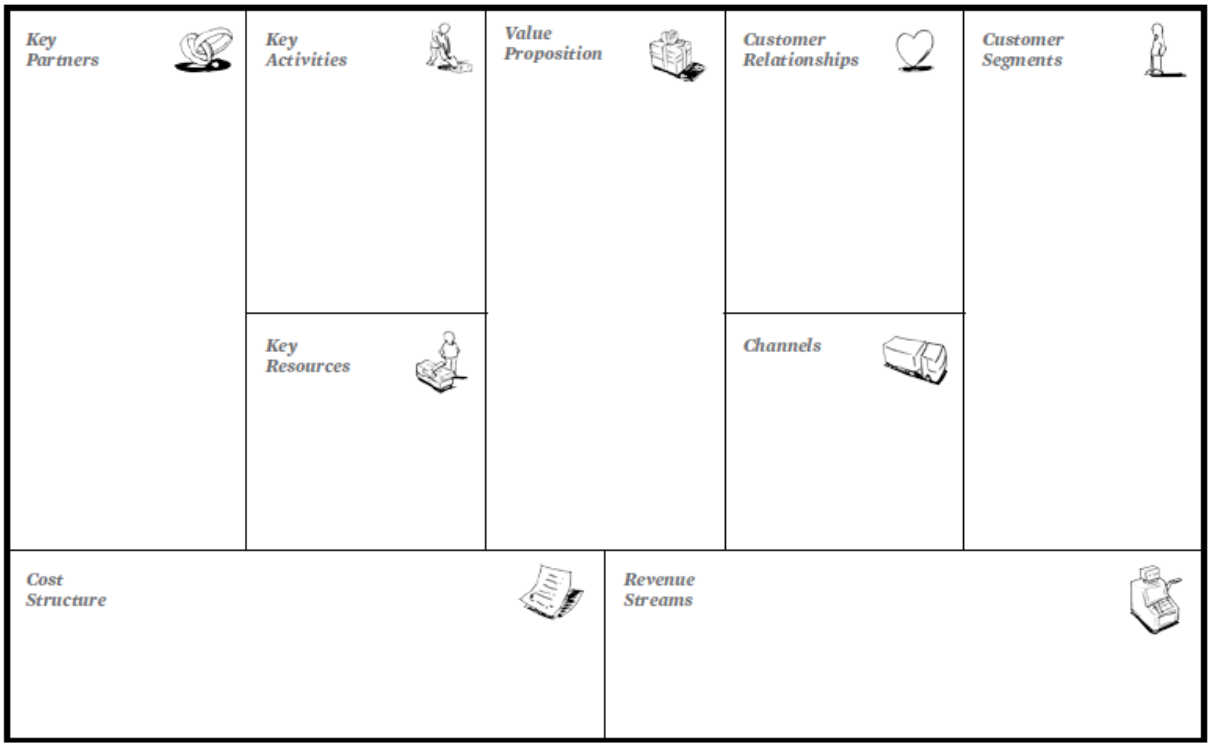

Figure 3: Business Model Canvas (Osterwalder & Pigneur, 2010)

The canvas gives a framework to systematically list and connect the most important properties of a business model. In the very same book, there is a short description of what exactly is meant by each of the nine building blocks. However, most of them should be self-explanatory. The center of the canvas is the value proposition. It defines which products and services are offered to the customer to generate value. On its left side the partners, suppliers, activities and resources are presented, which are needed to generate the value proposition. The right part of the canvas depicts in contrast, for who the value is generated and how the customers are reached. Last, the lower part of the tool demonstrates the financial aspects of the business model. It explains which costs incur and how revenues are generated.

In the context of COMPOSITION, the focus of the BMC is primarily on the factors 'value proposition', 'cost structure' and 'revenue streams'. This is because all use cases aim to either make existing production processes more efficient in order to reduce costs, or to create new value for customers and increase the pilot partner's revenue. These factors are therefore at the core of the qualitative analysis.

4.1.3 Usefulness and Characteristics of BMC

The BMC is seen as a tool contributing to the communication about business models with employees, partners and customers. It helps to show all involved parties the big picture of the business, their own roles and the interdependencies. When working with the BMC all the strengths and limitations should be taken into account. According to Osterwalder and Pigneur (2010), the BMC is "meant to be a business model concept that everybody understands: one that facilitates description and discussion". Instead of just having the nine basic components in a row of a table, they are put on a canvas. Through the visualization, the understanding of the individual issues and their mutual influence is enhanced. Furthermore, the tool assists in creating and discussing new business models. Altogether, it is a short, appealing way to map and innovate on business systems. It is therefore rapidly adopted in the entrepreneurial community.

However, the BMC does not capture everything that should be taken into account when creating a business. Highly relevant issues when starting a business, like external factors including competition, market or legal restrictions, are neglected. Also detailed cost and revenue structures and performance measurement are

outside of the scope of the BMC. To refute this argument Osterwalder and Pigneur (2010) propose to extent the nine building blocks with a framework including four further dimensions. Thereby key trends, market forces, macroeconomic forces and industry forces are considered. Through this extension, more relevant aspects of a business model can be considered. Furthermore, the BMC does not consider the strategic purpose of a company explicitly. Therefore, the purpose should always be kept in mind, when working with the BMC. To work successful with the tool, users should be always aware of these limitations and know how to deal with them.

Nevertheless, there has been much positive criticism for the BMC in academic literature because it is a well-balanced compromise between completeness and clarity:

- The BMC is a practice-oriented visualization of the key elements of a business model and their relationships.
- The BMC helps to focus on value creation and value capturing and simultaneously not to lose a holistic picture.
- The BMC helps to find a common language to communicate the business model comprehensible to other people.

Its usefulness is also confirmed by the high number of sold copies of the book “Business Model Generation”, the number of subsequent, refined models and its application by enterprises such as IBM, Ericsson, Deloitte, and many more. Concluding the strong points of the BMC are the visual representation, usefulness and simplicity of designing and communicating business models.

4.1.4 Best Practices of BMC

In order to work properly with the BMC, Osterwalder and Pigneur (2010) recommend some techniques and methods that companies can pay attention to.

First one should always include the customer perspective when evaluating the business model. So, a deep understanding of the customer and his needs, concerns, environment and daily routines is the basis for developing a successful business model.

To come up with new ideas for the business model and a good discussion, it can help to put together a diverse team. Brainstorming with the canvas can also be supported by the use of “What if …?”-questions. They are a good starting point to provoke and challenge out the thinking of the team.

To ensure an efficient brainstorming with the BMC, it is important to stay focused, enforce rules, be prepared, and to think visually. Therefore, visual tools like post-its, sketches or diagrams can be used. The visualization is essential to be able to capture the complex big picture of the business model.

To communicate the BMC comprehensible to employees, partners or investors, storytelling can be a helpful tool, too. Telling the business model with the support of the BMC like a story, can support to make the new business more tangible.

Last, applying scenario planning technique to the BMC can help to understand how the business model might have to evolve in the future under certain conditions. It is often useful to develop one or more appropriate BMC for each possible scenario. By using the canvas together with the mentioned techniques in the right way, new methods about describing and innovating the business can be created.

4.1.5 Characteristics of the BMC in context of IoT, Industry 4.0 and Smart Manufacturing

Since the publication of the book “Business Model Generation”, several adaptions and extensions of the BMC have been proposed and studied. For the IT sector, there is a refinement for the BMC, called the Service Model Business Canvas. Zolnowski, Weiß and Böhmann (2014) describe that the essential aspects of service, which to an increasing degree replaces traditional production, cannot be covered in the standard BMC. The spread of IT results in the need for many enterprises to transform its main focus from product to service, production to use, transaction to relationship and supply chain to value networks. Value is then often generated in co-

creation with the customer and has a unique and phenomenological character. This aspect has an important impact on the way one has to model such service business models. Based on the listed requirements, a service business model emphasizes the possibility of the customer to co-determine or to interact with other elements of a business model. Hence, co-creation of a service must be displayed in a holistic way.

According to Zolnowski et al. (2014), an applicable and useful business model approach for service environments must consider the following requirements:

- A comprehensive representation of relationships between the customer and the entire business model.
- Representation of the customers' share of costs and revenues.
- Representation of the customers' contribution to activities and resources.
- Representation of the specific context of a customer. Hereby, the value creation of the customer is emphasized.
- Representation of the relationship and channel between a provider and customer showing how these actors co-determine the interaction between them.

Therefore, the following adaption of the BMC to service-oriented businesses is desirable.

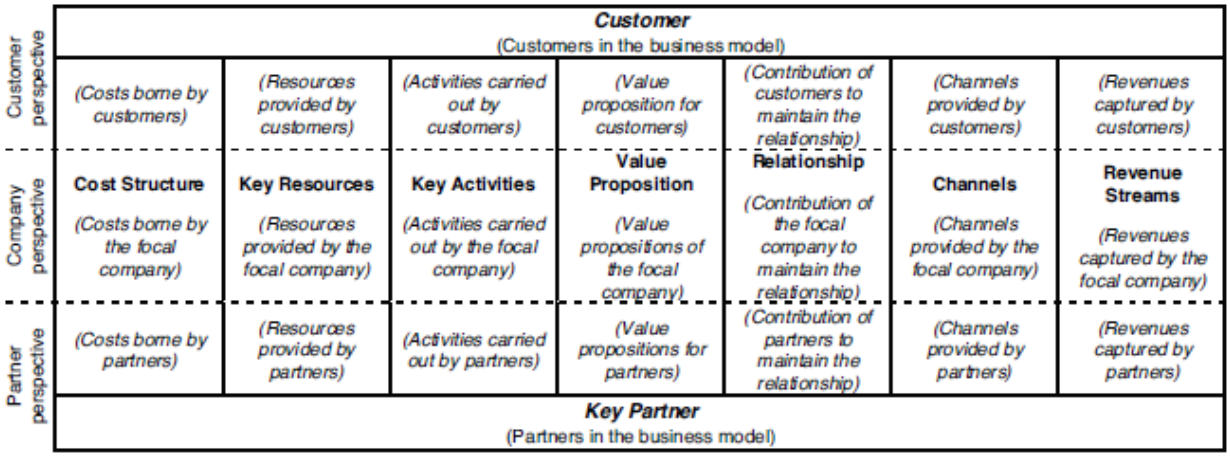

Figure 4: Service Model Business Canvas (Zolnowski et al., 2014)

Figure 4 demonstrates that the key components of the Service Business Model Canvas and the BMC are equal. Nevertheless, some differences can be found. The layout differs a lot from the original BMC. In the new model seven components are arranged in a row, to emphasize the relationship between the individual components and the key partners or customers. Furthermore, the seven components in the middle are viewed from three different perspectives. They are analysed from a customer, company and partner perspective. Outcome of this are new subareas, which helps to think about the key components in a more precise way.

Despite of the more detailed analysis by the Service Business Model Canvas, the Fraunhofer project members decide to use the original BMC. Reason for this is the easier handling of the BMC. Especially for smaller companies, a very precise analysis can be difficult and time consuming. It is often easier for small organizations to think about their business in a more general way. Nevertheless, the Fraunhofer project members consider using the Service Business Model Canvas for further benefits, costs and risks analysis in the future to ensure that all relevant aspects of the pilot partners' business model are taken into account.

4.1.6 BMC and what happens next

"It´s not the product - it´s the business model" - Steve Baker (Entrepreneur)

Despite the heterogeneous literature, most people agree on the enormous relevance of thinking about a firm's business model. However, there is the misguided belief that once you have chosen a successful model, you should stick to it. Companies often keep their old business model for too long. This phenomenon can be explained with the example of Kodak. Kodak was once famous for the development of photographic pictures. With the invention of the digital photography, the demand of physical photos dropped and so did the success of Kodak. The fact that Kodak invented the digital photography, but was unable to realize an appropriate business model, makes this example even more tragically. The Kodak situation can also be transferred to other firms and their business models. In order to be successful, companies have to be innovative and constantly adapt their business model to the changing environment.

Today established business models can be easily attacked by digital start-ups. The reason for the success of these digital firms can be found in their business model. A good example is Spotify. They saw the need of customers to listen to free music on demand. For that reason, they offered music streaming on a freemium basis to their customers. With their new digital business model, they disrupted the entire music industry. So, in order to prevent your model to fail, it is mandatory to review and evaluate your model constantly.

From the point of view of the pilot partners, being part of COMPOSITION significantly affects their respective business models. This refers, for instance, to the automation and improvement of basic manufacturing or logistic processes, which represent the value creation of the company. In addition, completely new distribution channels are being exploited, which will fundamentally change the value creation of the company in the future. Because the business model innovation is today seen as the most important type of innovation, the Fraunhofer project members want to use the BMC to identify and visualize the changes in the business model of the pilot partners. Based on this benefits, costs and risks can be derived and quantified to analyze them from an economical point of view.

4.1.7 Application to UC-ELDIA-1

As already announced, the Fraunhofer project members apply the presented procedure directly to an exemplary use case, UC-ELDA-1. This is meaningful because this use case is a nice illustration of how digitizing small work steps can have a big positive effect. At the same time the use case has a low complexity. At this point, it should again be noted that D2.1 and D9.8 also contain explanations and visualizations of the use cases and they can be checked for more detailed descriptions.

UC-ELDIA-1 aims to equip ELDIA's waste containers with sensors, which permanently transmit the current fill level to a central system that automatically sends a fill-level notification to a logistic manager. The latter subsequently notifies a company driver, who then picks up the container and replaces it with a new one. The implementation of this use case automates a process, in which ELDIA was previously very much dependent on the cooperation of its customers. For instance, up to this point a worker of KLE (another pilot partner in COMPOSITION) would check the container's fill level frequently during the day. He or she would notify ELDIA via phone when a certain amount of recyclable waste was collected so they can send a truck to replace it. Automated notifications for ELDIA, specifically for their drivers, increase the overall service efficiency. Additionally, the use case is targeted towards a higher certainty for ELDIA's weekly, daily and hourly planning and allocation of their transportation trips.

Figure 5 shows the BMC for UC-ELDIA-1.

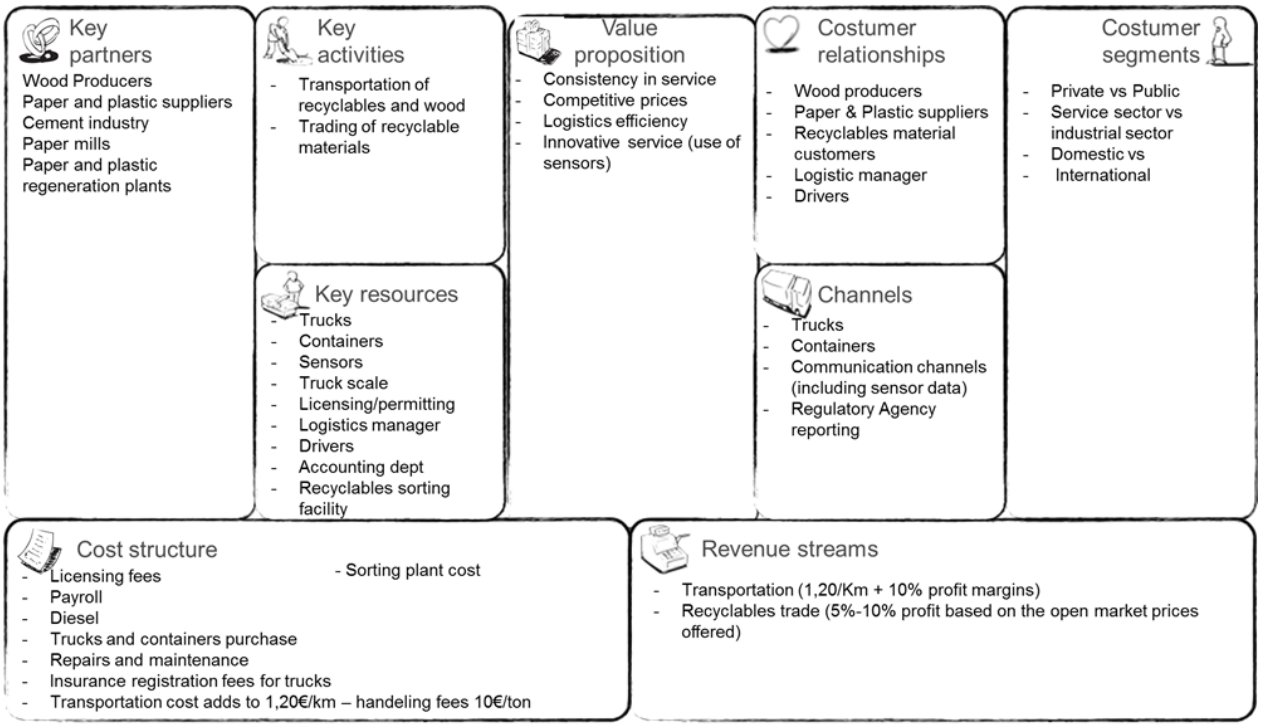

Figure 5: BMC for UC-ELDIA-1

4.2 Business Model Evaluation

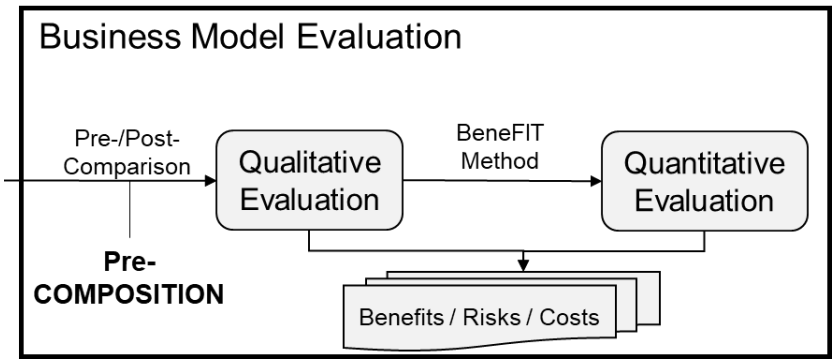

Figure 6: Business Model Evaluation

This section aims to explain the second part of the analysis approach, the business model evaluation. Every use case is either targeted towards an improvement of existing organizational processes or provides opportunities for the pilot partners to extend and enhance their current business model. Since all the use cases were defined in collaboration with the pilot partners, there is little to no doubt that their implementation adds business value in some way or another.

Nevertheless, the remaining question is how great this increase in value is compared to the organizational status quo and the project volume of COMPOSITION. Therefore, this deliverable evaluates the pilot partners' business model with a significant focus on the improvements by means of COMPOSITION solutions. This is achieved by conducting workshop with representative experts of the pilot partners. It is important to note that not the entire organization of the pilot partner is evaluated, but the Fraunhofer project members rather concentrate on the increase or decrease in business value (henceforth: delta of business value) that COMPOSITION creates. The delta of business value can be defined as the expected value of the project from the organization's point of view (henceforth: project value), while taking all benefits and costs that affect the pilot partner in to account. Uncertainty, by means of risk, primarily influences the value of benefits. Before the findings are reported, the term business value is introduced to determine why and how benefits can positively affect it.

4.2.1 Business Value and Business Evaluation Methods

Value orientation and value-based management has prevailed as a guiding paradigm of corporate management in economic research and practice (Buhl et al. 2011). The objective is to maximize the long-term sustainable business value by targeting all business activities towards this goal. Business value (or often referred to as enterprise or firm value) can be derived from the organization's future discounted cash flows. These, in turn, are calculated from cash outflows and inflows, which reflect changes in the businesses' instrument of payment, e.g. revenue and costs. Generally, performance measurement in value-based management must be conducted by means of value-oriented measures. Due to its proximity to the stakeholder value approach, it is an important asset of value-based management to consider the impact on the stakeholders of the company. In addition to typical shareholders, this also refers to external organizations or personas, for instance customers, employees and suppliers.

Value-based management is an established concept even in the context of manufacturing industries. Nevertheless, this does not necessarily lead to value-adding behavior of all managers. This causes the problem that not all business activities align with the objective of maximizing or increasing business value. Consequently, it is not enough to only consider the current business value. An organization must be able to assess the value of contribution of all individual business activities, assets and interactions. This includes, for example processes, but above all also projects. Therefore, decisions regarding projects, for instance by means of a decision support system for project portfolio selection, have to be made by taking the projects' value contributions into account. This concept can also be transferred to COMPOSITION. Figure 7 shows various important factors of business value that may be affected by projects.

Figure 7: Factors of Business Value

Warren Buffet stated in 2012 that "if business schools could offer just one course, it would not be on stock trading, the efficient market hypothesis or modern portfolio theory. Rather, B-schools should be encouraging students to learn the boring, but critically important, discipline of business valuation" (Forbes 2012). In times of digitalization, the evaluation of businesses gets more and more important. A firm´s market value depends not just on the sales and cash flows, but on customer satisfaction and brand awareness as well. Therefore, it is necessary to continuously collect and analyze data. The main goal is to get to know how much an organization is actually worth on the open market, considering all its stakeholders. A clear and supportable estimate, of what the fair market value of the business is, should be determined. The fair market value is generally referred to as the price at which the property will change handy between a willing buyer and a willing seller, neither being under any compulsion to buy or to sell and both having a reasonable knowledge or relevant facts.

In research and practice this process is called business evaluation. There are many reasons to carry out a business evaluation and they are not just limited to the case that an organization needs to be sold. This includes commencing a sale process, resolving shareholder disputes, business planning and future decision-making, determining tax obligations, litigation purposes or to access external sources of funding. Therefore, it is always helpful to have an up-to-date business valuation. The difficulty is that both over- and underestimation can cause problems. One could be led to make unnecessary investments based on expected standing in the market. Consequences are the waste of time as well as money.

It is important to keep in mind that the value of a firm is not a single fixed number. It depends on many inter-organizational and intra-organizational contextual factors, e.g. the current state of the economy or competitors. This means that calculations relating to the business value of one's organization must always be considered in context. This also plays a role in the calculation of the project value in this deliverable, which may look very good or bad at first glance but must also be evaluated in comparison to the pilot partner's size and the COMPOSITION budget. Therefore, the project values (from the different pilot partners' point of view) cannot be compared one-to-one. Rather, it is a matter of first evaluating them individually in the context of the pilot partner and later drawing a complete conclusion about all pilot partners and COMPOSITION.

Another difficulty may be insufficient data quality within companies or problems with the estimation and evaluation of qualitative factors of business value. This refers primarily to factors that deal with an organization's customers. Qualitative concepts such as customer satisfaction and customer loyalty have occupied research and practice for a long time and are difficult to convert into quantitative data. However, estimating the other factors may also be imprecisely and is especially difficult for the pilot partners before the use cases are actually implemented, which is right now the status quo.

While a business evaluation may be an expensive process with many uncertainties, it is an important input factor for decisions about a meaningful medium- and long-term organizational strategy. Sometimes it already has a positive effect on the organization if they have to deal with the quantification of drivers of business value. In addition, practice and research have shown that expert estimates are often more than enough to determine a meaningful project value. By re-evaluating the project values at a later stage, the Fraunhofer project members try to reduce the weaknesses of an inaccurate estimation. Another method used is to estimate in ranges rather than fixed values. This is easier for the experts and can be presented in a mathematically reasonable way.

Business Evaluation Methods

The chose evaluation method is the BeneFIT-Method. The reasons for this are explained in section 4.2.3. The theoretical basis for this method are, among others, the following three main types of business valuation method: The Asset-Based Approaches, Earning Value/Income Approaches and the (Fair) Market (Value) Approaches, as shown in Figure 8.

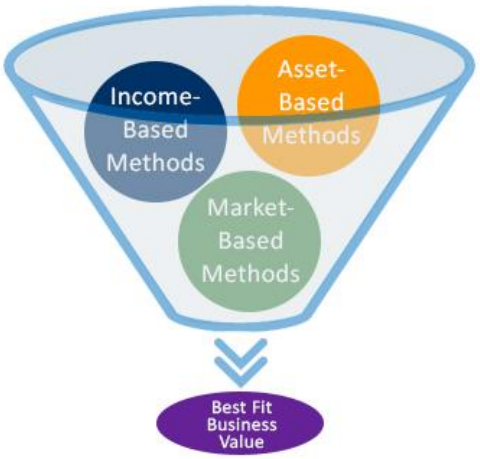

Figure 8: Business Evaluation Methods

Asset-Based Approach basically sums up all the investments in a business. This can either be done on a going concern or on a liquidation basis. A going concern asset-based approach lists the business´s net balance sheet value of its values and subtracts the value of its liabilities. By contrast, a liquidation asset-based approach determines the net cash that would be received if all assets were sold and liabilities were paid off. This method views the business as a set of assets and liabilities that symbol the business value. Therefore, you need to figure out what assets and liabilities you want to include into your calculations and a standard of measuring their value and then calculate what they are actually worth.

Earning **Value/Income Approaches** are based on the idea that a business´s true value lies in its ability to produce wealth in the future. It deals with the main reason for running a business: making money. What economic benefits will you get if you invest time, money and effort into a business ownership?

This valuation approach also factors in the risk, because since the money is not yet in the bank, there is a risk of not getting what you expected. You need to translate the expected risk and income into the present in order to evaluate your business. There are two ways of doing that: *Capitalization and Discounting*. These two methods are equivalent if the business earnings grow at a constant rate.

The Capitalization of Earnings (or Capitalization of Cash Flows) Method values a business based on the future estimated benefits. In the next step these benefits are capitalized with an appropriate capitalization rate, the reciprocal of the desired rate of return multiplied by the normalized earnings of a business to arrive at its purchase price (Jud & Winkler 1995). This method takes tangible and intangible assets into account and does not separate their values. It factors future earnings/ cash flows.

The Discounted Earnings (or Discounted Cash Flows) Method uses forecasts for the earnings of a firm and the firm´s estimated terminal value at a future date. With an appropriate discount rate, these earnings will be discounted back to the present. The sum of the discounted future earnings and discounted terminal value is equal to the estimated value of the firm.

Market Value Approaches to business valuation try to establish the value of a firm compared to other similar firms that have recently sold. Obviously, this method only works if there is a sufficient number of businesses to compare your firm with.

The most popular business valuation method is the Earning Value Approach. However, it might be the best to use a combination of business valuation methods. One of the first steps is to hire a professional Business Valuator who can give advice. He can give an objectively valuation. In the US, for example, you can find Business Valuators through the website of the American Society of Appraisers (ASA).

Valuation of a going concern business on the basis that the operations will continue to yield constant and regular earnings. These earnings (called 'normalized earnings') are multiplied by a capitalization rate (normally the reciprocal of the desired rate of return) to arrive at the value of the business.

4.2.2 Qualitative Evaluation

The qualitative evaluation was carried out in workshops with the experts by means of an analysis of the BMC for their use cases. It was specifically discussed within which factors changes occur after the implementation of the use cases. The experts derived the affected costs or revenues drivers and, additionally, identified completely new costs or revenues drivers. The first step is, thus, to create a list of benefits and costs. Within this deliverable, benefits are defined as a change within the business model, whereby ultimately costs are reduced or the overall revenues increase. Cost drivers are limited only to the increase of existing costs or the necessity for new cost centers.

Based on this list, various risks have been discussed that may have a negative impact on benefits and costs. The experts summarized these risks in a reasonable manner in order to form scenarios. A scenario is defined as the occurrence of the risks contained therein. In the simplest case, two scenarios are relevant, a scenario A for the best case without the occurrence of risks and a scenario B in which the identified risks occur. At this point, the experts also qualitatively discussed how strongly the scenarios influence the benefits and costs and how high the probabilities of occurrence of the individual scenarios is. This forms the basis for later estimating a meaningful gradation of the quantified benefit values in the different scenarios.

The qualitative evaluation of the showcase UC-ELDIA-1 is shown in chapter 4.2.4 together with the quantitative evaluation. This is mainly due to the fact that the Fraunhofer project members carried out both evaluations simultaneously in the workshops to complete the analysis of one benefit or cost driver before looking at the next.

4.2.3 Quantitative Evaluation

For the evaluation of the business models the Fraunhofer project members focus on the assessment of the organizational value increase that arises from their participation in COMPOSITION. More specifically this refers to the implemented solution for their use cases. By identifying, tracking and quantifying business benefits of the use cases, the Fraunhofer project members aim to determine the project value from the pilot partners' point of view. The process is commonly referred to as Benefit Management. This approach aims to assess the gain coming from a planned or executed project. It is, therefore, a crucial part of project management and in line with the prior presented value-based management as the project value aims to represent the change in business value (Beer 2013).

To implement Benefit Management, the Fraunhofer project members searched for an integrated and easily applicable method that considers benefits, costs, risks and interdependencies. In the end the decision is to go for the so-called BeneFIT-Method, a scientifically proven method, specifically designed for the Benefit Management of IT-projects. Besides the BeneFIT-Method, literature provides several other approaches for Benefit Management, for instance the scoring model, the WARS model or the SMART model. Below some alternatives are briefly presented and it is explained why they are not suitable for COMPOSITION.

The scoring model (Zangemeister 1971) identifies, weights and assesses relevant criteria ("scores"). A following aggregation allows the determination of an overall score for different investments. One criticism of this approach is the possibility of monetization (mere consideration of scores) and the high degree of subjectivity in the allocation of scores. Furthermore, risks are not considered in an integrated manner.

In the WARS model (profitability analysis with risk levels) developed by Ott (1993), additional categories of cost and benefit components are defined together with their corresponding realization chances. This is complemented by specific risk levels. Although benefits are monetized in the WARS model, the benefit components are divided into risk levels by the decision-maker in an arbitrary way. The comparability of the qualitative levels is missing and therefore the assessment is very subjective. The SMART model used by Walter and Spitta (2004) for the ex-ante evaluation of IT investments is similar in its approach to other scoring models and therefore similarly inadequate in terms of its proposed monetization and risk consideration.

Against this backdrop, the Fraunhofer project members decide to use a methodology for Benefits Management that provides a dynamic, holistic and integrated view of benefits, costs, risks and dependencies: BeneFIT (Beer et al. 2013). In addition, this method has proven itself to be applicable in practice with manageable effort and is therefore a reasonable choice for the evaluation of the project value in COMPOSITION.

4.2.3.1 The BeneFIT-Method

The BeneFIT-Method is a comprehensive, quantitative and mathematically well-founded approach to benefits management and particularly suitable for IT-related projects as well. It provides a scheme to collect all relevant data and a tool, namely an excel-worksheet, to compute the benefits quantitatively, taking uncertainties and dependencies of the organization at hand into account. Altogether, it gives a framework to track the progress of the project and to decide whether to continue or abandon it at all times.

By examining the BMC pre- and post-COMPOSITION, relevant benefits can be identified in a joint discussion. Usually, benefits can target towards more efficient processes by means of savings in internal administration costs or the aim to increase an organization's revenue. Experience shows that benefits related to IT-projects can typically be distinguished into six groups. For each of these issues, BeneFIT provides further suggestions for sub items which the IT project might affect.

- staff: benefits which directly affect employees, such as in terms of efficiency, motivation, e.g. *on-the-job training*
- process: benefits which have an impact on the performance (quality, time) of in-house processes, e.g. *automation*
- IT: benefits which directly change IT (software, hardware, response time) in the enterprise, e.g. *reduced hardware requirements*
- resources: benefits which change the demand for raw materials/commodities which are not directly associated with the fields of staff and IT, e.g. *reduced energy consumption*
- clients: benefits with an immediate effect on present or future customer relations, e.g. *higher reliability*
- partners: benefits which affect collaboration with partners such as suppliers, e.g. *improvement of communication*.

BeneFIT is typically conducted through interviews with experts. Thus, project members from Fraunhofer FIT, e.g. researchers who developed and tested the BeneFIT approach to Benefits Management in previous projects, work closely with the pilot partners, determining the relevant benefits their organization gains of the implemented use cases in COMPOSITION. This was done via semi-structured workshops that were attended by two researchers of Fraunhofer FIT and maximal two experts of the pilot partner for the use case at hand. With the help of this code of practice and the experience of researchers from Fraunhofer FIT, experts of the pilot partners were able to determine all the impacts of the project, namely benefits, costs and risks. Note that the presented code of practice for BeneFIT in literature should be treated as a rough guideline and not as an exhaustive list. Therefore, it can be regarded as a source of inspiration instead of a rigid structure.

Next, all the collected benefits must be quantified in terms of their expected value, variance and (quite roughly) the correlations to other benefits. This was done in collaboration with the associated experts from the pilot partners via the conducted workshops. Through a fruitful discussion, necessary and important numbers, further risks, opportunities and other estimates were determined by the Fraunhofer and pilot partner experts. The estimates of the values came from different procedures. A proven method was to look at the costs and revenue

of the pilot partner pre-COMPOSITION. On the basis of the benefit at hand, it was possible to determine to what extent this value would change relatively upwards or downwards. The corresponding difference could then be transferred and used as an estimation.

Afterwards, the Fraunhofer project members used the results from the workshops as an input for an implemented excel-based tool, the BeneFIT-Tool. This yields a final value for the monetary value of the IT project, accounting for uncertainty and interdependencies and calculates an overall expected project value for the use case at hand. The BeneFIT-tool will be explained more thoroughly in section 4.2.3.3.

4.2.3.2 The Value of the BeneFIT-Method for COMPOSITION and Implementation Specifications

The business models in the COMPOSITION ecosystem range from IT consulting to research and line production. However, the intention of COMPOSITION is to use IT for enhancing processes and success among all of these enterprises. Therefore, the BeneFIT-Method is sort of hand-made for projects originating from the COMPOSITION ecosystem - be it for improving communication and data analysis in a consulting enterprise or automation/monitoring of certain work steps in line production. Moreover, the mathematical framework of the BeneFIT-Method is universally usable for projects with companies in different organizational contexts. Even if one notices that the guideline for determining benefits given by the above scheme is incomplete or not appropriate for the case of interest, it is still possible to figure out the relevant benefits and then proceed with the BeneFIT-Method by determining expectation values, risks, and dependencies parameter in the usual way. It is always a matter of finding the right application method depending on the context.

Once all the numbers are collected, it is less time consuming than the initial data collection to adjust them in real time in the course of the project. This is in line with the objective of adopting a simple and easy to apply approach that allows for a re-evaluation at a later stage. A re-evaluation might be necessary due to the detection of wrong estimates, or because external effects, which were uncertain to happen pre-COMPOSITION. Hence, with only a minimum effort, the tool can be kept up-to-date. In particular, since the costs of the IT project have already been collected, one can trail the costs and benefits that are yet to come with the ones which have already been implemented, allowing for a continuous assessment regarding the value of the remaining parts. This allows triggering warnings or suggestions to abandon the project, preventing it from ending as a “black swan”, which unfortunately happens to far too many IT projects. Thus, it is intuitively clear that the described tool is of high value for project management.

The only thing that might be uncertain is whether the additional costs that arise from implementing BeneFIT, i.e. for releasing staff from work in order to do workshops with BeneFIT-experts, are outweighed by the gains of getting control over the project outcome and meantime value of the COMPOSITION. However, positive feedback from practice partners, as well as concerning number of IT projects in practice, which end up causing enormous costs with little or no revenues, indicate that it is very well worth the effort. Moreover, it has turned out that in many cases companies cannot determine the earnings and gains or value associated with single processes or products, i.e. collecting (good estimates of) their data does not only help them with tracking the progress of the IT project under consideration, but also refining their knowledge about their own business model, a resource which is well-known to have an important impact on success.

This finally raises the question of how the BeneFIT-Method will be implemented. An essential decision that must be made is for which year the expected project value is calculated. This is relevant because in line with value-based management, it is assumed that the individual benefits arising from COMPOSITION will create value for the pilot partners in the following year. Nevertheless, the Fraunhofer project members cannot simply assume that these benefits will create additional business value forever. This would not correspond to the reality in which an organization normally continues to develop through further projects or adapts to a changing market. The increase in value by means of benefits is therefore no longer noticeable or relevant after a certain point in the future.

The Fraunhofer project members therefore have to choose a meaningful period (henceforth: evaluation period) for the benefits’ effect, which is not too early, so that the companies also have time in the next few years to realize the full benefit value. Besides, it also should not be too late and thus lead to unrealistically high project values. The Fraunhofer project members’ experience in science and practice shows that considering an evaluation period of five to six years after the project starts, is a reasonable choice. On the one hand, this time

period is usually long enough to allow for significant contributions of the acquired benefits and, on the other hand, is also not too long to hinder giving reasonable predictions. The Fraunhofer project members, thus, choose an evaluation period of five years starting from the date of the evaluation, September 2018, nearly one year before COMPOSITION's project completion in August 2019. The evaluation period ends with September 2023. They must apply the same evaluation period for all pilot partners in order to ensure comparability and subsequent aggregations. To illustrate the development of the project value as a function of the evaluation period, the project values for 2020 and 2026 are provided for all pilot partners. Their analysis provides an indication of how important the duration of the benefits' effects is for the pilot partner.

Together with the pilot partner experts, a realization plan is defined for every use case within the evaluation period. The plan determines how the degree of realisation of the benefits will develop over the next few years. The degree of realization indicates to what percentage the full value of a benefit is realized. For example, a benefit provides maximal savings of 10.000€ annually. The pilot partner experts expect the benefit to reach a degree of realisation of 50% in 2019. Hence, the Fraunhofer project members assume for their calculation that the benefit will generate savings of 5.000€ in 2019. Figure 9 shows this concept exemplary for a realization plan of 50% in 2019, 75% in 2020, 90% in 2021 and 100% in 2022 and 2023.

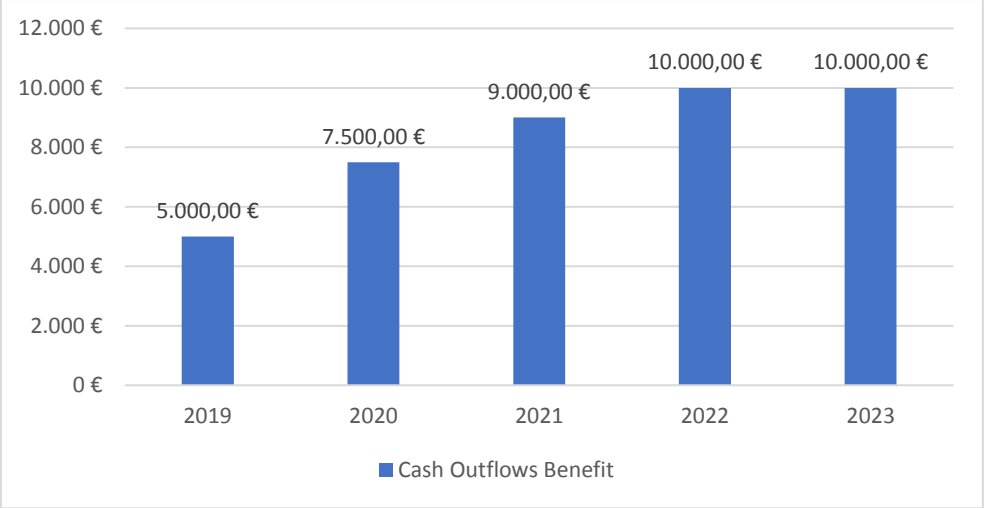

Figure 9: Exemplary Realization Plan for a Benefit with maximal Savings of 10.000€

The example shows the main weakness of this approach. Depending on the selected valuation interval, the cash outflows are assumed to be constant within a period, e.g. 5.000€ for the whole year 2019. This reduces the accuracy of the estimate, as the cash outflows of a benefit probably won't increase in steps but rather evenly. While this may be true, evaluating in an annual interval is an assumption that has to be made in order to keep the complexity of data collection as low as possible. Low complexity makes it easier for the pilot partner experts to estimate the necessary figures, reduces the effort (and thus the costs) involved in the estimation and makes it easier for the evaluation to be repeated at a later point in time. At the same time, the Fraunhofer project members state, based on their practical experience with the method, that an annual estimate is often sufficient enough to obtain meaningful results. The pilot partners agreed on this statement in the workshops and, thus, estimated the figure values on a yearly basis.

The realization plan aims to ensure that the value of benefits, by means of increasing revenue or reduced costs, is not simply generated after the implementation of a use case. Instead, its realisation is a longer-term task. For instance, employees have to get used to new processes or development potential has to be brought to light through further projects. For most pilot partners, the Fraunhofer project members assume that a degree of realisation of 100% will be achieved in the course of the years 2020 to 2023.

For the operational implementation of the BeneFIT-Method, the Fraunhofer project members use the BeneFIT-Tool already mentioned above. Its specifications are described in the next section.

4.2.3.3 The BeneFIT-Tool

Based on UC-ELDIA-1, the section aims to demonstrate how the BeneFIT-Tool works. By means of the first worksheet, one starts with specifying the overall project data. The needed key figures are the dates for the start of the project and the date when the impact of the benefits ends. Depending on the user input for the 'computation' cell, the cash flows associated with each benefit will have to be specified for every month, quarter or year in the period between the starting date end the end of impact of project benefits. Unfortunately, the latter is often not straightforward to determine because the impact of the benefits typically does not end at a fixed date but only decreases slowly or just gets harder to estimate. This problem occurs due to internal or external factors which have an influence on the business model are not constant but rather subject to permanent change.

For all use cases, the Fraunhofer project members chose to compute the cash flows yearly because this causes less effort when entering the data and is precise enough when taking into account that most numbers come from sophisticated estimations of experts rather than the accounting office.

Moreover, on the project data worksheet one can by now specify up to five scenarios with their respective probabilities of occurrence; typically, a best-case scenario, a worst-case scenario and a few intermediate scenarios. Since some of the use cases in COMPOSITION have turned out to be quite involved, the number of scenarios which can be defined has been increased to five in order to be able to deal with complicated combinations, in particular for ATL four highly distinct scenarios had to be considered.

Since the business models for the COMPOSITION use cases are highly sustainable and their implementation takes place only gradually over the period of several years, the number of partial realization degrees which can be respected has been increased to six. This improvement grants a more detailed recording of the development and therefore the aggregated benefits over the course of the project. Degrees of partial realization are defined both for the payments and the benefits and support in recording the results of the discussion and therefore in carrying out the subsequent estimations and calculations of cash flows. For example, the payments according to the final budget plan are split 50/50 between the time periods 2017/10/01 – 2018/10/01 and 2018/10/01 – 2019/10/01. According to the expert(s) from ELDIA, by 2019 a realization degree of 25% for every benefit will be realized. When one wants to track the project success over the course of the project, one can add further dates in the 'time of valuation' table. However, this is not the goal right now, but can be used for additional evaluations in the future. Figure 10 shows the basic structure of the project data sheet of the BeneFIT-Tool

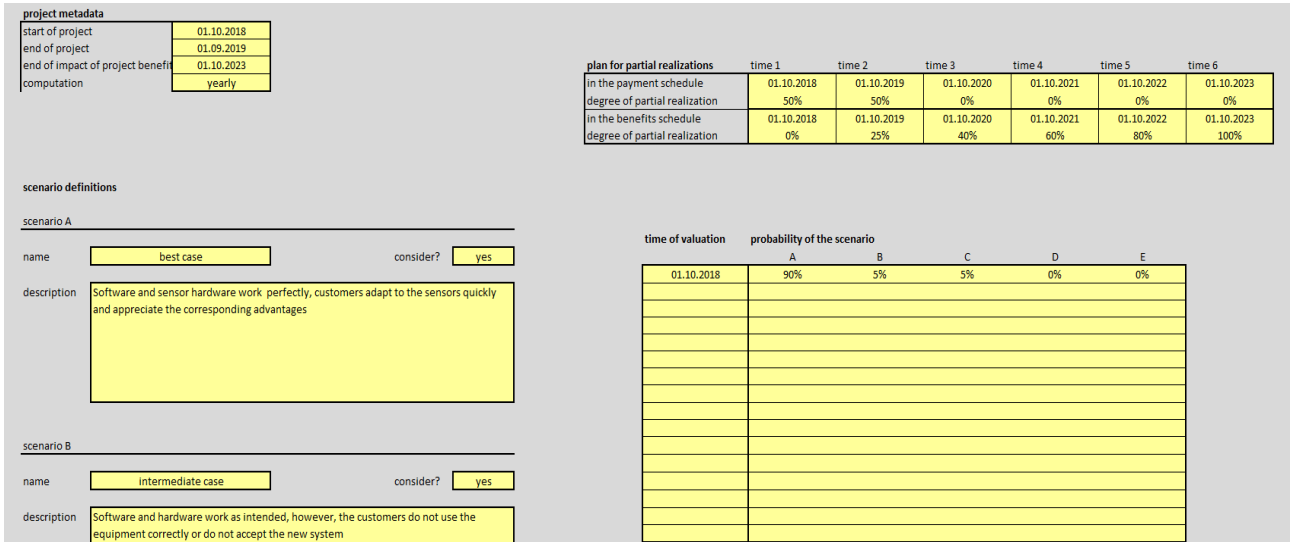

Figure 10: BeneFIT-Tool: Project Data

In the next step, a list containing all benefits associated with the project is created. The exhaustive list of benefits for IT projects, which has already been sketched before, together with the expertise of the

interviewees, ensures that all relevant benefits are captured and assigned to their scenarios. Note that for different scenarios there are typically different cash flows for the same benefit, so they are named according to the respective scenario. It might help to understand the relation between the best/worst suffix and the scenarios, if one knows that the scenarios in the ELDIA use case have been assigned as follows (this information is displayed on the project data worksheet):

Scenario A
Best case, i.e. hardware and software work well together and the customers get used to it quickly and appreciate the new system, in particular, every benefit takes the highest possible value.

Scenario B
The hardware and software work well, yet the customers do not get used to the system; consequently, benefits which are not related directly to customers still attain their best possible value, while by contrast those related to customers attain their worst-case value.

Scenario C
Worst case, consequently all the benefits take their lowest value.

Figure 11 shows an excerpt of the sheet in the BeneFIT-Tool for the collection of the benefits.

short name (benefit ID)	description	scenario(s)
personnel_hours_savings_best	savings in personnel hours (mainly from a significant reduction of time spent for taking and making calls in order to determine filling level of containers)	A
personnel_hours_savings_worst	" - "	B,C
less_drivers_best	optimized transportation implies that less trips are necessary in order to serve all customers, in particular, less drivers, trucks and fuel are needed	A
less_drivers_worst	" - "	B,C
less_trucks_best	" - "	A
less_trucks_worst	" - "	B,C
savings_transportation_best	" - "	A
savings_transportation_worst	" - "	B,C
higher_customer_satisfaction_best	faster and more reliable service increases customer satisfaction and loyalty	A
higher_customer_satisfaction_worst	" - "	B,C
costs_sensor_cases		A,B,C
costs_sensors		A,B,C
costs_software		A,B,C

Figure 11: BeneFIT-Tool: Collection for benefits

While the description column is merely of importance for summarizing the results of the discussion and understanding where the benefits come from, assigning the scenarios (from a drop-down menu) as a subset of all scenarios is crucial for the automatic computation that will be carried out by the excel tool later on. One can also enter area of effect, quantification rule and qualitative description for every benefit as additional attributes, which enhance traceability of the thoughts which lead to the specifications.

However, this is not always necessary (e.g. if the corresponding data is not recorded somewhere else during the interview). Moreover, it is rather a rare case that a single benefit can be associated with a certain area of effect or that there is a comprehensive mathematical formula for the computation of the cash flows assigned to the benefit. Note that it is always assumed that expenditures are deterministic and therefore independent of scenarios. Nevertheless, for a subset of expenditures, it is perfectly reasonable to introduce them as negative benefits; for example, if their value is also subject to uncertainty and might be correlated to other benefits. For

instance, in the ATL use case, there is a best-case scenario with a benefit ‘higher sales’ due to expansion, but there is also a higher negative benefit ‘expansion costs’.

As already mentioned before, for the correct mathematical computation of the standard deviation of the total project value we must also take correlations between the different benefits into account. Pairs of benefits which are not contained in this list have no correlation by default. The Fraunhofer project members distinguish between perfect positive and negative correlation, moderate perfect positive resp. negative correlation and no correlation, which corresponds to linear correlation coefficients of +1 resp. -1, 0.5 resp. -0.5 and 0. Of course, intermediate values could easily be used for the computation by manual insertion into the correlation matrix, which is created based on this table. However, a more sophisticated analysis of the correlation between single benefits is usually neither possible nor necessary because the values at choice already yield a sufficiently detailed estimate for the standard deviation. Additionally, they have no influence on the expected value anyway. Figure 12 shows the sheet in the BeneFIT-Tool for the assignment of correlations between the benefits.

benefit 1	benefit 2	qualitative description	reason for the specified correlation
3_less_drivers_best	5_less_trucks_best	perfect positive correlation	personnel hours for drivers, number of trucks and costs for fuel are proportional to the number of journeys needed and therefore perfectly correlated to each other
3_less_drivers_best	7_savings_transportation_best	perfect positive correlation	" - "
5_less_trucks_best	7_savings_transportation_best	perfect positive correlation	" - "
1_personnel_hours_savings_best	9_higher_customer_satisfaction_best	moderate positive correlation	customer satisfaction tends to be higher when less phone calls are needed
4_less_drivers_worst	6_less_trucks_worst	perfect positive correlation	personnel hours for drivers, number of trucks and costs for fuel are proportional to the number of journeys needed and therefore perfectly correlated to each other
2_personnel_hours_savings_worst	8_savings_transportation_worst	perfect positive correlation	" - "
6_less_trucks_worst	8_savings_transportation_worst	perfect positive correlation	" - "
2_personnel_hours_savings_worst	10_higher_customer_satisfaction_worst	moderate positive correlation	customer satisfaction tends to be higher when less phone calls are needed

Figure 12: BeneFIT-Tool: correlations between benefits

At this stage, all experts have usually acquired a good understanding of the business model and the benefits of the project and are thus well prepared for getting to the heart of the BeneFIT-Tool, namely specifying the quantitative estimates of the values for each of the benefits.

On the cash flows worksheet shown in Figure 13, the user now finds a complete list of all the benefits specified above and in the columns, there are all evaluation dates given by the start-of-project and end-of-impact-of-benefits dates. Hence, the next step consists of determining a lower and upper bound for the benefit value. The real value of the benefit should be within the limits of the interval, considering a probability of 80%. In the ELDIA use case, this led to the following table (note that only the yellow cells have to be specified, the grey ones are already filled-in based on the information entered into the worksheets which have been described before).

time of valuation	short name	scenario	exp. value	std. deviation	present value		01.10.2018	01.10.2019	01.10.2020	01.10.2021	01.10.2022	01.10.2023
01.10.2018	payments	-	220.673,08 €	- €	220.673,08 €	-	112.500 €	112.500 €				
01.10.2018	1_personnel_hours_savings_best	A	68.194,92 €	17.759,09 €	90.926,56 €	Max	- €	8.580 €	13.728 €	20.592 €	27.456 €	34.320 €
01.10.2018	1_personnel_hours_savings_best		- €	- €	45.463,28 €	Min	- €	4.290 €	6.864 €	10.296 €	13.728 €	17.160 €
01.10.2018	2_personnel_hours_savings_worst	B,C	34.097,46 €	8.879,55 €	45.463,28 €	Max	- €	4.290 €	6.864 €	10.296 €	13.728 €	17.160 €
01.10.2018	2_personnel_hours_savings_worst		- €	- €	22.731,64 €	Min	- €	2.145 €	3.432 €	5.148 €	6.864 €	8.580 €
01.10.2018	3_less_drivers_best	A	33.534,63 €	- €	33.534,63 €	Max	- €	- €	- €	- €	20.000 €	20.000 €
01.10.2018	3_less_drivers_best		- €	- €	33.534,63 €	Min	- €	- €	- €	- €	20.000 €	20.000 €
01.10.2018	4_less_drivers_worst	B,C	- €	- €	- €	Max	- €	- €	- €	- €	- €	- €
01.10.2018	4_less_drivers_worst		- €	- €	- €	Min	- €	- €	- €	- €	- €	- €
01.10.2018	5_less_trucks_best	A	22.635,87 €	1.964,92 €	25.150,97 €	Max	- €	- €	- €	- €	15.000 €	15.000 €
01.10.2018	5_less_trucks_best		-	-	20.120,78 €	Min	- €	- €	- €	- €	12.000 €	12.000 €
01.10.2018	6_less_trucks_worst	B,C	- €	- €	- €	Max	- €	- €	- €	- €	- €	- €
01.10.2018	6_less_trucks_worst		- €	- €	- €	Min	- €	- €	- €	- €	- €	- €
01.10.2018	7_savings_transportation_best	A	454.632,81 €	118.393,96 €	606.177,09 €	Max	- €	57.200 €	91.520 €	137.280 €	183.040 €	228.800 €
01.10.2018	7_savings_transportation_best		- €	- €	303.088,54 €	Min	- €	28.600 €	45.760 €	68.640 €	91.520 €	114.400 €
01.10.2018	8_savings_transportation_worst	B,C	227.316,41 €	59.196,98 €	303.088,54 €	Max	- €	28.600 €	45.760 €	68.640 €	91.520 €	114.400 €
01.10.2018	8_savings_transportation_worst		- €	- €	151.544,27 €	Min	- €	14.300 €	22.880 €	34.320 €	45.760 €	57.200 €
01.10.2018	9_higher_customer_satisfaction_best	A	2.640.772,89 €	687.701,27 €	3.521.030,52 €	Max	- €	- €	500.000 €	900.000 €	1.200.000 €	1.500.000 €
01.10.2018	9_higher_customer_satisfaction_best		- €	- €	1.760.515,26 €	Min	- €	- €	250.000 €	450.000 €	600.000 €	750.000 €
01.10.2018	10_higher_customer_satisfaction_worst	B,C	1.320.386,44 €	343.850,64 €	1.760.515,26 €	Max	- €	- €	250.000 €	450.000 €	600.000 €	750.000 €
01.10.2018	10_higher_customer_satisfaction_worst		- €	- €	880.257,63 €	Min	- €	- €	125.000 €	225.000 €	300.000 €	375.000 €
01.10.2018	11_costs_sensor_cases	A,B,C	- 27.837,06 €	- €	- 27.837,06 €	Max	- 7.500 €	- 4.500 €	- 6.000 €	- 6.000 €	- 6.000 €	- €
01.10.2018	11_costs_sensor_cases		- €	- €	- 27.837,06 €	Min	- 7.500 €	- 4.500 €	- 6.000 €	- 6.000 €	- 6.000 €	- €
01.10.2018	12_costs_sensors	A,B,C	- 16.702,24 €	1.449,85 €	- 14.846,43 €	Max	- 4.000 €	- 2.400 €	- 3.200 €	- 3.200 €	- 3.200 €	- €
01.10.2018	12_costs_sensors		- €	- €	- 18.558,04 €	Min	- 5.000 €	- 3.000 €	- 4.000 €	- 4.000 €	- 4.000 €	- €
01.10.2018	13_costs_software	A,B,C	- 7.500,00 €	1.953,13 €	- 5.000,00 €	Max	- 5.000 €	- €	- €	- €	- €	- €
01.10.2018	13_costs_software		- €	- €	- 10.000,00 €	Min	- 10.000 €	- €	- €	- €	- €	- €

Figure 13: BeneFIT-Tool: collection of cash flows

With this information inserted in the BeneFIT-Tool, the overall expected project value (expected value of benefits under the aforementioned normal distribution hypothesis) and its standard deviation is computed for each scenario based on the correlation matrix. As a final step, the values for the single scenarios are combined using the probabilities for the different scenarios, yielding a single project value with associated standard deviation, based on which the profitability of the project can be analysed.

4.2.4 Showcase - BeneFIT for UC-ELDIA-1

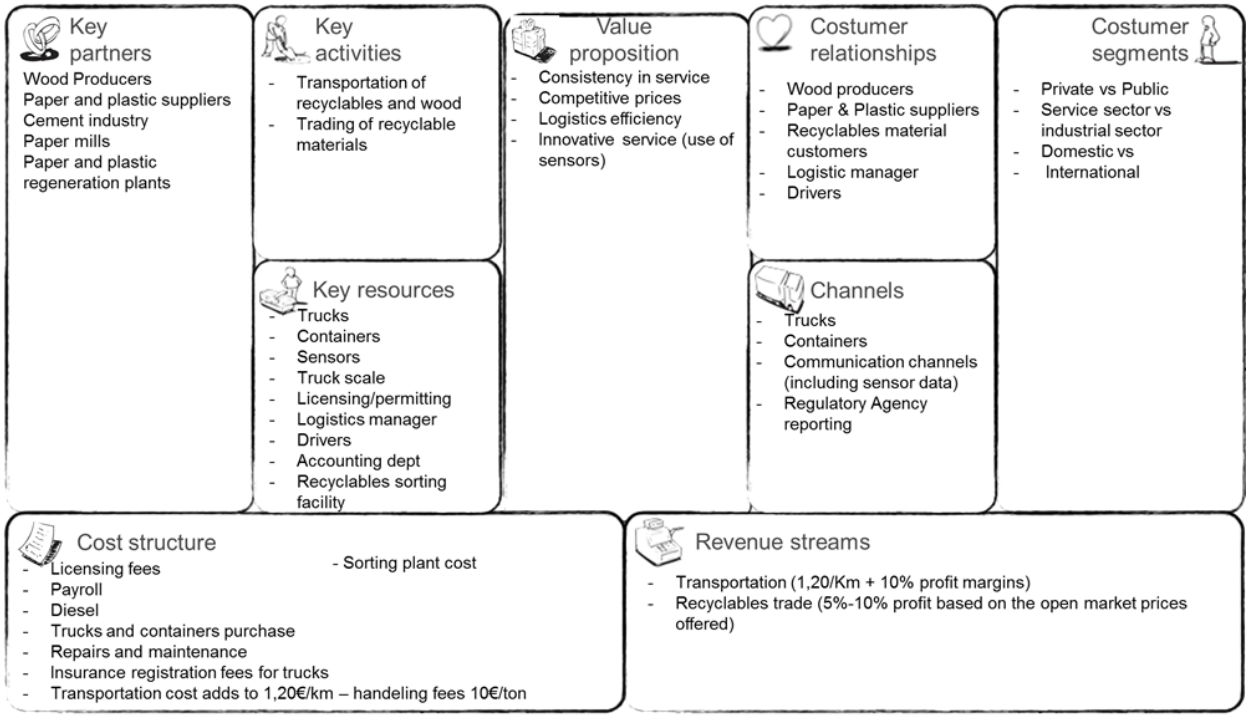

Figure 14: BMC for UC-ELDIA-1

By conducting a workshop with an expert of the organization the Fraunhofer project members were able to identify several meaningful benefits for ELDIA's internal processes as well as for their customer facing

processes. A distinction is made between three scenarios, whose premises, by means of occurring risks, affect the monetary value of these benefits.

Scenario A is considered to be the best-case scenario, for which all sensors are successfully installed, and the notification systems is nearly fully functional. On the contrary, in scenario B the pilot partner experts expect major technical difficulties to have a significant impact on the benefits of the notification system. For instance, sensors may be malfunctioning, or the notification system may be unreliable. Scenario C accounts for risks arising by customers, which use the equipment incorrectly or do not accept the new automated system. For instance, consequences may be dissatisfied customers.

Since the previous tests of the use case implementation were very promising, the experts assume that scenario A occurs with a probability of 90%. The remaining probability is split equally between scenario B and C, netting 5% each. However, if scenario B or C occurs, the experts assume that the value of the benefits will be reduced by up to 75%.

All benefits are based on the assumption that the use case implementation enables an optimization of the current transportation processes. ELDIA can, thus, proactively approach its customers and initiate the exchange of the containers before they are overfilled and no longer usable. They plan to complement the system with data analytics to predict replacement times in advance. Afterwards, an optimization tool identifies ideal transport routes for the next planning period, e.g. daily or hourly. ELDIA aims to save roughly 5-10 trips per day, which in turn enables a more efficient use of their current amount of trucks. On top, the notification system will be combined with their current payment process in order to make it more efficient and additionally save personnel costs in the accounting department.

Apart from the internal savings, the expert points towards the potential in terms of their customer relationship management. He states that consistency, innovative services and competitive prices are the main value propositions ELDIA offers to their customers (see also Figure 14). By keeping logistics expenses at a reasonable level, ELDIA can keep the costs for their services constant. Furthermore, proactive container replacements based on data analytics and complemented with optimized transportation routes represent a huge improvement by innovating their services. As a result, customer satisfaction and loyalty are expected to increase considerably. Generally, changes in customer satisfaction result in increasing or decreasing revenues (Anderson and Mittal 2000). Literature therefore assumes that revenues and customer satisfaction show a linear dependency. The most noticeable benefits of growing customer satisfaction are higher sales rates, customer retention, or word-of-mouth (Anderson and Mittal 2000). Therefore, the use case implementation will positively stimulate the relation between ELDIA and their current customers as well as the probability to acquire new customers. The experts even estimate that for scenario A the growth in customer satisfaction will increase ELDIA's annual revenues by roughly 1.500.000€ until 2023.

For UC-ELDIA-1 all benefits are strongly correlated to each other. Thus, the same realization plan for all benefits is assumed. The experts state that 25% of the benefits can be realized until the end of COMPOSITION in 2019. Afterwards, ELDIA has to implement the sensors organization-wide and for all customers to realize the full value of the benefits. Therefore, the expert estimates that the benefits reach a degree of realization of 40% by 2020, 60% by 2021, 80% by 2022 and finally 100% by 2023.

Figure 15 shows an overview of the scenarios' probabilities, project values and standard deviations for the years 2020, 2023 and 2026.

	Scenario A	Scenario B	Scenario C	Overall
Probability	90%	5%	5%	
Project value by 2020	211.000€	-22.000€	-22.000€	188.000€
Standard Deviation	94.000€	47.000€	47.000€	91.000€
Project value by 2023	2.947.000€	1.309.000€	1.309.000€	2.783.000€
Standard Deviation	698.000€	349.000€	349.000€	671.000€
Project value by 2026	6.040.000€	2.817.000€	2.817.000€	5.717.000€
Standard Deviation	1.374.000€	687.000€	687.000€	1.322.000€

Figure 15: Project Value for UC-ELDIA-1

By using the BeneFIT-Tool, the Fraunhofer project members calculate an overall project value of about 2.783.000€ and a standard deviation of about 671.000€ for the year 2023. When analysing the project value, two factors are important. First, the project value should be positive. This ensures that being part of COMPOSITION was not unprofitable for the organization at hand, considering the benefits' effects last until 2023. Secondly, the amount of the value allows a statement to be made about the profitability. Thus, it is reasonable to state that the implementation of the UC-ELDIA-1 is of great use for ELDIA. Even if scenario B or C occur, there's still a very good chance that the organization will increase its overall profits. The calculation also shows a positive project value for a shorter duration of the benefits' effects until 2020. It can therefore be assumed that ELDIA will benefit from COMPOSITION in any case, regardless how strong the project value fluctuates in between the standard deviation. Since ELDIA is one of the industry leaders within waste management services in Greece, the amount of the project value is also reasonable. One should also consider that the values were estimated very optimistically. This is based on the assumption that participation in COMPOSITION also has smaller qualitative benefits for ELDIA that are difficult to quantify. For instance, expertise in the field of automation and digitization projects that facilitates the implementation of future projects.

4.2.5 Conclusion

Altogether, the BeneFIT-Method for Benefit Management is particularly suitable for the use cases in the COMPOSITION ecosystem. It provides a mathematical scheme to facilitate a quantitative assessment of the aggregated benefits, considering costs, risk and dependencies (i.e. of correlations between benefits).

The application to the showcase shows that the method produces meaningful and interpretable results. This is an important prerequisite to be able to use it for the other use cases. Still, it is quite a precise method, requiring a detailed engagement into collecting data and estimating numbers. The gain is a statistically well-founded, monetary evaluation of the project and control during the whole project time. Therefore, it is important to record the experience gained from the first implementation of BeneFIT in this deliverable, so that future project evaluations for COMPOSTION can be conducted and refined more easily. This will be the case, for example, in D9.11, for which the BeneFIT-Method will be used again to monitor the progress of the project over the coming months.

4.3 Evaluation of the pilot partner's use cases

In the following the cost, risk and benefits analysis for every remaining pilot partner within the COMPOSITION ecosystem is presented by using the approach introduced above. After an individual consideration of the pilot partners and their use cases, the results are discussed in relation to the entire COMPOSITION budget. At last, the Fraunhofer project members try to answer the question whether COMPOSITION is worthwhile after current knowledge conditions and represents an attractive investment for further companies in the future.

4.3.1 Use Cases for ATL

Contrary to the other use cases, COMPOSITION provides ATL with new opportunities for their overall business model rather than focus on an improvement of one single or a few processes. As already stated in D9.9, the goal of ATL's use cases is to strengthen ATL's core business, selling software and consultancy, by using the software vendor within COMPOSITION as a central platform. They can advise potential customers, select suitable products and settle various contractual matters. Figure 16 and show the BMC for ATL's use cases.

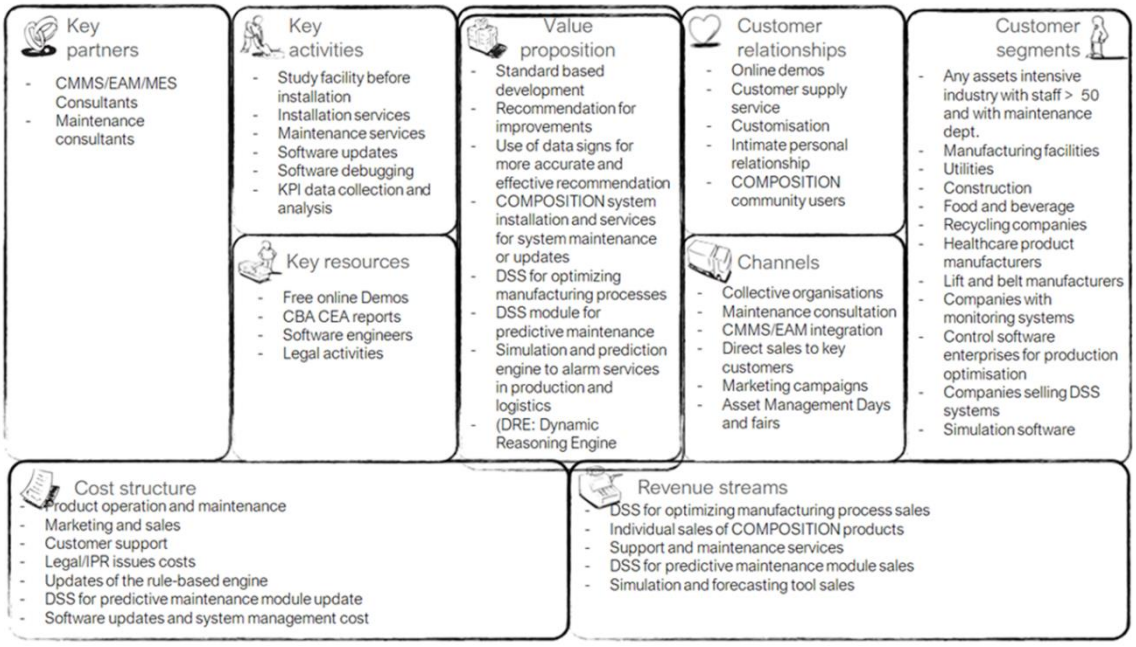

Figure 16: BMC for ATL

ATL did not have access to a similar ecosystem and platform like COMPOSITION beforehand and there is no directly comparable process for the pre-COMPOSITION status. Instead, the experts derive possible benefits of this opportunity based on the post-COMPOSITION goal. The experts identified four different scenarios and three benefits for ATL that would have a significant long-term positive impact on their business.

Scenario A is considered to be the best-case scenario with a probability of 65%. Scenario B accounts for the possibility of a low number of companies joining the COMPOSITION market place, which reduces the potential revenue growth of ATL significantly. Scenario C assumes that one or multiple internationally well-known IT companies release directly competing products to COMPOSITION. The resulting competition reduces the number of companies connecting to COMPOSITION in the long term. In scenario D the experts account for the possibility of ATL not being able to keep up with the growth in market share and customers they acquire through COMPOSITION. This leads to a reduced service level, the possibility of dissatisfied customers and less or none revenue growth. The experts estimate scenario B as the second most likely with a probability of 15% and state that scenario C and D are equally likely, each with a chance of 10%.

For the benefits, first and most important there are different factors leadings to an estimated substantial **increase in sales**. ATL has the opportunity to reach more customer markets since COMPOSITION isn't restricted to local boundaries and theoretically any number of companies can be connected. The experts estimate that in 2023 ATL could have access to about ten more markets compared to the status quo, which would roughly quadruplicate their sales in scenario A. Additionally, COMPOSITION enables ATL to offer a higher service level for their customers and, thus, increase customer satisfaction and loyalty. As already shown above, COMPOSITION therefore positively stimulates the relation between ATL and their current customers and their chance to acquire new customers.

Second, a central market place like COMPOSITION **reduces necessary costs for the sales & marketing departments** of ATL. This improvement can be achieved because of a diminished necessity for so-called cold

calls (customer acquisition without prior contact), online advertising and the distribution of marketing materials as most marketing can be done via COMPOSITION. The experts estimate that the costs for sales & marketing will decrease roughly by 30% until 2023. The potential savings are affected negatively by scenario B, C & D since fewer customers via COMPOSITION require recourse to previous methods of sales & marketing.

Third, by managing customer relations digitally within COMPOSITION, ATL could make use of **more efficient customer processes** (e.g. template based) and **reduce costs for the accounting department**. The experts estimate the effect to not exceed a 20% reduction. Scenario B, C & D negatively affect this benefit as well.

In order to achieve these benefits, ATL has to incur costs in the next years, especially with regard to the size of the organization they need for satisfying more customers. This includes the hiring of new employees or time and effort that has to be put into follow-up projects. Considering the potential growth in customers, ATL's personnel resources need to grow at the same rate and speed. The experts estimate the required investments to not exceed a maximum of 160.000€ by 2023 for scenario A, which poses the biggest challenge to ATL's personnel capacity. As scenario B and D assume a moderately lower increase of market share, costs for organizational expansion are considered to be reduced by half. The experts estimate the lowest amount of necessary investments for scenario C, as ATL's number of customers will increase the least for this one.

As ATL takes the role of a pilot partner and technical partner in COMPOSITION at the same time, it is inevitable to determine how much of their allocated project budget can be mapped specifically to their use cases. Therefore, the experts estimate a share of 17% of the budget as a reasonable proportion that represents the effort they put into their use cases in comparison to their work as a technical partner, netting roughly 70.660€.

For ATL all benefits are strongly correlated to each other. This may be attributed to the fact that all benefits are linked to the long-term success of the COMPOSITION platform. Thus, the experts assume the same realization plan for all benefits. The experts state that 15% of the benefits can be realized until the end of 2018 and 40% until the end of COMPOSITION in 2019. Afterwards, it is reasonable to assume that ATL takes some time to structure, e.g. for company growth, until the full benefits come into play. The experts estimate a realization of 50% by 2020, 70% by 2021, 80% by 2022 and 100% by 2023.

Figure 17 shows an overview of the scenarios' probabilities, and project values and standard deviations for the years 2020, 2023 and 2026.

	Scenario A	Scenario B	Scenario C	Scenario D	Overall
Occurrence Probability	65%	15%	10%	10%	
Project value by 2020	463.000€	145.000€	31.000€	-9.000€	255.000€
Standard Deviation	107.000€	170.000€	74.000€	71.000€	113.000
Project value by 2023	1.630.00€	617.000€	253.000€	124.000€	**1.120.00€**
Standard Deviation	340.000€	544.000€	237.000	226.000	**361.000€**
Project value by 2026	3.211.000€	1.283.000€	594.000€	465.000€	2.316.000€
Standard Deviation	622.000€	973.000€	428.000€	414.000€	655.000€

Figure 17: Project Value for ATL

By applying the BeneFIT-Method, the Fraunhofer project members calculate an overall project value of roughly 1120.000€ and a standard deviation of roughly 361.000€ for the year 2023. This is reasonable, considering the high potential COMPOSITION provides for the market share of ATL in the future. Individually, all scenarios result in a positive project value, declining from scenario A to D. This can mainly be attributed to the fact that even the estimates for the worse scenarios B, C and D still consider an increase in revenues and cost savings to be very likely. Even if all values were estimated very optimistically, one should bear in mind that being part of COMPOSITION, specifically for an IT company like ATL, generates impactful expertise for future projects. Related monetary implications are extremely difficult to determine or estimate as they depend on many contextual factors of the organization at hand. Therefore, high estimations for the increase in sales and cost savings are a reasonable approach to consider those factors in the benefits, cost and risk analysis.

4.3.2 Use Cases for BSL

Overall, three use cases will be implemented for BSL. Since UC-BSL-3 can be implemented largely independently of the others, the Fraunhofer project members decide to make a distinction for BSL. Generally, it makes sense to calculate a single project value per pilot partner in order to establish comparability to the other pilot partners' results. In the case of BSL, however, the independence of the use cases and their benefits would increase the complexity of the calculation tremendously. That is why the Fraunhofer project members calculate a joint project value for UC-BSL-2 and UC-BSL 5 and a separate project value for UC-BSL-3. UC-BSL-2 and UC-BSL-5 have fundamental similarities in the sense that the data, that is being collect for predictive maintenance in UC-BSL-2, is simply visualized on a monitor additionally for UC-BSL-5. It is therefore assumed that there is a high dependency between the two use cases and that they can be analysed together.

The discussed consideration raises the question of how divide the budget for BSL, netting roughly 509.000€, should be divided between the two cases. During the workshop the BSL experts state that UC-BSL-3 is much easier to implement and therefore requires less effort in the project. On the contrary, the implementation of a working predictive maintenance system in UC-BSL-2 is a time-consuming task not only for BSL but for other partners within COMPOSITION as well. As a conclusion, the Fraunhofer project members map 85% of the budget to UC-BSL-2 and UC-BSL-3, netting roughly 433.000€, and 15% to UC-BSL-3, netting roughly 76.000€.

4.3.2.1 Use-Case UC-BSL-3

UC-BSL-3 aims to reduce the number of lost materials in BSL's production by tracking the movement of components entering the factory with sensors. These sensors send the location data of the components to a central system, which displays their last known location and the time the data was obtained. A visualization screen enables employees to access the data. According to the interviewed experts of BSL, there was no standardized or automatized process targeting this problem pre-COMPOSITION. Employees had to search laboriously and manually for lost material and many components are no longer found. Consequently, this increases idle time, if the materials are necessary for production processes. Figure 18 shows the BMC for UC-BSL-3.

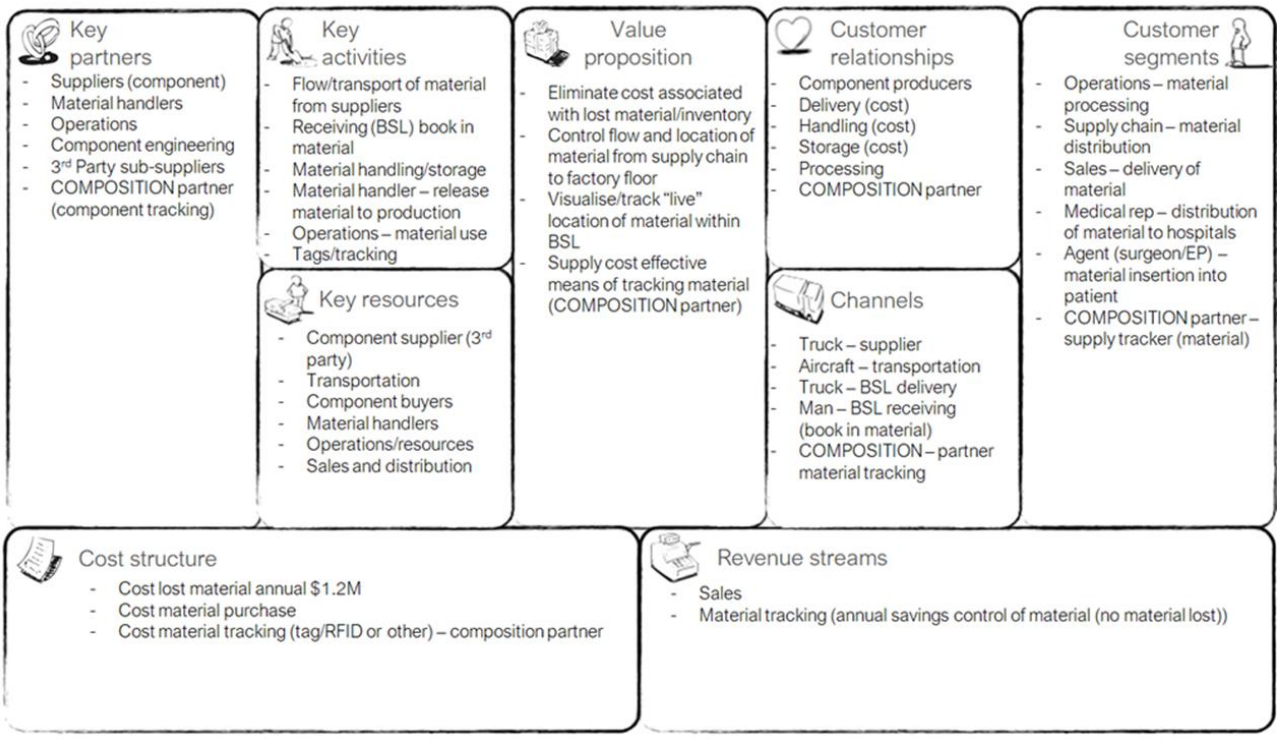

Figure 18: BMC for UC-BSL-3

As UC-BSL-3's main goal is to mitigate, possibly even eliminate, the damage of material loss in BSL's production, the experts derived the benefits by analysing the problematic scenario pre- and post-COMPOSITION. The experts estimate that lost material generates costs of 1.200.000$ annually pre-COMPOSITION. On the one hand, this is due to the raw material costs of the components that are lost. The experts quantified this as 70% of the total costs, netting 840.000$. On the other hand, the problem incurs employee costs because employees have to give up their time searching for lost materials. This accounts for the remaining 30%, netting 360.000 $. Therefore, the experts determined two benefits with two different scenarios.

Scenario A is the ideal case if all technical devices work most of the time and the search system can be used for its purpose almost continuously. In scenario B it is assumed that the technical implementation does not work properly, triggered by continuous hardware or software problems. As the experts stated that they are rather optimistic about the use case's implementation, they define the probability for scenario A as 85% and for scenario B as 15%.

The most important benefit is that **material loss can potentially be eliminated completely** since every component's location is being tracked all the time. Theoretically, any lost material can be found with the location data provided by the tracking system. Nevertheless, scenario A still considers possible minor technical difficulties, e.g. occasionally malfunctioning sensors or tracking inaccuracies. Thus, for scenario A the savings in material costs are roughly between 70%, netting 600.000$, and 100%, netting 840.000$. However, if the technical implementation is not working properly in scenario B, it is possible that this benefit will not generate cost savings at all. For example, if the tracking system only works in a few cases or if expensive follow-up projects are necessary to create an operational system. Depending on strength and extent of technical problems in scenario B, the experts estimate the savings to range from a maximum of 600.000 $ to 0 $.

Second, employees have to spend **less time to search for lost materials**. Even if the new system will significantly reduce the effort in scenario A, employees still have to stop their regular work to look for lost materials. That is why the experts assume that additional employee costs cannot be eliminated completely. More precisely, the maximal amount of savings ranges between 300.000$ and 250.000$ in scenario A.

Considering a malfunctioning system that works only partially or not at all in scenario B, the savings range between 250.000$ and 0 $. This is due to the fact that in scenario B the organization has to put effort into fixing the tracking system or the employees receive no benefit cause of inaccurate tracking for the components.

The main cost drivers for UC-BSL-3 are the budget for BSL and costs for hardware, e.g. sensors and RFID chips. As stated above, the budget for BSL is divided between the use cases and mapped 76.000€ to UC-BSL-3. The costs for sensors and RFID chips mainly depend on the degree of realization of this use case within BSL's production: The more sensors they implement, the higher the amount of costs.

Figure 19 shows an overview of the scenarios' probabilities and expected project value and standard deviation for the years 2020, 2023 and 2026. BSL's headquarter is located in the USA and, thus, the experts estimate all numbers in dollars. All figures are converted into euros, based on the exchange rate on August 27th, 2018, netting 0,86€/$.

	Scenario A	Scenario B	Overall
Probability	85%	15%	
Project value by 2020	560.000€	236.000€	365.000€
Standard Deviation	59.000€	168.000€	73.000€
Project value by 2023	3.116.00€	1.324.000€	2.373.000€
Standard Deviation	330.000€	929.000€	405.000€
Project value by 2026	5.538.000€	2.355.000€	4.277.000€
Standard Deviation	585.000€	1.650.000€	719.000€

Figure 19: Project Value for UC-BSL-3

By applying the BeneFIT-Method, an overall project value until 2023 for UC-BSL-3 of roughly 2.373.000€ and a standard deviation of 405.000€ is calculated. This is reasonable, considering the high economic damage that lost material causes annually for BSL. The pilot partner experts additionally pointed out that a tracking system for all their components potentially generates even more value in the future. They may, for example, use the system to increase transparency for their supply chain partners to improve existing supply chain processes. Moreover, attaching sensors and RFID chips to their material for the live tracking of location-based data facilitates future automatization projects in their factories.

4.3.2.2 Use-Case UC-BSL-2 and UC-BSL-5

The COMPOSITION solution for UC-BSL-2 aims at integrating so-called "predictive maintenance" features with the goal of determining the condition of fans in order to predict when maintenance should be performed to generate cost savings over routine. Right now, tasks are performed only when warranted. Also, the prevention of unexpected equipment failures should be reduced by having and analysing the relevant parameters of the fans. Therefore, maintenance can be better planned and what would have been "unplanned stops" are transformed to shorter and fewer "planned stops", thus increasing fan availability and production performance. On top, the lifetime of the fans potentially expands by using predictive maintenance solutions. Predictive maintenance evaluates the condition of the fans at BSL by performing real-time monitoring of parameters which give information about the fans` condition. The aim is to perform maintenance at a thoughtful point in time when maintenance work is most cost-effective. Figure 20 and Figure 21 show the BMCs for UC-BSL-2 pre- and post-COMPOSITION

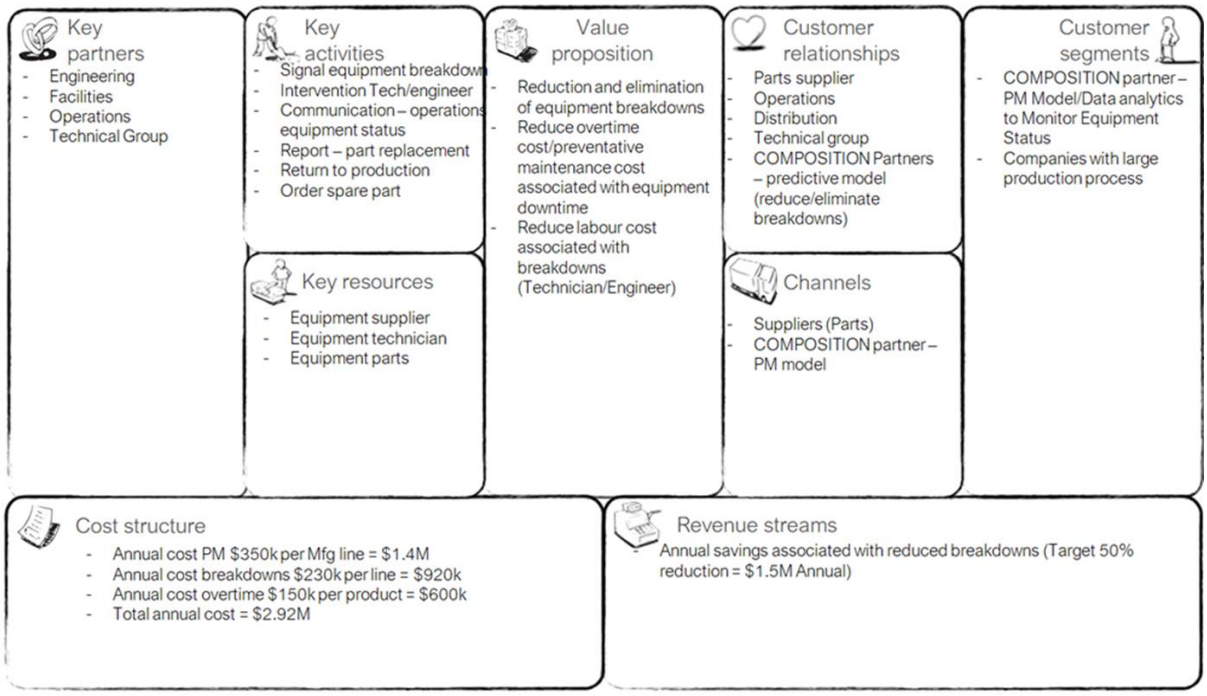

Figure 20: BMC for UC-BSL-2

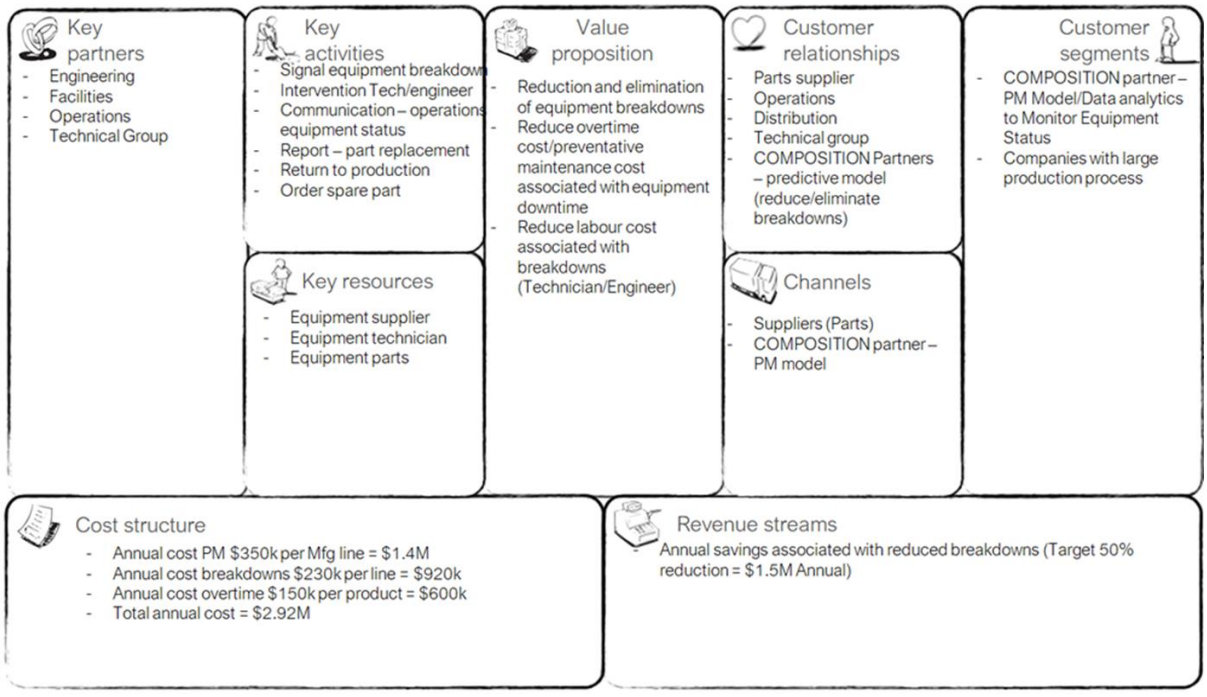

Figure 21: BMC for UC-BSL-5

The BMCs show that pre-COMPOSITION machine downtimes, costs for personnel overtimes and waste of material are primary cost drivers. This leads to the definition of three main benefits whose values are estimated and analysed in two scenarios.

In the best-case scenario, the predictive maintenance system is implemented successfully and works optimally. Medium to severe technical difficulties mitigate the potential savings in the second scenario significantly, while even no saving at all is possible. Due to the complexity and difficulty of implementing a predictive maintenance system, the experts estimate the probability for the best-case scenario as 70% and for the scenario with technical difficulties as 30%.

The current cost drivers conclude that **less machine downtime, personnel overtime and material loss** are the benefits of UC-BSL-2. The experts estimate that by the end of COMPOSITION, the use case will be implemented as a pilot for one of their manufacturing lines. Figure 22 shows the benefits, by means of estimated savings annually for the three benefits in both scenarios for one manufacturing line.

Benefits ***by means of savings***	Best-case		Technical difficulties	
	Maximum	Minimum	Maximum	Minimum
Less machine downtime	110.000$	55.000$	55.000$	0$
Less personnel overtime	70.000$	35.000$	35.000$	0$
Less material loss	32.000$	16.000$	16.000$	0$

Figure 22: Benefits for UC-BSL-2

Since this is only a pilot trial, the experts estimate that a degree of realization of 50% of the benefits will be reached at the end of COMPOSITION in 2019. Starting by the end of 2021, BSL can potentially maintain a completely operational system for the first manufacturing line. Afterwards, they may even quadruplicate their benefits by extending the predictive maintenance system to additional three manufacturing lines. Especially for scenario A, this leads to high potential benefit savings in 2022 and 2023.

On the contrary, there are several investments necessary to reach these benefits. First and most important, the experts consider the COMPOSITION budget for BSL. As stated above, the budget for BSL is divided between the use cases and mapped 433.000€ to UC-BSL-2 and UC-BSL-5. Furthermore, BSL has to buy additional hardware and equipment, e.g. PCs, monitors and especially sensors. The BSL experts estimate that there will be additional personnel costs after COMPOSITION ends, amounting to 10.000$. Considering BSL extends their predictive maintenance system to three further manufacturing lines, the experts estimate investments, amounting to 20.000$ for extra equipment.

As already stated in chapter 4.3.3., UC-BSL-5 builds on the data generated in UC-BSL-2. A visualisation screen provides the user with information about several important production indicators:

- Equipment status and production rate
- Equipment status (e.g. green for production ready/in production)
- Changes in equipment status (+ Notification of relevant actors)

The main goal is to reduce scrap and identify problems early to take appropriate actions. Thereby, the visualisation screen should provide information in a structured way and inform the involved parties instantly. Nevertheless, this does not completely replace manual supervision by an employee. Involved parties still need to keep track of equipment issues and react, when issues occur. Figure 23 shows the BMCs for UC-BSL-5 post-COMPOSITION.

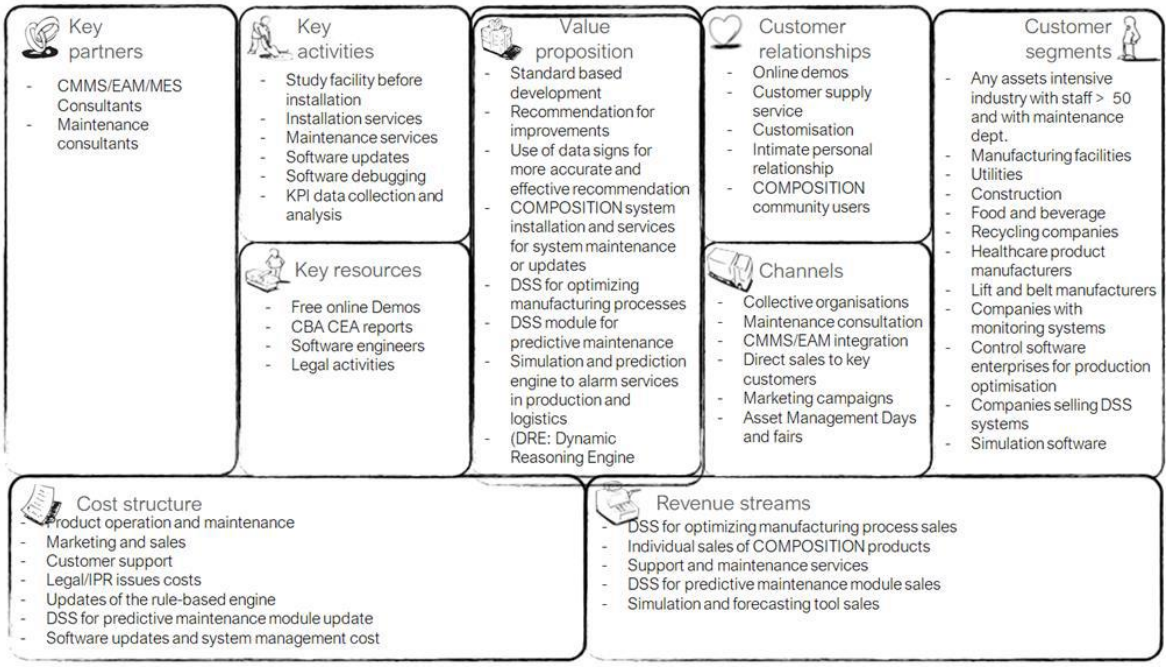

Figure 23: BMC for UC-BSL-5

Similar to UC-BSL-2, the experts consider two different scenarios. The best-case scenario represents the optimal case, for which the visualization screen is implemented successfully and proves to lead to an improvement of BSLs production. The second scenario represents a worse case with technical difficulties, e.g. a faulty visualization. The damage or effort to fix these issues may potentially eliminate all benefit value.

There is a reason only one holistic evaluation for UC-BSL-2 and UC-BSL-5 is carried out, especially as the benefits of the two cases complement each other. In both cases **increasing work efficiency** and **reducing employee costs** represent important benefits. The main reason for this is that the production supervisors can track the current status of the machines more easily and that maintenance workers see all important information about the machine at once, clearly structured, and prepared. Even if there is a working predictive maintenance system installed, it is still necessary that an employee monitors the machines' status periodically. For example, he must check whether the predictive maintenance system is functioning correctly. A visualization screen facilitates the effort for this task significantly. This also increases the chance that problems in the system will be detected early or positively affects identifying potential improvement factors. This leads to an overall improvement of the predictive maintenance system, for example in the **reduction of idle time**, and **increases productivity**.

The experts emphasize that the benefits of UC-BSL-5 are not completely dependent on a successful implementation of UC-BSL-2. Even if there is no functioning predictive maintenance system, the visualization, preparation and the processing of manufacturing data represents a huge improvement of BSLs current information management. Additionally, the experts state that the implementation of UC-BSL-5 is not as risky as UC-BSL-2 considering an easier realization. Therefore, the experts estimate a probability of 90% for UC-BSL-5's best case scenario and 10% for its second scenario with technical difficulties.

The estimated realization plan of UC-BSL-5 matches with the one of UC-BSL-2. Moreover, the system can be expanded to additional three production lines.

As UC-BSL-2s and UC-BSL-5s implementation demonstrate different levels of difficulty, the experts estimated different probabilities for the two scenarios (best case and technical difficulties). Therefore, it would be inaccurate to simply merge the scenarios for their evaluation without consideration of the differences in occurrence probability. Instead, the experts define a total of four scenarios, A, B, C and D for all possible combinations. Figure 24 illustrates the concept.

	Best-case UC-BSL-5	Technical Difficulties UC-BSL-5
Best-case UC-BSL-2	Scenario A	Scenario C
Technical Difficulties UC-BSL-2	Scenario B	Scenario D

Figure 24: Combinations of Scenarios for UC-BSL-2 and UC-BSL-5

Figure 25 shows an overview of the scenarios' probabilities, project values and standard deviations for the years 2020, 2023 and 2026. BSL's headquarter is located in the USA and, thus, the experts estimate all numbers in dollars. All figures are converted into euros, based on the exchange rate on August 27th, 2018, netting 0,86€/$. The scenarios' probabilities are calculated by multiplying the probabilities for the two considered scenarios. For instance, if the best case for UC-BSL-2 (probability: 70%) and the best case for UC-BSL-5 (probability: 90%) occurs one can calculate a probability of 63% (70% * 90*) for scenario A.

	Scenario A	Scenario B	Scenario C	Scenario D	Overall
Probability	63%	27%	7%	3%	
Project value by 2020	-285.000€	-403.000€	-305.000€	-424.000€	-322.000€
Standard Deviation	38.000€	37.000€	38.000€	37.000€	37.000€
Project value by 2023	1.256.000€	172.000€	1.178.000€	94.000€	923.000€
Standard Deviation	344.000€	337.000€	344.000€	337.000€	342.000€
Project value by 2026	3.141.000€	853.000€	3.011.000€	722.000€	2.441.000€
Standard Deviation	722.000€	707.000€	722.000€	707.000€	718.000€

Figure 25: Project Value for UC-BSL-2 and UC-BSL-5

By applying the BeneFIT-Method, the Fraunhofer project members calculate a project value until 2023 for UC-BSL-2 and UC-BSL-5 of about 923.000€ with a standard deviation of 342.000€. This value is positive and in the upper six-digit range. They therefore conclude that the implementation of both use cases is profitable for BSL. Compared to UC-BSL-3, however, the project value is a bit lower. This is mainly due to the fact that the probability for the best-case scenario of UC-BSL-2 was estimated to be significantly lower. It is therefore not surprising that technical problems in the other scenarios reduce the overall project value. Nevertheless, if you look at the further development up to 2026, it is obvious that a longer effect of the benefits has a strong positive impact on the project value. If BSL manages to implement the predictive maintenance system in a meaningful way in the long term, it cannot be ruled out that the benefits will have a significant impact beyond 2023. Additionally, it is very important that efforts are made to positively influence the occurrence of the scenarios AA and AB during the further course of the project. Both are the main drivers of the project value.

4.3.3 Use-Cases for KLE

For KLE the Fraunhofer project members chose a similar approach as for BSL and consider both use cases together for the calculation of the project value. There are two main reasons for this. First, both use cases have similar goals: Optimizing internal manufacturing processes. Second, there are also interdependencies between the benefits of both use cases. In addition, it was already emphasized that there is an improved comparability of the results if one focuses on one project value per pilot partner.

UC-KLE-1 aims at implementing a maintenance decision support system for machines in KLEs manufacturing. The machines' status is continuously monitored and analysed by the COMPOSITION system. Thus, suggestions can be made for necessary machine maintenance by notifying maintenance employees. There is a strong similarity to the predictive maintenance system at UC-BSL-3. Accordingly, the goal is to optimise manufacturing processes and procedures and to reduce the overall idle time caused by maintenance.

UC-KLE-4 is especially similar to UC-ELDIA-1. The aim is to install sensors in the garbage containers that measure their current filling level. Employees are to be notified automatically by COMPOSITION if the filling level exceeds a certain level. Waste management companies can send their offers and COMPOSITION selects the most suitable one which needs to be approved by an employee of KLE afterwards. As a last step, possible (sometimes already negotiated) pick-up arrangements are determined and the waste is being collected. Figure 26 and Figure 27 show the BMCs for UC-KLE-1 and UC-KLE-4.

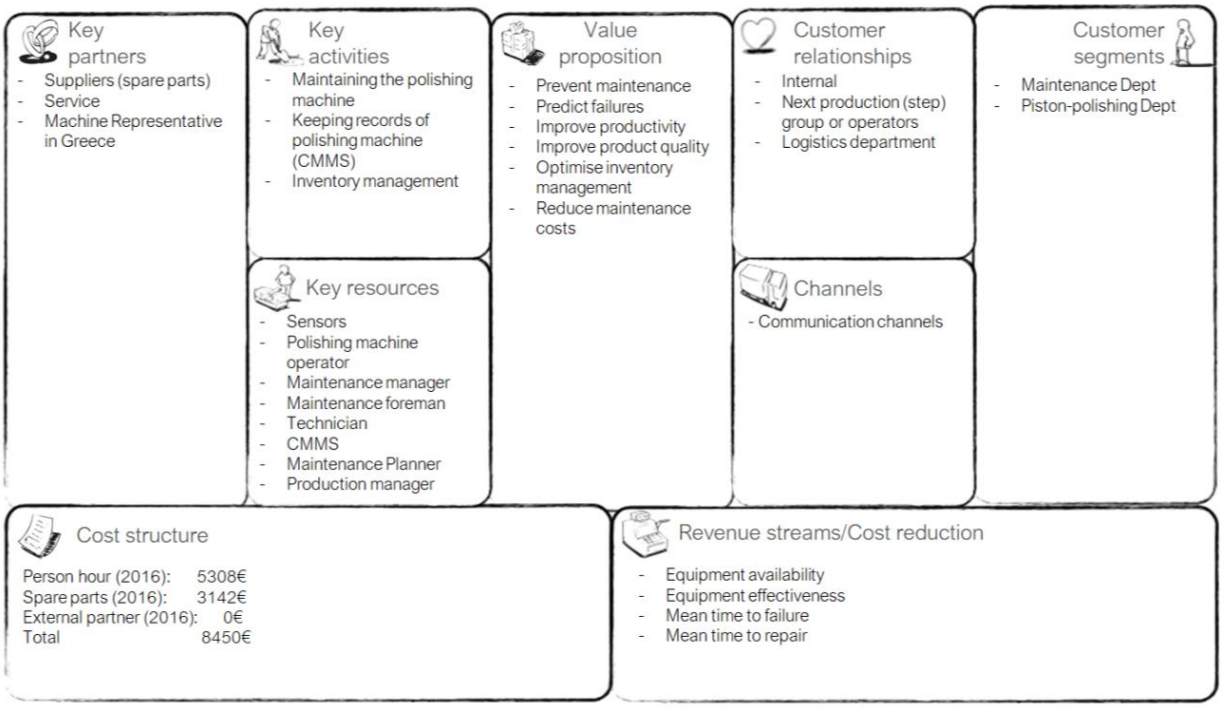

Figure 26: BMC for UC-KLE-1

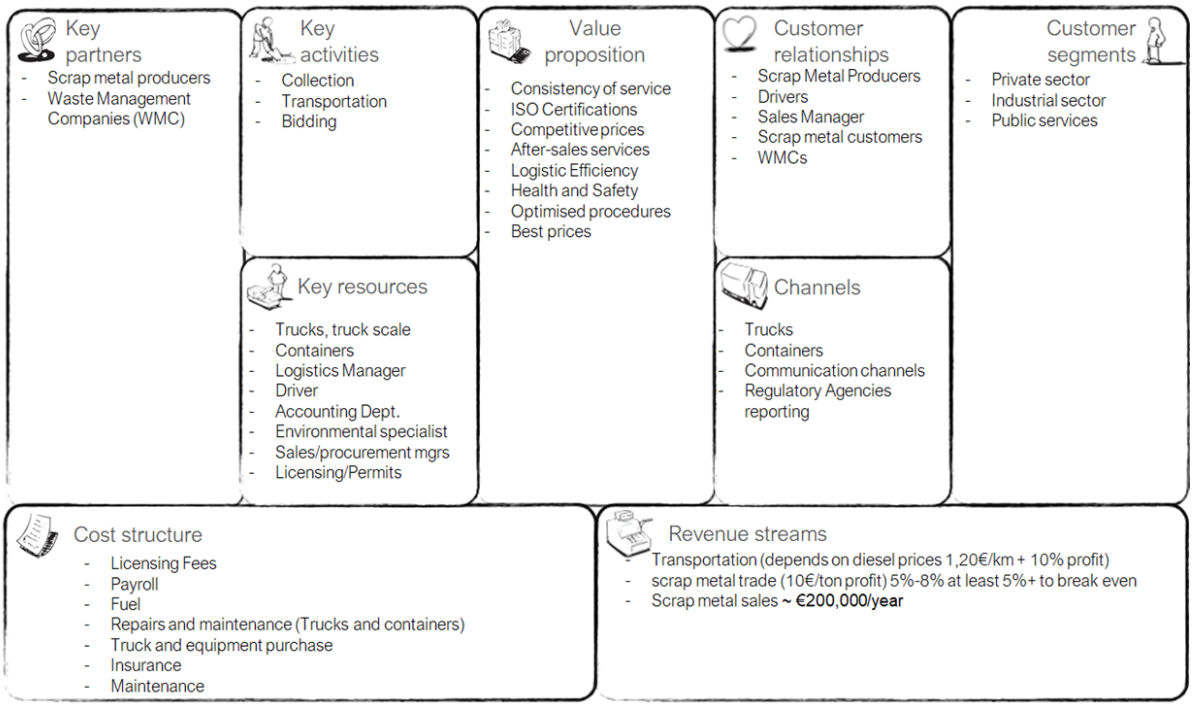

Figure 27: BMC for UC-KLE-4

The experts define two scenarios per use case whose probability of occurrence is slightly different. In both cases, however, the basic idea is to distinguish between the best-case scenario and the occurrence of technical difficulties. Typical problems are, for example, faulty sensors or sensors that are not suitable for the specific purpose of the use cases. In addition, the notification system may not work properly either, e.g. because rules are executed incorrectly in the integrated decision support system. The experts regard the implementation of the predictive maintenance system in UC-KLE-1 as more difficult than the measurement of the container fill level of UC-KLE-4. This is, for example, due to the complexity of predictive maintenance compared to filling level sensors, which mainly dependent functioning hardware. The individual and combined occurrence probabilities are shown in Figure 28:

	UC-KLE-1	UC-KLE-4	Combined
Best-case	85%	90%	76,5% (Scenario C)
Technical Difficulties	15%	10%	1,5% (Scenario D)
Combined	13,5% (Scenario A)	8,5% (Scenario B)	

Figure 28: Occurrence Probabilities

Most benefits improve internal process efficiency and thus reduce production costs. For UC-KLE-1 this applies to optimizing machine maintenance schedule and predicting polishing machine failure to manage them pre-emptively. On the one hand, this can save personnel costs: the employees are now less busy monitoring the current machine status and can pursue other activities. In addition, they can plan their work time more efficiently because there are fewer or no unexpected breakdowns. In addition, there is a reduction in expenditure on spare parts. This is because, for example, the early detection of problems also enables more cost-efficient solution methods, in which completely new parts have to be used less frequently. Another cost driver that will be influenced, is the shutdown of production. Predictive maintenance should ultimately reduce the number and duration of production stoppages. In general, KLE loses income if production is stopped, which can be interpreted as the cost of downtime. Less downtime also means lower costs of downtime.

In addition to efficiency aspects, the experts assume that product quality can also be improved in the long term. This is for example possible due to the assumption that optimally maintained machines generally work better as a result. Higher product quality influences customer satisfaction and loyalty. As already mentioned in several sections above, this also leads to an increase in value, especially to an increase in revenues.

None of the mentioned benefits are realised at the time of the workshops. For the coming years, the experts assume that 20% can be realized by the end of the COMPOSITION project in 2019. Thereafter, it will rise to 60% in 2020 and 90% in 2021. 100% of the benefits should then be effective from 2022 onwards.

These benefits are offset by some implementation costs. Besides the usual use of budget within COMPOSITION, sensor covers have to be purchased and software for the interface to COMPOSITION has to be created. In addition, the experts assume increased expenditure for their accounting & maintenance department.

UC-KLE-4 provides several efficiency benefits. This is mainly due to the fact that after the implementation of this use case, KLE needs less personnel to support the waste management process. For instance, there is an automated bidding process & notifications, for which employees mainly take the role of monitoring. In addition, there is also a reduction in administration costs, as contract and payment processes can also be handled more easily within COMPOSITION. Similar to UC-ELDIA-1, this use case also offers the possibility for various other automation solutions in production, for which the sensors and notification system sets the foundation.

On the cost side, sensor cases and other equipment must be purchased again. In addition, there are necessary investments for a gateway and accounting and maintenance department costs.

Figure 29 shows an overview of the scenarios' probabilities, project values and standard deviations for the years 2020, 2023 and 2026.

	Scenario A	Scenario B	Scenario C	Scenario D	Overall
Probability	76,5%	8,5%	13,5%	1,5%	
Project value by 2020	-274.000€	-302.000€	-310.000€	-338.000€	-282.000€
Standard Deviation	15.000€	15.000€	15.000€	15.000€	15.000€
Project value by 2023	48.000€	-75.000€	-112.000	-235.000€	12.000€
Standard Deviation	66.000€	66.000€	66.000€	66.000€	66.000€
Project value by 2026	364.000€	141.000€	77.000€	-136.000€	291.000€
Standard Deviation	115.000€	115.000€	115.000€	115.000€	115.000€

Figure 29: Project Value for UC-KLE-1 and UC-KLE-4

By applying the BeneFIT-Method, the Fraunhofer project members calculate a project value until 2023 for UC-KLE-1 and UC-KLE-4 of about 12.000€ with a standard deviation of 66.000€. Due to the fact that the value is positive, the Fraunhofer project members can assume that COMPOSITION is profitable for KLE. Nevertheless, compared to the other pilot partners' use cases, the project value is significantly lower. This can be attributed, for example, to the fact that KLE is not a very large company. On the other hand, it is also possible that KLE acts more conservatively in its estimation and planning than other companies and has therefore also given more moderate estimates of the benefit values. Considering the values at hand, the benefits require a slightly longer effect time in order to achieve an amortisation of the necessary expenses. This can be seen from the negative project value in 2020. However, since it can be assumed that KLE will benefit from the implementation of both use cases for at least five years, probably even longer, it is likely that being part of COMPOSITION has a positive impact on the business value of KLE. The project value in 2026 is already significantly higher than in 2023. This can be assumed, because the project value in 2026 is already significantly higher than in 2023.

4.3.4 Use-Cases NXW

Similar to ATL, NXW takes the role of a pilot partner and technical partner at the same time. Therefore, it is not surprising that NXW aims to be active on the platform as a provider of software and consulting in the Software Virtual Marketplace. It is important to mention that NXW doesn't change existing processes, but rather expands its existing business model by a new distribution channel. The products, specifically services, which they then offer via the COMPOSITION platform do not yet exist. Figure 30 shows the BMC for NXW.

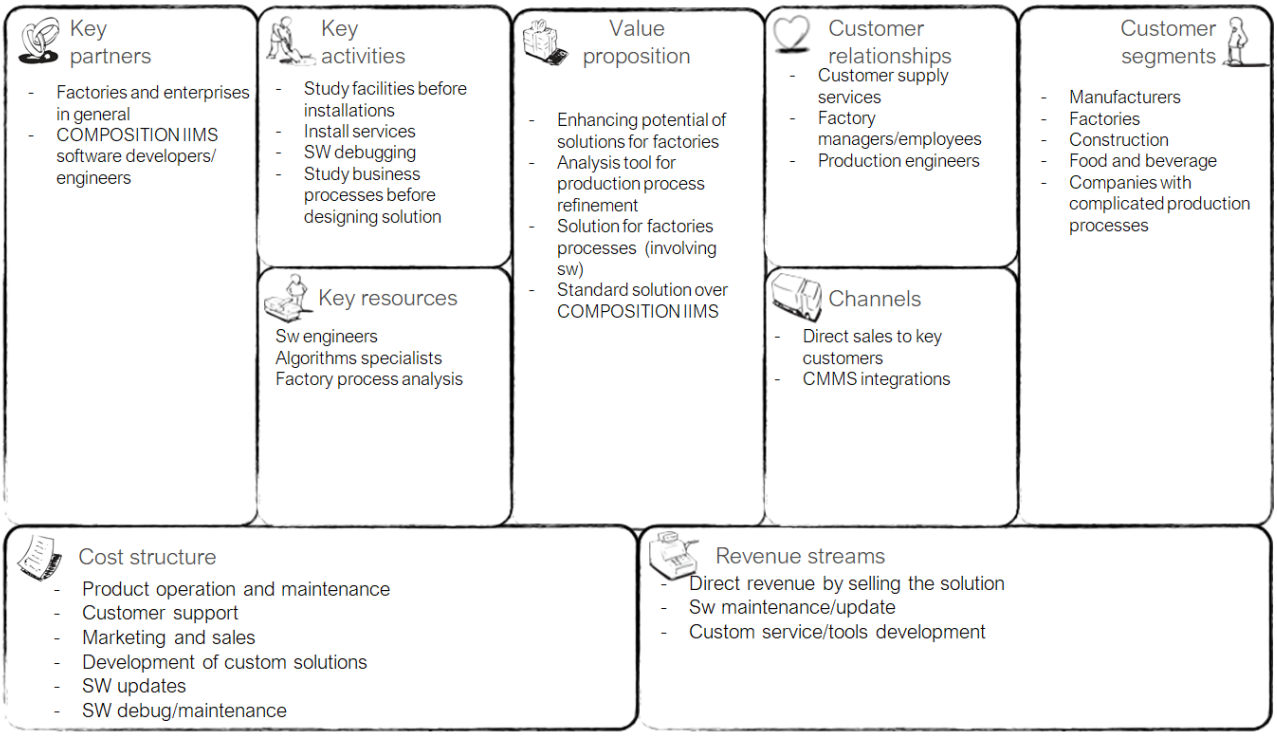

Figure 30: BMC for NXW

The difficulty in analysing NXW's use case is that the service they are offering to its customers as the value proposition of the use case is currently not in its product portfolio. The experts point out that this circumstance leads to the service price being highly uncertain. In addition, it also depends significantly on the specific context of the customer which price NXW will demand. The general rule is: the higher the expected savings potential of an industrial customer, the more money NXW can expect for its services. Before the actual benefits, the Fraunhofer project members therefore deal with a suitable estimation of the service price. Specifically, the experts would like to use the service price for predictive maintenance as a basis.

Since it is already known what potential savings KLE and BSL expect from predictive maintenance, their benefits can be used as a reference. The size of the two companies differs considerably. Therefore, the Fraunhofer project members consider them being close to the upper and lower end of NXW's customer spectrum. They also take into account that both companies have made a very optimistic estimate to include the increased project expertise and that the benefits of predictive maintenance are also offset by implementation costs, e.g. by means of personnel hours. It is therefore assumed that the expected savings will be between approximately 10.000€ - 20.000€ as a lower bound and 270.000€ - 510.000€ as an upper bound depending on the size of the company. In practice, NXW has more customers with similar company sizes to KLE than to BSL. For an estimate of the average savings potential, the Fraunhofer project members do not calculate the mean value from the two extremes. Instead, the calculation is made based on an 80:20 distribution between the two values. Thus, the Fraunhofer project members compute an average saving potential of 60.000€ to 115,000€ per company annually. Thus, the experts set an initial service price of 2,000€, targeting at least an additional 15% of savings using NXW's service. So, customers would spend 2.000€ more,

in order to save (worst case) between 15.000€ and 10.000€ more. This estimate is used as a basis to determine all further values.

But first the different scenarios of NXW's use case are presented. Scenario B again considers technical risks. On the one hand, this refers to problems in the connection and implementation of NXW solutions, but also to technical problems during active operation. In any case, this has negative consequences for NXW, who either have to put more effort into the sale of a service themselves or cannot fulfil customer expectations. Scenario C contains the risk already mentioned in the analysis of ATL that a large company will launch a product similar to COMPOSITION on the market. This results in fewer customers and lower sales. Scenario D takes into account the risk that the products and services offered by NXW in COMPOSITION will not deliver the expected savings potential for customers. Scenario D considers the risk that the products and services offered by NXW in COMPOSITION will not deliver the expected savings potential for customers. Accordingly, NXW would either have to significantly reduce the service price or risk dissatisfied customers. With a 65% probability of occurrence, experts consider scenario A to be the most likely. At 20%, however, the probability for scenario C is also very high. Scenario B has a 10% probability and scenario D a 5% probability. Thus, NXW has confidence that its products and services will deliver the expected benefits but estimate the market risks from competition to be higher.

For the benefits, there are three possibilities for NXW to increase its revenue. First, this is simply the **sale of services and products** in COMPOSITION. Considering the estimate service price, the experts assume a revenue increase of up to 100.000€ for the best case. However, when scenario C or D occurs, they even indicate the possibility that there is no increment at all. Overall scenario D is the weakest. The experts see even greater maximum potential in the second benefit, the sale of existing products and services to new customers in COMPOSITION or also referred to as **cross-selling**. Another benefit is the **sale of additional services related to the COMPOSITION product.** This could be, for example, maintenance work or updating or improving the system. As a final benefit, the experts have indicated **the increased experience and expertise**. As a provider of IT solutions, NXW can use the knowledge from COMPOSITION for future projects in order to be able to offer its customers even better products. Compared to the other three benefits, however, the maximum value of this is a lot lower.

On the costs side, COMPOSITION's budget is again the biggest driver. The experts estimate that NXW invests 20% of its project time in the role of pilot partner. The budget was therefore only included to this extent. In addition, the experts also assume increasing costs for their marketing department or for maintenance and administration of COMPOSITION services and products. Finally, NXW also needs to grow as an organization to meet the increased number of customers. To achieve this, more employees need to be hired or the company's own technical infrastructure needs to be improved. However, the maximum growth costs will probably not exceed 50,000€ per year in the best case of scenario A. Especially the costs for company growth but also the marketing costs are risky. The Fraunhofer project members therefore only assume value ranges for both, which additionally differ depending on the scenario.

The implementation plan envisages that by the end of 2020 60% of the maximum value of the benefits can already be realised. From 2022 this should reach 100%. Figure 31 shows an overview of the project values and standard deviations for the years 2020, 2023 and 2026.

	Scenario A	Scenario B	Scenario C	Scenario D	Overall
Probability	65%	10%	20%	5%	
Project value by 2020	199.000€	79.000€	-96.000€	-11.000€	156.000€
Standard Deviation	67.000€	25.000€	54.000€	15.000€	60.000€
Project value by 2023	843.000€	389.000€	449.000€	51.000€	679.000€
Standard Deviation	240.000€	82.000€	192.000€	44.000€	213.000€
Project value by 2026	1.494.000€	705.000€	808.000€	120.000€	1.209.000€
Standard Deviation	409.000€	139.000€	328.000€	73.000€	364.000€

Figure 31: Project Value for NXW

By applying the BeneFIT-Method, the Fraunhofer project members calculate an expected project value until 2023 for NXWs use cases of approximately 679.000€ with a standard deviation of 213.000€. The value is positive and, thus, one can assume that COMPOSITION is profitable for NXW. The expected project value's amount reflects the great potential for NXW. The analysis of ATL and NXW leads to similar results for the order of magnitude and the course of the expected project values for 2020, 2023 and 2026. This is reasonable since both companies play a similar role in the context of COMPOSITION, specifically after the end of the project and during operative business. If the expected project values for 2020 and 2026 are included into the analysis one can see linear growth that always shows a positive value even within the standard deviation range.

4.3.5 Conclusion of Evaluation

If solely the pilot partners are analysed, it is noticeable that the Fraunhofer project members calculated a positive project value for every organization, considering an evaluation period until 2023. The values differ greatly in their level between organizations but appear reasonable in view of the organizational context of the individual companies. This is a strong indication that COMPOSITION solutions create value for companies by means of cost savings and/or revenue increase and creates a strong argument for external organizations to join the COMPOSITION ecosystem. It is important to emphasize that the identified benefits have a long-term effect for each pilot partner and one can assume that they generate value longer than the estimated five years. Considering this, the Fraunhofer project members conclude that the participation in COMPOSITION is and will be economically profitable for the pilot partners.

Nevertheless, the project as a whole should be assessed as well. The overall budget of COMPOSITION is 7.634.253,75€. One part of the budget is for the participation of the pilot partners. These expenditures were defined as a cost item when calculating the project value and included in the evaluation above, as well as in the calculation. It should be once again pointed out that ATL and NXW are both technical and pilot partners. Therefore, only part of their budget is earmarked for one of their roles. Both estimated that they act as pilot partners or end users for about 20% of their time in the project. So, the Fraunhofer project members included 20% of their allocated budget as costs in the project value. Deducting all already considered costs, a budget of roughly 6.340.000€ for the project management and the technical partners remains. This raises the question of whether COMPOSITION is already reasonable from an economic point of view and how its future development will further influence the economic benefit.

If all expected project values of the pilot partners are summed up, and thus all use cases, a value of 7.890.00€ can be computed. Compared to the remaining COMPOSITION budget of 6.340.000€, it becomes apparent that the expected project value already exceeds the costs. However, if one considers the years after the end of the COMPOSITION project until 2023, necessary costs for the daily operation of the platform have not been taken into account yet. The Fraunhofer project members neglect this in their current view because it is reasonable to assume that an organization that manages the COMPOSITION platform generates at least as much benefit as it puts effort into it. In addition, one should consider that all technical partners and the project management benefit right now from the project by collecting worthwhile experience. This facilitates their

efficiency and effectiveness in future projects within their own organization. These values are not taken into account either, due to them being uncertain and almost impossible to quantify. Finally, it is important to look at the further development of the COMPOSITION ecosystem. Its goal is to include more companies in the ecosystem in the future in order to create additional value for them, as well as for the existing providers of solutions in the marketplace. If one assumes that the number of organizations in the platform will increase in the coming years, there are even more reasons to call the COMPOSITION project economically profitable and an overall success considering the current status.

5 Overall Project Risk Reporting

Risk and uncertainty play an important role within the presented evaluation and a sufficient risk management is an essential part of the long-term success of COMPOSITION. Thus, the Fraunhofer project members aim to analyse the risks for the pilot partners and COMPOSITION based on the results of section 4. First, it is necessary to determine best practices on how risks can be categorised and, afterwards, provide a risk report for the identified risks.

5.1 Why Risk Management and Risk Reporting are relevant in IT Projects

The term risk is used in many ways and different definitions are given, depending on the field and context. Mostly literature defines it as uncertain events, which may occur in the future. Risks consist of the probability that an event and its consequences occur. However, a risk can generally be regarded as both, upside opportunity and downside threat, which often results in a monetary loss. In the following, the Fraunhofer project members maintain the notion that risks exclusively refer to uncertain events with negative consequences. To sum up, a project risk is according to this a combination of the probability of not achieving a project goal and the resulting extent of monetary damage.

Recent trends in digitalization combined with continuous innovation pressure force companies to continuously come up with innovative ideas. This leads to an increasing number of IT projects. To handle this development and the resulting increase of IT project complexity, numerous IT project portfolio evaluation and planning approaches have been developed. Nevertheless, there is still an alarming high number of failed IT projects. About 44% of IT projects are challenged and 24% even fail. So, a lot of IT projects still do not achieve their goals. Risk management is particularly important for IT projects, as they are often very complex due to multiple dependencies within the project or to other projects. Furthermore, IT projects are usually per se exposed to continuous changes, for instance, due to frequently and constantly changing requirement. Risk management in IT projects is therefore mandatory in many organizations. Against this background, it is not surprising that major risk management standards focus on projects and some even particularly on IT projects.

A reason can be found in the high level of complexity in IT project portfolios, which entails a high systemic risk. Systemic risk refers to the risks imposed by the high interdependencies in a system. This means, that the failure of a single entity can cause a whole system to fail. Therefore, a reason why so many IT projects fail is the lack of transparency regarding dependencies within IT project portfolios. Adequately considering interactions among IT projects is a necessary condition to successful manage the whole company. In general, interactions exist, if resources consumed or outputs generated by a project influence the use of resources or outputs generated by one or several other projects. This can result in different types of interdependencies (Lee & Kim, 2001):

- Technical interdependencies: A project cannot stand alone and requires the outputs of other projects as mandatory resources or an influenced project may stand alone, but the outputs of related projects deteriorate or improve the resource requirements of the influenced project.
- Resource interdependencies: Projects require the same resource and therefore the amount of resource required for the joint implementation of the related projects is greater or less than the sum of the resources required if the projects would have been implemented separately.
- Benefit interdependencies: The benefit of the outputs generated through the joint implementation of related projects is smaller or greater than the benefit of the outputs generated if the projects would have been implemented separately.

Considering this, managing and actively exploiting project interdependencies can provide cost savings, greater benefits and prevent more IT projects to fail.

According to the systemic risks and the high project interactions of IT projects, the project risk management and an adequate risk reporting have been proposed as two important topics to increase the probability of success of large IT projects.

Risk management is needed to actively manage possible project risks. According to Duncan (1996) a successful risk management includes four major phases. In the first phase, risks are identified and documented. In the second phase, these risks are prioritized and their probability of occurrence plus their consequences are analyzed. The goal during the third phase is to plan adequate responses to reduce threats caused by risks. Thereby, often counter measures are implemented. In the fourth phase, the risks and responses are monitored, tracked, and risk response plans are executed. In this phase also risk reporting to all relevant stakeholders takes place. As a result, risks and responses need to be visualized and communicated. Following the evaluation of the use cases in section 4, this deliverable is targeted towards the second phase of risk management. The aim of this section is to finish the second phase of risk management and move on to the third phase.

Risk reporting is the communication of risks and risk management with the aim to compare the possible results with the policy. The risk reporting informs all relevant stakeholders about potential problems, so that they can find adequate solutions to handle them. Often, the traffic light reporting – in form of symbols or coloured matrices - is applied in risk reporting. The intent of traffic light reporting is to reduce information overload and therefore to focus management attention. When taking a closer look, this approach seems to be counterproductive: A key success factor for project risk management is transparency that enables decision makers to assess the criticality of a situation. Traffic light reporting leads to reports with low information density and therefore only little potential to compare and assess developments, which would be necessary for a rational risk evaluation. In other words, traffic light reporting is actually no decision support, but a decision that has already been taken by the author of the report. He or she decided what is important and needs attention, although this is not the responsibility of the report's author, but of the decision maker. In addition, the danger of wrong assessments of risk situations increases by the fact that a common interpretation of yellow lights in such reports is that "somehow things will work", while the intended message should be "attention, danger". As a result, companies have to be very careful with their risk reporting. The key factor of a good information reporting is not only a high objective information density but also the reduction of information overload.

5.2 Visualization of Risks

Since the amount and the complexity of information increased tremendously over the last years, many authors stress the importance of visualizing information for decision makers. Further decision makers need to be provided with information in such a manner that all relevant insights can be extracted. Also, with respect to risk management, literature emphasizes that the visualization of risks should be part of every risk analysis and risk communication. In this context, Eppler and Aeschimann (2009) summarize the use of visualization for risk analysis, discovery, and generation of insights and for a fast and clear communication.

However, risk reports in IT projects are often not designed in a way that enables decision makers to identify and understand the most important risks. This is often due to either not sufficiently or not properly used visualization techniques. The main mistakes when visualizing information are misleading colors, missing comparability and unreasonable simplification. To improve reports, the density of information in reports needs to be high. Thereby, especially advanced information technology may help to reduce complexity and provide a high information-dense by IT-assisted visualization. According to Eppler und Burkhard (2007) visualization through graphics can be processed better than text and may help decision makers to understand information and reduce the problem of information overload. Eppler and Aeschimann (2009) propose a framework that includes different purposes, contents, target groups, situations and formats in the context of visualization to enhance information-density for improved assessing and conveying risks. On top, it should decrease the potential for misleading or manipulation for decision makers. Alternative techniques such as so-called 'sparklines', which are defined as small but high-resolution graphics embedded in text, can also be used. Often, time series graphs are used to allow for presenting a lot of information with minimum space requirements. In general, visualization techniques should be combined instead of using only a single one.

An adequate visualization of the risks is also for COMPOSITION essential. There is a large number of different partners, countries, products and new software products, which are involved in the project. This implies a great complexity of the project. Therefore, the visualization can help to communicate and handle the possible risks of the project.

5.3 Risk Report for the COMPOSITION project

A risk assessment of individual use cases, specifically their technical aspects, is also carried out in parallel in other deliverables. D9.7 focuses more on long-term risk assessment and the impact on the economic success of COMPOSITION. It is therefore also conducted on the basis of monetary values and estimates. These values are already available because they were determined within the quantitative evaluation of the use cases in section 4.2.3.

5.3.1 Background

For the risk analysis of COMPOSITION, it is important to identify the relevant risks and categorize them in a first run. Typical categories of risk assessment are the so-called extent of impact and the probability of occurrence. The combination of these factors allows a statement to be made about how dangerous a risk is and what countermeasures need to be taken. A common method of visualizing the extent of impact and the probability of occurrence is the so-called risk matrix. Risks within a two-dimensional system are classified into categories of both factors. In the two-dimensional system, different areas are defined that allow a statement to be made about the dangerousness of a risk. Figure 32 shows the basic structure of such a matrix. (Beer et al. 2014).

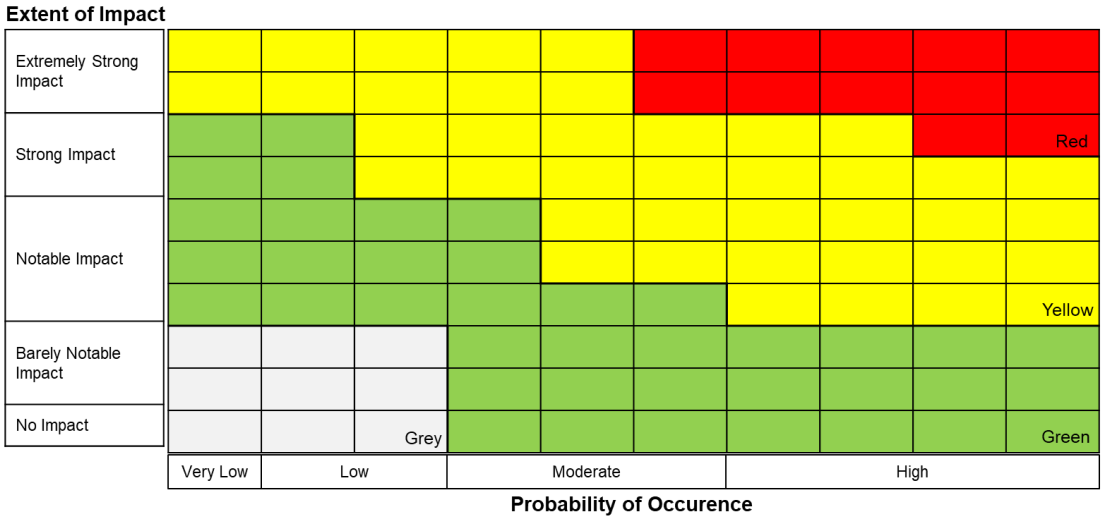

Figure 32: Example for a Risk Matrix

Four different areas have been defined for the following risk analysis. Risks in the grey area are not very dangerous, as they have a low probability of occurrence and a low extent of impact. Risks in the green area are typically characterised by a high probability of occurrence with a low extent of impact or vice versa. Risks in the yellow area threaten the project as they usually are impactful and likely at the same time. But they are very interesting for a risk analysis because successful countermeasures will have a significant positive influence on the project. Risks in the red area must be managed and monitored und any circumstance. It is essential to reduce either their extent of impact or the probability of occurrence as their occurrence is harmful towards the project's overall success.

The next step is to identify the (project-) overarching risks from the benefit, cost and risk analysis in section 4 and to work towards suitable procedure for classifying them in the presented risk matrix.

5.3.2 Risks and Uncertainty in the Use Case Evaluation

During the benefit, cost and risk analysis presented in section 4, uncertainties were considered by assuming all benefits and many cost drivers to be stochastic rather than deterministic. This was achieved in monetary terms by determining value ranges rather than deterministic figures. Thus, no fixed figures were estimated, but

the experts of the pilot partners defined areas in which the actual result is likely to be in practice. The probability of the actual results being within the value range should be close to 80% to ensure meaningful results. How wide the value range is and which practical circumstances influence its limits depends individually on the corresponding benefit or cost driver. The more secure the expected cash inflows or outflows are, the smaller the value range was chosen and vice versa for uncertainty. In total, this results not in a deterministic project value but in an expected project value with a standard deviation.

The wider the calculated interval of the standard deviation is the more dangerous deviations from the expected project value can be. For instance, the expected project value for KLE is 12.000€. However, a standard deviation of 66,000€ suggests that a negative result (up to -54,000€) is also possible by 2023. At the same time, the very high standard deviation (more than five times the expected value) indicates a high degree of uncertainty in the cash inflows and outflows of the benefits and costs. Apart from that, however, we can state that the other use cases are not influenced by uncertainties in the same way as KLE. This is shown by the fact that any other project value is still positive within the ranges of its standard deviation. Although this circumstance does not make the project values safe by itself, it reduces the probability of economic failure of COMPOSITION considerably.

Secondly, the Fraunhofer and pilot partner experts have taken risks into account by means of a scenario analysis within the BeneFIT-Method. This is a fundamental component of the method and enables the quantitative consideration of large-scale risks. In section 4.2.2 it was explained how the different scenarios were built during the workshops. It is noticeable that there are similarities between the scenarios of the individual use cases. In the next step, therefore, the same or very similar scenario risks are combined to form an overarching term that describes the underlying risk best. For instance, most pilot partner experts determined the technical risks that affect their use cases by reducing potential savings or revenue increments. Although this risk can occur in practice in different ways, especially between the pilot partners, the Fraunhofer project members summarize them under the overarching term 'Technical Difficulties of COMPOSITION Products/Services'. Figure 33 lists all the overarching risks and maps them to the pilot partners that determined them in the workshops.

Overarching Risk	**Pilot Partner**
Technical Difficulties of COMPOSITION Products/Services	• ELDIA • KLE • BSL • NXW
Low Customer Acceptance/Satisfaction	• ELDIA • ATL
Competitive Product/Service by a big Company	• ATL • NXW
Lower Performance than expected of COMPOSITION Products/Services	• NXW
Insufficient Company Growth	• ATL

Figure 33: Overarching Risks

The first question to be answered is whether each pilot partner identified all overarching risks relevant to it. The Fraunhofer project members state that the technical difficulties matter above all for the industrial companies BSL, ELDIA and KLE, which fits their role as an end user of COMPOSITION's products and services. Furthermore, market risks, such as the risk of a competing platform, affect the two pilot partners NXW and ATL, who will later act as sellers of products and services. For both it matters the most if COMPOSITION has many customers in the long run. Therefore, their experts also identified the risks of low customer satisfaction or poor product performance, which will most likely also affect COMPOSITION's reputation

towards customers. Nevertheless, market risks can also have an indirect impact on the industrial companies. Low success of COMPOSITION affects them, e.g. by means of higher costs for products or services or, in the worst case, the discontinuation of some services. Nevertheless, it is reasonable that these risks do not appear as separate scenarios in their use cases, but are, instead, considered by suitable value ranges for the benefits. An outlier is the risk of 'Insufficient Company Growth' identified by the ATL experts. It is worth considering whether this risk should also be included in future scenarios in the form of a separate scenario for NXW as both pilot partners act in COMPOSITION in a similar way. Overall, it can be said that the overarching risks are sensibly distributed among the individual use cases. There is certainly potential for improvement in further evaluation if the pilot partners have gained more experience with the implemented use cases.

Second, the goal is to determine how strong the impact of the overarching risks is and how high their probability of occurrence can be assessed in comparison to each other. In order to determine the impact, it is necessary to analyse how impactful the pilot partner experts estimated the risks occurrence. Information on this is provided by the values for the benefits given in the individual scenarios. The question arises as to how much worse the project value of a risk scenario is compared to the risk-free case, usually scenario A.

For example, scenario B for NXW involves technical difficulties as a risk. From Figure 31 one can see that scenario B, considered individually, leads to an expected project value that is 454.000€ worse than scenario A (843.000€). In percentage terms, the average damage is therefore 54% of the best case scenario. In the following, this percentage damage is understood as the risk's impact. 54% indicates a rather high-risk impact and, thus, the risk may be classified as the category 'Strong Impact' or 'Notable Impact'. However, this represents an assessment for one pilot partner. Figure 34 presents the results for all other overarching risks and the mean values ($\bar{X}$) of the risk impact across the pilot partners. BSL is divided into BSL1 (UC-BSL-2 and UC-BSL-5) and BSL2 (UC-BSL-3).

	Risk Impact compared to the best Case Scenario						
Overarching Risk	**ATL**	**NXW**	**BSL1**	**BSL2**	**KLE**	**ELDIA**	**$\bar{X}$**
Technical Difficulties of COMPOSITION Products/Services	-	54%	43%	58%	421%	56%	126%
Low Customer Acceptance/Satisfaction	62%	-	-	-	-	56%	59%
Competitive Product/Service by a big Company	84%	47%	-	-	-	-	65.5%
Lower Performance than expected of COMPOSITION Products/Services	-	94%	-	-	-	-	94%
Insufficient Company Growth	92%	-	-	-	-	-	92%

Figure 34: Risk Impact Assessment for the Overarching Risks

The risk impact assessment shows that the extent of the damage caused by the overarching risks is high, but for the most part does not generate loss. Loss, by means of a non-profitable use case implementation, occurs if the risk impact exceeds 100%, which is only the case with KLE for the risk of technical difficulties. KLE takes, thus, the role of a strong outlier. That is, its quantitative figure of 421% is left out from the subsequent analysis. Instead, the Fraunhofer project members take into account that technical risks have a high impact on the KLE use cases and include this circumstance in the analysis below.

The resulting mean value (without KLE) for technical difficulties is therefore recalculated as 53% and represents the lowest value out of every risk impact. With regard to the dependencies between the overarching risks, it is noticeable that all risks are indeed connected to each other. Technical difficulties can lead to dissatisfied customers or reduce the performance of products/services from the customer's point of view in the long term. Furthermore, KLE showed a high sensitivity towards technical difficulties. Hence, it reasonable that the overarching risk 'Technical Difficulties of COMPOSITION Products/Services' is categorized as 'Notable Impact', even though the Fraunhofer project members calculated the lowest risk impact for it.

Additionally, it should be considered whether a risk affects individual organisations in the COMPOSITION ecosystem or is dangerous for the entire platform. With the exception of ‘Insufficient Company Growth’, the Fraunhofer project members state that every overarching risk either is impactful towards the whole platform, e.g. ‘Competitive Product/Service by a big Company’, or towards most organizations in the ecosystem, e.g. ‘Technical Difficulties of COMPOSITION Products/Services’. While ‘Insufficient Company Growth’ may be an impactful risk for an individual organization in COMPOSITION, its overall impact for COMPOSITION is probably lower than the calculated risk impact would indicate. Based on Figure 34 and the presented discussion, the overarching risks are categorized as shown in Figure 35.

Overarching Risk	Category
Technical Difficulties of COMPOSITION Products/Services	Notable Impact
Low Customer Acceptance/Satisfaction	Notable Impact
Competitive Product/Services by a big Company	Strong Impact
Lower Performance than expected of COMPOSITION Products/Services	Strong Impact
Insufficient Company Growth	Notable Impact

Figure 35: Overarching Risk Categorization for Extent of Impact

The next step is to determine the probability of occurrence of the overarching risks. It is important to consider what probabilities the pilot partner experts estimated for the risk scenarios and how often a risk was mentioned at all. Technical difficulties, for example, were mentioned only with moderate probabilities but very often. It is therefore is mapped to the category 'High'. Both NXW and ATL have identified 'Competitive Product/Service by a big Company' as a risk. Therefore, it is also mapped to 'High'. All other overarching risks are assigned in different gradations to 'Moderate'.

Now a risk matrix can be set up that graphically presents the results of the presented analysis of the risk impact and the probability of occurrence. Figure 36 shows the risk matrix for COMPOSITION.

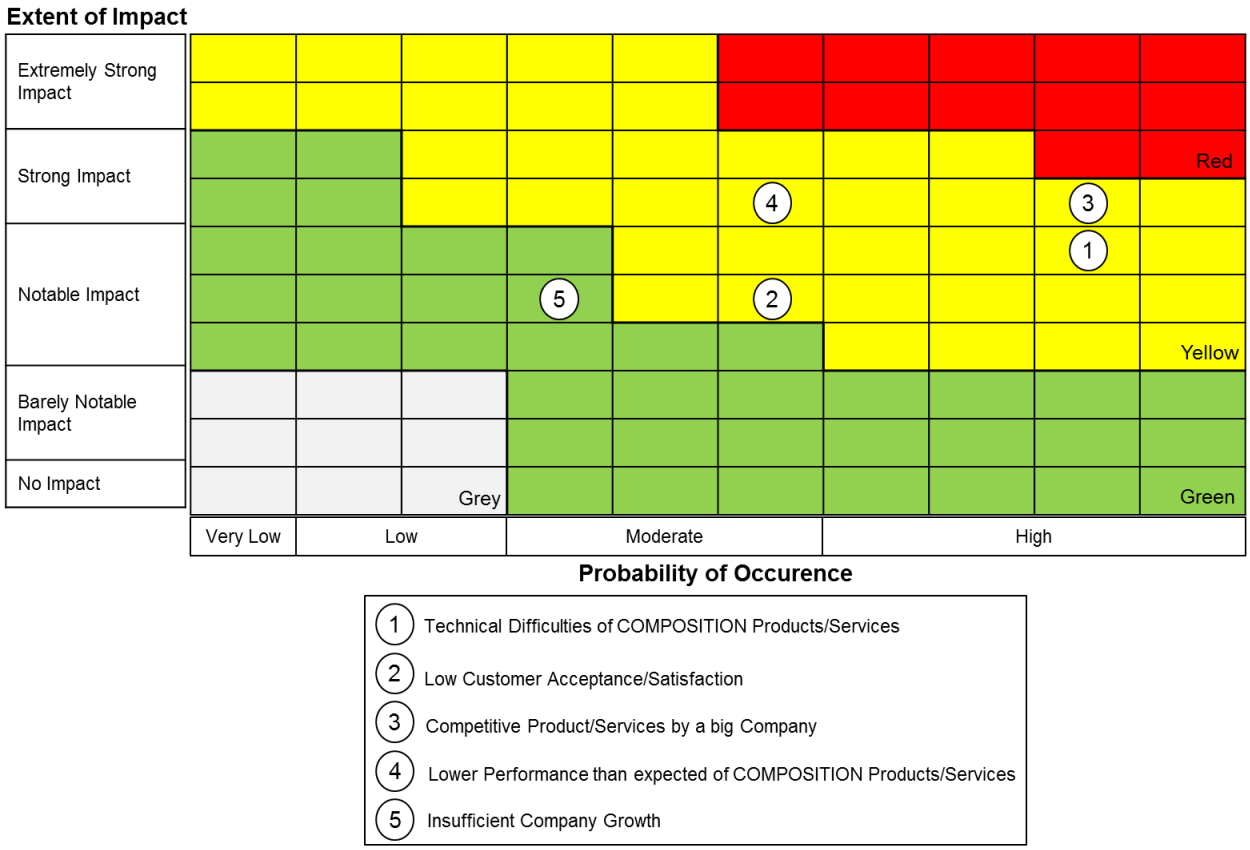

Figure 36: Risk Matrix for COMPOSITION

The risk analysis shows that ‘Technical Difficulties of COMPOSITION Products/Services’, ‘Competitive Product/Services by a big Company’ and ‘Lower Performance than expected of COMPOSITION Products/Services‘ pose the greatest threat to COMPOSITION overall. In this context, other deliverables provide more insights into the technical risks and analyze them at a finer level of granularity. ‘Competitive Product/Services by a big Company', on the other hand, represents a risk whose occurrence cannot be prevented. Nevertheless, the possible risk impact can be mitigated.

One possible approach is to take advantage of the time lead that COMPOSITION has gained through its development in order to offer the best products and services on the market. Furthermore, moving from an existing COMPOSITION solution to a different product may be not cost-inefficient for companies. Customers who are integrated into the ecosystem at an early stage are therefore very likely to remain loyal even in the case of competing products by big companies. The consideration of risk dependencies also plays an important role. If COMPOSITION keeps the probability of other overarching risks occurring as low as possible, especially regarding the performance of the products, the probability of customers being dissatisfied and migrating to the competition also decreases.

‘Lower Performance than expected of COMPOSITION Products/Services' is a risk that could be relevant in the upcoming months until the end of the COMPOSITION project. The advantage, however, is that after the implementation of the use cases in operative business, it is possible to find out whether the targeted savings potentials can be exploited and whether the estimated benefit values are reasonable. Then there is still time during the project to react to this problem. Later, when the COMPOSITION platform is live, it becomes much more difficult to minimize the extent of impact of low performing products and services. This risk is therefore definitely an issue that needs to be further monitored in the coming months.

6 Conclusion and Next Steps

6.1 Methodology and Results

For the benefit, cost and risk analysis the Fraunhofer project members used several different methods that are recognized, and field tested in practice and research. This includes, for instance, the BMC, semi-structured interviews and workshops, and Benefit Management by means of the BeneFIT-Method & BeneFIT-Tool (Beer et al. 2013). On this foundation, they developed an approach that meets requirements that were derived from COMPOSITION's project plan and strategic objectives. The approach was practically implemented by means of semi-structured workshops together with experts from the pilot partners. Starting with a business model visualization, the Fraunhofer project members identified benefits, costs and risk scenarios based on a comparison between pre- and post-COMPOSITION. The mathematical evaluation method BeneFIT builds the core of the evaluation approach. Using this method, they quantified the benefits and costs, while taking risks into account, and calculated expected project values for every pilot partner. The results were assessed from a value-based management perspective. Figure 37 shows the computed project values for all pilot partners, considering project benefits affect the company at least until the year 2023. BSL is divided into BSL1 for UC-BSL-2 and UC-BSL-5, and BSL2 for UC-BSL-3.

ATL	NXW	BSL1	BSL2	KLE	ELDIA	∑
1.120.000	679.000€	923.000€	2.373.000€	12.000€	2.783.000€	7.890.000€

Figure 37: Project Value until 2023 for all Pilot Partners and in total

As already summarized in section 4.3.5, the Fraunhofer project members conclude that COMPOSITION is economically profitable for the individual pilot partners, as well as from a holistic project point of view. One example of this is the budget for COMPOSITION, which is below the calculated project value. And it has not yet been taken into account that more companies in the COMPOSITION ecosystem will further increase the project value.

These results can be used to convince interested organizations of the positive benefits of COMPOSITION. It should be emphasized that COMPOSITION is valuable both for end users, by means of manufacturing companies, and for IT companies that want to offer automation solutions or consultancy in an industry 4.0 context. In conclusion, the results also show that the budget used for COMPOSITION is appropriate in view of the increase in business value of all currently participating organizations.

The following conducted risk analysis shows that there are currently three risks that are very dangerous for COMPOSITION: 'Technical Difficulties of COMPOSITION Products/Services', 'Competitive Product/Services by a big Company' and 'Lower Performance than expected of COMPOSITION Products/Services'. The problem is that the occurrence of the risk of competing products to COMPOSITION cannot be actively prevented. The risk report therefore states that it is all the more important to minimize the other risks in order to bind customers to the platform at an early stage. This includes above all the risk of technical difficulties but also the risk that COMPOSITION's products and services will generate less benefits than expected.

6.2 Next Steps

The intention is to update and reissue *D9.8 Market Segmentation and Potential of COMPOSITION in European Industry*, when the results of the pilots are available. When the update is done, the cost, risk, and benefit analysis may be also done again to re-evaluate the numbers and effects. The update of D9.8 may also have an influence on the overall project risk report. Another relevant input for the benefit, cost and risk analysis will be, when the software components and the platform are stable and the proper pricing models and revenue streams will be selected. A new evaluation is therefore advisable for D9.11 and is, thus, targeted for the beginning of 2019. Until then, the Fraunhofer project members will continue searching for scientific publications that can make a valuable contribution to the analysis approach at hand. This could be, for example, an improvement of the BMCs or an extension of the BeneFIT-Method.

7 List of Figures and Tables

7.1 Figures

7.2 Tables

8 References

(Anderson & Mittal 2000) Anderson E.W., Mittal V.: Strengthening the Satisfactio-Profit Chain. Journal of Srevice Research (3:2), pp. 107-120, 2000.

(Beer et al., 2014) Beer M., Meier M.C., Mosig B., Probst F.: A Prototype for Information-Dense IT Project Risk Reporting: An Action Design Research Approach. 47th Hawaii International Conference on Information Systems, Waikoloa, HI, USA, 2014.

(Beer et al., 2013) Beer M., Fridgen G., Müller H.V., Wolf T.: Benefits Quanitifaction in IT Projects. 11th International Conference on Wirtschaftsinformatik, Leipzig, Germany, 2013.

(Buhl et al., 2011) Buhl H.U., Röglinger M., Stöckl S., Braunwarth K.: Value Orientation in Process Management: Research Gap and Contribution to Economically Well-Founded Decision in Process Management. Business & Information Systems Engineering (3), pp. 163-172, 2011.

(Duncan, 1996) Duncan W.: A Guide to the Project Management Body of Knowledge. Project Management Institute, Newtown Square, 1996

(Eppler & Aeschimann, 2009) Eppler M., Aeschimann M.: A Systematic Framework for Risk Visualization in Risk Management and Communication. Risk Management (11:2), pp. 67-89, 2009

(Eppler & Burkhard 2007) Eppler M., Burkhard R.: Visual representations in knowledge management: framework and cases. Journal of Knowledge Management (11:4), pp. 112-122, 2007

(Forbes, 2012) Forbes, last access on 19.09.2018; https://www.forbes.com/consent/?toURL=https://www.forbes.com/sites/steveparrish/2012/08/14/if-you-value-your-business-you-should-value-your-business/

(Fridgen, et al 2015) Fridgen G., Klier J., Beer M., Wolf T.: Imporving Business Value Assurance in Large-Scale IT Projects – A Quantitative Method Based on Founded Requirements Assessment. ACM Transactions on Management Information Systems (5:3), Article No. 12, 2015

(Jud & Winkler 1995) Jud D., Winkler D.: The Capitalization Rate of Commercial Properties and Market Returns. Journal of Real Estate Research (10:5), pp. 509-518, 1995)

(Lee & Kim, 2001) Lee J., Kim S.: An integrated approach for interdependent information system project selection. International Journal of Project Management (19:2), pp. 111-118, 2001

(Osterwalder & Pigneur, 2010) Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, John Wiley And Sons Ltd, 2010

(Ott 1993) Ott H.J.: Cost-benefit-analysis of investements in computer systems using the WARS-model. Wirtschaftsinformatik, 1993

(Pigneur, 2005) Pigneur, Y.: e-Business model ontology for improving business/IT alignment, Interop, CAISE-EMOI'05, 2005

(PMI, 2012) PMI – Project Management Institute. PMI's Pulse of the Profession. Driving Success in Challenging Times, 2012.

(Teece, 2010) Teece D.: Business Models, Business Strategy and Innovation. Long Range Planning (43:2-3), pp. 172-194, 2010

(Walter & Spitta 2004) Walter S.G., Spitta T.: Approaches to the Ex-ante Evaluation of Investments into Information Systems. Wirtschaftsinformatik (46:3), pp. 171-180, 2004.

(Zangenmeister, 1971) Zangenmeister C.: Nutzwertanalyse in der Systemtechnik. Eine Methode zur multidimensionalen Bewertung und Auswahl von Projektalternativen, 1971.

(Zolnowski et al., 2014) Zolnowski A., Weiß C., Böhmann T.: Representing Service Business Models with the Service Business Model Canvas - The Case of a Mobile Payment Service in the Retail Industry. Hawaii International Conference on System Science (47), pp. 718-727, 2014