

Digital Coach [2020-1-DE02-KA202-007683] – Intellectual Output 07

Value Creation Process

Self-study module for Digital Coaches

Dr.-Ing. Christopher Prinz, Chair of Production Systems (LPS), Ruhr-University Bochum

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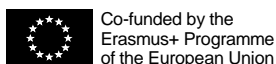
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1. Introduction

This self-study module focuses on value creation processes as the starting point for digitization. The main topics are digital transformation with reference to Industry 4.0, value creation and digitization, and lean management. Central features of a value creation process are presented and specific examples of value creation processes from different industries are worked out. Thus, prospective digital coaches are taught basics so that they are able to reproduce principles of process optimization and apply them independently in companies. The aim is to demonstrate the effects of digitization on value creation processes, as well as to present various methods and approaches to process optimization and to consolidate them with the help of various exercises.

1.1. Structure of the self-learning module

The module is divided into three main topics:

- 1) Digitization
- 2) Digitalization in value creation processes
- 3) Lean Management - Value Creation and Waste

Each chapter begins with a theoretical section in which the fundamentals of the focal points are discussed. The aim is to provide a sound basis for the subsequent practical application. With the help of the storytelling method, the theoretical content is transferred into concrete use cases and forms the basis for the subsequent tasks. The task section consists of multiple-choice tasks and application-specific tasks that are linked to the application examples (use cases). Finally, there is a chapter with sample solutions so that the various tasks can be checked.

The creation of the self-study module was supported by relevant literature. In this self-study module - without any discrimination - the generic masculine is used exclusively. All genders are included.

2. Basics of digitization

Learning objectives in this chapter

In this chapter...

...the concept of Industry 4.0 and the components belonging to it are explained.

...the basics of digitization are covered.

...a description of the digital transformation within a company takes place.

2.1. Industry 4.0

Closely related to digitization is the term **Industry 4.0**. There are a variety of definitions for Industry 4.0. For example, it can be defined as "[...]a real-time, intelligent, horizontal and vertical networking of people, machines and objects through information and communication technologies".¹ Industry 4.0 is often described in simplified terms as the **fourth industrial revolution**. The first industrial revolution began with the use of steam engines. This was followed by the second industrial revolution through mass production and electrical energy. The third industrial revolution was driven by communications and information technology, and then changed to the current fourth revolution.² The key features of this fourth revolution are provided by the *smart factory*. This is a production facility in which the far-reaching applications of digitization are used in a controllable and operational manner, thus enabling the full range of information and communication technologies to be used.² Furthermore, communication between all actors in production is possible via the **Internet of Things and Services (IOTS)**.³ The Internet of Things and **cyber-physical systems (CPS)** are central elements of Industry 4.0.³ Cyber-physical systems describe the connection between real objects as well as machines and virtual processes and objects. Cyber-physical systems are adaptable to the environment via sensor technology, in that the signals make adjustments to the real system through actuators.³ The **Internet of Things (IoT)** is the connections of several real objects that can communicate with each other via the Internet. For example, the production system can be connected with customers or sales.³

¹ Cf. Kagerman et al. 2013, P. 16-23

² Cf. Siepmann and Graef 2016, P. 19

³ Cf. Appelfeller and Feldmann 2018, P. 3-115

Digitalization, in addition to CPS and IOT, is another component of Industry 4.0. The term digitalization is omnipresent and is used in many different contexts.⁴

Despite the frequent use of the term **digitization**, it does not yet have a clear definition and is a fuzzy term. Originally, the term digitization or digitalization stood for the conversion of analogue data into digital data (mostly binary digits). Another approach to the definition is to describe digitization as an introduction or increased use of information and communication technologies by, for example, an organization, a country or even an industry. Both definitions focus on different aspects of digitization. The first on the 'result' and the second on the process.⁵

The term digitization usually describes a transformation, which is why digitization is also considered a *digital revolution or digital turnaround*.⁶ Because digitization is changing "[...]business models, processes, products, projects and services[...]" in the industry⁶ through the use of software solutions. This results in new services. The main focus of digitization is on exchange and action between market participants.⁶ However, digitization also creates new challenges. These include "the shaping of society and the world of work as well as the protection of privacy and the security of applications[...]"⁶.

Another definition for digitization is "[...]when analogue service delivery is replaced in whole or in part by service delivery in a digital, computer-manageable model."⁷ Subsequently, the models are processed automatically and from there used again in reality.⁷

The definitions presented show that digitization represents a change or causes it. This change affects all areas of life in the 21st century: "Everything that can be digitized will be digitized. And everything that can be networked will also be networked. This applies equally to people, machines and products."⁸

2.2. Digital transformation in companies

The sometimes-immense restructuring of companies for digital transformation requires separate treatment in the context of this work. Some objects could be completely digitized in a company, such as text documents on paper are scanned or written directly on the PC to save them as files on the hard disk or server. Digitization can also be an addition of digital technologies to analogue technologies. The integration of RFID chips in production serves as an example.⁸ RFID stands here for *Radio Frequency Identification*.⁸ This technology enables identification of real objects with the help of radio waves.⁹ These can be used to obtain precise information about production, for example by scanning the product after each work step to be able to determine the exact throughput time. The information can be used for subsequent optimization. This results in various components of a digital company here to track the digital transformation, which are discussed

⁴ Cf. Kollmann 2020, P. 6-7

⁵ Cf. Traum et al. 2017, P. 1-4

⁶ Cf. Barton et al. 2018, P. 4

⁷ Wolf und Strohschen 2018, P. 58

⁸ Appelfeller and Feldmann 2018, P. 150

⁹ Cf. Melski, Thoroe, and Schumann 2008, P. 469

below. Such digital processes consist of various components. In Figure 1, the components are placed in context to provide an overview of the relationships in the company.¹⁰

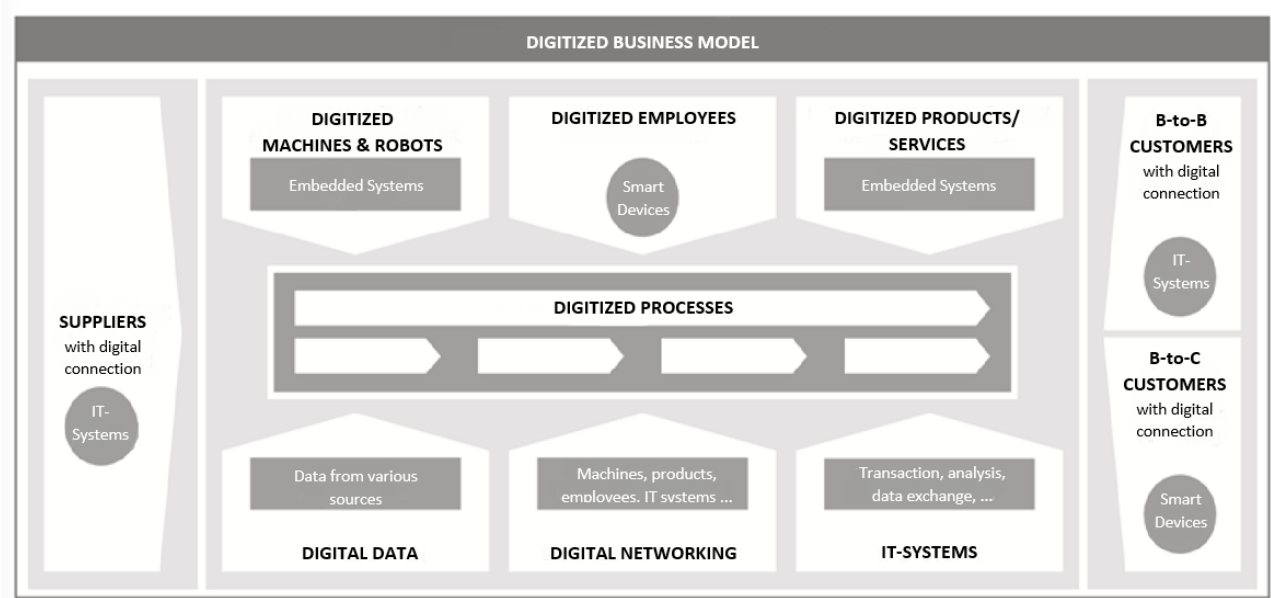


Figure 1: Digitized business model¹⁰

The roles of the individual components for digital transformation in the company are defined below. Here, Figure 2 creates an overview of the individual functions, this is the same scheme as Figure 1, only with the relationships to the digital transformation of the individual components. These are discussed in more detail below.

¹⁰ Appelfeller and Feldmann 2018, P. 3

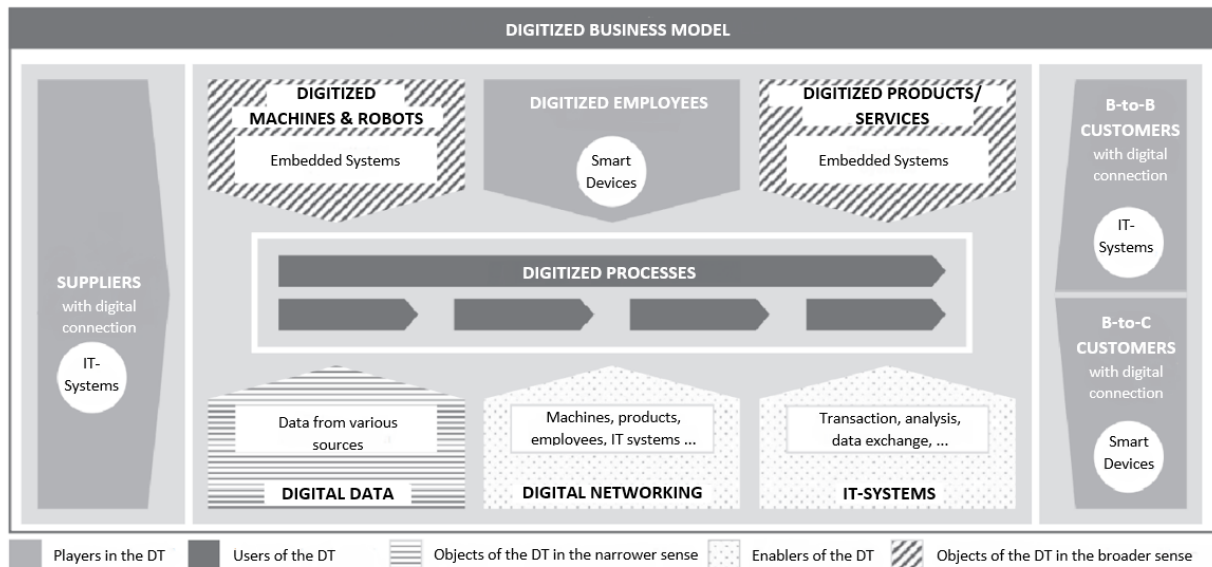


Figure 2: Influence of digital transformation ¹¹



Definitions

Enablers are the objects and technologies that make digital transformation possible in the first place, explained. This includes IT systems as well as digital networking.¹¹ One of the enablers of digitization in the company is **artificial intelligence (AI)**, which is defined in more detail below.¹²

Objects in the narrower sense are objects that, in the digital transformation, are completely digitized. This primarily includes data that is transformed from an analog form of files and paper into a digital state.¹¹

Objects in the broader sense are, for example, robots and machines. These are not fully digitized, but merely equipped with digital technology.¹¹

The **players** in the digital transformation are the people behind the processes. This includes the employees, suppliers and customers who also have access to IT systems.¹¹

¹¹ Appelfeller and Feldmann 2018, P. 9-10

¹² Cf. Lemke et al. 2018, P. 250

Definitions

Users of digital transformation are processes and business models that are optimized, enabling value creation and profits to be generated.¹³

Artificial intelligence refers to the ability of a machine to perform cognitive tasks that we associate with the human mind. This includes capabilities for perception as well as reasoning, independent learning, and thus finding solutions to problems on its own.¹⁴ Thus, with the help of artificial intelligence, machines can take over further task areas that overlap with human task areas. By using artificial intelligence, so-called *chatbots* can be created that "[...]conduct a dialog with humans in natural language[...]".¹⁵ The chatbot can contact customers via various channels, for example, via a dialog box on a website.¹⁵ In addition, a demand forecast can be created in connection with artificial intelligence. Through data from the past, a forecast for the future can be created using algorithms in order to better respond to future demand.¹⁶

Concluding the treatment of the components of digital transformation in companies is the topicality of this transformation. Digitalization within a company is nothing new. IT systems have long been integrated into a company's resource planning. What is new, however, is the digitization of objects, networking within the company and the resulting data.¹³

The digital transformation of our society and industry is creating changes, such as the new opportunities for international digital exchange of information.¹⁷ The emerging dissolution of boundaries also brings new opportunities for companies. This means that previously existing boundaries, such as specific industries, can be broken down and companies can define new business areas. Furthermore, according to the author, the acceleration of change will increase and develop into exponential growth.¹⁷ In addition, relationships and values such as trust are becoming increasingly relevant as a global network structure emerges. According to the author, rating portals, among other things, are a central factor. Furthermore, the value creation of digital products continues to increase and decouple from physical performance. In addition, according to the author, the focus is shifting from monetary goals to knowledge and innovation.¹⁸

This is how digital transformation impacts companies. Customers, products, services, production, processes, security and corporate networks are also affected by the change.¹⁸

¹³ Appelfeller and Feldmann 2018, P. 9-10

¹⁴ Kreutzer and Sirrenberg 2019, P. 3

¹⁵ Hildesheim and Michelsen 2019, P. 135

¹⁶ Cf. Herbrich 2019, P. 69-70

¹⁷ Cf. Weinreich 2016, P. 5-8

¹⁸ Cf. Weinreich 2016, P. 5-8



Also worth mentioning is the technology of the **digital twin**, which is a key technology for digital transformation. The digital twin is the digital or virtual image of an object or process that either already exists or is in the planning stage. This virtual mirror image recreates the characteristics and behaviours of the original as closely as possible. One of the central tasks is to make the data and information available in a uniform manner. This makes it possible, for example, to represent products particularly well before they are launched on the market so that further planning can be carried out. The digital twin can be passed on to partners or customers so that there is an equal exchange of product information at different levels.¹⁹ By means of this technology, objects can be virtually represented in a particularly realistic way and thus offer enormous advantages for various players in the industry. The digital twin can be described with three essential components. Among them "[...]a physical product, a virtual product and a data exchange."²⁰ The digital twin generates information through data acquisition, modelling and synchronization between the virtual and physical product. This technology increases the accuracy of forecasting. In this context, the use of forecasts is fundamental for supply chain planning.²⁰ In addition, the combination of digital twins with virtual reality and data glasses can be used for better visualization for the design of plants and processes.²¹

¹⁹ Cf. Kuhn 2017, P. 440-444

²⁰ Wang, et al., P. 198-199

²¹ Cf. Hoberg et al. 2019, P. 170

Summary

Digitization networks are all actors and objects in the company.

A lot of data is created through networking.

Industry 4.0 describes the fourth industrial revolution.

New technologies provide digital support for processes.

2.3. Tasks

1. Industry 4.0

What is behind the term cyber-physical systems?

- Connection between real objects and virtual processes and objects
- The motion sequences of a robot
- Visualize information via electrical displays
- Communication between employees via telephone

2. Industry 4.0

What is meant by the term Industry 4.0?

- Industry 4.0 stands for the four largest industrial sectors: Electronics, Mechanical Engineering, Services and Food.
- Industry 4.0 refers to the fourth industrial revolution.
- Industry 4.0 describes all industries that do business with digital technologies.
- Industry 4.0 means the industry that does business with data.

3. Digital transformation

What are the so-called enablers of digital transformation?

1. Digitally connected customers
2. Digitized products and digital data
3. Digital networking and IT systems
4. Digitized machines and robots

4. Objects of the digital transformation

In what form are objects and items digitized?

1. They are fully digitized as objects in the narrower sense and partially as objects in the broader sense.
2. All items are fully digitized.
3. Digitization is carried out to the extent that the best efficiency is achieved for the individual object.
4. Only objects that are already digital are interconnected in the digitization process.



Use Case Fundamentals of Digitization

The following use case was created based on the chapters Fundamentals of Digitization and Digitization in Value Creation Processes. The content of the authors was decisive Appelfeller and Feldmann (2018), Barton et al. (2018), Buchholz (2017), Deuse et al. (2020), Graf (2016), Herbrich (2019), Hildesheim und Michelsen (2019), Kuhn (2017), Kreuzer und Sirrenberger (2019), Kirchner et al. (2018), Lemke (2018), Melski et al. (2008), Siepmann and Graf (2016), Volk et al. (2020), Wang et al.(2020), Wolf and Strohschen (2018), Weinreich (2016) and Weber (2017) were decisive in the creation

The company Mueller SE specializes in the production of built-in cabinets. The company was founded over 100 years ago and has a long tradition and a lot of experience. Digitalization and the fourth industrial revolution present the company and its employees



Use Case Fundamentals of Digitization

with great challenges and many concerns. For this reason, the company has hired a management consultancy to design the digitalization of the company and its processes. At first glance, the production and sale of built-in cabinets can only be digitized to a limited extent by the fourth industrial revolution. However, processes can be digitally transformed in many places, which is why the consultancy is making various changes. The entire production of Mueller SE is monitored via sensors as a result of the transformation. In addition, all of the company's machines are connected via the Internet. The new IT systems enable digital networking and process digital data. Employees will also receive new devices equipped with RFID technology to also be networked with the new IT systems. All components will also be equipped with RFID technology to facilitate workflow. As soon as components have completed a processing step, they are scanned and the information is transmitted to a system. At the next processing station, employees can then scan the component again to obtain information about the processing progress to date and the processing steps still planned. The company's newly introduced digital twin is particularly effective. The comprehensive digital design of the various built-in cabinets makes it possible to create a completely digital image of each product, thus creating a digital twin. This allows employees to plan accurately during the design and production of the built-in cabinets. When developing other additional products, such as wardrobes, employees can precisely go through all processes via the digital twin to seamlessly adapt the product to the built-in cabinet. This includes dimensions, functionality or design. The digital twin technology also offers benefits for customers and suppliers. On the company's website, customers can use an online configurator to design their personal built-in cabinet, viewing it in an accurately visualized version. Furthermore, customers now have the option of using virtual reality glasses to obtain a precise image of individually configured built-in cabinets through the digital twin. This enables the company to provide better customer advice and support. Mueller SE's suppliers benefit from digitization and the introduction of the digital twin in several ways. On the one hand, they can use the digital twin of the individual products to adapt and test the products they sell to Mueller SE. Second, a complete digital twin of production has been created in Mueller SE's production and supply chains. This allows the company to simulate capacities and production downtimes and make adjustments in management. Suppliers also benefit from this, as the company can make precise forecasts regarding deliveries and thus provide their producers with timely information. As a result, sensitive links in the supply chains can be taken into account and, for example, provided with additional further stock. The networking of machines, customers and suppliers creates new opportunities for the company and a solution to several problems and complications, as the data obtained yields valuable information for planning and designing processes.

The following tasks relate to the use case of the fundamentals of digitization and consist of multiple-choice tasks and open tasks for independent work.

13. Basics of digitization

What makes the company's production a cyber-physical system (CPS)?

- By connecting the machines with digital processes and models
- Through the application of lean management
- Through the digital connection of customers
- By focusing on the interest of the customers

14. Basics of digitization

In this example, what is the benefit of the digital twin?

- An absolutely identical copy of digital data
- A digital safeguard for the most important data in the company
- A digital representation of the product with all data
- A production plant with digital technologies

15. Basics of digitization

What is the advantage of RFID technology in this example?

- The creation of digital twins
- Direct communication from employee to employee
- Checking for defects in the material
- The scanning of objects to retrieve data

1.1 Mueller SE's built-in cabinets have not yet been equipped with digital technology as a physical product. How could the products themselves or also the customers be connected to the networking of the company?



Your answer:

1.2 How could artificial intelligence technology be integrated into the business and value creation of built-in cabinets?

Your answer:



1.3 What changes in value creation processes can be enabled by digitization in the company?

Your answer:

3. Digitalization in value-added processes

In the 21st century, digitization is reaching every conceivable area of industry, including traditional mechanical engineering and the associated value creation processes.

Learning objectives in this chapter

In this chapter...

...the classic value chain is described.

...the impact on value creation in digitization will be addressed.

...examples of value creation in digitization are presented.

3.1. Classic value creation processes

In order to understand the digitization of value creation processes, it is important to first explain the term value creation and the key content points of the classic value chain. The classic definition of value creation describes the difference between the market values of the products created by an organization and the associated costs.²² "Value is created from existing resources, such as materials, machines, people and knowledge, which is then actually realized through the sale of products and services."²³ The structure of the classic value chain is as follows:²⁴

²² Cf. Kirchner et al. 2018, P. 29

²³ Kirchner et al. 2018, P. 29

²⁴ Cf. Weber 2017, S. 9

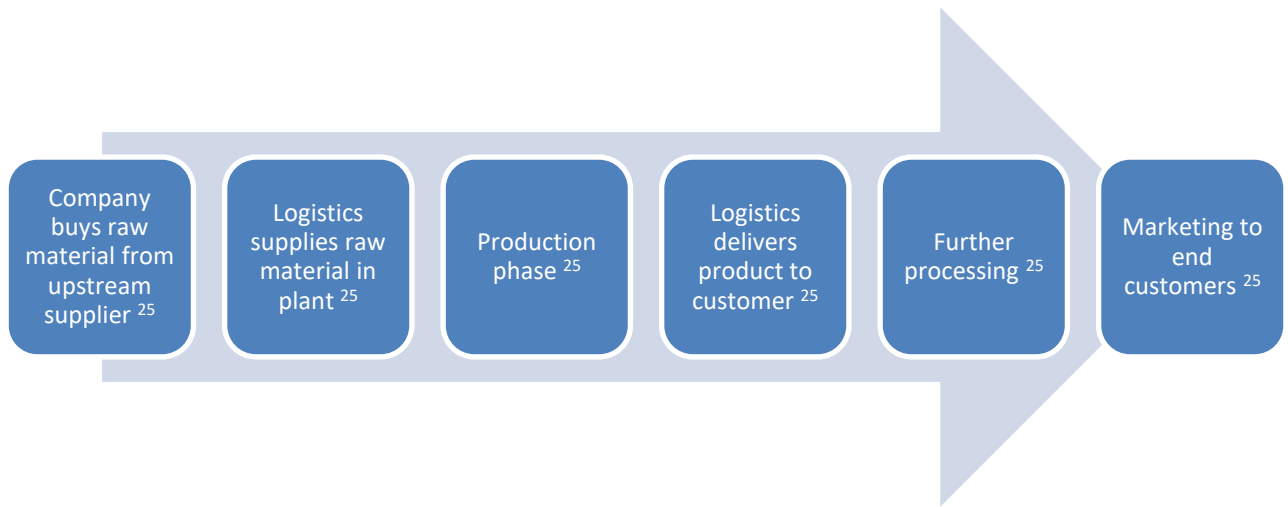


Figure 3: Structure of a traditionally designed supply chain ²⁵

The classic value chains are structured according to this pattern.²⁵ In this context, the focus of companies with regard to their value chains is only on the variable quantity × price.²⁵ "The more efficiently and effectively the members of the traditional value chain operate, and the more favourable the quantity-price variable turns out to be, the greater the earnings for the companies."²⁵ But this strategy is no longer sustainable due to the change in digitalization.²⁵

3.2. Value creation in the change of digitalization

Digitization is not just a trend, but a far-reaching change. For example, digitization is also changing the value chain. The central element in the future will be the interest of the customer. In this way, the value chain is viewed backwards and no longer focused on the finished product.²⁵ "Consumer value is becoming the all-important factor in the value chain."²⁵ One of the central tasks is to link the individual processes of the value chain with each other. In the process, the individual elements of the chain will have to interact closely with each other.²⁵ This means that all parties in the chain must participate in the process and align their processes with the consumer's benefit. However, the digital transformation also creates difficulties. It is particularly difficult to understand the exact ideas and wishes of customers and to absorb the enormous masses of information. Therefore, a particularly high value is attributed to this information.²⁵ By generating the information, the central questions "[...]what needs to be created when, how well and where[...]" can be answered.²⁵ The information about the customers can be obtained from data. According to the author, the communication of customers is done either through *active customer communication* or *passive customer communication*.²⁵ The decisive factor in the distinction is whether the data was left voluntarily or involuntarily. In *active customer communication*, customers share their information voluntarily, for example via posts on

²⁵ Cf. Weber 2017, P. 9-16

social media. *Passive customer communication* is involuntary. A trail is left by using services that leave information behind. Such as through the use of credit cards or the use of services.²⁶

Digitization is the "[...]core challenge of the industrial Small and Medium Enterprise (SME) sector in Germany[...]"²⁷ This transformation entails a strong adaptation of the industry and refers primarily to the "[...]digitalization, networking and automation of production systems[...]"²⁷ The companies surveyed in the work of Buchholz et al. (2017) state that the new digital technologies and the new influence of customers are changing business models and value creation processes.²⁷ Digitization is described as an ongoing development. It does not bring about a complete change, but enables a constant expansion of development opportunities for value creation processes.²⁷

In order to better understand the potentials of digitization, some examples and the reference to industrial practice will be explained in the course of the section. Digitization is creating more and more very large volumes of data, and more and more quickly. **Big data** technologies are needed to gain an advantage from these data volumes. Data can be seen metaphorically as the fuel and the algorithms as the engines.²⁸ *Big Data* had first been used as a term for large amounts of data. However, this definition has changed over time.²⁹ Thus, there is no universal definition of the term so far. Accordingly, the current definitions refer to the characteristics and nature of the data. However, the definitions also include the technologies that are related to the data.²⁹ Three different properties are used for the characteristics of the data: The amount, the variety and the velocity of the data.²⁹

The use of big data and the associated technologies opens up new potential. Big Data would improve strategic decision-making by 69% and customer understanding by 52%.²⁸ A study by KPMG shows that participating companies experienced a 27% increase in revenue and a 19% reduction in costs through the use of Big Data technologies.²⁸

There are different examples of the digital design of value creation processes. Thyssen Krupp Elevators, for example, used an intelligent monitoring system to increase the efficient use of elevators in operation. Thanks to the intelligent monitoring system, maintenance and possible breakdowns can be better coordinated.²⁸ There is also a described use of Big Data technologies at Saarstahl AG. Due to errors within production, one third of the steel products are rejected. However, these errors are usually only diagnosed at the end of the production chain. Thus, large parts still pass through production unnecessarily. However, the use of Big Data can provide a remedy. For example, sensors with laser technology are used to monitor during the production process. Ultrasound is also used to identify defects in products at an early stage.³⁰ Several terabytes are collected over the course of a year. By evaluating this data, decision support can then be provided for those responsible. In addition, algorithms can read the data and predict future deviations in production.³⁰

²⁶ Cf. Weber 2017, P. 12-16

²⁷ Buchholz et al., 2017, P. 4

²⁸ Cf. Kirchner et al. 2018, P. 32-34

²⁹ Cf. Volk et al. 2020, P. 1038-1040

³⁰ Cf. Kirchner et al. 2018, P. 32-42

To get an understanding of the dimension of the data volumes, the amount in which data is measured is described with 57 times the amount of all grains of sand of all beaches on our planet. This corresponds to a size of zettabyte, a number with 21 zeros.³¹

The use of Big Data and analytics algorithms can also be beneficial in other sectors, such as customer applications.³² Companies receive contact via various channels. Sentiment analysis can be applied in this field of application, analyzing opinions and sentiments in non-structured texts.³² This allows strategically useful submissions to receive priority responses.³²

In addition to the use of algorithms and Big Data in industry, they can also be used in healthcare, for example. The term specifically defined for this is *eHealth*. Here, medical data and data from patients can be recognized, made available and evaluated by electronic systems.³² A study by management consultants PwC shows that the use of digital technologies could achieve an efficiency potential of 39 billion euros in healthcare costs.³² Examples include an app called Klara, which uses a patient's photographic submission to provide a doctor's expert opinion of skin areas thought to be affected by cancer.³² Another example is the use of digital individual medicine. This consists of a multi-step information process. The first step deals with the collection of data from individual patients, such as family history. The second step involves the use of digital measuring devices in everyday life. These include smartwatches or smartphones that collect health data and also evaluate it with the help of a doctor for the third step. The fourth step then provides for diagnosis with a suggested therapy. This is done with the help of a digital health assistant.³²

Digital transformation is creating new relationships between suppliers, customers and companies. These are developing into so-called *value creation ecosystems*. A distinction is made between open and closed ecosystems.³³ One example of a closed ecosystem is Apple, which hardly allows any cooperation with other value creation systems. Yet this strategy is only successful for market-dominating companies.³³ As the central element of the value creation ecosystem are the customers. Because the age of blindly producing for an open need of customers is over. Instead, unmet needs with high relevance hardly exist anymore. Because "[...]instead, customers want to be delighted with new offerings."³³ There is a constant supply with end-to-end availability around the world. However, the emerging possibilities of digitization enable customers to express their needs and opinions about products in contact with companies. Incorporating this information directly into development is a task of **Lean Digitization**.³³ This integration into the development process of a value creation can be decisive for market success. It is not like the existing process chain, in which development is driven by the company and customers are presented as the last link. Instead, it forms a better strategy in which customers are involved with their needs from the very beginning.³³ An example of this is the company Hilti. The company's core business was to sell drilling machines. By better reflecting customer needs, the company started to offer a fleet service with the goal of providing "[...]the right tool at the right time in the right place[...]"³³

³¹ Cf. Weber 2017, P. 2

³² Cf. Kirchner et al. 2018, P. 32-42

³³ Cf. Weinreich 2016, P. 8-12



Consultation and feedback from customers have become essential for companies. This can be explained using the example of cell phone apps. Suitable software solutions are now available as mobile apps for many problems. These are available with almost identical capabilities. The success of such an app is determined by customer ratings, if these are better for an app without a clear difference in function.³⁴ Digitization leads to a composition of markets and makes all products with the same characteristics available on the spot. Minimal differences can have a huge impact on the success of products, so the relevance for customer co-creation in economic ecosystems is very high.³⁴

Customers take on a new role within the value chain. For example, they can be directly involved, as in the case of electricity production through ownership of a photovoltaic system. In addition, companies involve customers directly in product design via *Open Innovation*.³⁴

Amazon, HRS, Uber and Airbnb also serve as examples of the digital transformation, none of which produce their own products.³⁵ "They're just using algorithms to break down what customers are ordering and what producers have created. The business models of these companies are to interpret data and link supply and demand together in ways we've never seen before."³⁵

³⁴ Cf. Weinreich 2016, P. 8-12

³⁵ Cf. Weber 2017, P. 2

Summary

Digitization is generating a great deal of data, so-called big data.

With the help of Big Data technologies, the information and data can be used to advantage.

The customer plays an important role in digitization.

Digitization allows new types of value creation to be shaped.

3.3. Tasks

5. Value creation

What is the classic definition of value creation?

- All created products that add value in their function.
- The difference that arises between costs and the market value of created products.
- All products of a company that originate from its own production.
- All products of a company created from components.

6. Digitization and value creation processes

What will be the focus of the value chain in the course of digitization?

- The complete monitoring of all processes
- The interest and individual demand of customers
- The complete automation of all processes in the company
- The complete transformation of all analog processes into digital processes



Use-Case Digitalization in value creation processes

This use case was created with the thematic content of the previous chapters Fundamentals of Digitization and Digitization in Value Creation Processes. Especially the Autoren Appelfeller and Feldmann (2018), Barton et al. (2018), Buchholz (2017), Deuse et al. (2020), Graf (2016), Herbrich (2019), Hildesheim and Michelsen (2019), Kuhn (2017), Kreuzer und Sirrenberger (2019), Kirchner et al. (2018), Lemke (2018), Melski et al. (2008), Siepmann and Graf (2016), Volk et al. (2020), Wang et al. (2020), Wolf and Strohschen (2018), Weinreich (2016) and Weber (2017) were decisive in the creation.

Digitalization and the associated change threaten to make the previous processes and business models uncompetitive. The company, Kurzwiese GmbH, wants to face these changes in order to come out of the upcoming changes with an advantage. Kurzwiese GmbH offers several devices related to lawn care. The product portfolio ranges from edgers to ride-on lawn mowers. The bestsellers are the classic gasoline-powered lawn mowers. To redesign processes, the managing directors of Kurzwiese GmbH plan to collect and generate internal company production data and customer data. Therefore, production will be equipped with all sensor technology to get an overview of the production and to enable a digital mapping of the processes. The precise information generated in this way enables employees to carry out better error analyses and plan new products more quickly. In addition, Kurzwiese GmbH can now collect customer data. With the new generation of products, Kurzwiese GmbH equips all of the company's products with sensors and control devices, and these send data about the use of customers' devices in constant connection with the company's servers. This enables the company to keep track of the exact usage of their products. As a result, devices can be better adapted to actual use in the future. For example, certain parts that are exposed to strong forces during use can be designed to be particularly stable. In addition, the management is planning even more far-reaching measures. Digitization is expected to create new added value and thus complement the existing business. When purchasing a product from Kurzwiese GmbH, customers must install an app in order to put the respective device into operation; in doing so, they also accept a condition of use regarding data protection. Customers can read the collected data via status information of the device in their app, such as usage time or fuel consumption. With the newly developed app, a new way for customers to interact with the company has been made possible. This is because customers can provide feedback on the product in question at any time, giving the company an insight into their needs. In addition, new technologies such as artificial intelligence are in use. Through a dialog box in the app, customers can get in touch with an AI-based chatbot that answers all questions and concerns customers have about the company and its products.



Use-Case Digitalization in value creation processes

Kurzwiese GmbH's challenge now is to make the right use of the data it has acquired. However, because the company's managers are investing extensively in the new digitalization, they can use the information skillfully. That's why the company has managed to derive a perfect lawn mowing procedure from the data. The data from the different usage of the equipment in all weather conditions has then become the basis for a programmed algorithm that can recommend a mowing strategy to customers for an extra charge in their app. The new algorithm has also enabled the company to add a robotic lawn mower to its product portfolio.

Through the algorithm, the company can additionally derive the needs of the customers in a targeted manner. This makes it possible to advertise other products precisely and successfully or to create a suitable offer for a previously unmet demand. That is why the company is planning, among other things, an automatic irrigation system that connects and exchanges information with other products..

Overall, therefore, digitization enabled the company to improve its processes and make them more efficient, and to better adapt its products to its customers. However, the greatest success was to design a new value creation and thus a new business model from the collected and processed data. In addition, the company is prepared for future changes, as it has recognized that in Industry 4.0, the opinion and needs of customers come first.

The following tasks relate to the use case of digitization in value creation processes and consist of multiple-choice tasks and open tasks for independent work.

16. Digital creation processes

How does the company take into account the interest of customers?

1. About a sales call
2. Through the use of an app
3. About an external marketing company
4. Through sensor technology in manufacturing

17. Digital creation processes

What has the company accomplished by offering lawn mowing procedures?

1. A new way of creating value through digitization
2. A closed value creation ecosystem
3. A cyber-physical system
4. A connection to the Internet of Things (IoT)

18. Digital creation processes

How could the company generate data from its devices?

1. About customer conversations
2. About RFID technology
3. About control units and sensors
4. Über einen Prüfstand

19. Digital creation processes

What are passive communications from customers?

1. The data from the use of the products
2. The feedback via the app
3. The shared needs via the chatbot
4. A conversation with customer advisors



2.1 In what way could the company build a new business unit thanks to the opportunities gained through digitization?

Your answer:

2.2 How could the company use digital twin technology?

Your answer:



2.3 Another company, Seven GmbH, rents out different types of vehicles to customers for a certain period of time (from one day to one year). How could the company adapt to digitalization and usefully apply the new advantages? What could be a suitable scenario?

Your answer:

4. Lean management and digitalization

Learning objectives in this chapter

In this chapter...

...Lean Management is introduced.

...the link between lean management and digitalization is explained.

...the application of lean management for waste-free processes is addressed.

4.1. Lean Management

Lean management can be linked well to digital transformation. Lean management and the role of lean management in digitalization are discussed below.

"Lean management is internationally one of the most widely used approaches to improvement in manufacturing companies in terms of quality, cost and time".³⁶ For this purpose, the management approach can be divided into two areas. One is Lean Administration and the other is Lean Production. Lean Administration covers the indirect business processes of a company. Lean Production concerns direct processes, tasks and management areas.³⁶ Direct processes are a direct part of value creation; indirect processes do not create value themselves. These include, for example, the maintenance of machines.³⁶

"Lean management is a concept for process optimization of value chains and processes with the ultimate goal of customer satisfaction."³⁷ The definition of the value chain extends from the suppliers, through the company's own production, to the customers.³⁷ The intentions of lean management are listed below. Customer satisfaction becomes the focus of the company. The question of value creation for the end customer is addressed. Waste at all levels of value creation is to be eliminated. All structures, products and processes in the company are to be improved by suitable employees. In addition, employee co-determination is to become a central element in implementation. The entire company is to be aligned with customer needs through transformation. Thereby an integration of the machine with the human being will take place.³⁸ Lean management can be divided into different areas. The use of lean management in administration with *Lean*

³⁶ Hoellthaler et al. 2018, P. 523

³⁷ Helmold 2021, P. 1

³⁸ Cf. Helmold 2021, P. 2-134

Administration and in production with *Lean Production*. Other examples are Lean Maintenance for maintenance and Lean Logistics for logistics.³⁹

Among other things, **lean production** addresses waste-free processes.⁴⁰ The term Lean originated from the production. Lean production, he said, is a description that includes "waste-free processes in production and the organization of operations according to the principles of stabilization, flow, takt, pull and perfection." includes.⁴⁰ Lean production originally came from the Japanese company Toyota.⁴⁰ The term Lean stands for the combination of methods for optimizing processes, as well as the fundamental culture and structure of a company.⁴⁰

4.2. The role of lean management in digitization

Lean management also includes digitization. The following section deals with the combination of the two topics. However, the approaches of lean production and digitization are initially fundamentally different. Lean production is a philosophy and an organizational approach, and digitization specializes in technologies.⁴¹ Often, processes within a company become leaner and leaner with the lean management approach. However, this restructuring within a company is often associated with a reduction in flexibility. The increased flexibility, however, is often a product of digitization. This is where the sensible justification for linking the two approaches exists.⁴¹ "Digitization has the ability to counteract this deficit[...]"⁴¹

Lean is also a foundation for subsequent digitization, as waste is eliminated.⁴⁰ The standards and low waste characterized by lean must therefore be introduced before digitization. An analysis of the process flow is also relevant before digitization. "The focus on fast turnaround time remains important in the digital world. This means that lean is ahead of digital in the sequence."⁴⁰ This resulted in the following mnemonic: "*First eliminate waste, then automate*".⁴⁰

Digitization and lean management are different concepts, but both pursue the goal of improving value creation. It is effective to simplify processes in advance through lean management before they are digitized.⁴²

Another role of lean management in digitalization is given by the emergence of Industry 4.0. Lean production plays a major role in the development of **computer-integrated manufacturing** (CIM) into the industrial fourth revolution.⁴³

³⁹ Cf. Helmold 2021, P. 2-134

⁴⁰ Bertagnolli 2020, P. 4-383

⁴¹ Cf. Hoellthaler et al. 2018, P. 524

⁴² Cf. Prinz et al. 2018, P. 22

⁴³ Cf. Siepmann und Graef 2016, P. 20

4.3. Digital lean management approaches

The combination of lean approaches with the new digital tools of Industry 4.0 is a particularly good solution for linking the methods and technologies.⁴⁴ "We've supported hundreds of operational excellence programs over the years and have found that companies achieve valuable synergies by implementing Lean Management and Industrie 4.0 holistically, rather than independently or sequentially."⁴⁴ The integration of these two approaches is called **Lean Industrie 4.0**. The approach of Lean Industrie 4.0 can vary greatly depending on the area of application.⁴⁴

Lean management of the future describes the linking of the individual links in the value chain. By providing lean management tools of the future, complicated and unclear value streams can be made recognizable.⁴⁴ Lean management tools can increase their performance spectrum in the course of digital transformation. For example, digital devices can be used.⁴⁴

For the topic of lean management and its digital approaches, the **Scrum method** should also be mentioned. The Scrum method is one of the most successful in the development of software products.⁴⁵ The method developed among other things through the Lean Management.⁴⁵ The name comes from a situation in rugby where the players are all lined up together. The essential characteristics for this method are reproduced here below. First of all, the approach relies on a particularly strong team and thus also on an individual processing possibility with a particularly large amount of freedom for the employees. Through regular feedback, a continuous improvement can be achieved, where the results are fed back into the development process like a loop. In addition, the so-called Scrum Board is part of the method, where each person involved in the process can identify problems and previous successes. This is not only beneficial for motivation, but also for process organization. The immediate similarity to lean management lies in the focus on low-waste processes.⁴⁵

4.4. Implementation of lean management

As discussed in the previous chapter, the focus of lean management is on making value creation processes lean and preventing or eliminating waste. This is particularly relevant for digitization. For the application of lean management, the most important components are discussed in the following chapter.

Waste

On the subject of waste and lean management, the authors Hänggi et al. (2021) provide seven different types of waste in their work "Lean Production – einfach und umfassend", which are explained here below.⁴⁶

⁴⁴ Cf. Helmold 2021, S. 239-240

⁴⁵ Cf. Weinreich 2016, S. 18-19

⁴⁶ Hänggi et al. 2021, S.2

The 7 types of waste:⁴⁷

1. „Transportation“⁴⁷
2. „Storage“⁴⁷
3. „Routes“⁴⁷
4. „Waiting“⁴⁷
5. „Overproduction“⁴⁷
6. „Unnecessary process“⁴⁷
7. „Defects“⁴⁷

It should be noted at the outset that waste cannot always be prevented, or that there may be a lack of alternatives. However, it is still important to identify waste in order to adjust processes if necessary.⁴⁸

First, **overproduction** is explained. This is always a form of waste, as supply is higher than demand. Other wastes can be generated by overproduction, for example unnecessary storage costs for the surplus goods.⁴⁸

The second type of waste relates to **inventory and storage**. Inventory often needs to be built up due to another factor, such as fluctuating and unreliable delivery times. For this purpose, warehouses lend themselves to securing inventory and being able to plan for further value creation. From a Lean Management perspective, this is a type of waste, as high costs are incurred due to storage. On the one hand, the high level of inventory means that money is invested in products that could generate higher profits in the short term. On the other hand, there is a lot of effort involved in storage. For example, it needs space, employees, heating and administration.⁴⁸

The third type of waste is **transportation**. Globalization is making transportation around the world cheaper and cheaper. As a result, products are transported around the world several times for the cheapest possible processing in order to keep production costs as low as possible. In addition, transport always results in an organizational expense, which can also be regarded as a waste according to lean management.⁴⁸

Another type of waste is the **distances** that products have to travel. For components or for the product itself, various paths occur during the value creation process, for example to fetch parts from the warehouse or to bring the product to the next machine. But manual operations can also represent waste here. Duration, frequency and length also play a role.⁴⁸

The fifth waste is **waiting**. Waiting causes pauses in value creation that lead to waste. The number of breaks also plays a role here, which add up to minutes and hours if they are very frequent.⁴⁸

⁴⁷ Cf. Helmold 2021, P. 52

⁴⁸ Cf. Hänggi et al. 2021, P. 4-13

Another type of waste are **unnecessary processes**. Looking for glasses or keys serves as an example of this. The problem is that these processes may already be integrated into everyday life and are thus accepted as a habit.⁴⁹

The last type of waste is the **correction** of already finished products of value creation. If errors were made during production, it is often no longer possible to correct them after the supposed completion. Correcting the errors is usually associated with considerable effort. Inevitably, however, these scenarios lead to waste.⁴⁹

An eighth type of waste is also sometimes mentioned. This is the **unused knowledge** of employees.⁵⁰

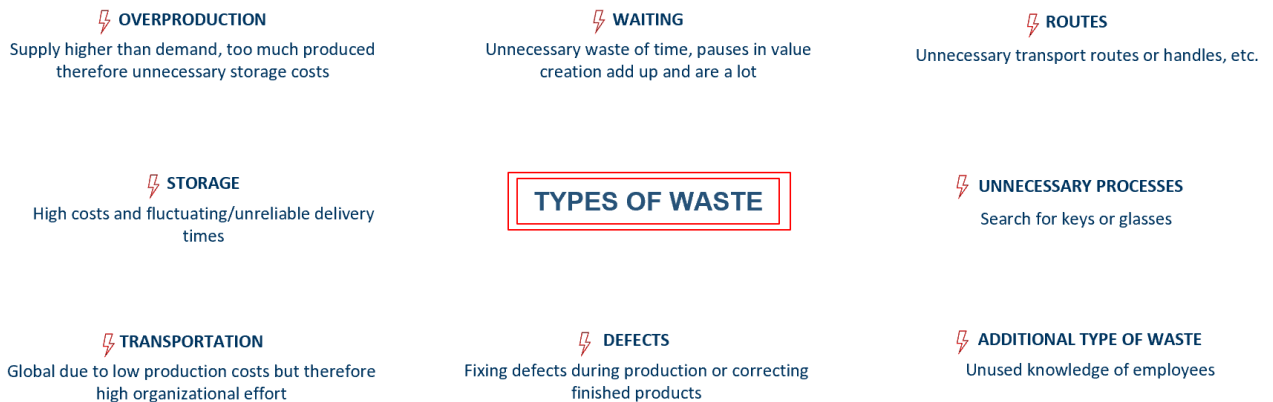


Figure 4: Overview of the types of waste in lean-management⁴⁷

Principles

As a suggestion for action to design a lean value creation process and to have as little waste as possible, there are nine principles. A conscious distinction is made between principles and methods.⁵¹ The principles are reproduced below.

The first principle is the **pull principle**. The pull principle tries to prevent overproduction. For this purpose, a stock quantity is defined that may not be exceeded. Only when the inventory is reduced may new production take place. However, the inventory limit must be taken into account in production. The pull principle is thus based on customer demand.⁵¹

This is followed by the **flow principle**.⁵¹ The principle is the countermeasure of batch production, in which a fixed quantity of a given product goes through a value-added process. The process of creating a product

⁴⁹ Cf. Hänggi et al. 2021, P. 4-13

⁵⁰ Cf. Bertagnolli 2020, P. 32-33

⁵¹ Cf. Hänggi et al. 2021, P. 17-33

gives rise to various costs. As soon as only slightly different products are created in a production, so-called set-up costs arise due to the changeover and preparation for the new product. These are always incurred for a specific product. In order to keep these costs low, one tries to create several copies of a specific product at the same time in order to keep the costs incurred for preparation for production as low as possible. However, this can quickly lead to overproduction. The production of several copies is also called production in batches. The specific size of the lots is the lot size. If setup costs are kept low, it is possible to have each part flow through the process individually. The authors call this process *one-piece flow*.⁵² For example, individual different T-shirts can always be printed in one machine instead of producing multiple prints of one T-shirt and risking overproduction. The flow principle is thus the counterpart to production in batches.⁵²

The next following principle is the **clock principle**.⁵² In this process, a takt triggered by the customers is made the basis for organization. The takt can be, for example, the interval in which different customers place an order. In the course of a production, it can happen that the different steps of this production take different amounts of time. Therefore, by setting a specific time for the production process, either overproduction may occur or the potential may not be fully utilized. Thus, from the point of view of lean management, it makes sense to design the steps with approximately equal cycle times in order to obtain a uniform process.⁵¹

Furthermore, there is the **0-error principle**. The basic principle here is neither to make mistakes nor to accept or pass them on. The most important thing is to analyze and work out the mistakes in a neutral process. By evaluation and rebuke it can come to understatements and concealments of the mistakes. Furthermore, an appropriate technique is necessary to implement a suitable working method. For example, the authors mention assistance systems in cars that recognize and warn of a driver's error.⁵²

The next principle is the **principle of separation of waste and value creation**.⁵² This principle is necessary to design an efficient process and to carry out a simple determination of the waste. Otherwise, the waste would be divided among many different processes.⁵²

The **FIFO principle** stands for First in - First out and thus forms the opposite of FINO, which means First in - Never out.⁵² This refers to storage principles. FINO means that the first stored goods are never used or only used at the very end, for example, by piling up the goods. FIFO means that the first stored goods are also used first. In this way, waste can be avoided and efficiency can be increased, since a loss of quality of the goods can be prevented.⁵²

The seventh principle focuses on the **minimum paths**. The shortest paths are always sought. However, this is often not taken into account in the planning. This results in many routes, which in total take up a large amount of time and lead to great waste. At best, the paths are taken into account in the planning of, for example, factories.⁵²

⁵² Cf. Hänggi et al. 2021, P. 32-55

According to the authors, the **principle of value stream orientation** focuses on the consideration of the entire process. In doing so, the view of the process takes place from the perspective of the customers into the company. Through this view, steps in the process can be redesigned to increase efficiency.⁵³

The last principle is the **principle of standardization**. Standardization can simplify and speed up many processes, as it can lead to automatic behavior. Furthermore, standardization is important to secure new improvements and optimizations. Through standards, these can be implemented more easily and become better anchored in the process.⁵³

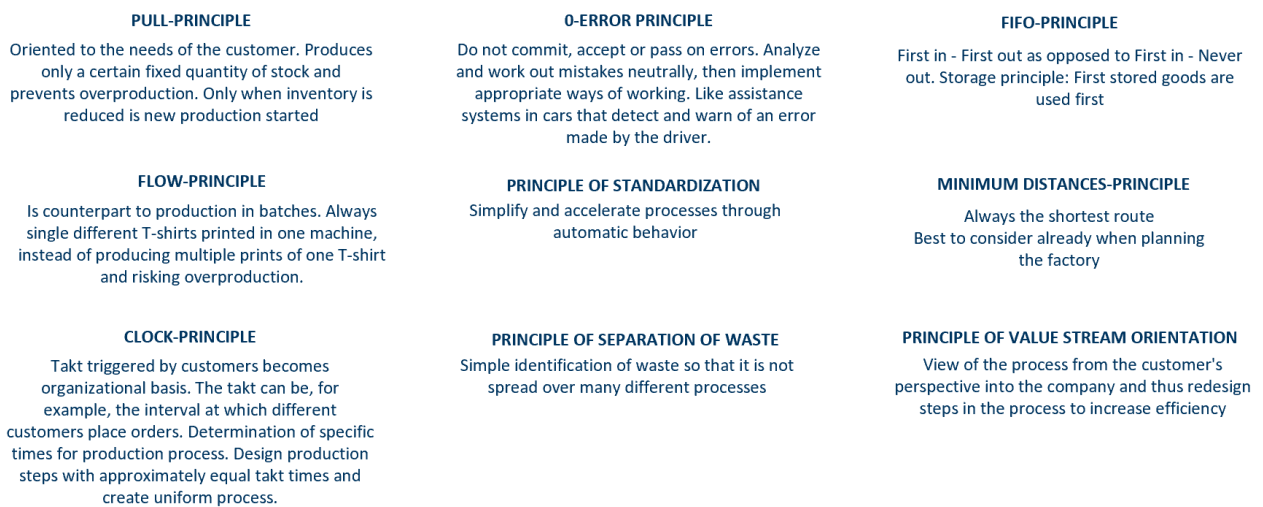


Figure 5: Overview of the principles in lean-management⁵¹

Methods

The types of waste and principles of lean management or lean production already discussed are supplemented by various methods for complying with the principles and identifying waste as easily as possible.⁵³

In order to identify waste within a process as well as possible, a **process map** serves as a possible tool. The goal is to gain an overview of a process with a complete overview, to understand the individual relationships of the elements and thus to locate waste. The method consists on the one hand of the creation of the process map and on the other hand of the search for wastes. It is particularly important that the processing is not only carried out by individual persons or departments, but that as many persons involved in the process as possible also participate in the processing of the process map.⁵³ First, all departments involved in the process are listed one below the other and given their own line. Since these lines are reminiscent of swimming lanes,

⁵³ Hänggi et al. 2021, S. 52

this diagram is also called a Swimlane diagram. Now the process can be represented by means of this division. Information and materials moving through the process are represented by arrows, optionally in different colours. Operations or individual processes are precisely drawn here and placed in the corresponding line of the associated department. Possible branches can be represented in the form of diamonds.⁵⁴ This allows the entire process to be clearly visualized, and an understanding of the individual steps is created so that potential waste can then be identified, for example if a product takes unnecessary routes or processes can be designed in a faster sequence. In addition, waste can already be identified during the creation of such a process map, in which process participants can point out waste during the creation of the overview. The following is a process map for a vacuum cleaner process dealt with by the authors (Fig. 6). Here, too, the individual departments, material and information flows, as well as branches and machining processes can be seen. Waste has been marked with the help of a lightning bolt.⁵⁴

⁵⁴ Hänggi et al. 2021, P. 52

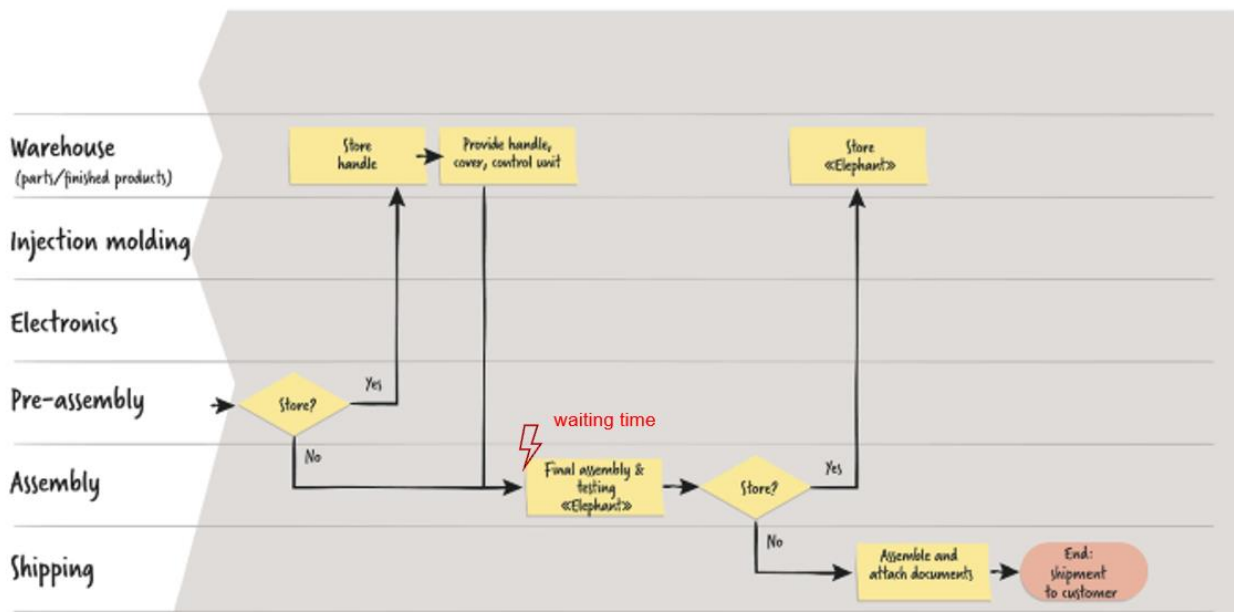
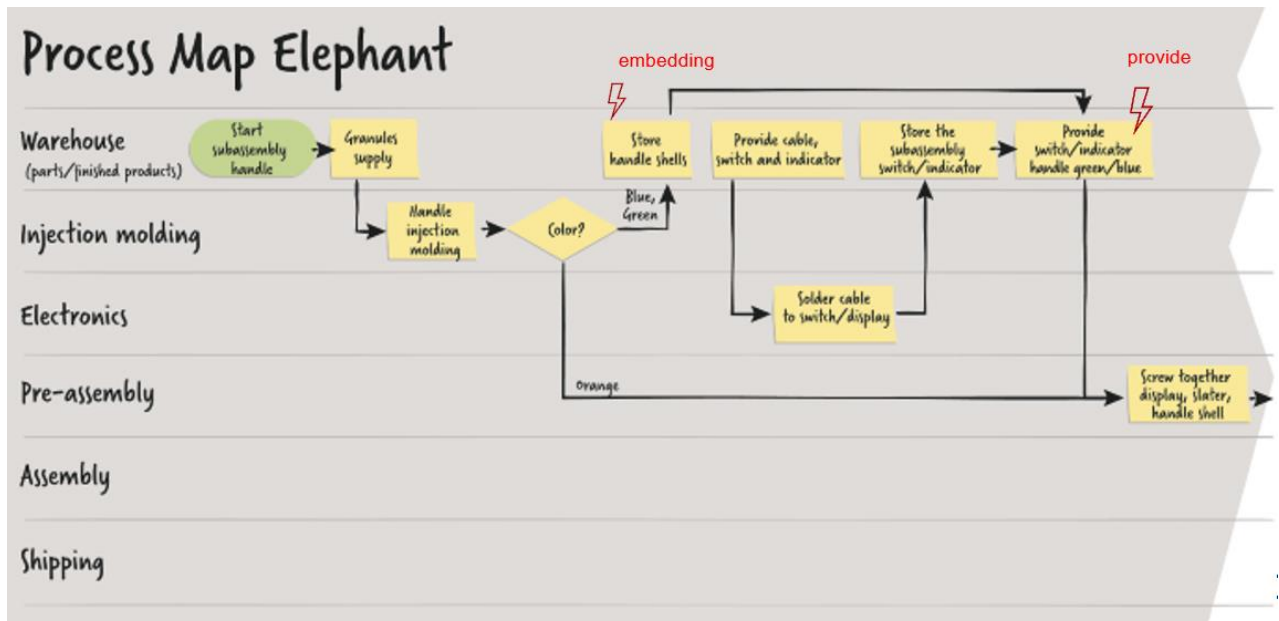


Figure 6: : Process Map ⁵⁵

⁵⁵ Hänggi et al. 2021, P. 52

Summary

Lean management optimizes processes and value creation.

Management approaches can be used to eliminate waste in processes.

It makes sense to apply lean management before digitization.

4.5. Tasks

7. Lean Management

What is the focus of applying lean management?

1. Waste-free processes
2. Digital processes
3. Environmentally friendly value creation processes
4. Logistics industry processes

8. Relevance of lean management

What relevance does lean management have for digitization?

1. Employee co-determination simplifies decision-making processes.
2. The digitization process is facilitated because the focus in lean management is on automation.
3. Applying lean management before digitization facilitates the digitization process by eliminating waste.
4. Various lean management methods include the digital restructuring approach.

9. Lean Management

What are the core components of the practical application of lean management

1. Waste, processes and methods
2. Waste, principles and methods
3. Costs, tools and waste
4. Waste, costs and results

10. Waste

Which events are all waste from a lean management perspective?

1. Waiting times, overproduction and movement
2. Supply bottlenecks, overproduction and transport
3. Overproduction, inventories and supply bottlenecks
4. Production variety, waiting times and movement

11. Flow principle

What is the flow principle?

1. The rapid subsequent delivery of materials in the flow
2. The production of several parts of one type for low set-up costs
3. The countermeasure of batch production
4. The use of automated transport systems in production

12. Process Map

What is represented with a process map?

1. The financial overview in the company
2. An overview for all projects in the company
3. The processing status and progress within a department in a company
4. The flow of materials and information across departments and stations within a company



Use-Case Lean Management

This use case on lean management was written with content based on the chapter on lean management, the work of Hänggi et al. (2021) as well as from Helmold (2021) and Walter (2013) was the basis for the following Use-Case.

In a company, there are naturally many processes and structures. The focus is on value creation. In order to better understand lean management, here is a use case that is intended to show the advantages and possible applications of lean management. The focus will be on the types of waste, the principles and methods that were previously discussed in the chapter on lean management. The following example is about an automotive supplier of Hello GmbH & Co. KGaA, which produces various parts around the car for the aftermarket, in our example brake discs. Within a company, wastes often occur, such as transportation, inventory, movement, waiting time, overproduction, rework and defects. The waste types movement, transport and waiting times and are present in this example company, Hello GmbH & Co. KGaA, are also present. Among other things, the distances between the individual machining processes are unnecessarily long. Various routes have to be taken between machines, but also from hall to hall and from plant to plant, in order to get the parts from one machining step to the next. There is also a particularly large number of transports to get the brake discs from one process step to the next. Waste is also caused by waiting times because the processes within the company are not optimally timed. These types of waste can, among other things, seem logical or relevant. If, for example, some production sites can produce more cheaply than others, it seems legitimate to accept transport and distances in return. Nevertheless, it is important to look at waste in order to get a better understanding of the processes.

20. Lean Management

Which of the following lean management principles fits the scenario in the example to address waste?

1. The 0-error principle
2. The clock principle
3. The flow principle
4. The pull principle



Use-Case Lean Management

To achieve the principles of lean management, there are several methods to implement them. For the example company, the previously discussed process map is applied to better understand the material and information flow of the brake disc and to get a better overview of the company.

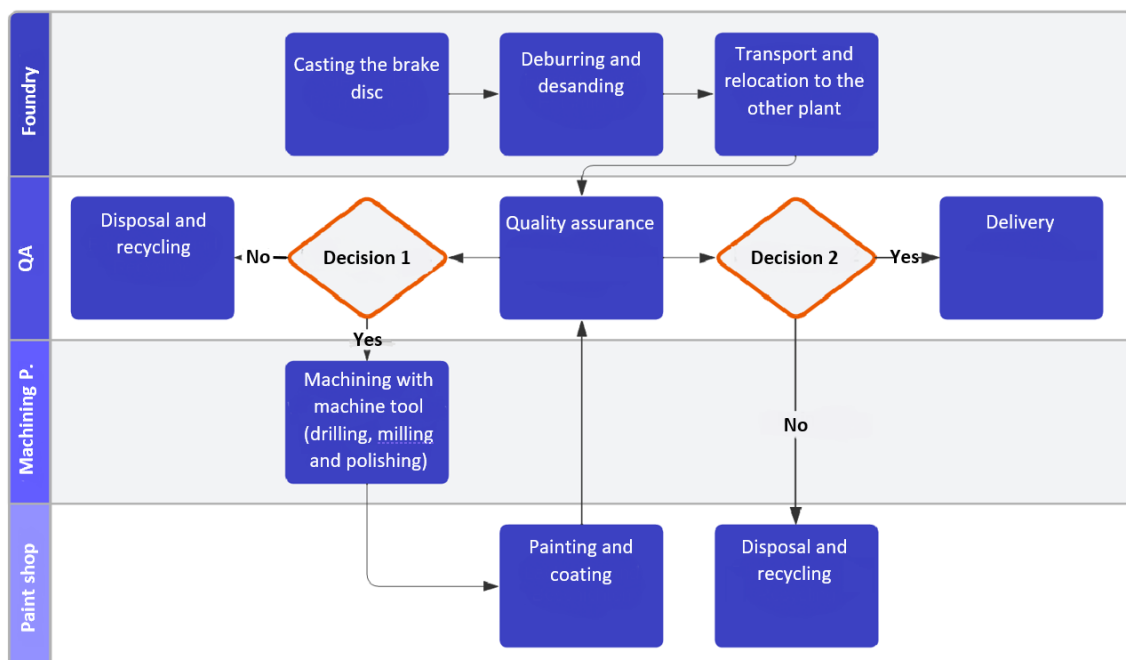


Figure 7: Process Map: Brake Disc



Use-Case Lean Management

Since the focus is on understanding the entire process, the details of the individual sub-processes are omitted here. As can be seen on the process map, the production of the brake disc starts in the foundry. However, this is located in a different plant than the rest of the departments involved in the process. In this plant, the brake discs are cast and then deburred and dispatched. The parts are then packaged and prepared for transport to be delivered to the other plant for further processing. There, the parts must first go to quality assurance to check for further processing. If the parts do not meet the required quality, they are recycled or disposed of. However, if they do meet the requirements, they are passed to the next department, machining production, for further processing. However, the machining production is located in its own hall, as the competences were divided into respective halls during the factory planning. In the machining production, the brake discs are further processed in machine tools. The advantage of these machines is that several machining steps can be carried out in one machine. Therefore, milling, drilling and polishing are carried out within the same machine. After the brake discs have taken on their final shape, the last processing step begins: The parts are now taken to another hall for painting. In the final step, the supposedly finished parts are taken back to quality assurance for delivery. As mentioned, the types of waste the company incurs are waiting times, transports and routes. Through the created process map, especially the wastes transports and ways become clear. Even if the numerical distance is not shown on the process map, unnecessary ways and transports can be identified. The fact that the brake disks are cast in a different plant may not be possible otherwise for practical reasons. The routes within a plant, however, could be optimized. In this respect, the division of the individual departments into different halls may make sense for individual work, but from the point of view of lean management it is a waste. A closer look reveals that quality assurance in particular accounts for an immense share of the additional routes. It therefore makes sense to subdivide quality assurance into the individual areas responsible. The process map optimized for this purpose shows the new structuring below.

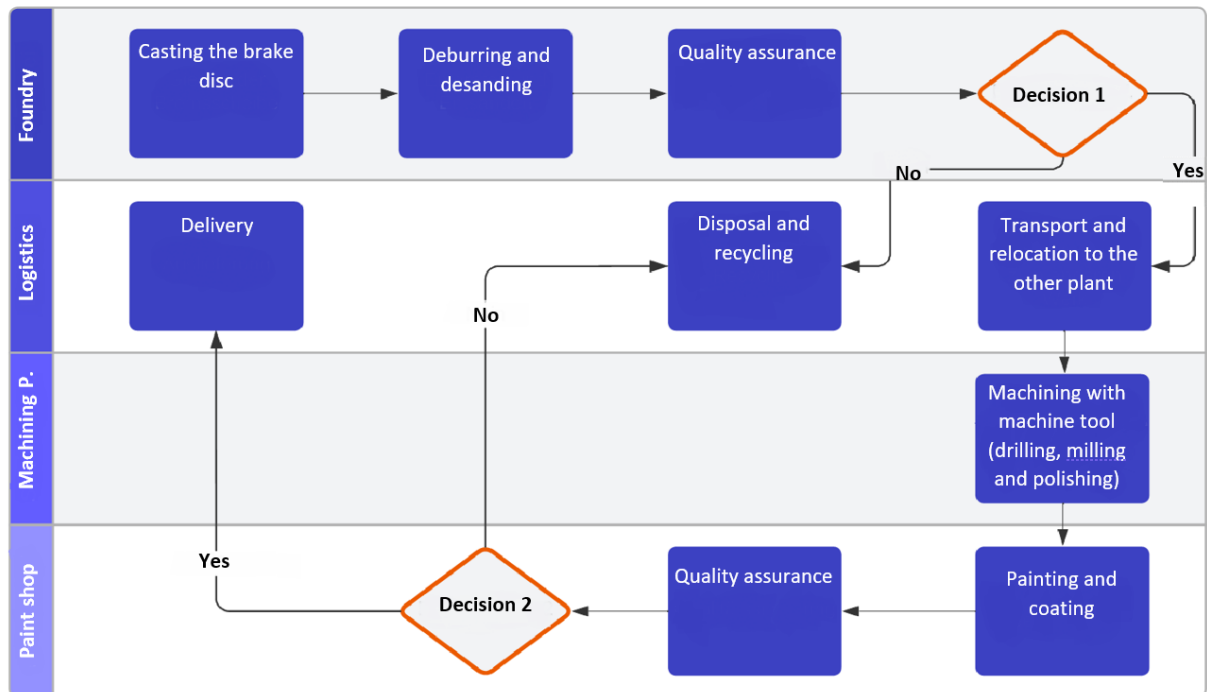


Figure 8: Optimized process map: brake disc



Use-Case Lean Management

As can be seen in Figure 8, the quality assurance department has been split between the foundry and paint shop departments. The place is taken by a new logistics department, which should better organize the company transports in order to work even more efficiently and with less waste. Quality assurance in the foundry will save unnecessary journeys. If parts do not meet the requirements, they can be recycled or disposed of directly and there is no need to make unnecessary trips to the other plant. Once the parts have arrived at the machining production plant, they only need to be transported to the further hall of the paint shop, as this is also where the final quality assurance is located. This case study has shown different types of waste and presented the appropriate process map method to counteract with possible measures.

Hello GmbH & Co. KGaA also manufactures steering wheels in addition to brake discs. Various processing steps are carried out for this purpose. In our example above, the wastes of routes, transport and waiting times were dealt with. In fact, Hello GmbH & Co. KGaA also has the waste problem of storage and inventories, thus also over-processing and unnecessary processes. The steering wheel for this example consists of a steering



Use-Case Lean Management

wheel skeleton, a steering wheel body, a steering wheel cover with horn function and an airbag, as shown in the following picture.⁵⁶

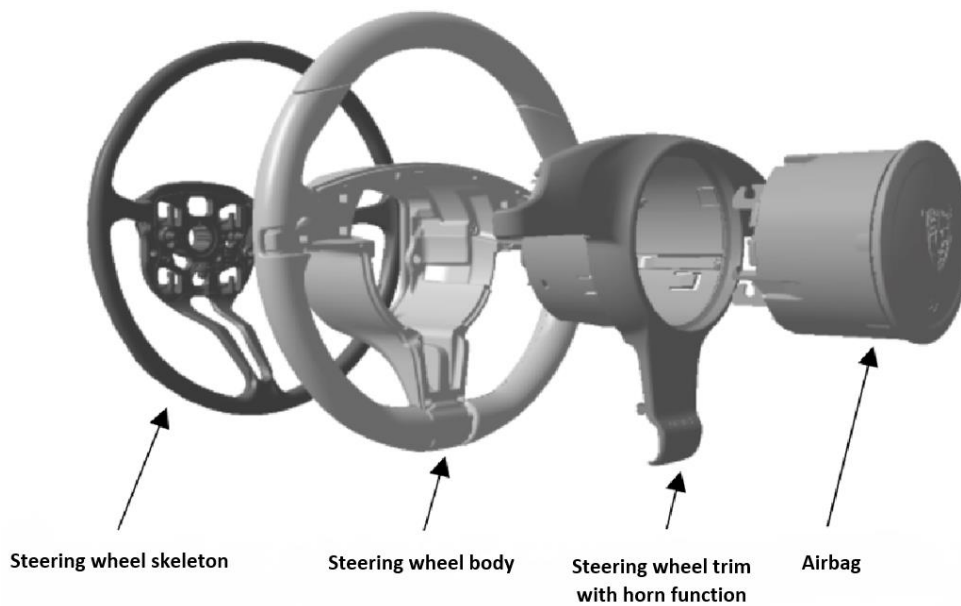


Figure 9: Composition of a steering wheel⁵⁷



Use-Case Lean Management

The following process map provides an overview of the production of the steering wheel at Hello GmbH & Co. KGaA.

⁵⁶ Cf. Walters 2013, P. 163-182

⁵⁷ Walters 2013, P. 165

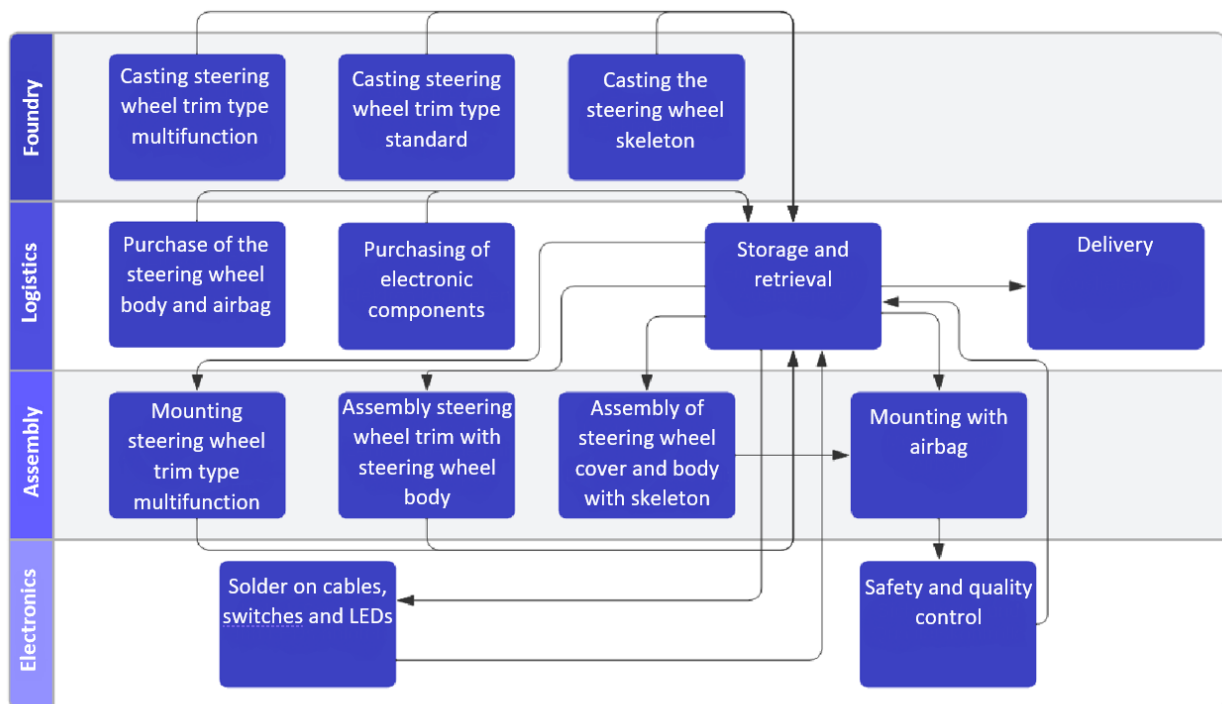


Figure 10: Process map: steering wheel



Use-Case Lean Management

Hello GmbH & Co. KGaA offers two different steering wheels: on the one hand a classic steering wheel without any additional functions and on the other hand a multifunction steering wheel with additional switches and LEDs. At the beginning of the manufacturing process, the steering wheel trims for the different steering wheel types are cast from plastic. The steering wheel skeleton is also manufactured in the same specialist department. All parts of this department are stored in a main warehouse after their production. The airbag, the electronic components and the steering wheel skeleton are provided as purchased parts in the warehouse for their further processing. In the electronics department, cables, switches and LEDs are soldered on and also stored. In the assembly department, the steering wheel trims of the multifunction type are assembled with the electronics and stored again. The two steering wheel trims are also assembled with the steering wheel body and stored. Then the steering wheel trims for the multifunction steering wheel or the standard steering wheel, connected to the steering wheel body, can be assembled with the steering wheel skeleton. The airbag is then placed



Use-Case Lean Management

in the assembly. Finally, a safety and quality check is carried out in the electronics department before subsequent delivery.

The following tasks refer to the use case Lean Management and consist of multiple choice tasks and open tasks for independent work.

21. Lean Management Steering wheel production

During the production of the steering wheel, there are repeated complaints about quality defects at the individual processing stations.

Which of the following principles could provide a remedy for the problem?

1. The clock principle
2. The 0-error principle
3. The FIFO principle
4. The flow principle

22. Lean Management Steering wheel production

A large supply of steering wheel skeletons accumulates during storage.

Which of the following principles could provide a remedy for the problem?

1. The principle of standardization
2. The clock principle
3. The flow principle
4. The pull principle

23. Lean Management Brake disc production

In the production of the brake disc, brake discs have recently been produced regardless of demand, as energy prices have become particularly favorable.

What type of waste are we talking about?

- 1. Transportation
- 2. Unnecessary process
- 3. Overproduction
- 4. Waiting times

3.1 In the process map for steering wheel production, mark the fields where waste occurs. Then draw an improved process in which waste has been eliminated in the template listed for this purpose.

Foundry	
Logistics	
Assembly	
Electronics	

Figure 11: Steering Wheel Production Template

Digitization process

After the previous use cases and the associated tasks, an insight was gained into the processes and possibilities for shaping digitization and value creation. In the following example, all three topics are combined.

The company Saubermat AG specializes in the manufacture and sale of dishwashers. The core business of the company are the dishwashers for household use.



Use-Case Digitization process

The company Saubermat AG specializes in the manufacture and sale of dishwashers. The core business of the company are the dishwashers for household use.

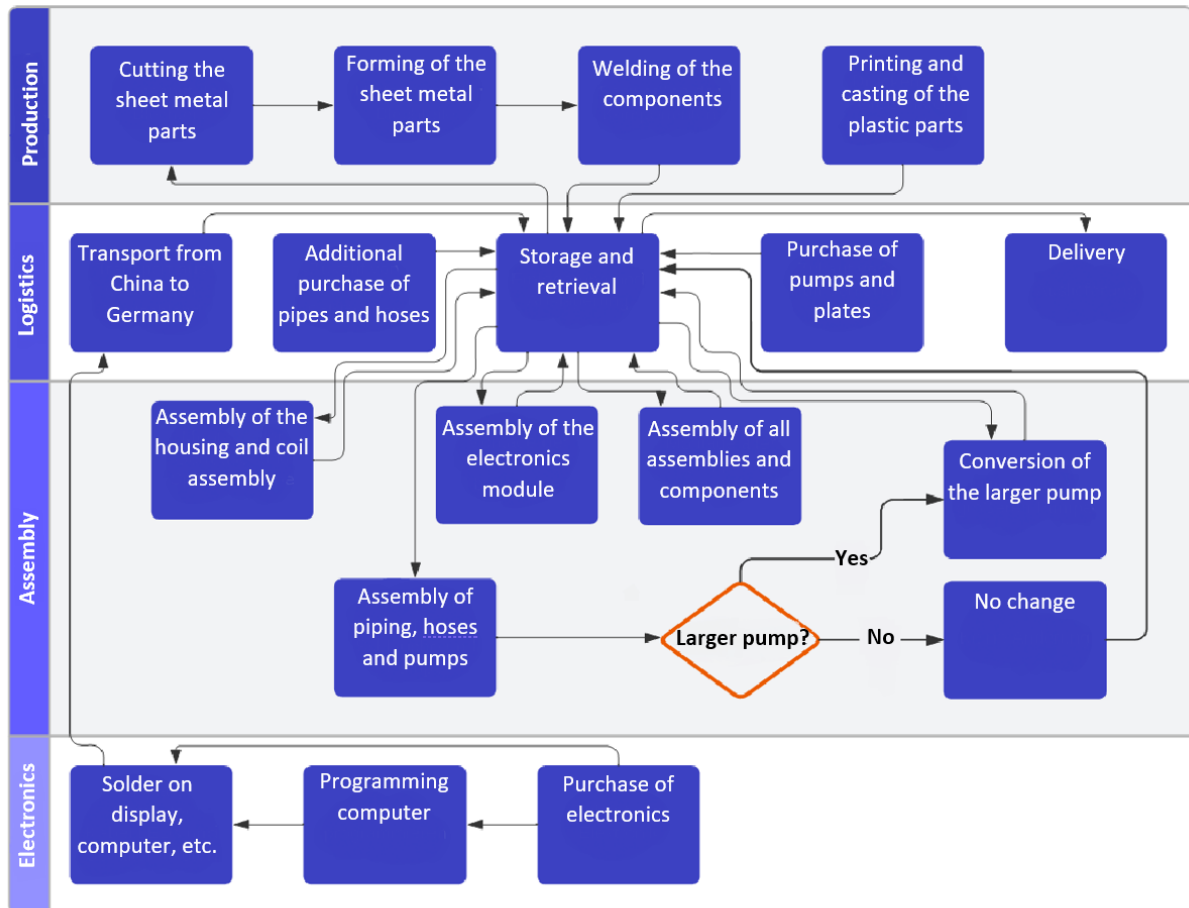


Figure 12: Process map Saubermat AG



Use-Case Digitization process

The following process map shows the manufacturing overview of Saubermat AG. Production begins with the cutting of the supplied sheets. These are then formed and welded together. After the process, the parts are put into storage. Also in production, the plastic parts are cast and partly 3D-printed. These parts are also put into storage. The electronics are processed and soldered together in China, and the components are supplied directly in China. The necessary computer is programmed and processed in China. The finished parts are brought to Germany and stored. The housing and flushing assembly is assembled from the parts produced in the warehouse and brought back to the warehouse. The same procedure takes place for the electronics assembly, which consists



Use-Case Digitization process

of electronics from China. The piping and hoses are assembled with the associated standard pump. However, there is a possibility of buying a premium model of the dishwasher, which requires a larger pump. If such a premium model is produced, the pump will need to be rebuilt and upgraded to a larger pump again. The assembly will then be placed in storage. Should the standard model be produced, the assembly will be put into storage without adjustment. Finally, all finished assemblies are assembled from the warehouse and stored before delivery.

4.1 Mark the places in the process map where you can identify wastes. Then draw the process without the wastes in the following template.

Production	
Logistics	
Assembly	
Electronics	

Figure 13: Template Saubermat AG

Now that the waste has been eliminated and the processes optimized, the digitization process can begin at Saubermat AG.

4.2 How could a digital transformation be accomplished in the company? Use the following topics in your proposal:

- Digital twin
- Internet of Things
- Artificial Intelligence
- Cyber-physical systems

Your answer:

Due to the shift to waste-free processes and a digital transformation, the company has new opportunities to create value.

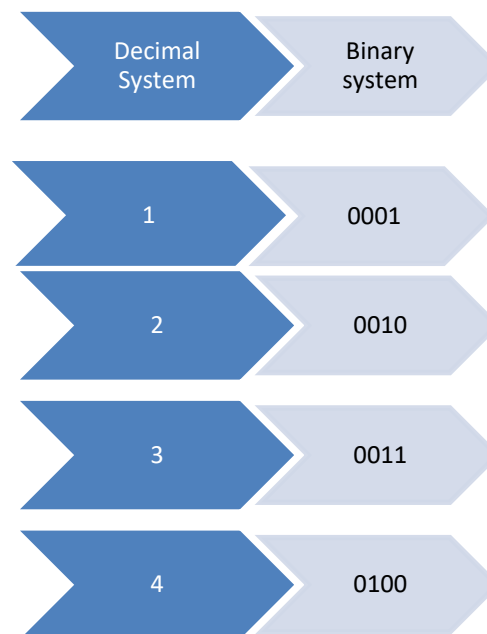
4.3 Geben Sie ein Beispiel für eine neue Möglichkeit der Wertschöpfung an. Skizzieren Sie außerdem die Auswirkung der Digitalisierung auf die bisherige Wertschöpfung.

Your answer:

5. Sample solutions

5.1. Sample solution for all multiple choice tasks

During the digitization process of Kurzwiese GmbH a file with a machine code was found. The machine code consists of ones and zeros. Help the company to convert the lines from the machine code as a binary system into a decimal system. The translation table will help you to do this. The lines here stand for the number of the previous tasks and the decimal numbers for the correct answer of each task. After the translation you have a ready sample solution of the multiple choice tasks.⁵⁸



Decimal System	Binary system
1	0001
2	0010
3	0011
4	0100

Figure 14: Translation table

⁵⁸ Lorig 2018, P. 35, 43

1.	0001	13.	0001
2.	0010	14.	0011
3.	0011	15.	0100
4.	0001	16.	0010
5.	0010	17.	0001
6.	0010	18.	0011
7.	0001	19.	0001
8.	0011	20.	0010
9.	0010	21.	0010
10.	0001	22.	0100
11.	0011	23.	0011
12.	0100		

Figure 15: Maschine code

5.2. Sample solutions for the use case tasks

There are several possible solutions to the following tasks. The following examples are suggested solutions, so it is a good idea to exchange and discuss them with learning partners.

1.1 The cabinets could be equipped with technology that can be controlled via the Internet. For example, sensors could be used to indicate the temperature and humidity. This function can offer advantages for food, for example. The ordering process and configuration could also be carried out via an app in the future. Furthermore, the app could also be used to contact the company and for warranty cases.

1.2 Artificial intelligence could, for example, help with the configuration of built-in cabinets. Customers could enter their wishes and requirements for the product as parameters in their app and then receive a suggestion for a built-in cabinet. Since the AI knows all the information about the products and can understand the problems. In addition, demand analysis with artificial intelligence could be used to adjust production. This could be used, for example, to procure components in time.

1.3 With the introduction of the app, the company has another opportunity to interact with customers. The company could also work on planning for interiors with the help of the new technologies. For example, the app could also serve as an aid for room layouts. Through a newly developed program, customers can use a planning tool to create their personal room layout and virtually adjust various pieces of furniture to achieve the best positioning of their furniture and built-in cabinet.

2.1 Through the successful use of the company's own app, customer feedback was taken into account and suitable solutions were worked on. In particular, other work within the garden has been addressed. As a result, the company has created a job board for gainfully employed gardeners who can be approached directly by customers for special gardening requests. In addition, customer feedback has made it clear that customers need specialized equipment for many applications for only a short period of time. Out of this concern, the company has also created an equipment rental service that can be used through the company's app.

2.2 The company could use the digital twin technology for its production and supply chains as well as for its products. Products could thus experience better development and design through digital representation. Crucial to this are modeling and synchronization, which provide valuable data through the digital twin. The same applies to production and supply chains, where the digital twin generates important data and forecasts that can make a big difference for design and prevention.

2.3 The company can carry out the rental and booking of various vehicles with the help of digital devices. The data generated, which customers pass on through feedback and evaluation of the various uses, enables the company to adapt its business model and thus its value creation. For example, a car-sharing service could be incorporated into the selection of offers. There could also be collaborations with e-scooter rental services to provide customers with a means of getting around within cities when needed.

3.1 The process map quickly shows that an unnecessarily large number of routes and thus also transports are taken. In addition, unnecessary processes or rework are created. Especially the storage and retrieval of components is very unproductive. This is where the greatest waste occurs. A better solution would be to move the individual parts to the respective machining step. In this way, the steering wheel trim type multifunction can be transported directly to the assembly with the electronics. Then the steering wheel trim type standard and type multifunction can be assembled together with the steering wheel body in one process. This is followed by the assembly of the steering wheel skeleton. The assembly of the airbag can be done with a direct safety check in the assembly department. For these processes to function properly, the steps must be coordinated with each other, for example with the clock principle.

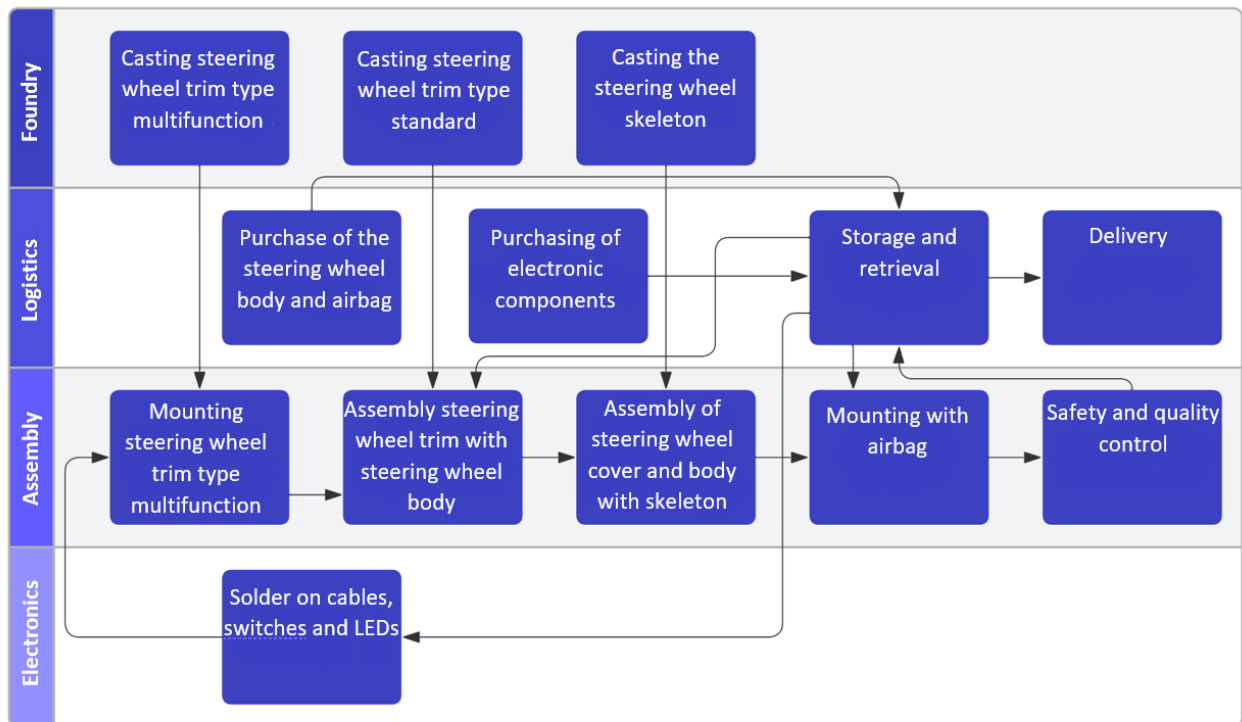


Figure 16: Optimized process map steering wheel

4.1 The created process map gives an overview of the manufacturing process of Saubermat AG. Here, unnecessary distances and transports are also taken into account, and unnecessary processes or revisions are also created. The processes could be better coordinated. In addition, it is a waste to only carry out a division after the pump has been assembled. Therefore, it is advisable to subdivide the piping and the pump into large and standard pumps before assembly, and only then to carry out the assembly. In addition, the process steps could be designed to build up one after the other, without intermediate storage. This means that the components can be taken directly from production to assembly, after which the process steps are built up on top of each other. The processing of electronic components could make sense from a financial point of view, but is still a waste from a lean management point of view. In order for these processes to function properly, the steps must be coordinated with each other, for example with the takt principle.

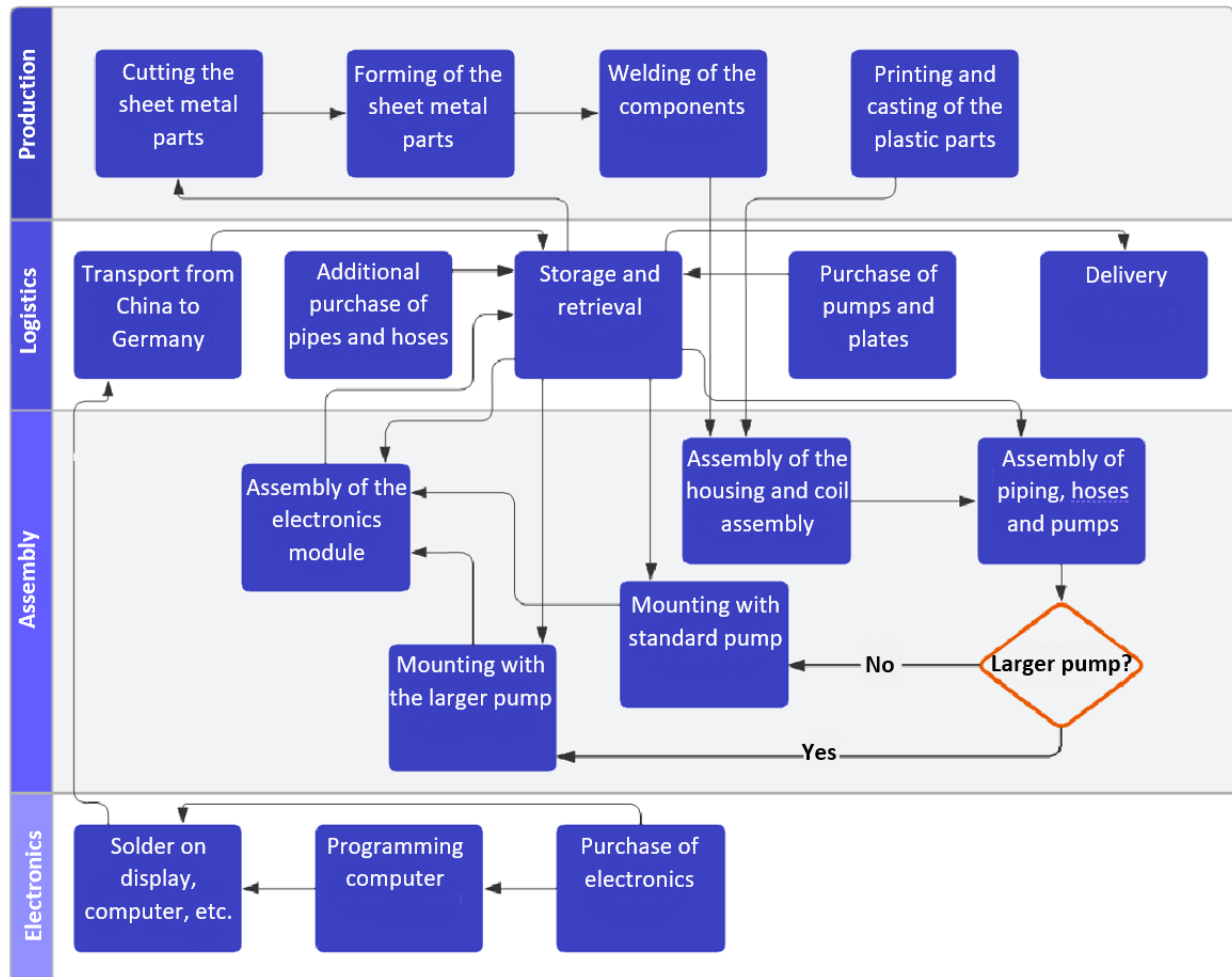


Figure 17: Optimized process map Saubermat AG

4.2 The company could transform production as a cyber-physical system. In this way, productions can be digitally monitored and controlled. The objects of production can communicate with each other via the Internet of Things. If, for example, production equipment were to fail, then those involved would be informed immediately. The company can also create a digital twin of its own production. This allows problem cases to be simulated and preventive measures to be taken. A digital twin of the company's own products also comes with many advantages. For example, kitchen manufacturers can use this twin in their kitchen planning with regard to dimensions. In addition, the digital twin would be of great benefit to the company's own design and development department in order to make adjustments in the development of products by means of analyses and modeling. However, the appliances themselves can also communicate with the company and contact support directly in the event of error messages, without involving customers. This provides the opportunity for remote evaluations, software updates or changes in the flushing program. Artificial intelligence (AI) could make adjustments in the device and specifically in the flushing program. If,



for example, the pump is heavily loaded or problems arise with the outflow of water, the computer as artificial intelligence can make adjustments in the economy program, for example, throttle the water supply. This means that the products of Saubermat AG are themselves cyber-physical systems..

4.3 The added value for Saubermat AG can, for example, get a better connection to its customers through an app. By controlling via the app, it is also possible for customers to operate the company's products via their smartphone. By using the app and its functions, customers are tied to a closed value chain. This also allows customers to monitor the condition of the equipment and order replacement parts or a new machine when it is worn out. To provide customers with an incentive to continue using their own system, the app can also offer other functions, such as automatic reordering of dishwashing detergent for frequent use.

ANNEX

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Value Creation Process

Self-study module for Digital Coaches

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