Ecosystem for COllaborative Manufacturing PrOceSses – Intra- and Interfactory Integration and AutomaTION
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# D7.10 Integrated Business Model Decision System

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# Index:

# 1 Executive Summary

This deliverable aims to develop a Business Model Decision System that supports decision makers at identifying and understanding COMPOSITION's benefits for their business model and facilitates the task of mapping pilot partner use cases to their own company. Thus, the results can be used by the pilot partners in COMPOSITION to further develop and improve their business models, and for future marketing purposes of the COMPOSITION platform, for instance to attract additional companies that may join the platform's network. Within the process of engaging new companies with COMPOSITION solutions and the network, the Business Model Decision System can play a critical role as the link between initial contact and identifying the right solutions for a company.

From a theoretical perspective, the deliverable adds knowledge to prescriptive knowledge on business modelling and Business Model Innovation (BMI) by providing real world case studies for the application of two scientific sound methods, the Business Model Canvas (BMC) and the Business Model Navigator (BMN). Both methods have been successfully implemented and applied to the pilot partners and their respective use case during the course of the project. The results indicate three main findings. (1) COMPOSITION use cases, which cover both COMPOSITION's solutions as well as the project's vision of a collaboration platform, improve and innovate the pilot partners' business models in a meaningful manner. (2) The use cases improve and innovate the pilot partners' business models fundamentally different, by means of the targeted business model segments, depending on the type of pilot partner (technical or industrial). (3) Both BMC and BMN can be used to facilitate analysing and predicting project effects on business models within an international project in the context of industry 4.0.

The developed artefact of this deliverable, the Business Model Decision System, is presented as a framework that maps segments of a business model that a company wants to improve to fitting business model patterns that describe fundamental changes or enhancements to business models. The patterns in turn refer to COMPOSITION use cases and, thus, COMPOSITION solutions.

Hence, there are two main tasks to accomplish before building the framework. First, changes within the business models of the pilot partners need to be visualized and analysed regarding innovation and improvement. Second, these changes need to be compared to the patterns of the BMN to find similarities and fitting patterns that reflect most aspects of the changes.

To visualize the pilot partners' business models the project partners from Fraunhofer FIT adopted the approach of Yin (2003) and conducted a case study for each pilot partner. Each case study was carried out by conducting interviews with experts of the pilot partners to visualize their business model as a BMC and mark changes within the business model, that occur as a consequence of being part of COMPOSITION. A distinction was made between when these changes would occur and whether they could only be attributed to COMPOSITION. The visualized business models are being analysed towards their focus of improvements, by means of the targeted segments of the BMC.

As the BMN is based on the concept of four questions of business models (Pigneur 2010), "who", "what", "how" and "how much", the results of the business model analysis are being mapped to the four questions. Each question reflects a specific set of segments of the BMC. Consequently, the result of the case studies is an aggregated analysis that reports on changes within the business models of the pilot partners structured along the four questions of business models. This analysis can then be used to compare changes within the business models to the patterns of the BMN to find patterns that target the same questions of business models as COMPOSITION. As this deliverable found multiple patterns that fit the general context of COMPOSITION, the use cases were being used as a reference to filter out the most fitting patterns.

These patterns build the basis for the Business Model Decision System as they enable a better understanding of innovation and improvement within COMPOSITION. Additionally, this deliverable reports on other noteworthy patterns that fit the context of COMPOSITION but not the specific use case that were implemented during the project. These patterns may help the pilot partners or a COMPOSITION platform provider in the future by pointing towards further potential use cases and COMPOSITION solutions.

# 2 Abbreviations and Acronyms

**Table 1: Abbreviations and Acronyms**

| Acronym | Meaning |
|---|---|
| ATL | Atlantis Engineering SA |
| BMC | Business Model Canvas |
| BMI | Business Model Innovation |
| BMN | Business Model Navigator |
| BSL | Boston Scientific Limited |
| D | Deliverable |
| ELDIA | ELDIA SA |
| IIMS | Integrated Information Management Systems |
| KLE | KLE Hellas ABEE |
| NXW | Nextworks s.r.l. |
| WP | Work Package |

# 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. In addition, a platform will be developed on which providers of technical solutions will collaborate directly with industrial partners. This deliverable contributes to the objectives of COMPOSITION in several ways. First, it enhances the understanding of the pilot partners about the improvements and innovation that occur in their business model through their participation in COMPOSITION. Second, the insights can be used to illustrate how COMPOSITION solutions create value for business models. Third, a decision support system is being developed that refers interested companies to the pilot partners' use cases that may be of interest to them.

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 a methodical input. The deliverable also uses the Business Model Canvas (BMC) method, which can be used to visualize business models. In *D9.9* it has therefore been shown that this method can be successfully applied in the context of COMPOSITION. The presented *D7.10* sets itself apart by visualizing the business models of the pilot partners with the help of the BMC. A similar goal was pursued in *D9.7 Cost, Benefit and Risk Evaluation*, but for *D9.7* one BMC was being illustrated for each use case. Within the scope of this deliverable, only one comprehensive and overarching BMC per pilot partner will be designed, which represents the status before COMPOSITION and incorporates all changes related to COMPOSITION.
- 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 proper pricing models and revenue streams will be selected and presented in *D9.11 Final Exploitation Strategy and Business Plans*.
- The business models also support the pilot partners' individual exploitation planning. The context is demonstrated in *D9.11 Final Exploitation Strategy and Business Plans.* The visualizations of the business models developed in this deliverable facilitate the understanding of where improvements and changes occurred exactly within the pilot partners. It differs, however, in terms of the purpose of use. In *D9.11* the basic question is whether COMPOSITION is value adding for the pilot partner, which is complemented by a quantitative analysis of benefits, costs and risks by means of the BeneFIT-method. This deliverable, however, focuses on a qualitative analysis of innovation within COMPOSITION. This way, the core of the innovation can be filtered out and a comprehensive model can be derived with the help of scientifically sound methods.

## 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 this deliverable is structured as follows:

Section 4 deals with business models in the context of COMPOSITION. It explains the theoretical foundations of business models and the innovation of business models in the industrial sector. Subsequently, a procedure is developed which aims to visualize and analyze the business models of the pilot partners in COMPOSITION. A case study according to Yin (2003) is the chosen method for this deliverable to analyze the business models of the pilot partners. As part of the case studies, interviews with the pilot partners are conducted and the business model of the respective pilot partner is illustrated using a visualization method from applied research, the BMC (Osterwalder & Pigneur, 2010). Thus, changes can be reconstructed that have occurred in the business model of pilot partner due to their participation in COMPOSITION. The results are aggregated until a sound statement can be made about how the core of the innovation of the business models of the pilot partner emerges.

In Section 5, the field-tested method Business Model Navigator (BMN) (Gassmann et al. 2014) is used to map the business model changes of pilot partners to so-called business model patterns. These describe basic types of business model innovation and thus provide an understanding of similar business model improvements. Sets of patterns are put together. Each set refers to a specific type of change that has occurred in the pilot partners' business models. A distinction is made between technical and industrial pilot partners whose innovation has occurred in a different manner. Each set in turn references certain use cases. The sets of patterns are used to develop a basic Business Model Decision System.

Section 6 summarizes and reports on the results of this deliverable. The limitations of the chosen approach are being discussed and possible improvements outlined.

# 4 Business Models in the Context of COMPOSITION

The aim of this chapter is to give a general overview of the creation and use of business models. Therefore, different ways of visualizing a business model will be shown. In addition, it will be explained how the clear statement of a business model is a prerequisite for Business Model Innovation (BMI) and how BMI can take place in different intensities.

## 4.1 Business Model

There is a variety of approaches and methods to create, visualize, analyze and adapt business models. Two of the most commonly used are the "four-box business model framework" (Christensen et al., 2016) and the BMC (Osterwalder and Pigneur, 2010), which will be explained in the following section. Hence, this chapter aims to answer the question: What constitutes a business model?

With the emergence of the digital age, the environment for businesses changes rapidly. Digitalization offers countless opportunities of doing business and creating value with and for their customers. Therefore, a change in business logic and activities becomes evidential for every company. To adapt a company to the volatile environments successfully, 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 business model also helps to realize the economic value of a company's products and services. Because companies can realize competitive advantages with the support of the business model concept, it is gaining popularity in research an practice. Despite a multitude of different approaches to defining a business model, there is no generally accepted business model definition.

One famous example for describing a business model by Teece (2010) is that it "defines how the enterprise creates and delivers value to customers, and then converts payments received to profits". Another description by Osterwalder and Pigneur (2010) defines a business model as a way to describe "the rationale of how an organization creates, delivers and captures value". Although these definitions show the core of every business model, they do not help companies to visualize theirs for the purpose of improving it. The better an organization's capability to state its business model, the better the business model can be analyzed. In order to help companies to state their business model, research developed different frameworks, which were validated by means of practical applications and evaluations (Gassmann et al., 2014; Christensen et al., 2016). These frameworks aim to guide firms in the process of visualization and can be applied regardless of the industry, size or location of the organization. There are also methods, which can only be applied to special industries. Since COMPOSITION is detached from a specific industry, only modelling methods that are generally applicable are presented below.

There might arise the question of why companies should put so much effort and time into the visualization of their current business model. A clearly stated business model is the cornerstone of every meeting and discussion about changes and innovations in the current organizational structure (BMI will be explained in more detail in Section 4.2). Without knowing the current state of the business model, it is difficult identifying options for development in the future and reacting to environmental changes of customers or competitors. Further, there should be a common understanding in every company about the business rationale of the company. The visualization of the business model should be in a clear and easy way with the intention to make it understandable for every employee. However, the challenge arises that the statement of the business model should not be too simplistic because the more details are taken into account the better the analysis can be performed and the deeper the understanding and discussion will be. Business models help to solve this dilemma and are a blueprint that can be used in an easy way without losing too many important details (Osterwalder & Pigneur, 2010). There are various scientific models that can be used to visualize and structure business model. In the ensuing we present some models that were used in the context of COMPOSITION.

The "four-box business model framework" (Christensen et al., 2016), which is used at the Harvard Business School in their MBA program, presents a commonly used approach to structure a business model. The four boxes consist of a **value proposition**, **profit formulas**, **processes** and r**esources**:

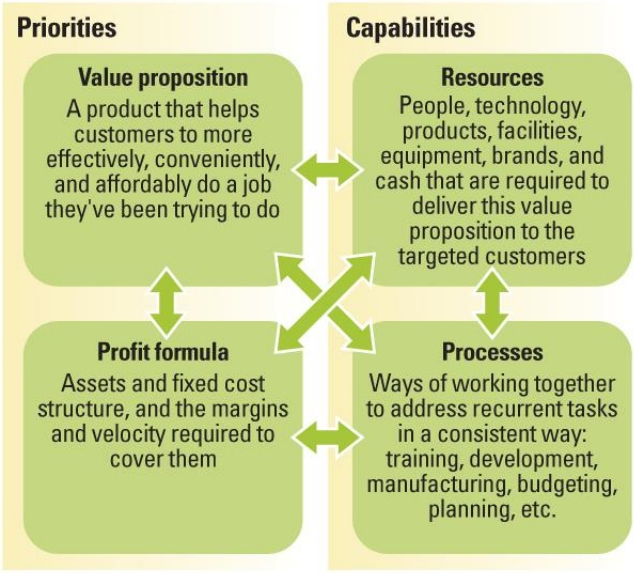


**Figure 1 four-box business model framework (Christensen et al., 2016)**

**Value proposition:** The value proposition can be regarded as the company's value promise to the customer. It helps the customer to perform his task better. This can be, for example, an increase in performance, but also the opportunity to better respond to customer needs.

**Resources:** To provide these products and services, the company needs resources, e.g. people or a certain technology. Usually resources are limited and cannot be distributed indefinitely. An organization must use resources efficiently to save costs and allocate the right resources to the right processes to work effectively.

**Processes:** The way how these resources are transformed into the product is described by business processes. Processes are defined as structured sets of activities designed to create specific outputs (Davenport, 1993). They are considered to split into core, support, and management processes (Armistead et al., 1999). Core processes create value for customers, support processes ensure that core processes continue to function, and management processes help plan, monitor, and control other processes (Harmon 2010).

**Profit formula:** According to Teece (2010) profits are the foundation of every business model. Thus, the profit formula contains information on how the organization aims to cover the costs of resources and processes and creates long term profit and value.

These four parts together help to explain the capabilities of a company. By stating the four parts, an organization may put them in relation to describe and analyze their interactions and dependencies (Christensen et al. 2016). The four boxes are one possibility to describe a business model. However, in the tradeoff between the level of details and simplicity, there might be the need for describing it in a more detailed way and taking more interdependencies into account. The more detailed you want to set up a business model for your company, the more information you need and the more time you need to spend on it. Higher complexity of dependencies leads to a more difficult form of presentation and visualization that cannot be understood without much effort.

The following scientific methodology to visualize a business model provides, therefore, a higher level of detail, which will also determine the quality of a possible applications.

The BMC (Osterwalder & Pigneur, 2010) is a tool to describe business models in a more detailed way and is built out of nine segments: **Value proposition, customer segments,, channels, customer relationships, revenue streams, key resources, key activities, key partnerships and cost structure.**

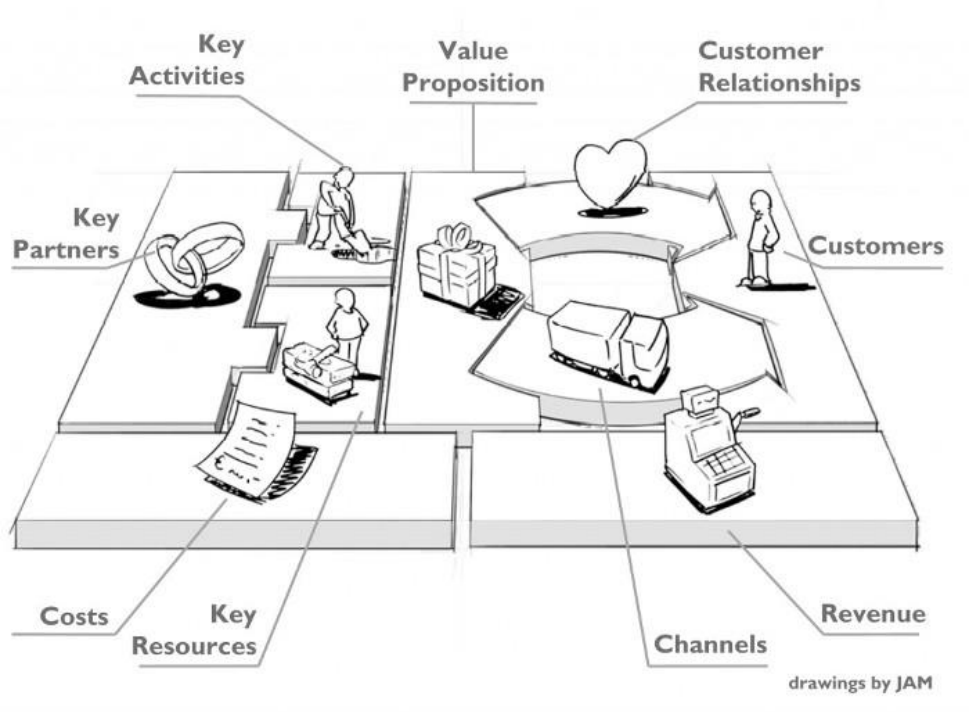


**Figure 2 Business Model Canvas (Osterwalder & Pigneur, 2010)**

**Customers** are a basic part because without having people who want to buy the products and services offered by the company, no business can exist. By defining specific customer groups and segments, a company can figure out the needs of the customers in more detail and can decide how the firm wants to serve them and can create more specific products and services.

After specifying the customer segments and understanding their needs, the company can state its **value proposition**. The value proposition contains, on the one hand, the reason, why a customer should buy the good or service by the company and not by one of its competitors. On the other hand, it represents the customers' addressed and hopefully solved problem or the need which is met by the company. The value proposition can be described by the benefits which are generated by the firm for its customers and the customer wants to pay money for. It is important to note that the value proposition is not the product. An example: When buying a car, the value proposition of the car seller is mobility, which is given to the customer by the car. Having a certain value proposition, however, is worthless without knowing how to serve the customer with this product or service.

Therefore, **channels** contain all the interaction opportunities between the company and its customers, i.e. the customer touch points: How to provide information about the product or service and how to get in touch with the customers. Typical channels are a retail store or an online store.

Not only a company needs to know how to serve its customers, but there also have to be created a relationship between the firm and the customers. By creating a **customer relationship**, the company has the opportunity to specify the contact and can treat different customer groups differently.

**Revenue streams** describe how revenue is created from the customer segments by providing value to them. Typically, this refers to the sale of products or services. In addition, it can also be specified how these products or services are sold, e.g. piece by piece. There are also other concepts, such as rental or pay per use, where a customer pays per use of the product or service.

The **key resources** are the factors that the company owns in order to create this value to the customer. Human capital is also contained in this part. But this also includes essential production machines or the expertise that employees have.

**Key activities** describe how these key resources help to convert or are converted into the value for the consumer. Thus, according to Davenport (1999), they mainly refer to internal business processes, but it is also possible to define processes that are carried out at interfaces to stakeholders.

**Key partnerships** can be explained by a network of suppliers and partners that make the business work. It covers everything where the company cooperates with external partners including not only the suppliers of resources that the company itself does not have at its disposal. It also includes all institutions that contribute to the success of the business model or minimize risk. It is also up to the parties how these partnerships are organized, i.e. forms of coopetition as well as joint ventures are included.

At last, the **cost structure** has to be obeyed. As the profit of a company is described by revenue without costs, it is not only important to generate revenues, but also consider the cost. Here it is primarily important for companies that the costs do not exceed the generated revenues. Especially, the previously considered segments key partnerships, key resources and key processes should be considered, and which costs are caused by them. Thus, a holistic view is generated. From this it is also possible to evaluate whether the costs incurred justify the generated advantage or not.

All in all, the BMC is a very often used frameworks to describe business models. By depicting all the nine segmetns, the business of a company can be visualized and analyzed in a detailed manner (Osterwalder & Pigneur, 2010).

If the current business model is visualized with the help of the BMC, the company can analyze the BMC to identify strengths, weaknesses, opportunities and threats, e.g. by means of a SWOT analysis (Hill and Westbrook 1997). However, this does not automatically focus on the further development potentials (Christensen et al., 2016). 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 customers. Therefore, a change in business logic and activities becomes evidential for every company. However, business models do not automatically change and adapt to new trends, technologies and the competition. Here it is primarily important to know the current state of the business model in order to recognize possibilities for changing it and how, for example, new technologies can be used in one's own company. Companies must actively question their business model and explore possibilities for renewal. This innovation process is explained in more detail in Section 4.2.

In addition, as a specific business model is used for a longer time, the flexibility decreases. What in the beginning seems to be contra-intuitive, is an outcome of the interdependencies between the different parts of the business model. This can be illustrated, for example, by key partners in the BMC: By having a certain dependency on the key partners, this relationship is regarded as fixed, e.g. due to long-time contracts. Consequently, alternative key partners are no longer considered. This leads to the fact that any options and innovations associated with other key partners are excluded from the outset and no longer considered. What is demonstrated with key partners, can be applied to every part of the BMC. With the loss of flexibility and without the adaption of new trends and technologies, companies cannot fulfill new customer needs with its current value proposition and lose competition (Christensen et al., 2016).

## 4.2 Business Model Innovation

Only 27 percent of the companies actively go after BMI. The Boston Consulting Group figured out this number in 2014 by pursuing a survey with 1500 senior executives (Lindgardt & Ayers, 2014). It is generally difficult for companies to implement innovations in the business model as it requires not only a deep understanding of the market but also the ability to predict trends and changes of customer expectations, which are both volatile concepts. Therefore, it is very important for companies to come up with a strategy for innovation (Anthony et al., 2016). This innovation strategy does not have to mean that everything within the current business model has to change. An innovation strategy can also mean to improve the existing business model by increasing efficiency and productivity to strengthen the value proposition provided to customers. Using, for instance, new technology in the portfolio of resources can improve processes and the economic value of the company (Osterwalder & Pigneur, 2010).

Nagji & Tuff (2012) came up with the term core innovations. Herby, the existing products and assets of the company were used and the existing markets and customers were served. Technology, which is a huge driver of changes in business models (Teece, 2010), can help to create such core innovations. Hereby, technology can not only be used to make the key activities within the company better, but also to adjust the value proposition to serve the customer needs in a better and more individual way (Nagji & Tuff, 2012). The term core innovation can be taken to mean, for example, that a company records its internal processes using sensors and thus recognizes optimization potential. Alternatively, a company can collect and analyzes customer data to improve their customer orientation and consequently increase customer relationships. The example of core innovations shows that companies can innovate their business model in different ways and that there is no given framework for how far innovation can go.

It is therefore very difficult for companies to see what opportunities there are for innovation in the current business model. Additionally, an innovation of the business model is always associated with risks, whether this new concept will work (Christensen et al., 2016). For companies, there is also the difficulty of how far the innovation of the business model should go. As mentioned above, should the current business model be improved or a completely new value proposition be generated (Nagji & Tuff, 2012)? The “St. Gallen business model navigator” (Gassmann et al.,2014) offers assistance in the innovation of business models. With the help of business model patterns, the innovation of the existing business model is considered and possibilities for innovation are discussed. The logic of innovation underlying the “St. Gallen business model navigator” is explained in detail in Section 5.1.

A business model pattern does not represent an entire business model but rather concepts that change individual segments of the business model. For instance, the pattern *E-Commerce* describes how products are offered online without any branch intervening. This covers the categories value proposition, revenue streams as well as customer relationship from the BMC. Gassmann et al. (2014) identified a total of 55 business model patterns and found that 90 percent of BMI in practice are only a combination of these.

The following procedure is proposed for BMI by Gassmann et al. (2014): First, the current business model must be represented, e.g. with the BMC. Subsequently, the 55 different business model patterns are randomly drawn. Teams from the company discuss what possibilities this business model pattern offers for the existing business model, i.e. how they can use E-Commerce for their current business model. Finally, the participants will decide on whether this pattern can be implemented into the existing business model and the organizational structure. This approach to BMI not only offers the advantage that the business model pattern can be used to identify various options and thus think far beyond the existing business model. The employees are also encouraged to take part in the innovation process and can contribute their experience and knowledge.

This procedure, however, does not fit the context of COMPOSITION as the use case have already been identified and implemented, hence, this deliverable is not about identifying patterns that should be implemented. Nevertheless, the patterns can be used to understand how BMI occurred and will occur within the pilot partners business models as a consequence of being part of COMPSITION. The derived approach will be explained in more detail in Section 4.4. and Section 5.2

## 4.3 Industry 4.0 - Disruptive Driver for Innovation in industrial Companies

The platform COMPOSITION offers among other things companies the opportunity to digitize parts of their production by using Internet of Things (IoT) solutions. It aims to gather various companies that have the knowledge and tools to innovate existing business models. One of the main challenges for companies is to understand the opportunities offered by IoT solutions. A certain understanding is needed to assess the potential of this new technology and to drive the innovation of the existing business model. For this reason, the following chapter deals with this new technology in order to provide an overview.

IoT is regarded as one of the largest disruptive technologies by changing the way organization interact with their customers and manage business processes. This chapter, therefore, deals with the question of what lies behind this new technology and how it can change the manufacturing industry. Finally, it highlights challenges and threats related to this new technology.

DHL and Cisco expect over 50 billion “smart things” (this term will be specified in the following) to be installed by 2020. This leads to market opportunities close to $ 8 trillion over the next few years (Macaulay et al., 2015). Not only are the two companies assuming this, which is why IoT is seen as an extremely disruptive technology (McKinsey Global Institute, 2013). Oberländer et al. (2018) define IoT as follows: „The equipment of physical objects with sensors, actuators, and connectivity enables new interactions between businesses, customers, and smart things.” These smart and connected products offer a wide range of possibilities in terms of functionality, reliability and use of the products. Basically, a smart thing consists of three core components: The physical object that has already existed and in many cases (not always) can be used without any connectivity. The "smart part" which is added to the physical part. This extends the possibilities offered by the purely physical product. Finally, connectivity is added (Porter & Heppelmann, 2014).

The transformation driven by IoT is not only within the company itself, but the entire value chain is changed. IoT offers immense opportunities for companies. This technology not only makes it possible to get the existing business more efficient but also leaves a lot of room for the innovation of the entire business model.

The four levels of capability enabled by IoT are Monitoring, Control, Optimization and Autonomy. It should be noted that it is an inclusive gradation. This means that the Autonomy level also includes the three lower levels. Monitoring means that the smart thing can display the current state of the product. As an example, the oil temperature meter can be cited here. It shows the condition of the oil temperature and can show the driver of the car if overheating is imminent or the oil is still too cold for maximum load. The Control level not only means that the current condition can be measured, but also that software and algorithms can be used to react to it. To stay with the example of the car, the smart measuring device not only detects that the oil is too hot but also reacts by activating a cooling system, for example. The Optimization section enables the data set generated by the smart product to be used to optimize the use of the product. The optimal maintenance intervals are calculated from the data and the longevity and maximum functionality are thus achieved. The last stage, Autonomy, means that the smart thing can act on its own and is no longer dependent on human interaction. Here not only the self-learning vacuum cleaner can be mentioned, but also the completely autonomous production plant (Porter & Heppelmann, 2014).

The biggest change in manufacturing since the second industrial revolution more than a century ago is currently due to IoT. The change taking place in manufacturing has been triggered by a new source of data. Previous data sources were generated by transactions within the value chain. The new smart products enable them to generate data and become value drivers themselves. The already existing product has been valuable. But because data can still be generated with the product, its value increases exponentially.

However, value generation due to IoT is not completed by equipping products with sensors, actuators and connectivity tools. The data pool, which is generated by several sensors, is only available in different silos. The challenge now is to contextualize this data, analyze it, and identify patterns. Only in this way can information be obtained from the data and ultimately value-generating knowledge be derived. It is, therefore, a basic requirement for companies to develop data analysis capabilities and thus to be able not only to generate data but also to evaluate and visualize it. This is further complicated by the fact that there is no standard for the data format and data quality. From the pool of structured and unstructured data, a database must first be created that is suitable for analysis and visualization (Mourtzis et al., 2016).

This can be shown in simplified terms in the context of the manufacturing industry. A smart production machine can be used to optimize the production process while reducing waste. To perform this optimization process, three different data sources can be used: external data, the company generated data and machine data. Data must be processed from external data sources to determine the qualities of the materials to be processed and at what point the delivery of materials can be guaranteed. In order to optimize the process, the data of the

machine itself must be accessed. Use, temperature and necessity of the next maintenance can be given here as examples. At the company level, data such as maintenance history and the number of incoming orders must be taken into account, because it makes little sense to let the machine run at maximum performance if the incoming orders weaken. This relatively simple example illustrates the important role that data analysis will play. To process this data, which is available in different formats, and to draw from it information that can ultimately be used to optimize the production process.

In addition, there are new opportunities for companies in terms of product improvement. The product life cycle changes in a certain way. Before the IoT, new and improved products were offered at certain intervals. By providing products with actuators and connectivity, companies can make improvements to the product directly via software updates. On the one hand, this can be illustrated by the fact that there is a further development of software and that this can be instantly applied to existing products. This includes, for example, Tesla, which has enabled its vehicle fleet to drive autonomously by means of software updates. On the other hand, a machine could be moved from hall one to hall two, where e.g. the temperature and humidity are different. This can be detected using sensors and the machine can be optimized in relation to the new conditions (Porter & Heppelmann, 2015). It should be noted here that the synergy between the existing machine and the newly implemented sensors can also lead to difficulties. On the one hand, this can be caused by the fact that the machine receives an update from its manufacturer and thus the communication with the sensors no longer functions. On the other hand, an improvement in the software of the sensors could lead to the communication and the collection of the machine data no longer being error-free or, for example, in a different format. All in all, a certain amount of caution must therefore be exercised when retrofitting an existing machine with new technology.

The possibilities offered by new IoT solutions are immense. The examples given here are only a small selection. In addition to the competencies that have to be built up within the company, there is a great challenge in data security (Gubbi et al., 2013). Data security is now an issue that extends through the entire company to the end product. Hacker attacks are therefore no longer just an issue for the existing administrative IT in the company but can affect every single smart product. The extent of this can be immense. Not only can production come to a standstill, but harmful attacks are also by no means ruled out. The problem that arises here is exacerbated by the fact that smart connected devices usually do not have the power to use intensive data security tools. From the moment the product is connected to the internet, it is vulnerable to any threats that the internet poses (Mourtzis et al., 2016). In addition, the use of smart things also results in a certain availability risk for IT. This risk refers to the fact that in a smart network the availability of IT is essential, and a failure of IT can lead to immense risks. On the one hand, this can lead to the breakdown of the production network. On the other hand, the entire flow of information can come to a standstill as soon as IT is no longer available. As a result, there is always a risk that the entire enterprise system will collapse. As a result, when using IoT, companies must put in place the necessary safeguards and prepare for such threats (Berger et al., 2019).

In the meantime, the networking of smart products has progressed so far that the immense opportunities are already apparent. The working world in the manufacturing industry must use the opportunities offered by IoT to remain competitive. In addition, those companies have an immense advantage over those who let this opportunity pass them by (Muhtaroğlu, 2013). The change that this sets in motion will change and modify existing forms of organization. In addition to this challenge, companies face the great challenge of ensuring data security and protecting themselves against cyber-attacks. All in all, it is the responsibility of the management to innovate the business model of the company with regard to this new technology and to balance advantages and threats.

According to the definition of Oberländer et al. (2018) and Port & Heppelmann (2014), COMPOSITION is a project that is closely linked with the IoT and smart things concepts. Depending on the use case, different IoT levels are addressed. We can learn from both research on IoT and research on business models that BMI as a core innovation does not necessarily only include the development of completely new business models. IoT acts as an enabler that supports the change and improvement of basic industrial infrastructures, leading to BMI and laying the foundation for future innovation. In the further course of this work it is now necessary to work out the core of the innovation more precisely and to understand how exactly IoT leads to BMI in the context of COMPOSITION.

## 4.4 Evaluating the Changes through COMPOSITION via a Case Study

As explained in the previous chapter, the business models of companies can be changed through the use of IoT and industry 4.0 technical solutions. Since the COMPOSITION project is developing precisely such solutions and these are being implemented by the pilot partners, the question arises as to what changes the pilot partners' business models are undergoing and what further changes can be expected. For this reason, the project partner Fraunhofer FIT conducted one case study per pilot partner to increase the understanding of changes that occur in the business models of the pilot partners and to conduct a well-founded analysis of the improvements. "[T]he distinctive need for case studies arises out of the desire to understand complex social phenomena" because "the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events" (Yin, 2003). The findings thus summarize how COMPOSITION solutions create value for companies and can be used to demonstrate the potential of the solutions to outside companies interested in COMPOSITION. In the following, the general theoretical structure of a case study will be explained. Afterwards, this section explains how the generic theoretical approach of a case study was implemented in the context of COMPOSITION in order to develop a holistic BMC for each pilot partner. The BMC should be holistic in the sense that it reflects both the business model of the company prior to its participation in COMPOSITION and visualizes changes, especially improvements, that have been created by the use cases.

According to Yin (2003), a case study consists of three phases (Figure 3): *Collecting evidence*, *analysing evidence* and *reporting results*. In the first phase, evidence is collected from a variety of data sources, with structured or unstructured interviews being two of the most commonly used methods. However, a case study is not limited to this medium. Further sources of qualitative data are, for example, observations, questionnaires, document analysis, photos or the researcher`s own impressions. In the course of this, it is particularly advantageous not to use only one source for the evidence, but to fall back on different ones (Mayring 2001, Flick 2004). It also makes sense to first check the setting of your case study in the context of a pilot and only then officially start with the correct runs. Since one wants to reveal additional patterns by means of a case study, the generated evidence is evaluated in the second phase. The results of the individual rounds are first evaluated and presented in such a way that similarities and contradictions can be identified. Here it is also possible to go through the results again with the participants of the case study in order to increase the validity. The last step to be taken is the reporting of the results. Here the results are presented by means of a medium and made available to the group of interested parties (Kohlbacher, 2006). Of course, certain quality criteria must also be observed when carrying out a case study. Attention must be paid to construct validity, internal validity, external validity and reliability (Yin, 2003).

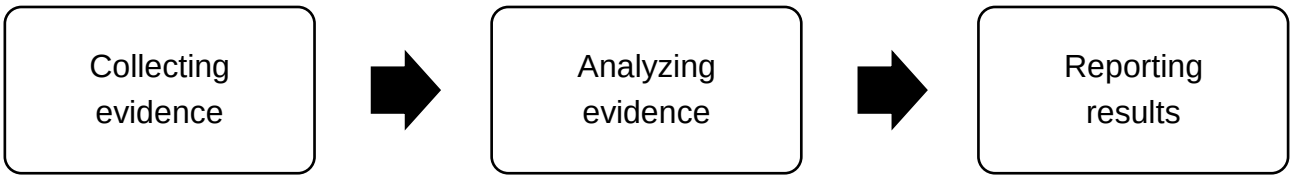


**Figure 3 The Three steps of conducting a case study (Yin, 2003)**

The timing for such a case study fits the current progress of the project COMPOSITION. The project is in its final phase and many use cases have been implemented and tested. As a result, the pilot partners have already gained initial experience with the COMPOSITION solutions and can therefore assess how they influence their organizational structure and processes. By visualizing the pilot partners' business models with the help of the BMC, these changes can be made visible, and discussed and analyzed with regard to the entire company's context. The main questions are: why companies have changed and how they have changed. These questions, in turn, reinforces the need to conduct a case study in order to find answers. If one wants to explore such questions in the context of a company, it is called "exploratory" case study (Yin, 1981; Yin, 2003). The pilot companies were the first to test how companies can develop with the help COMPOSITION. Since this was only the beginning and more and more companies should be on the platform in the future, the usage of a case study would help to generate a theory of how companies develop their business model after using COMPOSITION solutions (Eisenhardt, 1989; Hartley, 1994; Hartley, 2004).

For the case study the approach as illustrated in Figure 3 was used as a reference. The participants in the case study were the pilot partners of COMPOSITION and the partner Fraunhofer FIT carried out the case study as a scientific project partner.

The first phase, *collecting evidence*, was carried out jointly by experts from Fraunhofer FIT and the pilot partners. First, experts from Fraunhofer FIT improved their understanding of the business model of the individual pilot partners. They used their project experience to date, other deliverables and project-relevant documents, and sources from the internet, such as the company websites as a reference. Following this, an interview was conducted with each of the five pilot partners via Skype to collect evidence. Participants in the interviews were always two interviewers from Fraunhofer FIT and at least one expert from the pilot partner at hand. Each interview lasted approximately three hours. During the interview, the experts of the pilot partners were first explained the basics of business modeling and the BMC was presented as the chosen visualization method. Open questions were clarified, and the BMC was filled out for the pilot partner based on a joint discussion.

First, it was only about the business model of the pilot partner before its participation in COMPOSITION. Thus, no content was incorporated which is newly added or changed by COMPOSITION. The order in which the BMC was developed was not arbitrary but followed common best practices (Osterwalder and Pigneur 2010). Thus, the discussion started with the customer-oriented segments and the value proposition before turning to the areas that are targeted towards organizational structure and processes. The external perspective of Fraunhofer FIT, which reduced the effect of bias, complemented the internal organizational perspective of the experts from the pilot partners.

In the next step, the BMC was being discussed again in the same order as it was filled in before. This time, however, the interview partners determined changes that occur due to the company's participation in COMPOSITION. This concerns both the changes to existing structures of the business model as well as completely new aspects that were not yet present before COMPOSITION. Changes to the existing business model are, for example, improvements to business processes or the improved fulfilment of value propositions towards the customer. New aspects could be, for example, the expansion of the business model to new customer segments or a broader variety of customer communication channels.

A distinction was made between the time horizons of business model changes, i.e. the point in time on which they will probably come into effect, and whether they are directly related to COMPOSITION. "Short-term" changes occur in the immediate future until the end of the project or for about 1-2 years thereafter. "Long-term" changes only become noticeable later but are still directly related to COMPOSITION. Changes of the type "beyond COMPOSITION" can be short-term as well as long-term, but do not depend on COMPOSITION solely. Although there is a relation to the project and it also contributes positively to the achievement of the “beyond COMPOSITION” changes, there are other factors, such as other projects or external factors, which affect it. A typical example of this could be the goal of a production company to have fully autonomous production. Although the COMPOSITION solutions have an impact on this goal, they are not enough in themselves for a fully autonomous production.

All changes were made visible in colour in the BMC and a distinction was also made as to whether a change modifies an existing aspect of the business model or is completely new. When the experts of the pilot partner at hand were satisfied with the result, the interview was finished and the partners of Fraunhofer FIT finalized the BMC, optical as well as content-wise in the aftermath. For the purpose of evaluation, the pilot partner then received the resulting BMC and had the opportunity to validate it internally with colleagues from other departments.

With regard to the next phase, *analyze evidence,* the changes in the business model were analyzed within the BMC and, afterwards, regarding the so-called **four questions of business models**. These questions are actually a pre-release of the BMC. They are based on the assumption that a business model can be characterized by answering four questions *what*, *who*, *how* and *how much* (Osterwalder, 2004). As a pre-version of the BMC, the four questions of business models are not necessarily less suitable. As discussed in chapter 4.1, there are several ways to visualize a business model. Depending on the application, the right degree must be found between simplicity of use and level of detail. The four questions of business models are basically more simple to use than the BMC, but they also provide less structure for the results. During the first phase and the initial analysis, it was decided to use the BMC for this deliverable in order to map as many aspects of the business model as possible. For further analysis and in preparation for the BMN, the results from the BMC must be aggregated. The business model patterns are not based directly on the BMC, but on the four questions of business models. Thus, in the course of the phase *analyze evidence*, a transfer of the results from the BMC into the four questions must take place. Fortunately, there is an established best practice that assigns a certain set of segments of the BMC to each of the four questions of business models. Figure 4 shows this assignment.

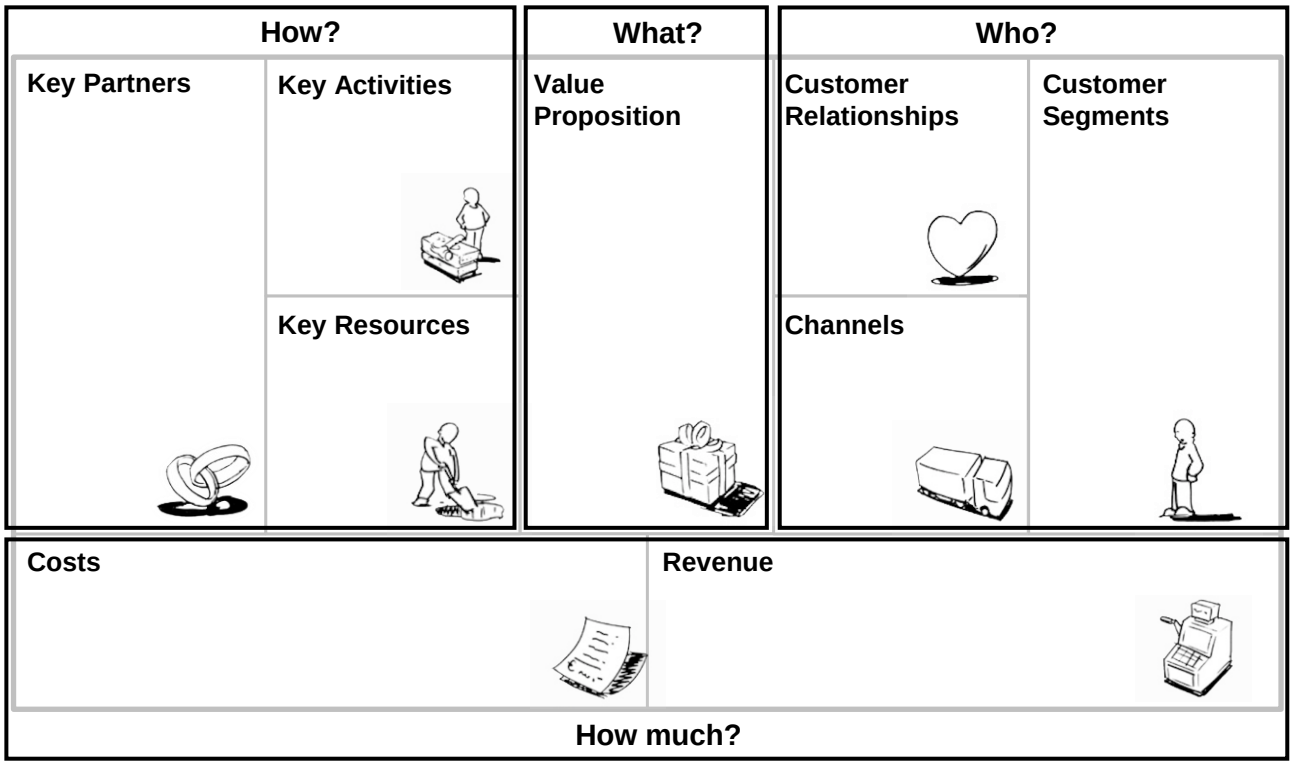


**Figure 4 Four questions of business models mapped to BMC segments**

The first question „what“ addresses the value proposition of the BMC and describes what value the company delivers to its customers by its products and services. The next question “who” deals with the changes in the customer segment, the channels and the customer relationships in the BMC. These components are called the customer interface and describes who the customers are, how the company at hand delivers the products and how it builds a relationship with them. The question “how” deals with the challenge how the company efficiently performs infrastructural or logistical issues, with whom, and what kind of network enterprise. The question includes the key partners, the key activities and the key resources of the business model. The last question “how much” consist of the components costs and revenues of the BMC. The question addresses the revenue model and the cost structure and describes in a comprehensive way how a company produces monetary value.

The aim of the phase *analyze evidence* is to aggregate the results of the individual segments of the BMC into comprehensive core results for the four questions of business models. In this way, it is qualitatively described how COMPOSITION affects a question for the pilot partner at hand. This summary makes it clear which questions COMPOSITION addresses for the pilot partners and to what extent. This deliverable distinguishes between two levels of impact. "Strong impact" refers to when the segments of the BMC within the business model question are improved both in the short term and in the long term in several aspects. "Little impact" ultimately refers to when COMPOSITION influences the segments of the BMC within the question very weakly or not at all.

Regarding the phase *reporting results,* this deliverable serves as a suitable medium. This deliverable presents the used methodology comprehensibly and summarizes results from the case studies. For a better understanding, the case study for one pilot partner, ATL, is run through in detail before the core results are presented for the other pilot partners.

## 4.5 The Impact of COMPOSITION on the Pilot Partners' Business Models

The aim of this section is to present the results of the case study carried out together with the pilot partners. The procedure is illustrated in a comprehensible way by presenting the process of analysing the business models using the pilot partner ATL as an example. For this purpose, the changes in the business models of ATL will be examined in detail and mapped to the four questions of business models. From this it can be deduced which questions of the business model were particularly strongly addressed by COMPOSITION. The final BMCs of the remaining pilot partners are then presented and the results of the analysis of the business models with regard to addressing the four questions of the business model are summarized.

### 4.5.1 Example – ATL

In this chapter, the procedure within the case study is shown exemplary for the technical pilot partner ATL. ATL, Atlantis Engineering, is an ICT SME with various activities. Atlantis has long standing experience in the industrial manufacturing domain. The expertise of the company is mainly in the decision support for the management and optimisation of production activities and assets' life-cycle, in the design, interconnection and implementation of models and protocols for the manufacturing sector, and in the streamlining of the various maintenance related processes (predictive, condition-based, and reactive). The company is offering various software, consulting and training solutions for maintenance and asset management, aiming at the support of daily production activities in factories. In COMPOSITION, ATL acts as technology provider, end user (inter-factory pilot) and dissemination manager. In the following, we will show what the business model of ATL looked like before being part of COMPOSITION and how it evolved and will evolve through the project.

During the phase *collecting evidence*, the Fraunhofer FIT partners conducted an interview with experts from ATL that work on the project COMPOSITION. The interview was prepared by the partners of Fraunhofer FIT and an initial alpha version of the BMC for ATL was created. Contents of this alpha version were derived on the basis of other deliverables, previous project experiences within COMPOSITION and online sources, such as ATL's website. The alpha version of the BMC does hence not claim to be complete, but supported the interview, because it improved the understanding of the partners from Fraunhofer FIT and gave the experts of ATL a basis to work with. As an introductory part to the interview, ATL received a brief introduction to the concept of business models and terminology related to the scientific field. Also presented were the four questions of the business model and the concept of the BMC. In this way it was ensured that the participants of the interview had the same understanding of the theoretical basis of business models. This is important because the individual segments of the BMC are not always clearly defined, especially in business practice, which can falsify the results.

In the second step of the phase, the updated version of the BMC was used to discuss changes to the business model that occur due to ATL's participation in COMPOSITION. The partners from Fraunhofer FIT acted as moderators of the discussion and provided input based on their expertise with innovation and development of business models and based on their experience gained within COMPOSITION. The experts from ATL used their extensive knowledge of the use cases and their own company to identify the changes and assign them to the corresponding type by means of "short-term", "long-term" or "beyond COMPOSITION". The interview ended when the experts from ATL and the partners from Fraunhofer FIT were satisfied with the current version of the BMC.

The interviews were conducted in April and May 2019, which meant that all pilot partners should already have had a deep understanding of the project and its impact. Nevertheless, it was possible that during the interview aspects were forgotten that were not considered by Fraunhofer FIT or the ATL experts. For this reason, after the interview, ATL received an updated version of the BMC containing all discussed contents and changes from the interview. The aim was for ATL to be able to expand and improve the BMC through internal discussions with other departments or superiors of the experts. This procedure also creates an additional evaluation step, whereby the resulting BMCs can be validated from the pilot partner's perspective. In the case of ATL, there were only minor changes to the BMC after this additional evaluation and the partners from Fraunhofer FIT adapted the BMC accordingly.

The resulting BMC shows both the initial business model of ATL before being part of COMPOSITION and changes that occur by being part of the project. Structured along the four questions of business models, Figures 5 to 8 show the individual segments of ATL's BMC. The non-colored components visualize original aspects that are not affected by COMPOSITION. Parts marked with a red star are new and were not an aspect of ATL's business model before being part of COMPOSITION. Modified aspects of the business model are marked in color, which automatically includes all new aspects. Depending on the color, the change is of the type "short-term" (green), "long-term" (orange) or "beyond COMPOSITION" (blue). In the following, we also

provide a detailed description for each of the four questions of business models by summarizing the changes for ATL. Based on this, we derive an overall qualitative description for ATL for each one of the four questions of business models that aggregates the changes to its business model structured along the three pre-defined types of changes.

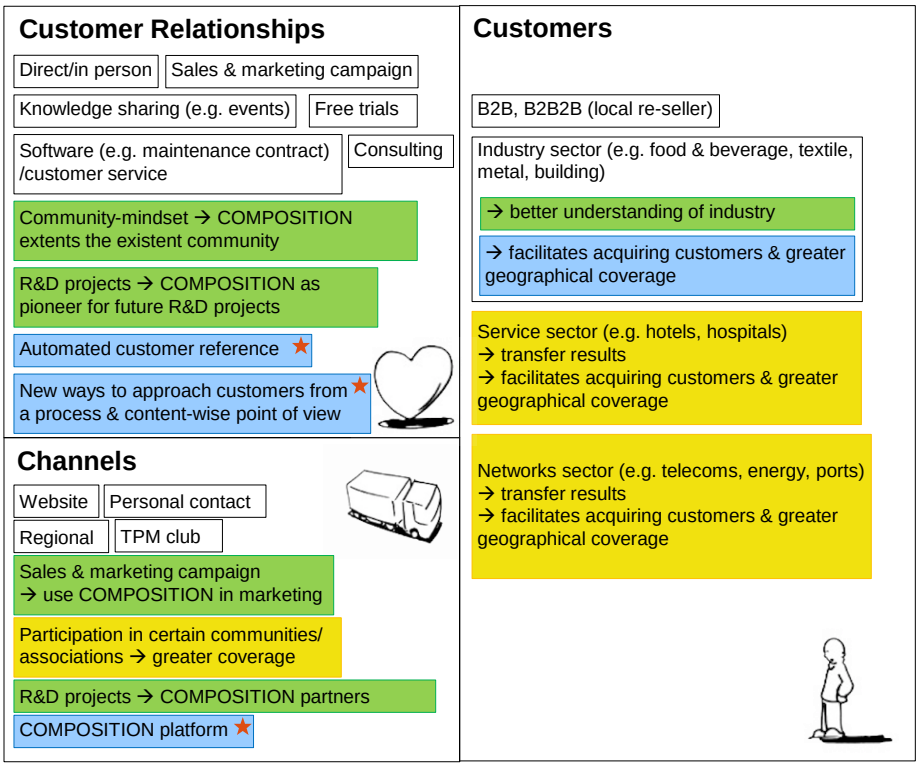


**Figure 5 Question "who?" – ATL**

Regarding the question "who", COMPOSITION results in business model changes of all three types. In the short term, some improvements are already effective today. The community-mindset aimed at by ATL was promoted by COMPOSITION and the personal customer network could already be extended within the scope of an R&D project. The project is being used by the marketing department for the acquisition of companies and across the board ATL was able to improve its knowledge of the industry by working together with the other project partners. In the long run ATL will use the results of COMPOSITION to increase its own customer orientation and to address customers via new channels, e.g. the COMPOSITION platform itself. In addition, the reach of ATL will be extended in order to address new customers. Beyond COMPOSITION, new customer groups can be targeted, which, however, requires a transfer of the project results to other industries.

**Table 2. Question "who" – Core Results for ATL**

| | **Who?** | | |
|---|---|---|---|
| | ***Short Term*** | ***Long Term*** | ***Beyond COMPOSITION*** |
| **ATL** | Improvements in all segments, new marketing opportunities and better establishment in the community | Higher customer loyalty, especially in the industrial sector. New possibilities to interact with the customer. | Opportunity to extend benefits to further customer segments |

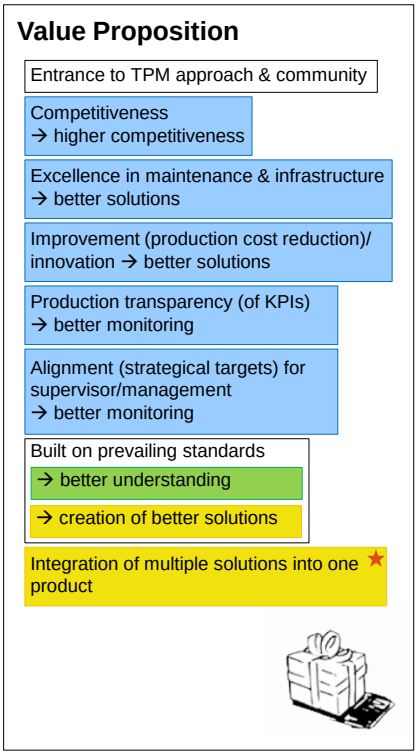


**Figure 6 What? – ATL**

Regarding the question “what”, COMPOSITION will change ATL's value proposition primarily from a long-term perspective. New value propositions will not be developed as direct consequence of the project, but existing ones can be substantially improved. This applies especially to the quality and flexibility of the products offered by ATL, which can create more value for customers through COMPOSITION solutions and better help them to achieve their goals. It should be emphasised that the changes will address all but one of the value propositions and, in the opinion of ATL's experts, will lead to lasting improvements. This observation is closely linked to the previously discussed question "who", as it is essential for an expansion of the customer segments to offer high-quality products that create value for the customer.

In addition to COMPOSITION, there are plans in the future to offer all-in-one solutions that increase the value generated specifically on the customer side through seamless interfaces. COMPOSITION solutions can be an important component of such a product and thus represent the first step towards this vision of the future for ATL. However, it is up to ATL to pursue this idea further after the end of the project.

In addition to these positive observations, it should also be mentioned that during the interviews only one improvement of the short-term type was identified. This is mainly due to the fact that the experts at ATL assume that further internal development work must be put into the COMPOSITION solutions before they can deliver the promised added value to their customers.

**Table 3. Question “what” – Core Results for ATL**

| | What? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | Slight improvement of internal expertise regarding prevailing industry standards | Fundamental improvements of almost all value propositions. | COMPOSITION as the first step towards an all-in-one solution |

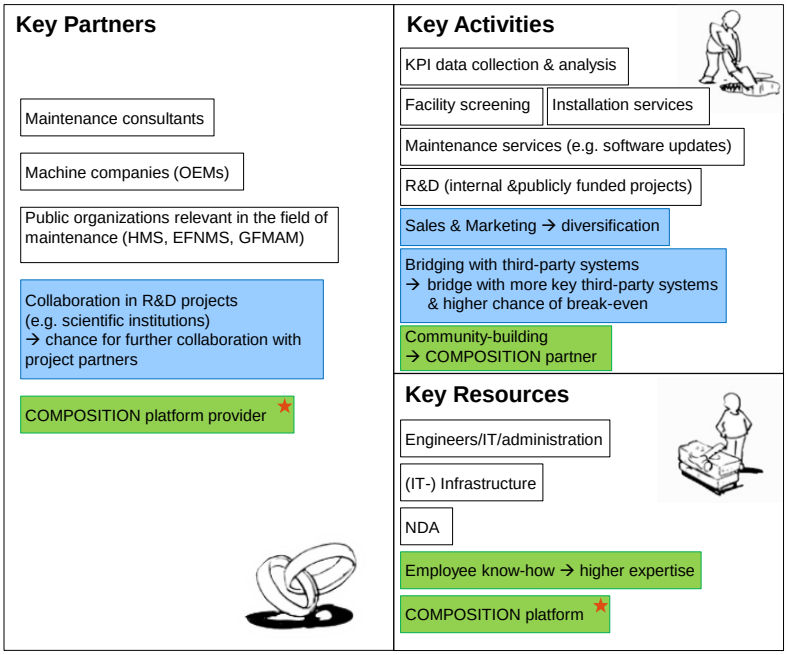


**Figure 7 How? – ATL**

Regarding the question “how”, ATL expects small improvements in the short and long term. The focus is on acquiring new key partners via the network and improving the internal key resource of employees through higher expertise gained by being part of the project. The COMPOSITION platform itself, which will be relevant for ATL in the future as a new key resource, deserves special mention as this could lead to further changes in the business model. As a pilot partner who does not use COMPOSITION solutions itself, but wants to develop and distribute them, it is understandable that the internal processes of ATL are only slightly changed. That being said, the marketing and sales department of ATL can use COMPOSITION as advertisement towards potential customers.

As a side note it can be pointed out that ATL wants to use the improvement regarding the questions "who" and "what" in the future to grow continuously as a company. It is therefore quite possible that this will also have effects on several aspects of the BMC segments at hand, e.g. new key partnerships or an expansion of the IT-infrastructure or the number of employees. These far-reaching changes are highly fraught with risk and cannot be substantiated at present, which is why they are not illustrated in the BMC.

**Table 4. Question “how” – Core Results for ATL**

| | How? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | New partnerships and increase of employee expertise | Community-building and collaboration, could lead to future projects | - |

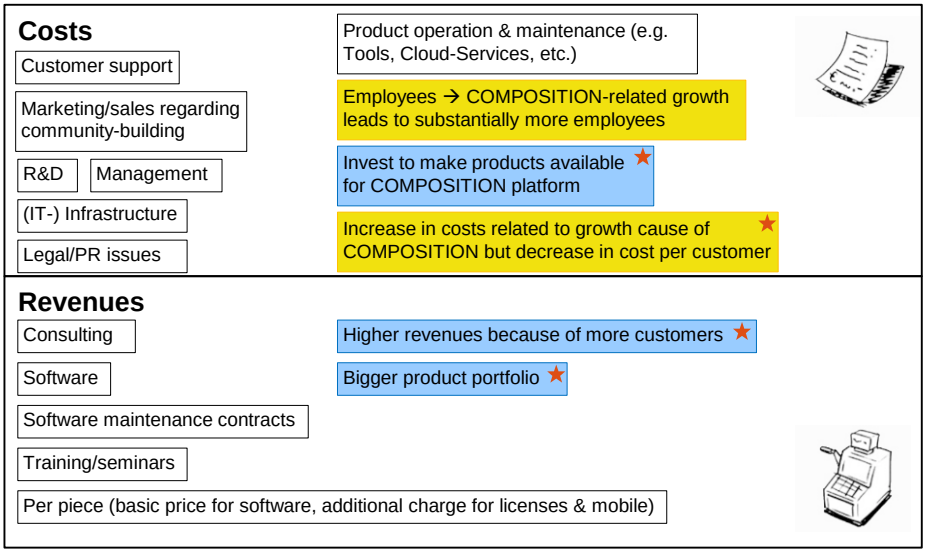


**Figure 8 How much? – ATL**

Regarding the question “how much”, **Figure 7**Figure 8 shows that there are no short-term changes in the company`s cost and revenue structure. In the long term, however, both revenues and costs will continue to rise as a result of COMPOSITION. On the one hand a larger product portfolio, higher customer orientation and additional customer segments will increase revenues of ATL. This aspect can affect several parts of the revenue model through network effects, since ATL generally has a high level of customer loyalty. If a company becomes a customer of ATL through COMPOSITION or supported by the new COMPOSITION solutions, the entire revenue model of ATL profits.

However, ATL also expects its costs to rise as a result of COMPOSITION. This is of course due to the investment that has to be made during the further development of the products, but also due to the possible increase of internal costs. These include, for example, the hiring of additional employees to manage the increased customer portfolio, but also general cost increases that go hand in hand with company growth. However, since these changes cannot be attributed only to COMPOSITION, but are also dependent on other factors, they belong to the "beyond COMPOSITION" type.

**Table 5. Question “how much” – Core Results for ATL**

| | How much? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | - | Increase of product portfolio and revenues, but further investments necessary | Higher costs due to company growth |

### 4.5.2 Business Models of the Pilot Partners

In the following the final BMC of each pilot partner will be presented. All BMCs have been developed according to the procedure described above. The BMCs are also part of *D9.11 Final Exploitation Strategy and Business Plans*, as they provide important insights into the individual exploitation plans of the pilot partners. While *D9.11* mainly dealt with the question whether the use cases are beneficial for the pilot partners, the presented deliverable deals with how this knowledge can be used to derive an overarching Business Model decision system. Figure 9 to 13 show the BMCs of the pilot partners, including changes that occurred by being part of COMPOSITION. In the following, for each figure and pilot partner a short description is being provided that reports on the main findings of the discussion during the interviews.

**ATL**

As the presented analysis of the individual segments of the BMC for ATL has already shown, the interview revealed improvements in each segment and for each type of change. However, there are only a few changes within the segments, which mainly address internal processes and resources. In the interview, the experts pointed out that the improvement of their employees' expertise is a major benefit of the project and has already positively influenced other work and projects. However, the strongest changes due to COMPOSITION relate to segments related to ATL's customers. For example, ATL plans to acquire new customer groups, e.g. through the marketing opportunities of COMPOSITION. On the other hand, the COMPOSITION solutions offer the potential to be extended to other industries and to be applied there as well. However, since this change also requires further projects by ATL, these were marked as "beyond COMPOSITION". In direct contact with its customers, ATL relies on COMPOSITION as a new communication and transaction channel. In principle, the work in COMPOSITION complements ATL's goal of collaborating with potential customers through research and development projects in the community. The strongest change occurs in the segment of the value proposition for ATL. The COMPOSITION solutions can complement ATL's product portfolio in a meaningful and complementary way and improve the existing value propositions in the long term.

**NXW**

Nextworks s.r.l. boasts long-term experience and proved skills in the frameworks of control technologies applied to networks and interconnected devices, design and development of complex software on both traditional and embedded platforms, Quality of Service in packet networks, IP telephony, digital video encoding and streaming. NXW built a customer oriented solution portfolio incorporating digital systems and networks for sophisticated luxury technology systems.

Similar to ATL, NXW does not act as a pilot partner that uses the COMPOSITION solutions itself but rather develops the solutions together with other technical partners in the consortium and aims to offer the solutions to current and new customers after the project ends. Hence, it is reasonable that just like ATL, the value proposition of NXW seems to be the main BMC segment in focus. The experts stated that almost all value propositions are being directly improved by COMPOSITION in the short term. Furthermore, the segments related to customers are being targeted as well. Thus, NXW estimates to extend their customer portfolio by transferring the COMPOSITION solutions to other customer segments. Likewise, ATL, they may use COMPOSITION as a new communication and collaboration channel with their customers. Regarding internal processes, changes to the business model refer to higher expertise of employees that work on the projects. As NXW plans to increase their market reach with new customer segments, they estimate an increase in revenues. Additionally, the increase in revenue is strongly connected to the improvement of the value proposition, which should in turn increase customer orientation and satisfaction accordingly. Nevertheless, company growth will result in higher costs, e.g. for more employees or a better IT-infrastructure.

**ELDIA**

ELDIA S.A. is an industry leader in waste management and recycling in Greece. The company provides solutions for issues concerning the solid waste management and disposal of industrial and commercial enterprises, local government or organizations of the broader public sector. ELIDA is governed by principles targeting ecological sustainability and customer orientation.

For ELDIA, a wide range of changes can be observed in different areas. These include all segments of the BMC that affect internal processes and resources. The implementation of the use cases enables an increased efficiency of transport processes and forms the basis for future mobile transportation systems and an expansion of the IT-infrastructure. The other COMPOSITION partners can be regarded as new key partnerships. Overall, the focus of these changes is on reducing costs. However, since ELDIA is also a company with a high customer orientation, they expect improvements in the area of customer relationship and an improved communication via the COMPOSITION platform. However, the changes rather have an indirect

effect on the segments of the BMC that relate to customers. In essence, the interviews showed that the improvements made by COMPOSITION will also have a lasting effect on ELDIA's value proposition. For almost all value propositions, a long-term improvement can be expected from the customer's point of view. This includes not only increasing the quality of ELDIA's services, but also effects resulting from the increased efficiency, whereby ELIDA can continue to offer competitive prices

**BSL**

Boston Scientific is a worldwide developer, manufacturer and marketer of medical devices whose products are used in a broad range of interventional medical specialties. It is one of the largest medical device companies in the world with over 25,000 employees worldwide.

BSL belongs to the manufacturing industry and therefore uses COMPOSITION solutions to increase the quality and efficiency of its own production. Related use cases address, for example, the introduction of predictive maintenance or control systems for key production figures. This is also reflected in the changes to BSL's business model. While for BSL very little changes in the way they interact with customers occur, COMPOSITION influences many internal aspects of BSL. Above all, it increases the efficiency and productivity of many key internal activities. In addition, sensors are also used to track material and avoid loss of important ressources. Beyond the project, COMPOSITION could be the basis for a fully automated production. BSL also hopes for further collaboration in the form of research projects. Ultimately, these changes will have an impact on BSL's costs, which will decrease in the short and long term. Even if no changes for customer related segments were identified during the interview, there are still many improvements that affect the customer. The positive effects on production can be converted into improvements of various value propositions and have a direct impact customers as well. Thus, BSL is known for a high degree of innovation, not only for its products, but also for the production of these. As BSL is active in the medical sector, trust plays an important role for customers. Implemented safety mechanisms, such as predictive maintenance, which greatly strengthens the quality promise of production, also have a positive effect on the value proposition of trust. Just as for their product portfolio, customers expect BSL to adapt to changes in the market and to use processes that at least meet the technical standard. With COMPOSITION, BSL can exceed these expectations and sustainably innovate its own production.

**KLE**

KLEEMANN operates in the manufacturing and the trading of lift systems. The range of products includes domestic and commercial lift systems, car parking and multi-storey building lift systems. KLEEMANN ranks among the large international companies of the lift industry in the European and global market, with manufacturing facilities in Greece, China and Serbia.

Just like BSL, KLE is also active in the manufacturing industry. Their use cases therefore also focus on the improvement of internal processes. In the BMC this becomes visible through numerous changes in the segments of key activities and key resources. Thus, predictive maintenance is used to make maintenance processes more efficient and above all more effective. This also has a positive effect on quality assurance processes and extends the lifetime of essential and expensive production machines. There could also be improvements beyond COMPOSITION. Further research and development projects are conceivable, which use the knowledge and results from COMPOSITION and further innovatively improve production. With the COMPOSITION partners, KLE's network has also expanded and new key partnerships have emerged. Due to the increased use of IT and technical solutions in production, KLE has to expand its IT infrastructure, which in turn can serve as a basis for future projects. In summary, KLE's participation in COMPOSITION reduces many cost factors and creates a solid base for even more efficiency and productivity. It is worth mentioning that KLE will also use COMPOSITION for marketing purposes, e.g. for presentations at events. This has a modest impact on BMC's customer segments. Finally, strong improvements in KLE's value proposition were also identified in the interview. As with BSL, improvements in production can be transferred to it. In KLE's business, security and customer trust are essential value drivers that are improved by increasing production quality. In addition, KLE can make its production more transparent, which is important to KLE's customers, e.g. to find out the status of a delivery.

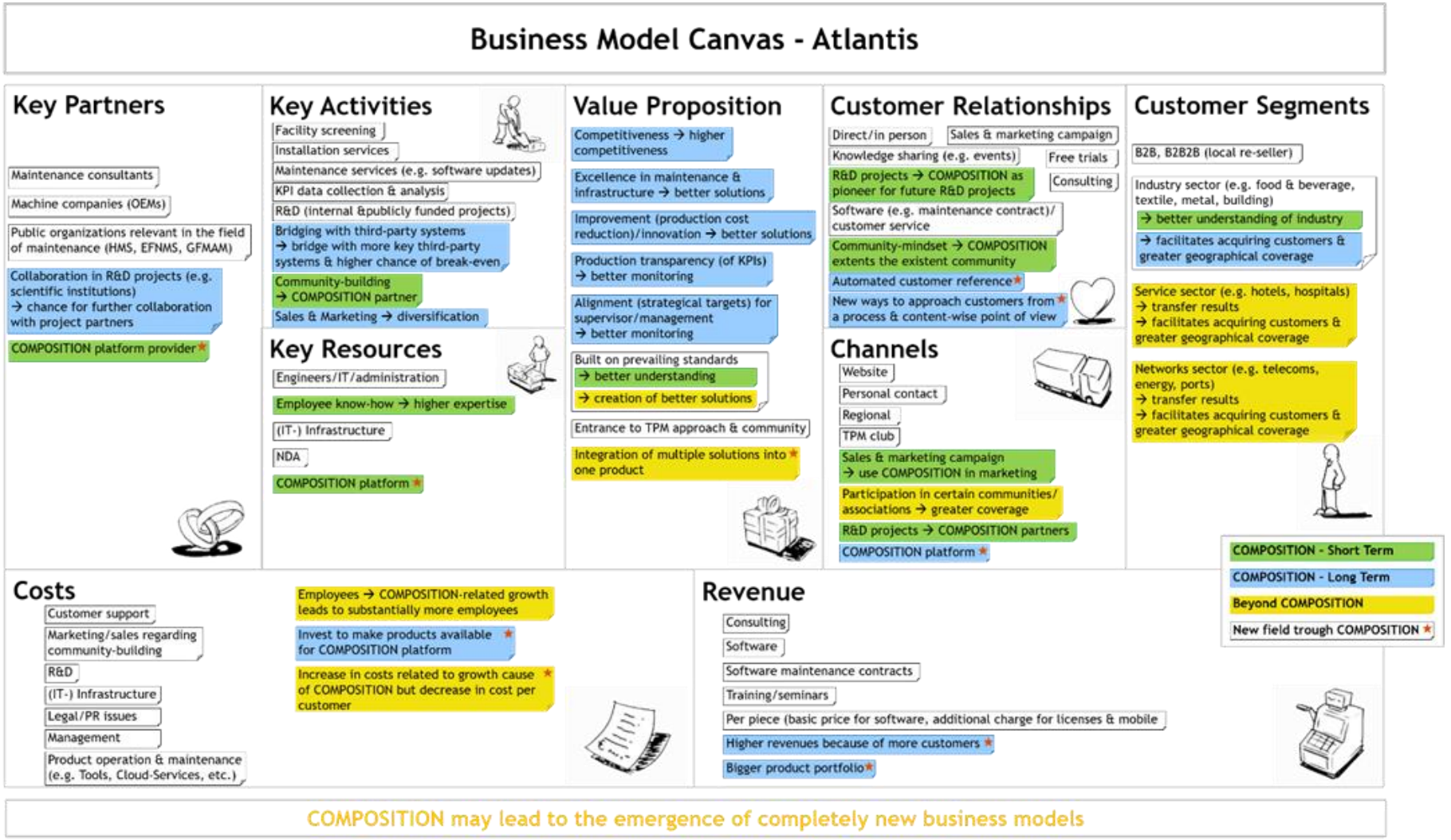


**Figure 9. BMC of ATL**

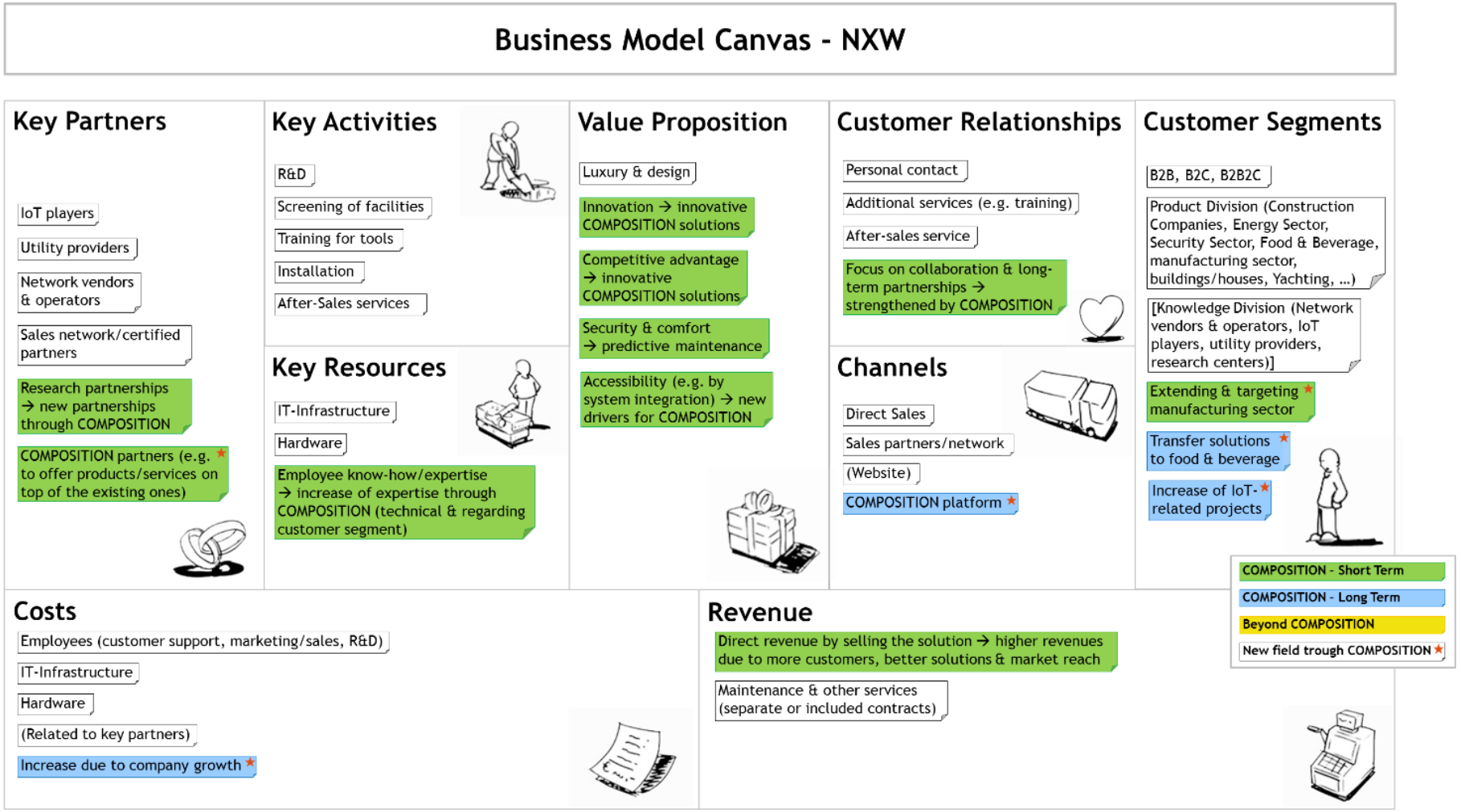


**Figure 10. BMC of NXW**

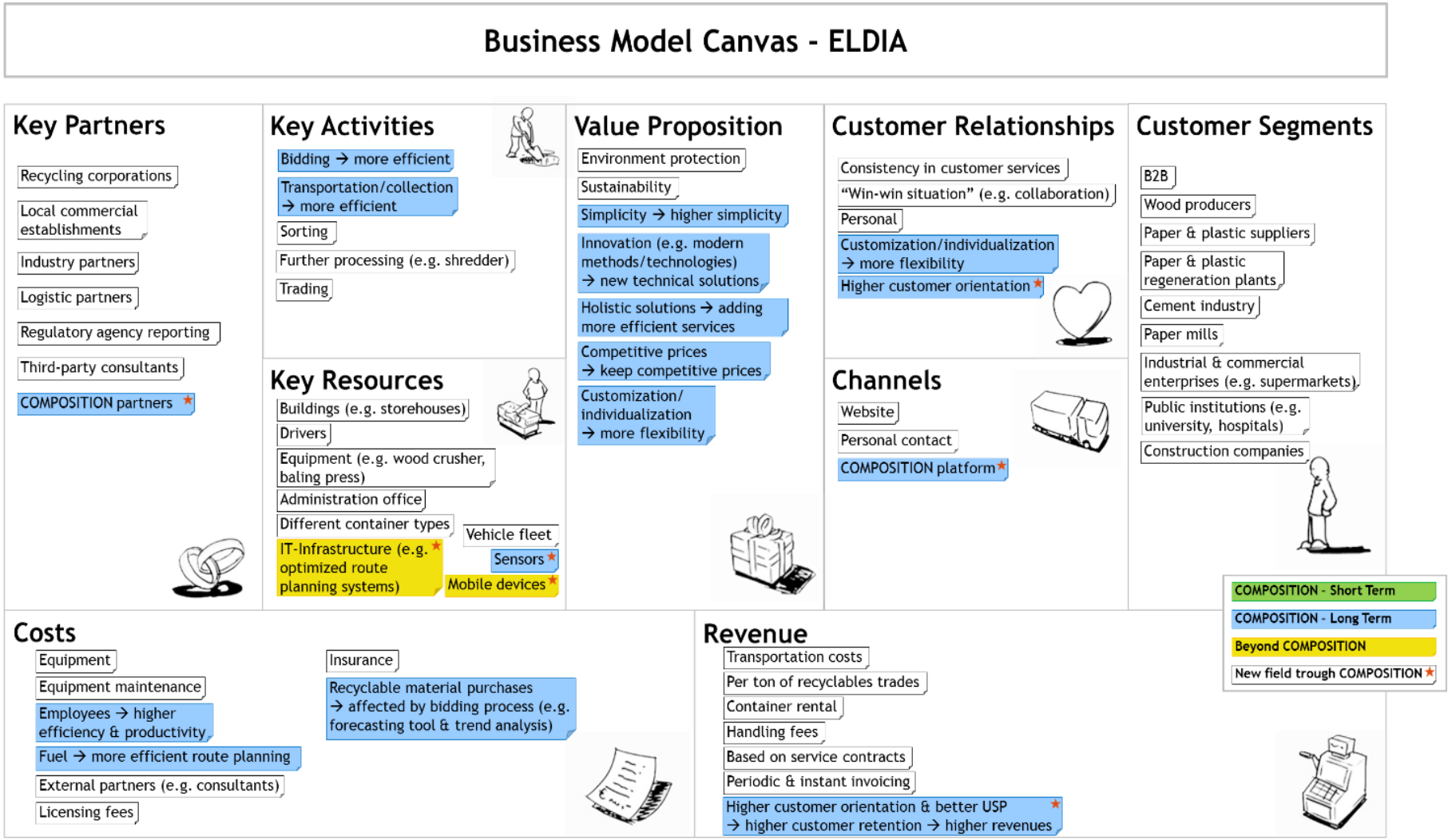


**Figure 11. BMC of ELDIA**

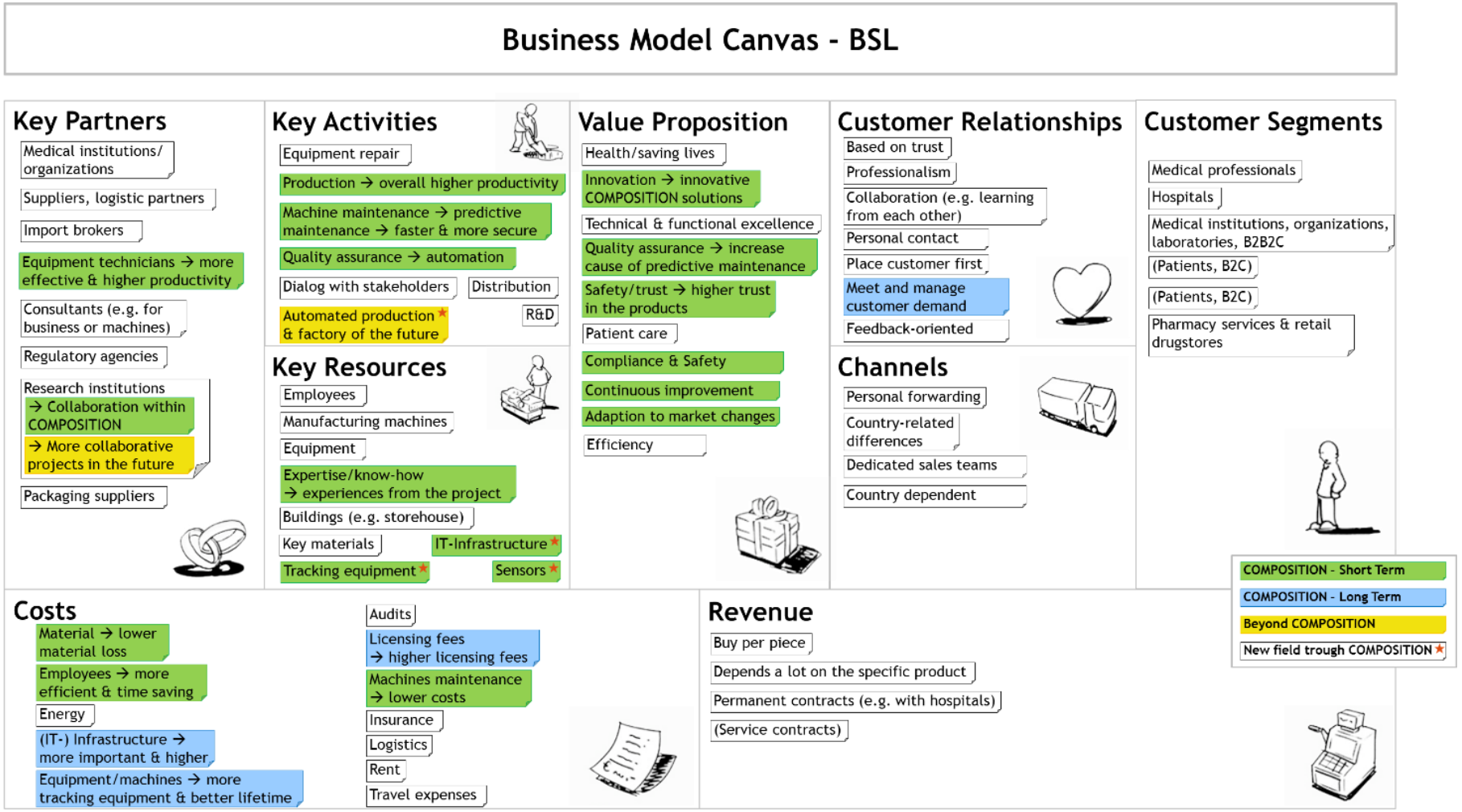


**Figure 12. BMC of BSL**

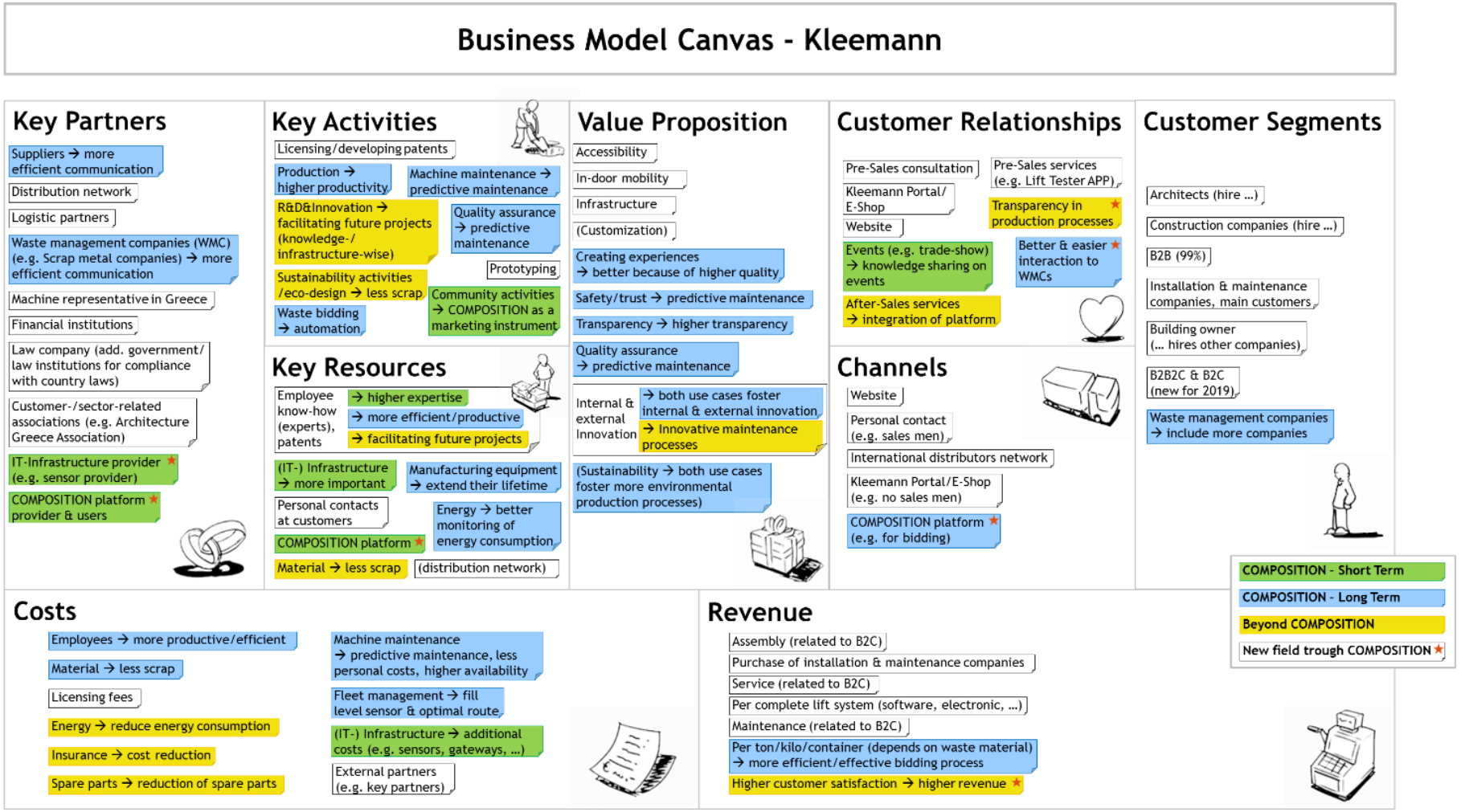


**Figure 13. BMC of KLE**

It can be concluded that the BMC is a suitable tool to visualize changes in the business models of the pilot partners in the context of COMPOSITION. At the same time, one can state based on the BMC that the business models of all pilot partners have been and will be improved as a consequence of being part of COMPOSITION. The BMC segments in focus of improvement and innovation differ depending on the role the pilot partner within the project. Industry partners, by means of BSL, KLE and ELDIA, benefit regarding their internal processes and resources and are able to reduce costs. Nevertheless, they can use the resulting positive effects also for other segments in the BMC, e.g. by a higher reliability and improved quality of their products. Technical partners, by means of ATL and NXW, benefit regarding the range of their product portfolio und customer segments. BMC's segments, which also relate to internal corporate divisions, are addressed only weakly, as the focus is primarily on the use of COMPOSITION solutions in their own sales. In addition, the effect of improved collaboration and community integration also plays an important role, as both companies benefit from a positive position within the community and can build up new customer relationships.

It is noticeable that for each pilot partner a comprehensible and meaningful improvement of the central segment of the BMC was found, the value proposition. Consequently, COMPOSITION has the potential to enable the pilot partners to create more value for their customers, which can also have an impact on customer orientation and customer satisfaction. Both factors are proven drivers of revenue and therefore have a positive effect on the economic success of the company (Anderson and Mittal 2000). This also makes it clear why an innovation, by means of a core innovation (see Section 4.2) of the business models, has actually taken place for every pilot partner within COMPOSITION. Even if the direct improvements take place in different segments, it is ultimately the case that every company can also increase the value that they create for customers. In the long run, this has positive network effects on their customers and improves collaboration within their community.

One aspect that could not be proven in the course of the interviews and this deliverable is the opportunity for pilot partners to develop completely new business models with the help of COMPOSITION. Especially in the interviews with BSL, ELDIA and KLE, there were no discussions that led towards this direction of thought. With the technical partners, especially with ATL, the possibility of new business model was mentioned and discussed during the interviews. The result is that new business models are theoretically possible, but so far it has not been specified what they could look like. For this reason, the scope of the Business Model Decision System was slightly adjusted at this point in time by the partners from Fraunhofer FIT. Besides the identification of business model patterns that fit exactly to the pilot partners and use cases, now also patterns that fit into the context of COMPOSITION in general, but were not directly implemented so far, should be identified. These patterns can be used in the future to develop new COMPOSITION solutions or to further develop the business models of the pilot partners. The results will be presented in detail in Section 5.

As with ATL, there were only a few change requests from the pilot partners after the updated BMC was made available to them after the interviews. This validates the correctness of the presented BMCs. Nevertheless, it is possible that additional aspects, such as further changes, were missed during the interviews and the evaluation. This circumstance is reinforced by the fact that project effects, especially in such a large and international project as COMPOSITION, are fraught to risk and therefore there is a chance of unrecognized positive but also negative network effects (Beer et al. 2013). Thus, the completeness of the presented BMCs can only be conditionally validated and will require further analysis by the pilot partners in the future to identify all changes in the business model.

Since the final goal of this deliverable is to assign the changes to the business model of the pilot partners to individual business model patterns, the results of the analysis of the business models must be further aggregated. This is because the business model patterns are structured according to their impact on individual segments of the business model by means of the four questions “who”, “what”, “how” and “how much”. Therefore, the changes in the business model of the pilot partners must also be structured according to the four questions. Hence, the general segments of the BMC were assigned to one of the four questions as shown in Figure 4. From the completed BMCs of the pilot partners it can now be deduced which questions are addressed how strongly by COMPOSITION. The results of this analysis are shown below for each of the four questions of business models, each clustered according to the type of change.

**Table 6. Changes regarding the "who"**

| | Who? | | |
|---|---|---|---|
| | ***Short Term*** | ***Long Term*** | ***Beyond COMPOSITION*** |
| **ATL** | Few short-term changes, mainly marketing opportunities and a better establishment in the community. | Higher customer loyalty, especially in the industrial sector. New possibilities to interact with the customer. | Opportunity to extend benefits to further customer segments |
| **NXW** | Greater reach in the manufacturing sector and building relationships in the COMPOSITION network. | Expansion of the customer segments to new industries and COMPOSITION as a new channel. | - |
| **BSL** | - | Better management of customer demands, especially for varying demands. | - |
| **ELDIA** | - | More flexibility regarding customer demands and increased customer orientation. | - |
| **KLE** | COMPOSITION as a marketing opportunity | Increasing network for waste management companies | Higher customer orientation through production process transparency |

**Table 7. Changes regarding the "what"**

| | What? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | Slight improvement of internal expertise regarding prevailing industry standards | Fundamental improvements of almost all value propositions. | COMPOSITION as the first step towards an all-in-one solution |
| **NXW** | Improvement of most value propositions due to the increase in product quality | - | - |
| **BSL** | Safety, trust and quality can be improved as key value propositions. | - | - |
| **ELDIA** | - | COMPOSITION as driver of innovation and customer orientation | - |
| **KLE** | - | Improvement of internal processes leads to increased trust in quality assurance and further value propositions | COMPOSITION possibly as a basis for further innovations |

**Table 8. Changes regarding the "how"**

| | How? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | New partnerships and increase of employee expertise | Community-building and collaboration, could lead to future projects | - |
| **NXW** | New partnerships and increase of employee expertise | - | - |
| **BSL** | Improvement in terms of efficiency and productivity, expansion of IT-infrastructure and new tracking options | - | COMPOSITION as a building block for fully automated production, e.g. by means of smart factory |
| **ELDIA** | - | Increased efficiency, e.g. in route planning, and new partnerships | Expansion of the IT-infrastructure |
| **KLE** | Expansion of the IT infrastructure and collaboration in the COMPOSITION network | Improvement of productivity, efficiency, and communication with key partners. | Improvement of the knowledge base and infrastructure for the implementation of future innovation projects |

**Table 9. Changes regarding the "how much"**

| | How much? | | |
|---|---|---|---|
| | **Short Term** | **Long Term** | **Beyond COMPOSITION** |
| **ATL** | - | Increase of product portfolio, customer segments and, thus, revenues | Higher costs due to company growth |
| **NXW** | Higher revenues by selling COMPOSITION solutions | - | Higher costs due to company growth |
| **BSL** | Cost savings due to higher efficiency | Improvement of the service life of important machines, expansion of the IT-infrastructure associated with higher costs | - |
| **ELDIA** | - | Cost savings through higher efficiency, higher revenues through improved customer orientation | - |
| **KLE** | Costs for expansion of IT-infrastructure | Reduction of many costs, but also more efficient sales possible | Facilitation of future projects |

### 4.5.3 Aggregation of Results

In order to apply the results of the analysis of the business models to the scientifically founded concept of the BMN, a final step of aggregation is necessary. The business model patterns only specify which of the four questions of business models are addressed and improved by the pattern and which are targeted less impactful. For this purpose, Tables 6 to 9 were used again by the partners from Fraunhofer FIT and processed as part of an internal employee discussion. The challenge is to decide as comprehensibly as possible for each pilot partner which question was sufficiently addressed by COMPOSITION.

A distinction is made between a "strong impact" and a "little impact". "Strong impact" refers to when the implemented and to be implemented use cases fundamentally change and improve several segments of the BMC within one of the four questions of business models. "Little impact" refers to when the implemented and to be implemented use cases change only a few segments of the BMC or the identified changes have only a small impact in the overall context of the company. For the classification into one of these categories, it was no longer relevant whether a change was made in the short term or in the long term. More emphasize was put on the quantity and intensity of the changes. Changes of the type "beyond COMPOSITION" were not considered as impactful as the other two types of changes, since the analysis is mainly concerned with the innovation resulting from COMPOSITION itself. Future developments of the business model that require additional internal projects are too risky to be used as a reliable reference for the evaluation of COMPOSITION's innovation.

The result of this discussion is presented in Table 10 and summarizes all previous results into a binary assessment of each pilot partner for one of the four questions of business models.

**Table 10. Mapping the impact of COMPOSITION to the four questions of business models**

| Strong impact, use cases improve related segments of the business model substantially in the short and long term. |
|---|
| Little impact, use cases improve related segments of the business model only within a few aspects and/or only weakly |

| | Who? | What? | How? | How much? |
|---|---|---|---|---|
| **ATL** | | | | |
| **NXW** | | | | |
| **BSL** | | | | |
| **ELDIA** | | | | |
| **KLE** | | | | |

As was to be expected from the previous analysis, the result for technical pilot partners and industrial pilot partners differs. It is also worth mentioning that the order of action, by means of business model segments affecting each other, is fundamentally different for these two types of pilot partners.

NXW and ATL extend and improve their own product portfolio through COMPOSITION solutions. This has a direct effect on their value proposition, which they can now better fulfill. Based on the changes of the question "what" changes in the customer area will be noticeable. For example, customer orientation and customer satisfaction will increase, and an expansion of the customer portfolio is conceivable. Thus, COMPOSITION also improves the question "who". Ultimately, both addressed questions have an impact on the "how much", above all because the two companies expect higher revenues and internal costs increase due to the accompanying growth of the company. If one looks for the origin of the innovation of ATL and NXW in the context of COMPOSITION, it lies in the question "what" and thus the value proposition. Due to all these changes, it is possible that ATL and NXW will also have to deal with the question of "how" in the future in order to adapt internal processes to the growth of the company. However, as this is not yet the case, the effects of COMPOSITION on the question "how" have been classified as "little impact".

For BSL, ELDIA and KLE innovation begins for the question "how". Internal processes become more efficient and effective and are modified by technical innovations, by means of IoT as presented in Section 4.3. The maintenance of important resources such as production machines is being facilitated and new key partnerships arise by means of IT-service providers. As companies for which a high level of customer orientation is extremely important, these improvements do not only affect product quality. Essential components of their value proposition refer to values that are independent of the specific product, such as trust or safety. Thus, the changes regarding the question "how" can also influence the "what" of the pilot partners and improve their value proposition. Hence, COMPOSITION solutions not only reduce the costs of BSL, ELDIA and KLE, they also create the possibility for securing customer relationships and increasing customer satisfaction, which in turn increases revenues (Anderson and Mittal 2011). Consequently, the question of "how much" is also affected. For BSL, ELDIA and KLE, innovation in the context of COMPOSITION begins with "how" and from there affects other areas of the business model. The question of "who" was classified in the "little impact" category. Even though there were isolated aspects of these segments of the BMC that were improved by COMPOSITION, these changes were not substantial enough to speak of a "strong impact".

Three core results can be summarized. With regard to the COMPOSITION project, it was established that BMI, by means of a core innovation, has taken place and has improved the business models of the pilot partners. The improvement differs in its mode of operation depending on the pilot partner. Hence, the innovation starts in a different segment of the BMC for technical and industrial pilot partners. In any case, the customers of the pilot partner and the value generated for them play an important role in the process of innovation. A quantitative evaluation of the incremental improvement of the business models can be found in *D9.7* and *D9.11*, in which benefits generated by COMPOSITION are economically evaluated with the help of the scientifically founded method of BeneFIT management (Beer et al. 2013). This deliverable, however, focuses in the further course on deriving a comprehensive Business Model Decision System from the findings of the analysis of the business models and identifying additional business model improvements.

# 5 Business Model Decision System

The aim of this section is to derive a comprehensive Business Model Decision System from the results of the analysis of the business models. The scientifically founded and practically validated concept BMN is used for this purpose. The BMN (Gassmann et al. 2014) is based on the use of 55 business model patterns to describe innovation of business models and make it usable for the innovation process. In the context of this deliverable, however, the business model patterns are applied from an ex-post perspective. This means that the patterns are applied to the COMPOSITION project to find out which patterns best describe the innovation of COMPOSITION. The identified patterns form the core of the Business Model Decision System, which is composed of all previous results of this deliverable. In addition, further patterns are described which fit into the context of COMPOSITION and are conceivable for future extensions of the product portfolio.

The structure of the section is therefore as follows. First, the BMN is introduced and the theoretical foundations behind the concept and the business model patterns are presented. Then the patterns are compared with the results of section 4 and the relevant patterns are identified. Subsequently, the Business Model Decision System is derived and presented.

### 5.1.1 The Business Model Navigator

After more than five years of research Gassmann et al. (2014) developed a systematic methodology to support the innovation process of business models. Their scientifically substantiated and process orientated methodology is called the BMN. It is a well-known concept, which helps successfully structuring the path towards an innovative business model and acts as a guide for innovation processes.

The tool is based on an empirical study of the University of St. Gallen, which studied a broad variety of company's business models (Gassmann et al., 2014). About 400 successful business models were analyzed, which have been developed over the past 50 years and a few pioneering ones from the past 150 years. Gassmann et al. (2014) take the view that innovation corresponds to understanding, translating, recombining and transferring successful patterns to one`s own business model. The St. Gallen BMN transforms the main concept of creating business model ideas by utilizing the power of recombination, into a ready-to-use methodology, which has proven its usefulness in countless workshops. The central idea of the concept assumes that through creative imitation and recombination business models can be successful innovated. The idea is based on their finding, that 90% of all new business models consist of already existing models or are a recombination of them. Often innovations are only variations of something that has already existed in another industry or geographical area. Overall, they identified 55 repetitive patterns, which form the core of the analyzed business models. The patterns aim to inspire companies by what already exists and motivate them to learn from others to reinvent their own industry. Thereby, the tool still provides flexibility and avoids the "not invented here" syndrome. Gassmann et al. (2014) give a detailed profile of each of the 55 patterns, by explaining the origins, the innovators and information about when and how to apply the patterns.

There are different strategies on how to generate BMI along with the 55 patterns, by means of one at a time or combined. One possibility is to transfer an existing business model pattern to a new industry. Despite there is less room for experimentation and adoption, mistakes can be easily avoided because existing companies serve as blueprints. Another option is to combine two or even more business models. The execution is often very complex, but therefore, it is often harder for competitors to copy the new business model. For innovative business models it is also possible to use them for another product range, to make use of synergies and reduce risks.

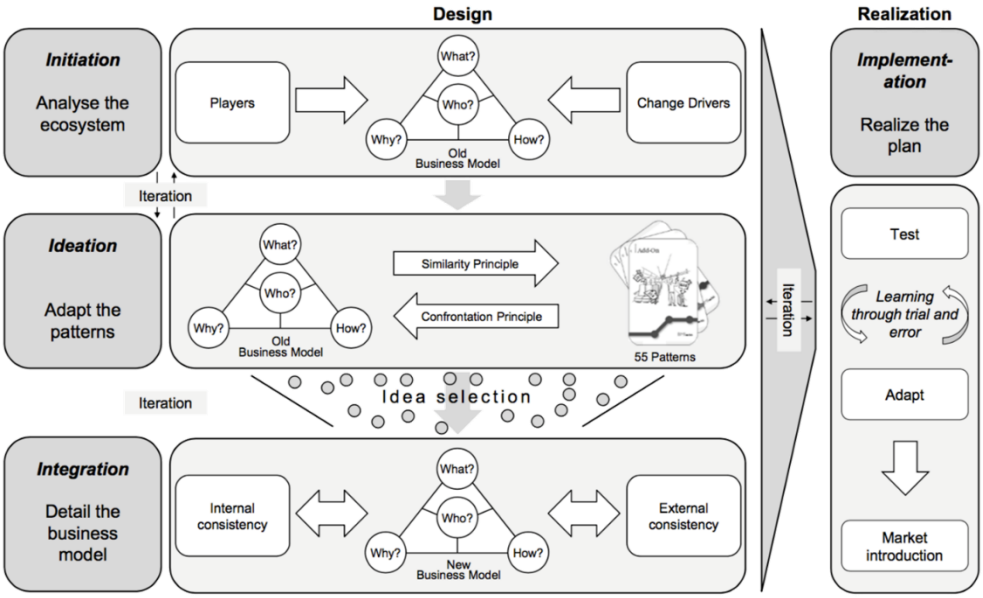


**Figure 14 The business model navigator (Gassmann et al., 2014)**

The BMN consists of two phases, design and realization. First, the design part has to be done, to identify potentials and after the realization starts. The whole process can be further separated into four steps: *initiation, ideation, integration* and *implementation*.

First, the BMN recommends defining a starting point and a direction in which you want to head. This step is called *initiation*. During this stage an in depth understanding of the own business model, the roles of stakeholders and other influencing factors is essential. Describing the current business model and analyzing the ecosystem is an important step to identify opportunities for beneficial BMI. To successfully capture the own business model, Gassman et al. (2014) propose to describe it with four core dimensions of “who”, “what”, “how” and “why”.

The ideation process is also a core element of the BMN. Re-combining existing concepts is a powerful tool to break the dominant industry logic and generate new ideas. To ease the process of pattern adaption Gassmann et al. (2014) have profiled successful BMs in a set of 55 pattern cards. Each card contains essential information that is needed to understand the concept behind the pattern. In Figure 15 one can see, that every pattern card contains the title, a description of the patterns underlying idea and descriptions of real-life firms that use or applied the pattern in their business models. The business model pattern which is used as an example is called *add-on*. The pattern card first explains the idea of offering a basic product, which can be individually expanded by buying extra services. Afterwards it mentions two concrete examples and explains how SAP and Ryanair already applied the pattern to their business model. Hence, when using the pattern, participants should discuss how e.g. *add-on* might be adopted to a specific manufacturing industry. The quantity of information provided is geared to your need at the ideation stage. The information neither bring you out of your comfort zone, nor inhibit your creativity.

During the stage of *ideation*, the level of information on the cards is just right to trigger the creation of innovative ideas. The aim of applying 55 different patterns on the existing business model is to confront individuals with new ideas they have never considered before. The different patterns help to get a diverse perspective on a business model and to develop new ideas besides the dominant industry logic. Working with the patterns allows organizations to develop new business models in a structured manner. The 55 patterns can be applied in two ways, using either the similarity or the confrontation principle. The similarity principle analyzes business model patterns from related industries and adapts them to the user’s business model. This principle is considered to be less abstract and rarely leads to radical innovations, which change the essential components of a business model. The similarity principle is especially useful for innovation projects with a specific problem formulation. Another way to apply the cards is termed pattern confrontation. The principle compares your current business model with scenarios in completely unrelated industries to bring up entirely new areas of innovation in situation where your problem is still largely unknown. Pattern confrontation also requires a high degree of creativity and is more demanding in its application.

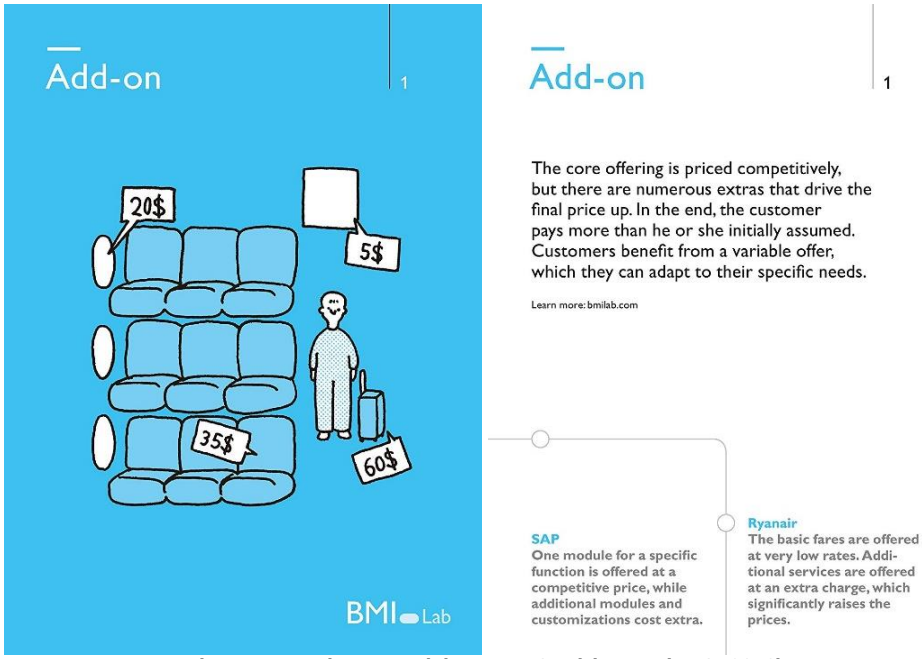


**Figure 15 Business Model Pattern Card (BMI Lab AG, 2018)**

Most ideas or rather most patterns do initially not fit perfectly for an organization. Thus, the integration process needs to shape the new ideas into a coherent business model that meets the company´s internal requirements and is consistent with the external environment, e.g. by the customer. A successful BMI will not only break the dominant industry logic, but also have a high level of internal consistency. Gassman et al. (2014) define the internal consistency as a harmony between the questions “who”, “what”, “how” and “why”. When one question is changed, the rest has to be adapted, as well. External consistency refers to the fit between the new business model and the company´s environment.

During the implementation, the company will have to question all their previous assumptions and overcome the resistance from the market, their partners and employees. The newly designed business model is just based on assumptions in the beginning. Therefore, a step-by-step approach with *designing*, *prototyping* and *testing* can be helpful, when rolling out the BMI. Developing prototypes and testing them on a small scale, is especially useful to accurately evaluate and redefine the BMI.

With the St. Gallen BMN, a new methodology has been developed that structures the process of innovation of a company’s business model and encourages outside-the-box thinking, which is a key for successful BMI. The tool helps to gain an initial understanding of the core elements of business models and encourage to consider alternative business models. Well-grounded in theory, the concept has proven its applicability in practice many times. Because there is no focus on a specific industry, the concept is a widely spread tool to innovate business models in a structured manner. Such a general point of view can also get problematic, when working with business models from only one specific industry. For example, when working with business models only from the manufacturing industry, different patterns can be relevant or even additional patterns can be identified. To successful account all new opportunities in specific industries an adaption of the patterns can be necessary. There is already research, which try to adapt the business model patterns to specific industries or technologies. The Bosch IoT Lab supplements for example the 55 business model patterns with two additional patterns, which have a specific focus on IoT technologies (Bilgeri et al., 2015). With the new patterns they try to reinterpret the existing ones and redefine them through an IoT perspective, to account all possibilities to reinvent a business model with an IoT focus.

## 5.2 Mapping Business Model Patterns to BMI in COMPOSITION

The common BMN method is not directly transferable to the context of COMPOSITION. This deliverable is not a matter of identifying innovation potentials, but of better understanding the existing innovation and making it transparent for the pilot partners and external companies. As a scientifically sound and practically proven method, however, it can make sense to adapt principles from the BMN and transfer them to COMPOSITION together with the business model patterns.

Therefore, it is necessary to find out which patterns of the BMN fit the context of COMPOSITION. Each pattern is clearly defined regarding which of the four questions of business models it addresses and which it does not. From a project perspective, the analysis in Section 4 shows which questions were addressed by the COMPOSITION use cases. If the patterns are mapped with the findings of the analysis of the business models, one can get a collection of patterns that could fit into the context of COMPOSITION. Since the assignment only happens based on the four questions of business models, it cannot be guaranteed that the identified patterns also correspond to the idea and goals of the specific use cases. Therefore, it is necessary to filter out those patterns that fit the use cases particularly well and describe them approximately. This approach makes use, among other things, of the ideas of the principle of similarity from the BMN.

Before the patterns can be screened, it is necessary to determine which combination of the four questions of business models should be searched for. A distinction is made between the BMI of the technical partners and the industrial partners. In addition, an overarching assumption was made. The core of the innovation for all pilot partners lies in improving their value propositions. It is therefore clear that only those patterns are sought that address the "what". For technical partners, the innovation of the "what" also leads to the improvement of the "who". For industrial partners, the innovation of the "what" results from an improvement of the "how". The two questions are therefore of essential importance to describe the BMI of COMPOSITION.

The question of "how much" is addressed by each pilot partner. However, it should be noted that this is an automatic consequence from the change in the other questions and does not act as a starting point for changes. It was therefore decided by the partners from Fraunhofer FIT to prioritize the question of "how much" less than other questions when screening the patterns and to concentrate on the core of the innovation.

In summary, this deliverable is looking for patterns for the technical pilot partners that mainly address the "who" and the "what". For industrial pilot partners, this deliverable is looking for patterns that mainly address the "what" and the "how". Fitting patterns were identified accordingly and are shown in Table 11 and Table 12. For each pattern a description according to Gassmann et al. (2014) is attached, which briefly explains its characteristics. This description does not cover all facets of the pattern but aims to create a basic understanding of it. In practice, however, a pattern can appear in many forms and implementation possibilities and does not need to correspond exactly to the description according to Gassmann et al. (2014).

It should be mentioned that, just because a pattern appears in this list, it cannot necessarily be transferred directly to the use cases of COMPOSITION. In some cases, it may even be that the pattern has very little to do with the use cases. Nevertheless, it is important to present all patterns within this deliverable that come into question based on the addressed questions of business models. There are three reasons for this. First, it increases the transparency of the pattern selection process, as all selection alternatives are presented. Second, the opportunity should be preserved to identify those patterns which are similar in their effect to the impact of COMPOSITION. Since the goal was formulated after the interviews to also determine patterns that can be applied in the future, it is understandable to also analyse similar patterns. Finally, an aim of this work is to contribute to scientific research in the context of business models. Therefore, it makes sense to carry out the presented approach, which was derived from the BMN, completely. This is the only way to determine how well the application of the business model patterns has worked and whether there is potential for improvement in future research projects. In addition, aspects of the BMN principles of confrontations are used in which seemingly irrelevant patterns from other industries are deliberately confronted with the business model. In this way, ideas for BMI can emerge and, accordingly, opportunities for further development for COMPOSITION.

**Table 11.Business model patterns for technical pilot partners**

| **Technical pilot partners** |
|---|
| **Experience Selling**<br>“The value of a product or service is increased with the customer experience offered with it. This opens the door for higher customer demand and commensurate increase in prices charged. This means that the customer experience must be adapted accordingly, e.g., by attuning promotion or shop fittings.” |
| **Open Business Model**<br>“In open business models, collaboration with partners in the ecosystem becomes a central source of value creation. Companies pursuing an open business model actively search for novel ways of working together with suppliers, customers, or complementors to open and extend their business.” |
| **Open Source**<br>“In software engineering, the source code of a software product is not kept proprietary but is freely accessible for anyone. Generally, this could be applied to any technology details of any product. Others can contribute to the product, but also use it free as a sole user. Money is typically earned with services that are complimentary to the product, such as consulting and support.” |
| **Aikido**<br>**“**Aikido is a Japanese martial art in which the strength of an attacker is used against him or her. As a business model, Aikido allows a company to offer something diametrically opposed to the image and mindset of the competition. This new value proposition attracts customers who prefer ideas or concepts opposed to the mainstream.” |

**Table 12. Business patterns for industrial pilot partners**

| **Industrial pilot partners** |
|---|
| **Customer Loyalty**<br>“Customers are retained, and loyalty assured by providing value beyond the actual product or service itself, i.e., through incentive-based programs. The goal is to increase loyalty by creating an emotional connection or simply rewarding it with special offers. Customers are voluntarily bound to the company, which protects future revenue.” |
| **Digitization**<br>“This pattern relies on the ability to turn existing products or services into digital variants, and thus offer advantages over tangible products, e.g., easier and faster distribution. Ideally, the digitization of a product or service is realized without harnessing the value proposition which is offered to the customer. In other words: efficiency and multiplication by means of digitization does not reduce the perceived customer value.” |
| **From Push-To-Pull**<br>“This pattern describes the strategy of a company to decentralize and thus add flexibility to the company's processes in order to be more customer focused. To quickly and flexibly respond to new customer needs, any part of the value chain - including production or even research and development - can be affected.” |
| **Guaranteed Availability**<br>“Within this model, the availability of a product or service is guaranteed, resulting in almost zero downtime. The customer can use the offering as required, which minimizes losses resulting from downtime. The company uses expertise and economies of scale to lower operation costs and achieve these availability levels.” |
| **Integrator**<br>“An integrator is in command of the bulk of the steps in a value-adding process. The control of all resources and capabilities in terms of value creation lies with the company. Efficiency gains, economies of scope, and lower dependencies from suppliers result in a decrease in costs and can increase the stability of value creation. |

| |
|---|
| **Leverage Customer Data**<br>“New value is created by collecting customer data and preparing it in beneficial ways for internal usage or interested third-parties. Revenues are generated by either selling this data directly to others or leveraging it for own purposes, i.e., to increase the effectiveness of advertising.” |
| **No Frills**<br>“Value creation focuses on what is necessary to deliver the core value proposition of a product or service, typically as basic as possible. Cost savings are shared with the customer, usually resulting in a customer base with lower purchasing power or purchasing willingness.” |
| **Object Self-Service**<br>“By using sensors and integrating them into an IT structure, an object can generate orders independently. This enables fully automated processes such as stocking and increases the speed of interaction with the object. The customer is integrated into the system, which leads to recurring sales.” |
| **Open Business Model**<br>“In open business models, collaboration with partners in the ecosystem becomes a central source of value creation. Companies pursuing an open business model actively search for novel ways of working together with suppliers, customers, or complementors to open and extend their business.” |
| **Robin Hood**<br>“The same product or service is provided to ‘the rich’ at a much higher price than to ‘the poor’. Thus, the main bulk of profits are generated from the wealthy customer base. Serving ‘the poor’ is not profitable per se, but creates economies of scale, which other providers cannot achieve. Additionally, it has a positive effect on the company's image.” |
| **Self-Service**<br>“A part of the value creation is transferred to the customer in exchange for a lower price of the service or product. This is particularly suited for process steps that add relatively little perceived value for the customer but incur high costs. Customers benefit from efficiency and time savings, while putting in their own effort. This can also increase efficiency, since in some cases, the customer can execute a value adding step more quickly and in a more target-oriented manner than the company.” |
| **Sensor as a Service**<br>“The use of sensors enables additional services for physical products or completely new, independent services. It is not the sensor that generates the primary turnover, but the analysis of the data generated by the sensor. Real-time information can further strengthen the performance promise.” |
| **Solution Provider**<br>“A full-service provider offers total coverage of products and services in a particular domain, consolidated via a single point of contact. Special know-how is given to the customer in order to increase his or her efficiency and performance. By becoming a full-service provider, a company can prevent revenue losses by extending their service and adding it to the product. Additionally, close contact with the customer allows great insight into customer habits and needs which can be used to improve the products and services.” |
| **Subscription**<br>“The customer pays a regular fee, typically on a monthly or an annual basis, in order to gain access to a product or service. While customers mostly benefit from lower usage costs and general service availability, the company generates a steadier income stream.” |
| **Ultimate Luxury**<br>“This pattern describes the strategy of a company to focus on the upper side of society's pyramid. This allows a company to distinguish its products or services greatly from others. High standards of quality or exclusive privileges are the main focus to attract these kinds of customers. The necessary investments for these differentiations are met by the relatively high prices that can be achieved – which usually allow for very high margins.” |
| **White Label**<br>“A white label producer allows other companies to distribute its goods under their brands, so that it appears as if they are made by them. The same product or service is often sold by multiple marketers and under different brands. This way, various customer segments can be satisfied with the same product.” |

It is noticeable that the number of patterns is different for technical and industrial pilot partners. This is because the question of “who” is rarely addressed in the business model patterns provided by Gassmann et al. (2014). Therefore, only a few patterns come into question, some of which do not coincide with the predefined combinations when combining the addressed questions. Since this deliverable does not aim to identify as many patterns as possible, but the most suitable ones, the quantity of patterns is no problem.

**Technical pilot partners**

Among the patterns of the technical pilot partners, four patterns were found, which at first glance are all well applicable to COMPOSITION. The pattern *open business model* is particularly suitable. The description fits exactly to the idea of COMPOSITION, in which the customers, the industrial pilot partners, collaborate with the user of the business model pattern, the technical pilot partners. The resulting network can be expanded by further partners in the future and strengthens the positive effect of the pattern.

The pattern *experience selling* also provides many parallels to COMPOSITION. NXW and ATL are building up expertise in the field of sensor-based production solutions as well as expertise methodological skills in various industries in which the industrial pilot partners are active. In the next step, these findings can be transferred to other customers of the two companies and, additionally, form the basis for the acquisition of new customers.

The connection of the pattern *open source* towards COMPOSITION is not immediately obvious. If one considers, however, that with the deliverables of the project fundamental results from COMPOSITION are publicly available, the reference becomes clearer. Thus, companies interested in COMPOSITION can access project results, but implementing them in their own company requires time and economic effort without corresponding experience. Hence, NXW and ATL complement the project results with their expertise and methodological skills and can support the company during the implementation of the COMPOSITION solutions. This approach can be actively supported by NXW and ATL by informing potential customers about the freely available project results and subsequently promoting collaboration during implementation of the solutions.

The pattern *aikido* fits most weakly to COMPOSITION within the list of patterns for the technical pilot partners, but also has some striking reference points. Even if the COMPOSITION solutions themselves are not directly opposed to the competition within the market, it is the holistic approach of COMPOSITION that stands out. As shown in *D9.11*, it is the idea of a collaboration platform for several partners in a company network that sets itself apart from competitors and thus creates a strong argument for NXW and ATL in the acquisition of customers.

For these reasons, all patterns found are classified as suitable for COMPOSITION and the technical pilot partners. The following list prioritizes the patterns with regard to their fit to the project.

1. Open Business Model
2. Experience Selling
3. Open Source
4. Aikido

**Industrial pilot partner**

Among the patterns of the industrial pilot partners, there are a few that are directly noticeable to not fit COMPOSITION very well. For example, *white label* or *subscription* describe concrete sales strategies, which have no relation to COMPOSITION or the pilot partners.

Two patterns are particularly striking. *Sensor as a service* and *object self-service* are both sensor-based patterns that fit well with the implemented use cases. Sensors are used for most use cases of the industrial pilot partners, for example for the fill level notification of ELDIA or the use cases of predictive maintenance for BSL and KLE. For the pattern *sensor as a service*, however, the scope of use cases does not focus on offering new services. Instead, the focus is on improving value propositions related to performance and product and service quality. But, according to the BMC in Section 4, it is possible that sensor-based solutions will also be offered in the future by one of the industrial pilot partners. Such a sensor-based service could be strongly linked to the pattern *object self-service*. Since this type of services, however, does not exist right now, it can be concluded that the pattern *object self-service* does not refer to the implemented use cases but rather serves as an option for future business model improvements.

Furthermore, the pattern *guaranteed availability* fits well to the use cases. This means that all industrial pilot partners can provide their products or services more reliably with the help of the implemented use cases.

ELDIA ensures that containers are picked up promptly and at the optimum time and BSL and KLE reduce down-time in production due to breakdown or necessary repairs of production machines.

The pattern *customer loyalty* also fits with aspects of the business model change that have emerged during the analysis in Section 4. For example, the industrial pilot partners of COMPOSITION want to use the solutions to increase their value proposition towards their customers, which do not directly affect product quality. Instead, values such as trust or security are being addressed by COMPOSITION, which in turn increases customer focus and loyalty. Hence, the added value goes beyond the offered physical product or service. However, as the pattern tends to focus on additional offers, the fit is ultimately too low to make a direct reference to COMPOSITION. Moreover, customer orientation is only an indirect consequence of the BMI of the industrial pilot partners and not part of their core innovation.

*Digitization* is also a pattern associated with the use cases. Basically, every use case can be described as a form of digitization. In contrast to the description of the pattern, BSL's focus is less on the digitization of services or products than on digitization of their production. However, with an automatic bidder system from BSL and the fill level notification system for ELDIA, there are also use cases in which the services offered by pilot partner are digitally supported. This fits in turn directly to the featured pattern.

As with the industrial pilot partners, the pattern *open business model* also appears in the list of patterns for technical pilot partners. The idea of transferability of this pattern to COMPOSITION remains, as BSL, ELDIA and KLE also enter into close partnerships with the other COMPOSITION partners within their business model.

In addition, there are some patterns that should be mentioned as well. These either fit very weakly to COMPOSITION or only affect individual use cases. The pattern *integrator* describes the idea very well that the industrial pilot partners benefit directly from the cost savings through COMPOSITION solutions. However, it is difficult to say whether the pilot partners actually command most of the steps in value-adding processes, and COMPOSITION solutions are not aimed directly at this aspect either. The pattern *leverage customer data* could be transferred to some use cases of ELDIA and KLE. Theoretically, this results in the potential to collect customer data via the automatic bidder system or the sensors of the containers. However, there is no direct relation to the goal of the use cases at the current point in time. In the future, however, this would definitely be a next conceivable step in the direction of improving their business model. *No frills* shows parallels to ELDIA, whose experts also highlighted the importance of competitiveness in terms of their prices during the interview. Nevertheless, the use cases have not really made the value creation more simplistic, thus, missing an essential aspect of the pattern.

The following patterns are selected as suitable for COMPOSITION for the industrial pilot partners. The order corresponds to the prioritization of these with regard to their fit.

1. Open Business Model
2. Sensor as a Service
3. Guaranteed Availability
4. Digitization

**Noteworthy additional patterns**

Based on the analysis of the patterns' fit with the technical and industrial pilot partners, the following patterns show potential for future developments of the pilot partners' business models and COMPOSITION solutions.

1. Leverage Customer Data
2. Integrator
3. Object Self-Service
4. No Frills

## 5.3 Building the Business Model Decision System

All previous results of this deliverables show the different ways in which BMI arose among the pilot partners. Figure 16 summarizes these findings from an ex-post perspective.

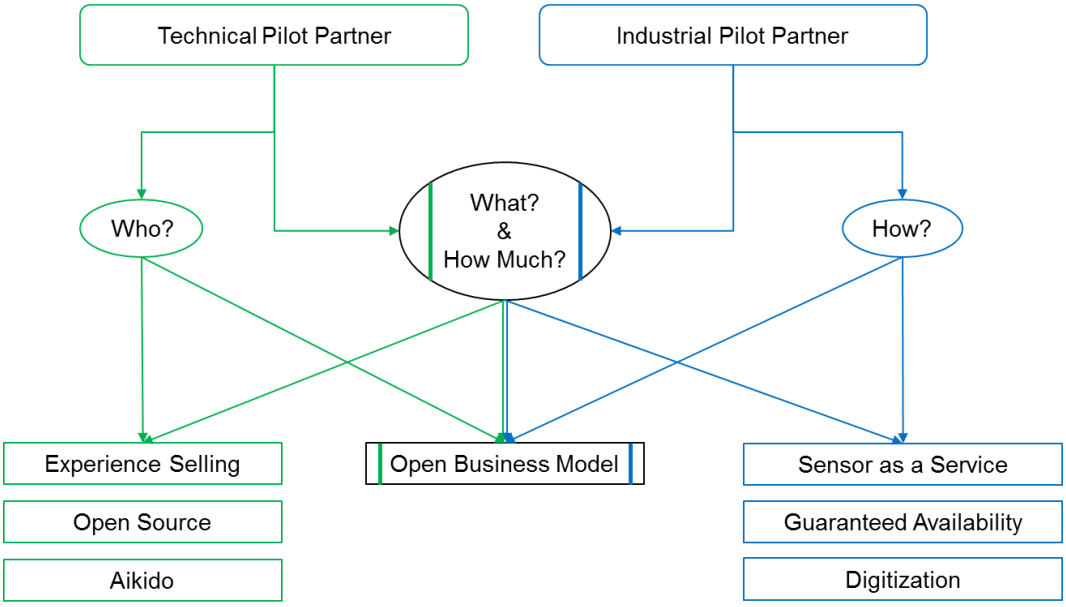


**Figure 16. BMI in COMPOSITION – Ex post perspective**

Figure 16 shows that there are three types of patterns. The first set of patterns relates to the use cases of the technical pilot partners and refers above all to the supplier of technical solutions within the COMPOSITION network (henceforth: Technical Solution Pattern). The second set of patterns relates to the use cases of industrial pilot partners and addresses the use of sensors and the digitization of services and products (henceforth: Industrial Solution Pattern). The third set consists only of one pattern, *open business model*. This pattern describes the basic idea behind COMPOSITION, a network in which companies and stakeholders collaborate and develop innovation. As a result, each pilot partner in COMPOSITION applied this pattern.

The ex-post perspective summarizes the results comprehensibly but is difficult to use by a company that is interested in COMPOSITION and wants to become part of the network. The Business Model Decision System therefore faces the challenge of how such a company goes through the decision-making process. Assuming that a company is approaching this issue with the goal of innovating its own business model, the process begins by identifying the segments of the business model that are to be improved. The result is either directly a subset of the four questions of business models or segments of the BMC, which in turn can be assigned to the four questions.

Thus, the following approach for applying the Business Model Decision System can be proposed to derive goals for its development. If a company knows which of the four questions it wants to address and improve, the Business Model Decision System can be applied as a catalysator between the four questions and the use cases. Based on the questions, it should point out fitting business model patterns and describe their effect on the business model in general, and it should refer to the fitting use cases of the pilot partners. This addresses two benefits. First, the company can use the patterns to obtain practical and easy-to-understand summaries of the potential improvements to their business model. Practical examples of the pattern are provided within the work of Gassmann et al. (2014). Second, the use cases of the pilot partners show implementation options for the patterns within COMPOSITION. The successful implementation in COMPOSITION proves that the pattern increases business value (see also the BeneFIT-method in *D9.7* and *D9.11*) and makes the pattern more tangible for the company.

Figure 17 shows the Business Model Decision System resulting from the presented goals. The identified noteworthy additional patterns from Section 5.2 were also included in the set of Industrial Solution Patterns.

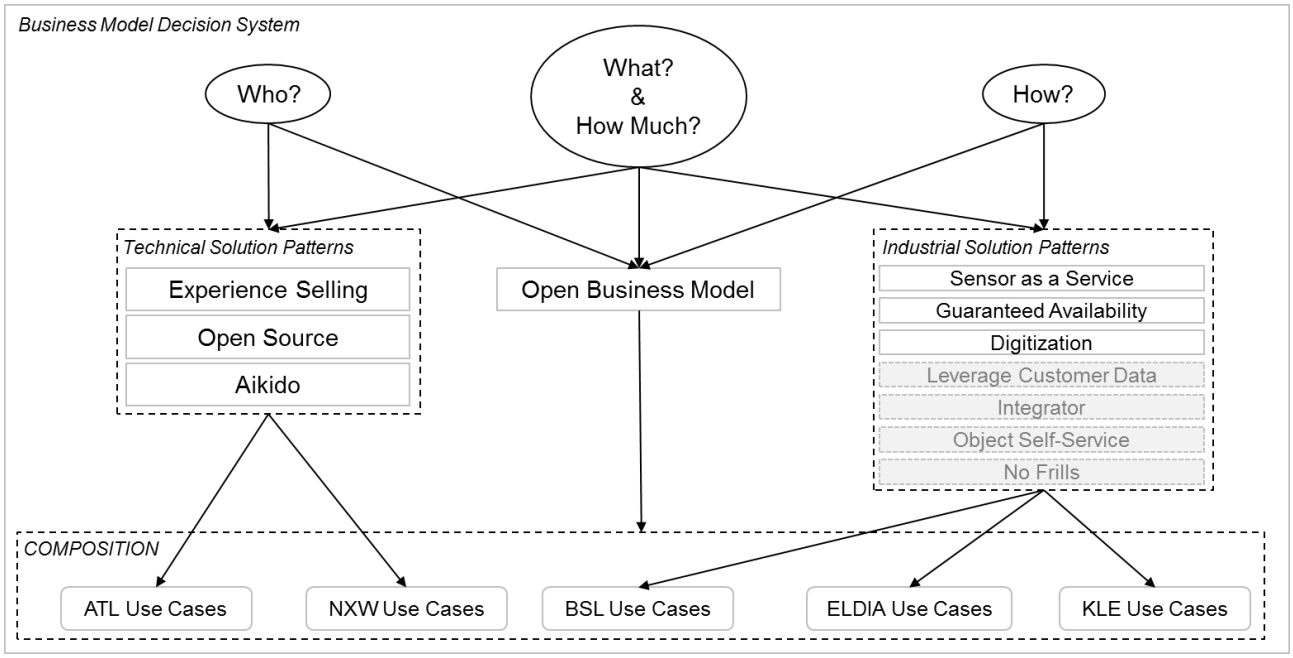


**Figure 17. Business Model Decision System**

In contrast to Figure 16, it is noticeable that the decision-making system does not take into account which type of company it uses, by means of an industrial or technical company. Although this subdivision has existed in the context of COMPOSITION, it is quite possible that in the future, an industrial company may be interested in a *Technical Solution Pattern* or a technical enterprise for an *Industrial Solution Pattern*. Therefore, it is more important that the company interested in COMPOSITION solutions first clearly defines which of the four questions of the business model it wants to improve.

The pattern *open business model* is at the core of the model and is therefore part of every BMI created by COMPOSITION. Consequently, the company interested in COMPOSITION has to be aware that this pattern will always be implemented, no matter which segments of the business model it wants to target.

The Business Model Decision System can be an important link in the future, inspiring new companies for COMPOSITION. The ideas and goals behind the use cases hold enormous potential for companies, but they can lose their comparability due to their company-specific application. The decision-making system closes the gap between a company with the will to develop its own business model and the concrete use cases or the COMPOSITION solution that supports this goal.

# 6 Conclusion

## 6.1 Summary of Results

This deliverable has dealt with the development of a Business Model Decision System that can be used by future companies interested in COMPOSITION to better understand the innovation brought by the project and the use cases. This hopefully increases the chance that further companies will join the COMPOSITION network and use solutions via the platform.

The deliverables procedure consisted of two steps. First, case studies were conducted to visualize the business model of each pilot partner as a BMC. The initial business model was captured before participating in COMPOSITION and any changes made by COMPOSITION were identified and incorporated in the BMC. The improvements of individual segments of the business model were then aggregated up to the level of the four questions of business models. This made it clear which questions were primarily addressed by COMPOSITION, i.e. what the core of the improvements were aimed at. In the second step, the BMN method was used and the existing business model patterns were compared with the business model changes of COMPOSITION. Thus, those patterns could be identified which fit best to COMPOSITION and the use cases. A comprehensive decision-making system was then derived from this. This system can be used to link targeted business model improvements with a use case. A procedure model was proposed for this purpose. This provides that a company interested in COMPOSITION first identifies those of the four questions of business models that they want to improve, e.g. by means of the BMN. Afterwards, the Business Model Decision System points to a suitable pattern that can be implemented with COMPOSITION solutions.

The deliverable has derived a final project understanding of the changes that have occurred in the business models of the pilot partners as a result of the use cases. This can be used by the pilot partners as an evaluation tool to check whether the project enables the targeted improvements. In addition, further development potentials can be derived, and a suitable target image can be developed with the help of the filled BMC. It was found that an innovation of the business model will take place for each pilot partner in the short or long term. This is indicated by the fact that an improvement in the value proposition was identified for each pilot partner. The BMI is different for the pilot partners, depending on whether they are technical or industrial pilot partners. The technical pilot partners improve their value proposition directly through the COMPOSITION solutions, thereby increasing customer satisfaction and acquiring new customers. The industrial pilot partners improve internal processes and resources, increasing the quality of their products and their value propositions.

By transferring these findings to the business model patterns, it was possible to identify several patterns that address the core of innovation at the pilot partners. Above all, the pattern of the *open business model* illustrates how value is created within COMPOSITION. This makes it clear that the pilot partners in the network do not only collaborate with each other via external interfaces. Much more, the individual companies intervene in each other's business model and improve profound aspects of their business models. This collaboration forms the basis for further innovations that can be jointly created by the partners in the future.

The patterns of the technical pilot partners aim above all in the direction of the knowledge that they can collect through their participation in COMPOSITION. This includes the specifics of the individual industries as well as a better understanding of the technologies used, e.g. sensors. This knowledge naturally increases their value as a company as they can offer their customers more value through higher quality products and services.

The patterns of the industrial partners deal with the use of sensors and the digitization of services. In addition, COMPOSITION solutions strengthen a strategy in which the availability and high quality of products can be guaranteed. These patterns are currently mainly implemented from an internal company perspective. However, the use cases create the basis for being able to offer more digital services in the future and to further increase one's own value proposition.

In addition, patterns were identified that fit the project context but were not implemented with the existing use cases. However, the already implemented use cases form an ideal basis to implement these patterns in the future. This includes above all the pattern *leverage customer data*, which deals with the extended use of customer data. The use cases give the pilot partners more possibilities to collect data about their own production and their customers. This data can then be used to improve their own products or to develop new data-based business models. For example, pilot partners who interact with each other in day-to-day business could provide each other with more transparency in internal processes and thus generate value-enhancing interfaces or improve their collaboration

From the point of view of scientific research, this deliverable has expanded the knowledge base to business models. With the help of case studies for each pilot partner, two scientifically sound methods, the BMC and the BMN, were applied to five companies as part of an international public research project. This promotes an understanding of the possible applications of the two methods and validates their practicability. In the case of the BMN, this deliverable was used to show how the method can also be applied ex post to projects in which the innovation of the business model has already occurred or been implemented. It was found that both methods are highly practical and can make a valuable contribution to the visualization of project results.

## 6.2 Limitations

This deliverable suffers from some limitations regarding the chosen approach and implementation. For the interviews conducted for the case studies, complete objectivity cannot be ensured. Objectivity was supported by the active participation of the partners from Fraunhofer FIT, which are largely independent from the pilot partners. However, Fraunhofer FIT are also project partners and therefore could be influenced by their knowledge about COMPOSITION. In order to further mitigate this risk, the BMCs developed from the interviews were validated internally by the pilot partners. In addition, for each interview one person in the project team of Fraunhofer FIT was not involved in the interview and subsequently examined the BMC for meaningfulness and inner logic afterwards.

Another limitation also applies to the interviews. There were always experts on the pilot partner side who were involved in the project and have a very good understanding of its use cases, but the position of the interview partners within the company differed. It may therefore be that the respective interviewee cannot cover all aspects of his company's business model. Two points mitigate this limitation. On the one hand, the experts validated the BMCs internally after the interviews. If the interview attendants made an error or missed important aspects in the developed BMC, other employees of the pilot partner may point them out. On the other hand, it is probably only a slight constraint if there are aspects of the business model that are not reflected in the BMCs. More importantly, they should include all aspects related to COMPOSITION and specifically those addressed by the use cases. Ultimately, the goal of the interviews was to clarify changes in the business model, and all the important aspects relevant to COMPOSITION suffice.

Another limitation concerns the application of the BMN and the business model patterns. The chose approach for this deliverable differs from the classic BMN because it takes an ex post perspective. The results show that the procedure was suitable for the project context and meaningful findings can be derived. However, these findings are based on only five companies in the same project. It is therefore not proven that the chosen procedure can be freely transferred to any other project and company. For example, it may be that non-industrial projects can only be evaluated with a customized version of the BMN. It is therefore necessary to reapply and incrementally improve the chosen approach in the future and identify specifics that need to be considered, depending on the type of project of industry.

## 6.3 Next Steps

From a project perspective, the results of deliverables can be used primarily for acquiring new companies for the network. For example, the results could be summarized on a dedicated website or set of slides and made available to interested companies. In this way, a basic economic understanding can quickly be developed of what advantages COMPOSITION could have for one's own business model. In addition, the procedure proposed in Section 5.3 could be adapted. It is conceivable to construct a workshop format that reflects this approach. In the workshop, a COMPOSITION operator could work with companies on potential business model innovation and hence application areas for COMPOSITION. As already mentioned in section 6.1, the pilot partners can also use the results. Thus, the developed BMCs can serve as a basis for developing a target image of their own business model.

Finally, scientific research could use the results to improve methods such as the BMC or BMN to even greater practicability. Especially for the BMN, this deliverable is the first approach that takes an ex post perspective. It could therefore be a starting point to develop further ex post implementation possibilities.

# 7 List of Figures and Tables

## 7.1 Figures



## 7.2 Tables

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