Increasing the revenue from service-provision through servitization

Kaltenbach | Gietart

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PREFACE

Dear reader,

In front of you lies my bachelor thesis about "increasing the revenue from service-provision through servitization", written for the bachelor Industrial Engineering and Management at the University of Twente. The research has taken place at Kaltenbach in Hengelo and aims to give a clear overview of what servitization is and how it can be implemented to improve the service-provision and the corresponding revenue.

I want to thank Kaltenbach and my supervisor within the company, Stephan Toxopeüs, for giving me the opportunity to do my bachelor assignment within the company. I also want to thank the employees of Kaltenbach for their support and cooperation during this period, I have learned a lot from you. Special thanks to Rogier Harmelink, my first supervisor at the UT, for the extensive feedback and support throughout the whole period, I enjoyed the discussions about my bachelor thesis. Also, I would like to thank Engin Topan, my second supervisor at the UT, for the time and feedback on this thesis.

I hope you enjoy reading this thesis.

Kai Langeveld

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MANAGEMENT SUMMARY

The company where this research took place is called Kaltenbach, which is in Hengelo. They produce shotblasting machines to process steel, along with the components to transport the steel through these machines and the production facility of the customer. Kaltenbach is a mechanical oriented product-driven company, which means that the focus of the company is on selling products based on a one-time purchase, along with basic services like installation and reactive maintenance. The problem that Kaltenbach encounters, is decrease in revenue from selling spare-parts and other services. The reason for this decrease in revenue is the highly competitive market for manufacturers to be competitive based on prices for spare-parts and service-provision. Through servitization, Kaltenbach wants to find out how the customer can be helped in focusing on their primal processes, by producing tasks to take over from the customers. After creating a problem cluster, the core problem in this research is that the product-driven business model does not focus enough on the customers' needs.

After defining the problems, the current situation analysis of the company showed that Kaltenbach is a product-driven and reactive manufacturer because the main component of the value proposition is receiving payment for the machines based on the transactional business model. This model is about delivering a product once and receiving the payment for it. A way to increase the revenue from spare-parts and service is to look at servitization. To gain knowledge on this, literature research has been conducted on servitization and the organisational and technical factors that enable the shift towards the servitization strategy. This resulted in four stages of maturity of the servitization strategy, from a basic product-driven company to a performance-driven business where all the risks and tasks are taken away from the customer. Kaltenbach is currently in the lowest stage, and in this research a combination of the second and third has been established where Kaltenbach would become a preventive/predictive manufacturer.

After linking this literature research to the current situation, the desired situation was created. The most important changes are the basis of the solution generation. There are some changes Kaltenbach can consider that can enable the increase in revenue by making the business model more customer driven. In this research we produced three solutions that can help Kaltenbach achieve this goal. They are prioritized by using the AHP-method in correspondence with the employees of Kaltenbach, and are as follows:

1. Change of content and structure of service-contracts due to changes in the services that Kaltenbach can provide.
2. Change of the ERP-system and including a CRM-module to increase total insights of the actions within the company.
3. Implementation of data-extracting sensors and a module for including the Internet of Things in the transition to servitization.

To visualize and explain how the service-contracts change and what shifts of responsibility occur, a model using the Business Process Modelling Notation was created. This model shows what processes change within Kaltenbach and at the customer so we can use that to support and underpin the changes within the service-contracts. These solutions and the model contribute to solving the core problem: 'the product-driven business model does not focus enough on the customers' needs.' Customers can be relieved from service-tasks by being notified when there is an error message and the service/maintenance that is provided is better specified and documented. These are therefore ways to include the customer needs into the activities from Kaltenbach, which is enabled by the implementation of servitization.

1. INTRODUCTION

1.1 The company

Kaltenbach is a company that was founded in 1887 in Lörrach, Germany. The company started with manufacturing machine tools and eventually expanded their business to multiple sectors. This assignment takes place at the department that is based in Hengelo. In Hengelo, the department consists of a production facility and an office who have a combined surface of 20.000m^2. Kaltenbach designs and produces all kinds of machines for steel processing, but the machines that are produced in Hengelo, are branded as Gietart. Gietart was an independent company until their bankruptcy in 2009, after which they were acquired by Kaltenbach. The Gietart-brand consists of shotblasting and painting machines for the treatment of steel. The function of the machines is to clean, de-rust, process and paint steel beams or constructions.

There are three machines the factory in Hengelo produces that we highlight, as we use these machines to focus on the processes of the company throughout the complete research. The three machines are called the Eco Blaster 1506 (Figure 1), the High-Speed Blaster 1506 (Figure 2) and the 3D Blaster 3010 (Figure 3). The Eco Blaster is the smallest shotblasting option, the High-Speed Blaster is the middle-sized option and the 3D Blaster is the biggest option from the Gietart-brand. The numbers behind the machine name illustrate the dimension of the machine. The first two numbers denote the width of the machine entrance, whereas the last two numbers denote the number of turbines inside the machine to process the steel. The main differences between these machines are therefore the maximum throughput and the maximum size of constructions that can be processed.

Kaltenbach does not just offer the abovementioned machines, but also complete solutions for processing steel. This means that they want to be responsible for transporting and processing the steel that enters a company until the process is finished. They do this by offering customer-specific solutions and advice on what solutions would work best at the customer. Next to offering these machines, Kaltenbach also offers service and maintenance, which is a significant part of the turnover of the company. An important aspect to keep in mind, is that Kaltenbach also sells spare parts for the machines. This is also considered in the research, as it is a significant part of the service that Kaltenbach provides.

Figure 1 - Eco Blaster 1506 (Kaltenbach, n.d.-b)

Figure 2 - High Speed Blaster 1506 (Kaltenbach, n.d.-b)

Figure 3 - 3D Blaster 3010
(Kaltenbach, n.d.-b)

1.2 Problem identification

In the problem identification, the problems and related causes within the company are established and listed. It shows the problems within the company, which forms the base of this research and is step 1 of the Managerial Problem-Solving Method from Heerkens & van Winden (2017), which is explained in the next subsection. By creating a problem cluster, the problems and causes for these problems are described through logical relations between the problems.

Currently, Kaltenbach is a mechanically oriented product-driven company. This means the company is focussed on selling a product, along with additional services. The company is primarily mechanically oriented, which means almost all the employees are mechanically educated and there are almost no technical employees. In a mechanically oriented product-driven company, the ownership of the product is transferred to the customer and services only provide additional value (Weking et al., 2018). The problem Kaltenbach encounters is that the installed base is decreasing. This can be seen in Appendix A. The main reason for this is the highly competitive and turbulent market for manufacturers. In response to these changing market conditions, manufacturing companies should become more customer-driven and innovative to keep their competitive position (Gebauer et al., 2011). A survey by Schoonis (2017) concluded that 89% of business-to-business customers expect the company to understand their personal needs. In addition to that, 82% of the same business-to-business customers indicate that personalized service is directly connected to their loyalty to the company. Therefore, it is important to comply to these customer needs. A way for Kaltenbach to increase the customer intimacy and loyalty can be achieved by offering more service in addition to solely selling the machines.

This means that this research consists of finding out the opportunities of transitioning the company from a mechanical oriented product-driven business to a business where revenue from selling spare-parts and providing service is generates more revenue. The problem we eventually want to solve is called the action problem, and we describe it as follows:

> ▸ Action problem: The revenue from selling spare-parts and service is decreasing

This action problem is solved when the solution at the end of the research shows that the revenue for selling spare-parts and providing service increases when implemented.

The action problem mentioned above is the affected problem, which implies this problem has some causes. There are multiple causes, which are shown in Figure 4, with the core problem as main causing problem. A solution for this core problem gets us closer to a solution for the action problem, so the focus is on this core problem during this research. To visualize this, a problem cluster has been created in which all the problems leading up to this problem are defined, with the abovementioned action problem in the orange block and the core problem in the blue block. The problem cluster can be found in Figure 4 - Problem cluster. The core problem is therefore defined as:

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The other candidate core problem, which can be found on the left side of Figure 4 is 'Service is seen as an expense.' This is the case because currently, providing service is seen as a required part of selling products, whereas it has much more opportunities. It can become a way to differentiate from competitors and add value to the products. However, the choice is to not solve this problem now, as it is a management problem, which is defined as "issues and obstacles that are beyond a manager's direct control to solve." (Spacey, 2021) This candidate core problem is a management problem because it is about changing the view on certain aspects of the company and therefore not suitable for this research.
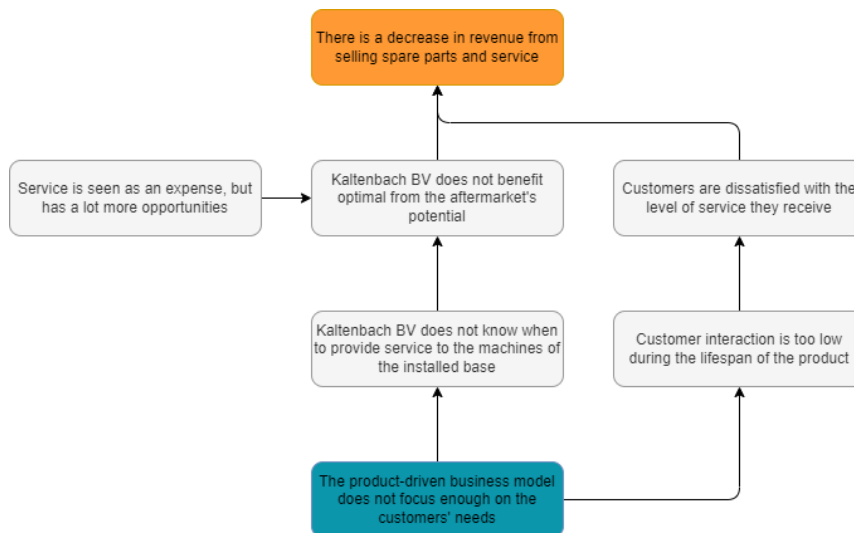
Figure 4 - Problem cluster

1.3 Problem-solving approach

This research is designed according to the Managerial Problem-Solving Method from Heerkens & van Winden (2017). The MPSM is one of the systematic problem-solving approaches and is applicable in various problems in all areas of expertise and is used to solve action problems. When a problem occurs and there is not enough knowledge to proceed to the next step, a research cycle can be used to solve this problem. The seven phases of the MPSM are visualized in Figure 5. These phases are used to form a chronological problem-solving approach.
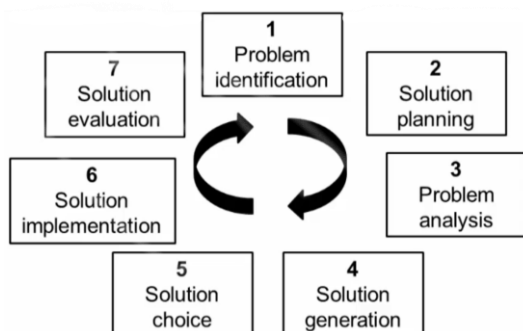
Figure 5 - The Managerial Problem-Solving Method

The first phase is about problem identification, which was already explained already did in 1.2. This means that the problems are clear and the second phase can be initiated, which is about solution planning.

The second phase entails planning what to do to arrive at possible solutions. The rule of thumb from the MPSM is the do-know-choose method, which is about what to do to arrive at solutions, what knowledge is needed to get there and what choices must be made within the research. Firstly, the current situation must be clear to be able to draw conclusions on improvements of the business model. The knowledge to do this is received from research within the company and customers and from research in existing literature. The most important thing to make a choice about, is on what solution has the most impact on the company.

The third phase is the problem-analysis phase. In this phase the information for this research is obtained and the causes of the problem are defined. The information used to perform this research comes from two main sources as stated in the previous paragraph: literature and knowledge from stakeholders. The most important cause for this problem is that Kaltenbach is a company which traditionally focusses more on the product they make than the customer they serve. In addition to this, customers nowadays expect more interaction and participation on the products they buy. Providing real-time information and extensive data-sharing is the rule rather than the exception. Therefore, customers expect interactive and predictive service from companies.

The fourth phase is about the generation of solutions. The information gathered in the previous phases is used to produce solutions for the problem. The two directions that are followed to elaborate on the solutions are the following: defining the components of the current business model and compare this with business models in servitized companies, which results in giving advice on how to change these components. The other direction for a solution is in improving the processes within the company and change the service-provision with small steps to a more servitized business model.

The fifth phase is the phase where the solution is chosen. To choose a solution there is a list of solutions with their corresponding attractiveness based on the criteria we produced in internal discussions. In this phase, the decision on what solution to implement is made. The choice for a solution is based on the results of the research and the authority-based opinion of the decision-maker.

The sixth phase is about implementation of the solutions found in the previous sections. In this phase the solutions will be given a weighted score based on criteria established together with the management and the customers to assess what is the best-scoring solution for Kaltenbach.

The seventh phase is about the evaluation of the solution implementation. As this research will not contain full implementation, this phase will consist of what impact we think the solutions will have on the company when they would have been implemented.

1.4 Conclusion

The company where this research takes place is Kaltenbach from Hengelo. The company offers machines and full steel processing solutions for steel companies. The problem Kaltenbach encounters is that the revenue from providing service and offering spare parts is decreasing. From this, the core problem was derived: 'The product-driven business model does not focus enough on the customers' needs.' The steps we use in this research to solve this problem is the MPSM from Heerkens & van Winden (2017). In this research the MPSM is used from the problem identification, which was done in this section, to an implementation plan for the solution.

2.   CURRENT SITUATION ANALYSIS

This section contains an overview of the current business model, service-provision, processes and systems within the company. The business model canvas shows how and where the value from the company is produced. At the end of the research, when there are possible solutions for the problems, this business model canvas is compared to the business model canvas in the desired situation, which shows how the core of the business changes to solve the problems. Then the customer contacts and the processes and systems that enable how Kaltenbach conducts business are discussed.

2.1 Business Model Canvas

To get to know how the company works, it is important to know how the value is created and what infrastructure is present to create this value. The business model canvas is a way to create this overview and the base version of this canvas can be found in Appendix D. The goal of this business model canvas is to see how Kaltenbach creates value for its customers and what components enable this value proposition. That is why the first group is about the value proposition in Offering, as the business model starts with the creation of value. Then the second group elaborates on the Infrastructure to create and deliver the value proposition. The third group consists of the Customers, which means we find out who the target customers are and how the infrastructure makes sure the value proposition is delivered to them. The fourth and last group is the Finance, which explains the costs and revenue that comes with all the actions mentioned before (Osterwalder, 2004). In Figure 6 this business model canvas can be seen, after which this subsection elaborates on all nine components is reviewed to get a complete overview on the value creation and the components to achieve that.

BUSINESS MODEL CANVAS

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENTS
The sales centres are important for making worldwide sales possible. In places where there are no sales centres, agents are placed who act as intermediaries. The suppliers of raw materials are important for making production in Hengelo possible Companies that perform service and maintenance under the name of Kaltenbach.	Research and development into improving existing components and machines, and developing new components. The production of the machines, which happens mostly at the factory in Hengelo. Providing spare-parts and training on how to use the machine. **KEY RESOURCES** Tangible assets like the production facility, the equipment to make the machines and inventory of parts. Intangible assets like the distribution channels consisting of partners and sales centres and the service-level agreements. Human-based skills like project planning and service-provision.	Machine that is reliable and of highest possible quality to process steel. Multiple types of machines to serve as much potential customers as possible. Complete solutions, so from the moment the steel enters the factory of the customer until the process is finished. Extraordinary adherence to delivery dates and planning of the projects Service-provision like installation, maintenance and spare-parts.	Service-agreements on what spare-parts a customer can buy and what maintenance they want. Personal assistance in deciding the best possible solution per customer. Reliable and trustworthy service-employees for improving customer relationships. **CHANNELS** Contact mostly through email or through phone where there are ambiguities. Two head offices in Lörrach and Hengelo from where sales and service are handled. Website with contact-form to order spare-parts. Word-of-mouth advertising, fairs and sometimes pro-actively reaching out to target customers.	Companies that process steel (structures) for other companies. Kaltenbach is the best option when it comes to shotblasting machines for steel.

COST STRUCTURE	REVENUE STREAM(S)
Manufacturing costs like materials and labour to produce the machines. Fixed production costs like the equipment to produce the machines and rent of the office. Variable production costs like supplies, wages and utility costs.	Transaction revenue model as most of the revenue is generated through a one-time purchase. Service-provision and spare-parts add revenue after the initial transaction Service-revenue was 5% of the total revenue, selling spare-parts contributes with 29% to the total turnover.

Figure 6 – Current business model canvas

2.1.1. VALUE PROPOSITION

The value proposition is what distinguishes the company from its competitors. It is an overall view of the bundles of products and services that represent value for the customers. Therefore, the value proposition shows what Kaltenbach offers, how this adds value for (target) customers and why that distinguishes them from their competitors.

At first, it is important to make clear what Kaltenbach exactly deliver to their customers. The main thing the company offers to customers, is a reliable and qualitatively good machine with which they can process steel. Next to that, the possibility to buy complete solutions creates value for (target) customers. Complete solutions mean that Kaltenbach cooperates with the customers to deliver the complete supply chain, from the moment the steel enters the factory of the customer until the product is finished. This means that Kaltenbach also provides the logistics to get the steel through the supply chain, for example by providing the rollers to transport the steel within the company. Examples are complete systems for the automotive sector, a shot blasting and painting line or a processing line for the bridge building sector. By showing what the possibilities are with the machines Kaltenbach offers, customers get a good overview of what value the machines can offer their company.

Next to having clear what Kaltenbach exactly provides to the customers, the second way to visualize the value proposition is to examine the reasons customers choose for Kaltenbach. This is important to know, because we can use that to improve other parts of the company. One of the most important features that the company offers, is that the machines are of the highest quality possible. This is assured by the high vertical range of manufacture. This means most of the components of the machines are manufactured in their own factory. For example, the welding, cutting and painting of the components happen in Hengelo. This makes them less dependent on external factors and makes sure quality can be monitored very precisely. Next to this, the company states it is very proud on the extraordinary adherence to delivery dates and this is confirmed by the customers (De Boer Staal, personal communication, May 9th 2022). The project planning is taken care of by multiple experts and a lot of focus is on meeting these predetermined deadlines, so the customers get the machines on the predetermined delivery date.

2.1.2. KEY PARTNERS

This subsection introduces the key partners of Kaltenbach. This group consists of the key partners and suppliers, what they contribute to the company and what the differences are between activities that are done by partners and what Kaltenbach does themselves. We divide this subsection into two parts: the distribution in other countries and the suppliers of Kaltenbach.

The sales and distribution in other countries take place in two different ways. In a lot of countries and regions, there is a sales centre. Here there are sales executives responsible for the sales. For regions where there is no sales centre, there are agents who function as intermediaries. They get a commission for delivering customers to Kaltenbach, but Kaltenbach is still the sales actor. As the main offices are in Germany and the Netherlands, these two groups are vital for the contact and sales to other parts of the world.

Next to the partners mentioned above, Kaltenbach also relies on suppliers. There are different kind of suppliers for Kaltenbach. There are suppliers who deliver all the parts and components to produce the machines and to realize the solutions, but also companies who perform the service under Kaltenbach's name. There are all kinds of contracts with these companies on how Kaltenbach expects them to perform and deliver their goods and/or services to the customer, so Kaltenbach can make promises in that regard to their customers.

2.1.3. KEY ACTIVITIES

Next to the key partners, it is important to know the key activities that make up the value proposition and revenue streams, which is why they are elaborated on in this subsection.

For a mechanical oriented and product-driven company like Kaltenbach, one of the main activities takes place in the research & development department. Like stated before in 1.2, a product-driven company focusses on designing and producing the best possible product, but most of the time without taking specific customer needs into account. Kaltenbach does take customer wishes into account when providing the full solutions for a supply chain, but they still consist of established and unchangeable machines. This is one of the reasons the R&D-department is particularly important, because they are the ones that create new (parts of) machines and they are improving existing products. Another key activity for Kaltenbach is the service-provision. It mostly consists of maintenance and selling spare-parts, but installation of the machines and training on how to operate the machines are also part of the service-provision from Kaltenbach. These activities are therefore seen as additional revenue and to support the sales and use of the machines (Huikkola & Kohtamäki, 2018).

An example of an activity that adds value to Kaltenbach, is the fact that as many tasks as possible are done in their own factory. Most of the activities that need to happen for creating the machines happen at the factory in Hengelo. In this factory, the separate parts that make up the machine are welded and screwed together according to the wishes of the customers. There is also room for painting the machines and preparing the machines for shipment. Kaltenbach therefore only relies on the delivery of the delivery of parts to realize the full products, which ensures their strong competitive position.

Next to making the complete machine in their own factory, Kaltenbach also holds the inventory of the spare-parts themselves. However, because there is no CRM-system and the inventory to produce the machines is the same as for the maintenance department, there can be misunderstandings on how much products and parts are available in the inventory. It can therefore happen that production and service both need the same part, which could lead to delayal in producing the machine or performing maintenance.

2.1.4. KEY RESOURCES

To create value and generate revenue, a company uses resources. In the business model canvas, these are called the key resources. Kaltenbach generates its value proposition through these resources, which makes them the input for the value-creation. To show what the key resources are for Kaltenbach, they are divided into three groups: tangible assets, intangible assets and people-based skills (Osterwalder, 2004).

The tangible assets consist of the resources that are physical and therefore represent a certain value, like the buildings and the equipment to make the machines. The production facilities are therefore also tangible assets. Another important part of the tangible assets of Kaltenbach is the inventory of spare-parts that are present at the company.

The intangible assets entail non-physical assets like patents and goodwill that creates value for the company. Because they are intangible, they are harder to give a numerical value. For Kaltenbach this consists of the distribution channels, where the dealers and partners of the company represent a significant amount of value because of their actions in various parts of the world to sell the machines there. The installed base and the existing service agreements with the customers from the installed base are also intangible assets because they add value to the company, but they are not physical assets.

Next to the tangible and intangible assets, people-based skills are indispensable for Kaltenbach. These skills include for example the expertise of planning the projects, because this is something of market-leading quality. The knowledge within the company to help customers construct the solutions they need for processing steel is seen as a convincing reason to choose for Kaltenbach when looking at machines to process steel (Van der Most, personal communication, May 6th 2022). Next to this, the field personnel have skills that add value to the company because they know how to offer service and do maintenance on the machines, which is important to keep the machines in operation (Huikkola & Kohtamäki, 2018).

2.1.5. CUSTOMER RELATIONSHIPS

The next component of this canvas is about the relationships the company has with its customers. Profits can be achieved through the acquisition of new customers, improving the profitability of existing customers and the extension of duration and quality of existing relationships. Every customer should be addressed differently based on their wishes and the costs for maintaining relationships should be examined. The components discussed in this subsection are about the connection between Kaltenbach and its customers.

Firstly, it is important to specify how Kaltenbach has contact with their customers. The contact with the customers is quite personal. As stated before, Kaltenbach offers solutions instead of just single products, so the contact with the customers must be extensive and personal. Some projects might look the same, but because of slight differences in wishes and possibilities, every project is different. This explains why it is important that Kaltenbach offers personalized mechanisms to have contact with customers. The service-employees know all the customers and the customers know them, which has provided relationships based on knowledge and trust.

Secondly, the customers are positive about the contact with the company (Van der Most, personal communication, May 6th 2022), but there is something missing that would improve customer relationships a lot: a CRM-system. Currently, customer data and information are not stored in a proper module within the company. An example is that for the customer data on the purchasing of spare-parts and service the company uses Excel, which is not optimal for the kind of relationships Kaltenbach should maintain.

2.1.6. CUSTOMER SEGMENTS

This subsection elaborates on the type of customers Kaltenbach wants to reach, also called the target customers. It is important to know who the target customers are and why they choose for Kaltenbach or should choose for Kaltenbach when looking for the types of machines Kaltenbach offers.

This subsection starts with defining the target customers of Kaltenbach. As the machines from Kaltenbach are for processing steel and steel constructions, the customers are companies that process steel for other companies. The installed base therefore consists of companies that process and sell steel plates, hollows and beams. The service Kaltenbach provides is for the customers from the installed base. Examples of customers from Kaltenbach are Stahlbau Fasshauer, who bought their first machine from Kaltenbach already back in 1974, Tata Steel and Snijcon. These are all big companies that are very satisfied with the machines and service from Kaltenbach. This shows that customers who have already chosen for Kaltenbach, are very loyal to the company and that is mostly because of the quality of the machines and the effort the company puts into maintaining customers.

Next to addressing who the target customers are, it is important to know why customers choose for Kaltenbach. In an interview with customers (Van der Most, personal communication, May 6th 2022) (Douma Staal, personal communication, May 11th 2022), it came forward that they chose for the machines of Kaltenbach because of one main reason: Kaltenbach is the best option when it comes to expertise on shotblasting machines. These customers also chose to use the service that Kaltenbach provides because of two main reasons: the steady relationship with Kaltenbach and because they bought the machine from Kaltenbach, so they expect the service to be the best by the supplier of the machine.

2.1.7. CHANNELS

This subsection discusses the channels through which Kaltenbach reaches their customers. These channels are the connection between the value proposition and the target customers, described in 2.1.1 and 2.1.6 respectively. The channels are the ways to deliver the created value to the target customers.

Kaltenbach reaches its customers through the two head offices of Kaltenbach in Lörrach (Germany) and Hengelo (The Netherlands). Next to these head offices there are contact-persons and departments on almost all continents and agents on places where it is not efficient enough to have a department. These two groups are divided in direct and indirect channels. The direct channels consist of the sales force and the website offering products, from which the customers can contact the company through email or phone to make an order or get more information. On the other hand, there are the indirect channels. The indirect

channels consist of the intermediaries and brokers who help to sell the products at the places where there are no salespersons from Kaltenbach.

Secondly, there are multiple ways to contact Kaltenbach for buying a machine or requesting service-provision. On the Kaltenbach (n.d.-a) website companies can fill in a form with their name, machine-type and what spare-part or type of service they need. However, most of the customers choose to have direct contact with Kaltenbach. This means they reach out through email or telephone. The customers specified in the interviews that the main ways in which they contact the company is through email or phone/WhatsApp (De Boer Staal, personal communication, May 9th 2022) (Douma Staal, personal communication, May 11th 2022).

Next to these direct and indirect channels, there are some other ways to contact customers. This is for example by going to fairs for the steel industry and display the machines there. An example is the Biehm fair in Bilbao, where a machine from Kaltenbach was displayed at the stand of a partner in Spain. Word-of-mouth advertising also contributes a lot to attracting new customers, as the market Kaltenbach operates in relies a lot on trust and imago. Sometimes Kaltenbach proactively reaches out to customers to offer the machines, and at last, customers can of course also find Kaltenbach by finding them on the internet.

2.1.8. COST STRUCTURE

To get a complete overview of the business model, it is important to know what the costs of the company are and where these costs come from. The most important costs that Kaltenbach has are elaborated on in this subsection.

As a mechanical oriented product-driven company, the costs for Kaltenbach can be divided into two groups: the production costs and the manufacturing costs. The difference between these two cost groups can be described as follows: "Production costs reflect all of the expenses associated with a company conducting its business while manufacturing costs represent only the expenses necessary to make the product." (Beers & Drury, 2021) The manufacturing costs for Kaltenbach consist of the direct costs for materials and labour to produce the machine. For delivering services, also the effort of implementing the service and any direct labour costs count as manufacturing costs for Kaltenbach. Next to the manufacturing costs, there are the production costs are divided into two categories, the fixed and the variable costs.

Fixed costs are the costs that stay the same with every output, so the fixed costs do not change when the quantity of output has increased or decreased. On the other hand, the variable costs are the costs that depend on the output of the product, which means the total variable costs only increase when the quantity of the output increases and vice versa. When the output increases, the total cost per product decreases, because the fixed costs can be spread over more products.

The fixed costs for Kaltenbach are for example the machines Kaltenbach uses to produce their solutions. The depreciation costs for these machines are also fixed costs because the machines that produce the solutions depreciate over time. Next to that, costs for the office like rent and interest payments on loans are also fixed costs, as these do not change when the output increases or decreases.

The variable costs consist for example of the supplies, the wages and the utility costs. The supplies consist of materials used to make Kaltenbach's solutions, which must increase when output increases. The wages are defined as the hourly pay for employees, which makes them variable costs as more hours are worked when the output increases. The costs for utility are variable, because more energy, electricity and gas are used when the output increases.

2.1.9. REVENUE STREAMS

The revenue streams explain the last part of the business model canvas. Revenue is vital to keep a company going, because to make profit, the revenue must exceed the costs. Therefore, the revenue model the contribution of all the revenue streams to the total are explained.

To see what revenue streams enter the company, it is important to know what type of revenue model Kaltenbach uses. The biggest part of the revenue is generated through one-time purchases. The customer orders the product or full solution and pays for the machine to become the owner of the product. This is called the transaction revenue model, which is defined by transactions conducted by users, for which they get the product in return (Enders et al., 2008). A crucial factor of this revenue model is customer trust, which must ensure that customers are satisfied with the product and want to come back after one purchase. Coming back after the purchase also includes purchasing service and spare parts from Kaltenbach. Customers have stated in the interviews (De Boer Staal, personal communication, May 9th 2022) (Van der Most, personal communication, May 6th 2022) that they come back to Kaltenbach for the service-provision because no other company has the same expertise on the machines. The customers that we interviewed rated their service experiences with an 8 on a scale to 10.

For this research, there is a division between the turnover from service and spare parts. There is also a division between the turnover for service and spare-parts made from the Gietart-brand and the complete product-line from Kaltenbach. All the numbers mentioned below can be found in Appendix C. The service-turnover in Hengelo is around 5% of the total turnover, where-as the service-turnover of Kaltenbach is around 7% of the total turnover. Next to the turnover from service, the calculation of the turnover from selling spare-parts shows a different image. For the Gietart-brand, the spare-part sales contribute 29% to the total revenue, whereas the spare-parts sales only contribute for 18% to the total revenue of Kaltenbach. Adding these numbers to the percentages on service-turnover, gives us respectively 34% contribution in Hengelo and 25% contribution at Kaltenbach. This means that 66% of the revenue in Hengelo comes from the purchasing of the machine.

One thing that is not considered in the percentages above, is the share of customers that has a machine from Kaltenbach but does not buy service and/or spare parts directly at Kaltenbach. Some parts are universal, which is a reason for customers to look at the cheapest option possible. The turnover calculated in the paragraph above, therefore only consists of hours that are registered in Hengelo.

2.2 Processes and systems within the company

The business model canvas in the previous subsection gives an overview on the activities Kaltenbach distinguishes, what value these activities create and what infrastructure is available to deliver this value to the customers. However, all these components must be supported by systems within the company. As a company that sells full solutions to customers, it is important to professionally document, maintain and follow-up the processes within the company. In this subsection the focus is therefore on what systems and processes are needed to deliver the value to the customers. One of the systems within the company is the ERP-system. An ERP-system (Enterprise Resource Planning) "consists of technologies and systems companies use to manage and integrate their core business processes." (Investopedia, 2021)

This subsection starts with the process from drawing all the components to ordering the components needed to produce the machines. At the projects-department, the drawings for the new projects are made in the digital drawing program Creo. In this program, the drawers can adjust the machines to the wishes of the customer, for example on the dimensions and number of turbines in the machine. In Creo, the drawers must add data on every part they add, so it can be processed in the ERP-system more easily. This data consists of the elements of the part like weight, material type and whether Kaltenbach must buy the component or the component can be made in their own factory. As almost all components are already available in the drawing program, this information is copied to avoid mistakes when filling in this data. When this has been completed, the drawing goes to the production preparer. This production preparer checks the drawing and separates the parts that must be bought at suppliers and what products are made in Kaltenbach's factory. This is done as fast as possible after the drawing is done, so the components that must be bought at suppliers are ordered immediately. When all components have been checked, the components that come from Kaltenbach's factory are sent there and the components that must be bought are sent to the purchaser in separate invoices. The purchaser then manually orders these components

after looking at how much stock there is, while taking the different prices at all the suppliers into account. The ordering of all the products is aligned with the proposed delivery date to the customer, so the components are available at exactly the right times. This is all monitored and taken care of in the ERP-system Baan.

The process of going from technical drawings to ordering the components needed to realize these drawings, is enabled by systems within the company. The most important systems within the company, are Creo, the program for the technical drawings, and the ERP-system called Baan. In Creo, all the drawings of the full solutions are made. As Kaltenbach designs the solutions according to the wishes of the customers, all drawings are made up of the same components, but all solutions are different. During the making of these drawings, the drawers check and discuss the feasibility of the proposed solution with the service department and the production facility. When the drawing has been approved, the production preparer converts the drawing to the ERP-system Baan.

Baan is an ERP-system which connects the departments and all the data between these departments. In Baan the projects, finance and planning are combined and when one employee adds data to the system, this is immediately visible for the complete company. The components in Baan are the projects that Kaltenbach is working on, the tools that are necessary for these projects like planning and the components of the machines and the finance around these projects. Currently, the service and spare-parts department upload the orders for service-provision and spare-parts manually into Baan. The number of components in an order can vary, but most of the time it consists of a lot of components, which is why this is a process that takes up a lot of time.

Currently, Kaltenbach does not have a specific CRM-module. A CRM-module is a system companies can use to "record, report and analyse interactions between the company and its users." (Salesforce EMEA, n.d.) Without a dedicated system like that, there is no overview on what happens at the customers. Responding to personal wishes and needs from the customers is also harder without a module like that because there is no complete overview on customer data. Data on which (service)components are purchased more than others is not available, which makes the customer contact part of the company hard to document. Purchasing patterns are difficult to recognize, with not enough customer interaction and involvement as a result. In the next subsection, we elaborate on how the customers are contacted and what the components of the current service-provision are.

In terms of spare-parts, Kaltenbach distinguishes them based on how often they need replacement. These are called the wear-parts, the spare-parts and the usables. The wear-parts are the parts that get replaced most often, because they are the parts that wear out faster than the spare-parts. Wear-parts are for example the plates inside the machine, because the grit from shotblasting the steel hits this when processing the steel or the brushes to clean the steel. The spare-parts are the parts of the machine that last longer, for example screws and bolts and parts on the outside of the machine. The usables are the resources used in the process, like the grit to shotblast the steel or the paint for the painting system. The usables are therefore resources that need replacement on a regular basis, as the machine can run out of paint and the grit can become too small to still be useful.

2.3 Contact and service-provision

After defining the current business model canvas and the systems that support the business model, this subsection elaborates on the contact with the customer and the current service-provision. This also includes how the company has contact with its customers. This is derived from 2.1.7, which shows that customer contact is mostly through email. It can also be through phone, for example when there are ambiguities in ordering spare-parts or deciding what service should be delivered. All customer contacts are documented in Excel, which could be inconvenient and is easily sensitive to errors.

The first part of service-provision that takes place, is the phase where the personalized solution for the customer is designed. As the customer can choose the machines they want to add to their solution,

Kaltenbach already provides a service before selling the product. When the product has been designed, the delivery takes place. When the machine or solution has been delivered to the customer, mechanics from Kaltenbach install the machine at the customer. Because the machines are complex, the customer's mechanics and operators need knowledge to work with the machine. This is offered through Kaltenbach in the form of a training. This training is also a form of service and it is included in the installation. The content of this training is to explain how to perform small service activities when the machines are being installed, because then the customer can see what the machine looks like and how it is constructed. The training for the employees that are going to work with the machines, starts immediately after the machine is installed, along with manuals on how to operate the machine.

Next to designing the machine with the customer, selling spare-parts and performing maintenance are the main components of the service that Kaltenbach offers. The company has spare-parts in inventory which can be shipped to the customers on request. To make sure Kaltenbach has enough stock, there is an inventory module implemented in Baan, which makes a list of what spare-parts must be ordered to ensure the safety stock. Baan produces a list of spare-parts that must be produced in the factory or ordered externally, after which the production preparer orders these spare-parts for the best price available. The safety stock Kaltenbach wants to manage depends on the combination of the demand, the inventory turnover ratio and the delivery time. The service-employees look at the average demand for a spare-part and combine that with the delivery time, to make sure that there is enough safety stock for the demand for that spare-part. For a lot of small spare-parts it is the case that customers have safety stock themselves, which means that when parts of the machine wear out unexpected, customers often own safety stock themselves. (Douma Staal, personal communication, May 11th 2022)

There are a few contact moments in the first year the customer has the machine in its possession. Immediately after the installation of the machine, Kaltenbach introduces its services to the customer, to let them know that every part of the after-sale activities can be bought directly from Kaltenbach. At this time, a starter kit with spare parts that wear out the fastest is offered. There are starter kits for all the types of machines, which have a fixed price. However, the price of buying spare-parts as part of the starter kit is more expensive than buying the spare-parts separately (Zerrou, 2022). When looking at the prices for a starter kit for the Eco Blaster 1504, the price of the full starter kit is 30% more expensive than when all the spare-parts in that starter kit are bought separately.

The next moment of contact is after around 4 months, when approximately 1700 hours of operation have taken place. A service-mechanic from Kaltenbach then visits the customer to evaluate whether the customer is satisfied about the machine and what is necessary to keep the customer satisfied or improve the relationship in terms of service and training on the machine. This is then also registered in the Excel-file on customer contacts. The third contact moment is after a year, when it is likely that the machine needs maintenance. During this visit, the customer is offered a service contract because then it is known how the customer uses the machine and what kind of services and spare parts are necessary at that specific customer. If that service offer is accepted, an inspection visit is planned every year. The process of this service-offer is visualized in Figure 7. Based on the information above and the reactions on the question in the interview about how the customers have contact with Kaltenbach, the company operates a reactive strategy in terms of services, whereas the first months are very pro-active.
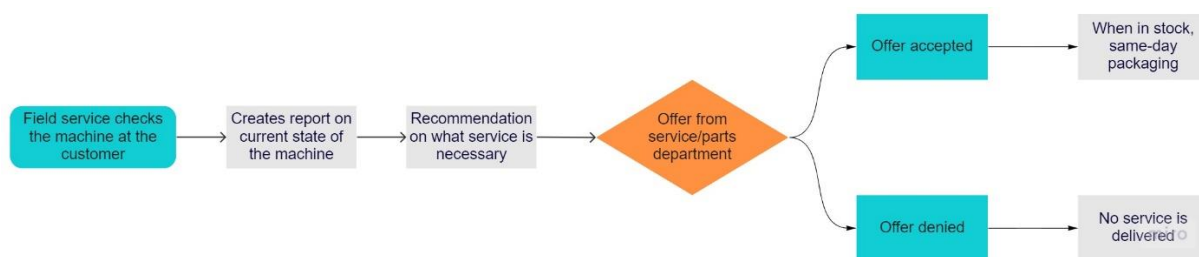

Figure 7 - Process of service-request

2.4 Customer input

To gain input on customer experience and expectations, we held four interviews with customers. These customers were selected by looking at how much they spent on service and parts in 2021. The customer pyramid which can be found in Appendix E was created with the pareto-effect rule, which states that 80% of the revenue is generated by 20% of the customers. The customers we interviewed were Douma Staal (top customer), De Boer Staal (big customer), Staalbouw Van Der Most (medium-sized customer) and Thyssenkrupp Materials (medium-sized customer). The interviews were held by calling them and using the semi-structured interviewing technique. To obtain more reactions, the same questions from the interviews were put into a questionnaire, which was then sent to almost all customers in the Netherlands that had a machine of Kaltenbach. In this section the interviews with customers are used to gain insight in their experiences and wishes on service and spare-parts sales. The subsections therefore consist of the customer experience on service, how the customers contact the company and what types of service they expect.

2.4.1. CUSTOMER EXPERIENCE

This subsection is about examining what the customers think of the service-provision from Kaltenbach and what they want or expect from the company. This is vital to find out, because to improve the service-provision, the input from the customers is important. Some things from the current situation should be preserved, while changes must be made to become a more servitized company.

In general, the customers are very satisfied with the service from Kaltenbach. From the interviews the most important reasons that customers choose for Kaltenbach can be derived: the quality of the machine and the corresponding service. The interviews showed that the customers are satisfied with the basic services now, primarily because the machines are very reliable and the expertise of the employees are reasons to staying a customer at Kaltenbach. It is nevertheless interesting that customers order some basic spare-parts at other companies, even though they are mostly standard parts like screws or bolts. The reason they are bought somewhere else is because those spare parts are the same everywhere and price and delivery time are sometimes better at other companies (Douma Staal, personal communication, May 11th 2022). On the other hand, there are also customers that order all spare-parts and services at Kaltenbach, because the employees from Kaltenbach know their own machines best and can therefore be of great use in deciding what spare-parts must be bought or what service must be conducted (Van der Most, personal communication, May 6th 2022).

The contact with the customers happens mostly through email, but when something is unclear there is the possibility to call the service-department. Through telephone the service-employees can explain what the customer needs, which is an asset of the company (De Boer Staal, personal communication, May 9th 2022). The relationship Kaltenbach has with its customers is a long-term relationship. The machines have a long lifetime and service-provision happens mostly through Kaltenbach, so communication is important. The customers know the service-department and therefore trust them with the maintenance of their machines (De Boer Staal, personal communication, May 9th 2022).

2.4.2. CUSTOMER CONTACT

In a mechanical oriented and product-driven company like Kaltenbach, there is contact with customers, but it can be organised better. When implementing servitization in the business, this will only become increasingly important. Therefore, in this subsection certain ways to be more in contact with customers and cooperate more instead of the traditional business-to-customer relationship are elaborated.

As discussed in Section 2, the Current situation analysis, the contact Kaltenbach has with its customers goes through email or telephone, which is something the customers are satisfied with. However, there might be other ways to contact the customers. One way is to produce a webshop for the spare-parts, as making this process automated can save time in some departments and make ordering easier for the

customer. We examined the use of a webshop or customer portal for ordering spare-parts and requesting service, but this is not seen as an upgrade/improvement (De Boer Staal, personal communication, May 9th 2022). The customers state that with the complexity of the machines from Kaltenbach, it is much more convenient to have real-time contact with the employees who have the most knowledge about the machines. Therefore, the improvements for the contact with the customer should be made in improving and documenting the customer relationships, as customers tend to be more loyal to the company when their personal needs are considered.

2.5 Collection of data

To follow up on the service-provision and conclude this section, the collection of data and what is done with it to improve the sales and service within the company are explained. We do this by looking at what data is collected from the customers and to what extend data is collected from the machines and what happens with it. This is therefore linked to the previous subsections, as the focus is on (the storage of) data about the customer contacts and the systems that process this data.

Kaltenbach recently delivered two machines to customers from which data is tracked and sent to the company, but these are the first tests that are conducted with this software. The module the Kaltenbach uses for these tests, is from Docksters.IO, who are specialized in IoT monitoring. For the machines Kaltenbach produces, they provide sensors which can measure the temperature or the motions within the machine, which can be helpful for Kaltenbach and its customers. Kaltenbach analyses this data to see what aspects they can use. In the future, when these tests turn out to be successful, the data can for example be used to forecast failures within the machine or do preventive maintenance when the data shows some parts are about to break down. But as stated before, this is still in the testing phase and therefore not widely available for customers. The tracking of the machines is also seen as an opportunity by one of the customers, who stated that "There is no possibility yet to remotely check the machine, this would be very helpful and the techniques are already available." (Thyssenkrupp Materials, personal communication, May 6th 2022)

2.6 Conclusion

This section contains the current situation analysis on the business model, contact with customers and processes within the company. Kaltenbach's business model is a product-driven business model, which means they focus on selling the products they make based on a transactional model, where Kaltenbach delivers the machine and receives the money for it immediately. Additional services are offered and can be acquired separately. The contact with the customers is through email or telephone, through which customers are updated on upcoming maintenance appointments or other issues. Important systems within the company are the ERP-system called BaaN and the drawing program Creo. An important process is about how a service-request takes place, which showed that a report is made up whether the machine needs maintenance, after which the company can agree or deny the offer and the maintenance takes place or is postponed.

3.   THEORETICAL FRAMEWORK

Now that the problems and the current situation are discussed, theory must be added to this research to gain knowledge for solving the problems. Therefore, knowledge questions have been added to obtain this knowledge. These problems are about the differences in the business model between a product-driven and customer-driven company, what the organisational factors are that Kaltenbach should consider, what different levels of servitization there are and how the Internet of Things is connected to implementing servitization.

3.1 What does the business model of a servitized company look like?

To know how to change the business model of Kaltenbach, it is important to do research on how business models of servitized companies look like. Therefore, in this subsection this question by looking at companies who already introduced servitization and see what various kinds of offering service there are.

One way to elaborate on a more service-oriented business model, is through a product-service system (PSS). A product-service system is defined as: "a system that integrates products and services in order to create a competitive solution." (Basirati et al., 2019) This means that a PSS is seen as an output of servitization: a package of products and services that deliver value to customers and stakeholders. Next to this definition, Basirati et al. (2019) also introduce three different PSS types where they include how value is created, delivered and captured within each PSS. The three PSS types and their characteristics can be found in Table 1 below. When looking at these definitions, it can be concluded that Kaltenbach is a mechanical oriented product-driven company.

	Product-driven	Use-driven	Result-driven
Value creation	The manufacturer is responsible for the contracted services	The manufacturer is responsible for the usability of the product and the service	The manufacturer is responsible for delivering output for the customer
Value delivery	The manufacturer is responsible for the sale and service of the product, for example maintenance and recycling at end of life	The manufacturer is responsible for the highest uptime possible for the physical machine, along with service	The manufacturer is the one delivering the output for the customer
Value capturing	The customer pays for the full product and for service and maintenance during the lifetime of the product	The customer pays a periodic fee to use the product but is not the physical owner of the product	The customer pays for the output of the machine and that is what they pay for

Table 1 - PSS Types (Reim et al., 2015)

So, Table 1 shows that in the business model of a product-driven company the revenue comes from one-time purchase and separate service-requests. The change from a product-driven company to a result-driven company involves an enormous shift in the use of technology and leads to radical changes in the PSS. This change might very well be too extensive to achieve without becoming a use-driven company as an intermediate step. This is called "incremental innovation, which means that the product-driven PSS slowly evolves into a use-driven PSS and eventually further into a result-driven PSS." (Basirati et al., 2019) To explain what the business model of a servitized company looks like, there are four different business

models, from product-driven to performance-driven. These are the following four (Huikkola & Kohtamäki, 2018):

- › The first business model, the product-driven business model, is about manufacturing, selling and delivering a product and offering additional services/maintenance. The service-provision consists of maintenance, repairs and spare-parts. An advantage of this business model is that it is less complicated than other business models. On the other hand, a disadvantage is that there is no opportunity to really differentiate on something else than price.
- › The second business model, the service-agreement business model, focusses on service agreements. This business model includes services to improve the productivity of the machine and decrease the total cost of ownership for the customer. The services delivered improve the product availability, reliability and focus on maximum uptime of the machine. An advantage of this business model is that the revenue is very predictable and stable because of the services that are needed on a known periodic basis. The value proposition can be found in the availability and reliability of the uptime of the machine.
- › The third business model is the process-driven business model. This business model is based on subscriptions to use the product instead of owning the full product. It is therefore most suitable for customers who look to outsource (parts of) their production. An advantage for the manufacturer is the improved utilization rate of the production. Disadvantages for the customers can be that they lose control over the product and they are not able to see all the different costs anymore, so the business model requires a lot of trust from both parties.
- › The fourth and last business model is the performance-driven business model. This business model consists of integrated solutions and consulting services. Therefore, the manufacturer must be careful and acquire other competencies because they are entering the market of the customer. The biggest advantage of this business model is that it is the most differentiated from competitors. It is the most integrative business model of all four.

3.2 What organisational factors are important for implementing servitization at an OEM?

This subsection elaborates on the organisational factors that are important to keep in mind when implementing servitization. It consists of indicators that are important throughout implementing the servitization strategy, what the drivers are for implementing servitization and a case study on Hitachi Limited, who have implemented servitization throughout their company.

3.2.1. INDICATORS FOR IMPLEMENTING SERVITIZATION

In this subsection the five different indicators from Ahamed et al. (2012) are elaborated to examine the influence of organisational factors on implementing servitization. These five indicators are:

- › Vision and strategy: For the vision and strategy behind implementing servitization, it is important to make clear in what the direction the company must change, as a strong vision and strategy is vital a successful transition from a product-driven to a customer-driven company.
- › Leadership: The leadership indicator shows how the strategy is implemented from the top and how the new culture of servitization is developed within the company. For example, giving employees more freedom in exploring the changes instead of having strict leadership has a higher success rate.
- › Organization: The third indicator is about the organization of implementing servitization, which for example consists of the time-planning of the implementation and bundling possible sellable units and the infrastructure to deliver this.
- › Human resources: The human resource indicator gives information about hiring new people or enable current employees to learn the skills required for implementing servitization, as employees are important for successfully implementing the new strategy.

> Sales and marketing: the fifth and last indicator, sales and marketing, is about how these departments change when the company shifts from selling products to selling services.

3.2.2. ORGANISATIONAL DRIVERS FOR SERVITIZING A COMPANY

Next to these five indicators, there are five drivers that can convince companies to servitize their business (Ahamed et al., 2012). The drivers and how they influence the company on making the decision to implement servitization are as follows:

> Financial: The financial benefits lay in the fact that "service retain potentially higher margins than products and generate substantial revenue from an installed base of products with a long lifecycle." (Ahamed et al., 2012)
> Strategic: In terms of strategic advantages, implementing more kinds of service helps differentiate the company from its competitors which makes it more difficult to imitate the service-provision.
> Economic: The economic pressure comes from the fact that "the de-industrialization and increasing international division of labour between manufacturing and services led to the declining shares of manufacturing in developed economies." (Ahamed et al., 2012)
> Marketing: For the marketing opportunities it is important to realize servitization as the service component of a machine has great influence on the decision to buy the product and to come back for more/other machines.
> Environments. Servitizing a business also improves the environment, with the use of resources happening in a more responsible manner.

3.2.3. CASE STUDY AT HITACHI LIMITED

To see how these drivers and indicators are worked out in practise, a case study performed by Ahamed et al. (2012) has been studied. In this case study the indicators from are evaluated at Hitachi Limited in Japan, from which important information can be obtained on how the indicators were considered in a practical example of implementing servitization. The indicators at Hitachi Limited are defined as follows:

> The first indicator is vision and strategy. In the shift towards servitization the company produced a clear strategy, which was: "To maximize the profit margin through operation and maintenance services rather than focusing on producing goods and just sell it." (Ahamed et al., 2012) By defining this strategy, the services become a significant part of the company.
> The second indicator is leadership. It is important to have a CEO who has a clear vision on the importance of servitization. The most important part of leadership, however, was making sure all the departments within the company were able to work together and were motivated to implement this new strategy.
> The third indicator is organization. An important aspect of organising the implementation the servitization strategy, is to assign people to certain tasks. For instance, making packages of services and having the IT department run smoothly. Next to that, during the transition phase from a product-driven to a customer-driven company, the implementation of servitization requires a significant financial investment. This is because the company goes from one-time sales to other types of contracts with more characteristics of a subscription.
> The fourth indicator is human resources. The organization must motivate people to be part of the change within the company and acquire new people for the service dimension. Next to that, Hitachi Limited produced a combination of promoting employees and expertise from the outside to get the best outcome. Also, a special training program was started to improve important qualities, like communication and collaboration, for existing employees.
> The fifth and last indicator is about sales and marketing. A strong marketing department is the key for creating value and respond to changes in demand. Hitachi Limited "created a special section of 'service promotion' in the period of transition from manufacturing service provision. The mission of this section is to maintain two activities mainly; packaging, and marketing from solution-oriented viewpoint." (Ahamed et al., 2012)

3.3 What are the different stages of servitization?

To understand what different types of service-provision Kaltenbach can offer to its customers, it is important to distinguish the different levels of servitization. Along the way to delivering products as services, manufacturers can enter different stages of maturity. Adrodegari & Saccani (2020) describe a maturity model as: "representing theories about how organizations evolve in a stage-by-stage manner along an anticipated, desired or logical path." In this subsection two different approaches describe a maturity model for servitization, after which the combination between these models and the business model canvas concludes this subsection.

3.3.1. SERVITIZATION MATURITY MODEL (SEMM)

The levels that can be distinguished from the servitization maturity model, according to Syncron (n.d.), are a bit different then the levels Adrodegari & Saccani (2020) distinguish. The levels as distinguished by Syncron are as follows: reactive, preventive, predictive and proactive.

A reactive manufacturer already provides some services, but it has not much to do with servitization. The services a classical manufacturer provides consist of installation and providing warranty. Next to that, spare parts are delivered on request and there is a helpdesk for support. The customer operates the machine and repairs are made after the machine has already broken down.

When becoming a preventive manufacturer, the focus shifts from reactive services to preventive service-provision. In addition to the installation of the machines, guidance is offered for setting up the machines in the most optimal way. The strategy focusses more on avoiding problems in regular maintenance rather than waiting until problems occur. Downtime still exists, but unplanned downtime is reduced to a minimum. When the machine has reached the end of its lifecycle, the manufacturer helps with/is responsible for taking the machine out of operation.

For a predictive manufacturer, the focus shifts from the products to usage. The risk for the product is now moved from the customer to the manufacturer. Manufacturers optimize for minimum contractual risk and maximum understanding of product usage. The manufacturer is connected to the product in the field, which gives understanding on how the customer uses the product. So, through this the company can implement predictive maintenance, performance measurement, data analysis and benchmarking, which generated valuable insights for the customer.

As a proactive manufacturer, the manufacturer is fully connected to the machine through IoT-enabled parts, which sends all the necessary information from the machine to the manufacturer. In the proactive stage, manufacturers sell an outcome. Customers pay for a specific outcome, and it is the manufacturer's responsibility to deliver the products they need to realize that outcome. In this stage, manufacturers optimize for total delivery cost, as they are responsible for producing the products and services to meet a designated outcome.

3.3.2. INTEGRATION BUSINESS MODEL CANVAS AND SEMM

In this subsection the maturity model is connected to the business model canvas. Next to the four stages from the previous subsection, Adrodegari & Saccani (2020) identify five relevant maturity dimensions. These maturity dimensions evaluate the company on its readiness for implementing the four levels as described in the previous subsection. These dimensions are organisational approach, process management, performance management, tools and capabilities. These five dimensions are used to show the critical requirements and their maturity to achieve servitization per component from the business model canvas. They can be found in Appendix B, but the most important findings from this table are in the list below:

> The first dimension is the organisational approach. This is about the company's point of view on certain aspects and the mind-set of the people within the company. There must be an approach on how the

company wants to become more customer-driven and how the service in the field will be taken care of.

> The second dimension is process management. For the process management dimension, the requirements consist of procedures and practises to manage the process and to develop new products, services, business agreements and ways to evaluate the costs and revenue.

> The third maturity dimension is performance management, which entails the sensors and methods to measure and evaluate the supply chain and for example the state of the product in each stage of life.

> The fourth dimension is about the tools. This consists of requirements that enable the implementation of servitization. Examples are the IoT-systems that support automatization and developments within the company.

> The fifth and last dimension is about capabilities. For all the business model components it is important to have the right capabilities to implement the service into the business. For example, in the value proposition it is important to be able to create value through meeting customer needs and for the customer segment it is important to understand the customer's needs and have skilled service personnel to do so.

3.4 How is the IoT involved in becoming a servitized company?

When shifting to a servitized company, an inevitable change that must be included is the use of the Internet of Things (IoT). The IoT is used to get an interconnected system of machines and operators and is defined as follows: "Interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless large-scale sensing, data analytics and information representation using cutting edge ubiquitous sensing and cloud computing." (Basirati et al., 2019) In this subsection possibilities and requirements for using IoT in becoming a servitized company are discussed.

3.4.1. FIVE-LAYER ARCHITECTURE

Section 3.1 described different PSS's and showed the characteristics of the different types of PSSs, which is followed up in this subsection through introducing the combination between a PSS and the IoT. There are five layers of the IoT-architecture, which are visualized in Figure 8. The perception layer consists of monitoring the machines with sensors. Here the data from the machines is collected, after which it is transmitted to the middleware layer through the network layer. This network layer consists of ways to transfer data to other devices/computers, for example through Bluetooth or Wi-Fi. In the middleware layer the data can be stored and analysed, to be able to see what is happening with the machines and what decisions can be made based on this data. The processed data can then be shown to physical persons in the application layer. After that, in the business layer the system administrator can control the complete IoT-architecture (Antão et al., 2018).
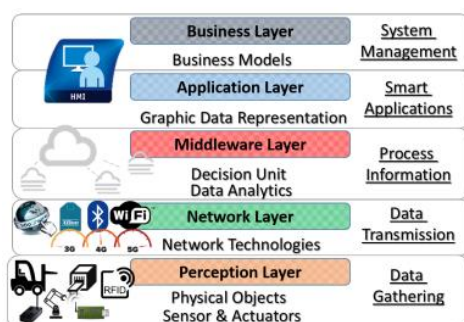

Figure 8 - Five-layer IoT architecture

Next to these layers of the IoT-architecture, the core of the business model must change when implementing the IoT into a company. This change is identified by Boehmer et al. (2020) as follows: value creation through data analytics, monitoring and remote control. They say that "The identifying, sensing, communicating and computing characteristics of IoT devices allow physical products to become platforms for data generation leading to invaluable analytics." This results in being able to monitor customer behaviour and therefore more efficient forecasting of future problems and tasks. This also paves the way for offering new types of services, like predictive and preventive maintenance, which are valuable to manufacturers. This reduces the costs of maintenance but increases the uptime of the machine, because a fault is known before the machine breaks down.

3.4.2. IOT AS PSS BUSINESS MODEL ENABLER

The framework of IoT-PSS in business models, presented in Figure 9, shows how IoT can fit within the business model of a servitized business (Basirati et al., 2019). The vertical axis shows the level of involvement IoT has on the business model type presented in the horizontal axis. The vertical axis consists of the following components: tracking, interacting, optimizing and transforming. The first two components, tracking and interacting, are so-called supporting IoT-components. The last two components, optimizing and transforming, are so-called driving IoT-components. This division shows how much influence IoT has in the corresponding business model and that there is a difference between improving the business through IoT and letting IoT control the business and letting everything depend on the IoT.

Tracking is the lowest level of IoT and enables tracking the products quality and performance. By tracking the product, "the manufacturer can add extra value by improving the quality in use for the customers and decrease the maintenance costs." (Basirati et al., 2019)

Interacting is the next level of IoT and does not only track and report data from the machines but can also act on it. The product can react proactively to changes in the condition of the product. The product has sensors to make a diagnosis which it can send to the user or the manufacturer. By having a product that can interact with its owners, new types of services can be offered, like preventive/predictive maintenance.

Optimizing is the third component and is the first IoT-component that drives the PSS business model rather than just support it. IoT will be used more for developing the business model, rather than supporting an existing business model. This is done by optimizing the capability of what can be done with the data from the machines. The IoT-supporting phases are mostly useful in the phase where the machine is operational at the customer, but with the optimizing IoT-driver enables companies to improve the product before, during and after the lifetime of the product. Things like aftersales-service and pricing can be continually analysed and optimized. Eventually machine learning algorithms will help automating processes and create more complete solutions.

The fourth and last component is about transforming capabilities of the business model. It is characterized by "high level of autonomous operations and seamless communication with other networks." (Basirati et al., 2019) Machine learning and interaction with all the stakeholders in the system provides for the total connectedness of the system. By this the performance of the product and the quality of the product/service in combination with communication across the system is maximized.

		Product-oriented PSS	Use-oriented PSS	Result-oriented PSS
IoT-Driven PSS	**Transforming**	Autonomous Product and Manufacturing	Continuously Improving Advanced Services	Proactive Smart Results
	Optimizing	Efficient Product and Manufacturing	Personalized Services	Smart Results
IoT-Supported PSS	**Interacting**	Smart Product	Engaging Services	Engaging Results
	Tracking	High Product Quality; Advanced Sales	High Service Quality; Lower Maintenance Cost;	Customized results

Figure 9 - Framework of IoT-PSS in business models

3.4.3. IOT AS LIFECYCLE MANAGEMENT ENABLER

Another concept to look at, is Closed-Loop Lifecycle Management (CLLM). This entails the availability of information about the product throughout the three phases of a product: beginning of life (BOL), middle of life (MOL) and end of life (EOL) (Basirati et al., 2019). In product-driven businesses, there is a limited amount of data available which leads to negligible insight in the product and services for the manufacturer. By having as much data as possible available, manufacturers can continuously improve the quality of the products and services. In this research we only focus on the MOL-stage, as this can have a direct impact in solving our action problem. In the MOL-phase there are two opportunities for implementing IoT: smart logistics and predictive maintenance. The tracking and optimizing components, discussed in the previous subsection, can be used for smart logistics. Because of the connected machines, products can be delivered more efficient and "it supports activities such as resource allocation and inventory management. Moreover, with the help of IoT, autonomous vehicles would be able to optimize transportations during the manufacturing and facilitate distributed orders." (Basirati et al., 2019) Predictive maintenance can help minimize the amount of downtime and number of repairs of the machine. Service employees can see where the problem is instead of examining the machine on their own which will lead to more customer satisfaction.

3.5 Conclusion

The theory we gathered in this section concerns the business model, organisational factors and IoT-involvement for manufacturing companies. A business model of a manufacturing company can be described as product-driven, use-driven or result-driven. These three terms are used to specify the value creation, delivery and capturing of a certain business model. We can combine this theory with the theory on the different stages of servitization, which are: reactive, preventive, predictive and proactive. These different stages show the path along which companies can transform their business from purely offering products to offering products as a service. Kaltenbach currently is a product-driven and reactive manufacturer based on these two parts of theory. The five organisational factors that are vital for implementing servitization are: vision and strategy, leadership and organization, human resources, sales and marketing. For every of these indicators, Kaltenbach must examine how they will take them into account and keep in mind during the process of implementing the servitization strategy. To conclude, the IoT is an essential component for a manufacturing company that wants to implement servitization. The IoT is the connection between the machines and the operators and can give useful insights into the operations and data about the use of machine.

4.   DESIRED SITUATION

This section starts with combining the literature from Section 3 to the current situation, to examine where Kaltenbach stands now on the components of the theory. By doing this it becomes clear what the desired situation will look like and therefore also the business model canvas for the desired situation. The desired situation shows how the components of the current business model canvas change when the servitization strategy is implemented, which ensures we can compare the desired situation to the current situation. Next to these changes, the organisational factors to achieve this are discussed in combination with the theory about these factors from 3.2.

4.1 Literature analysis

In this first subsection the current situation at Kaltenbach will be linked to the literature from the previous section. We do this to see what aspects of servitization are already present and where the possibilities are to implement new aspects.

The literature from 3.1 and 3.3 states that improvements in the business model must take place progressively. A product-driven company is not able to change into a performance-driven business where the company offers fully integrated solutions. A company should first shift into a predictive and pro-active business before being able to offer subscription-based and fully integrated solutions. It is a process in which first basic and supportive services need to be explored, before proactive services and full outcomes can be offered as a service (*Servitization for Manufacturers: Benefits & Challenges*, n.d.). Therefore, we examine all the theory components and how Kaltenbach addresses them now.

Firstly, the literature in 3.1 consists of Table 1, which states where the value creation, delivery and capturing comes from in the different PSS types. When looking at this table, it becomes clear that Kaltenbach is a product-driven company. In this section, Huikkola & Kohtamäki (2018) described that the tasks for a product-driven company about manufacturing and selling the machine, in combination with basic maintenance and spare-parts. Looking at the current situation, we conclude that Kaltenbach is responsible for the contracted services, for the sale of the product and that the customer buys the machine in a one-time purchase. Therefore, all the indicators for a product-driven company are present.

Secondly, the organisational factors that are needed for implementing servitization are discussed in 3.2 by Ahamed et al. (2012). This consists of the indicators that are important to consider when implementing servitization and the drivers for companies to implement servitization. Some important indicators which are present at Kaltenbach are for example the vision and strategy and the leadership necessary. The CEO of the company has a clear view on how he wants Kaltenbach to serve the customers. The part about human resources, sales and marketing are not yet available within the company. Most of the employees have a mechanical background, whereas technical human resources are important in the digitalisation that comes with servitization. The most important drivers for Kaltenbach to implement servitization are the strategic and financial drivers. These can be seen as interconnected, as Kaltenbach wants to differentiate their machines by implementing more types of service, which can generate more customers and revenue because of the shift from one-time purchases to subscription-based services.

In the third place, 3.3 continues on 3.1 and shows us that we can conclude that Kaltenbach is a reactive manufacturer, but with some characteristics of a preventive manufacturer. This can be seen when looking at the different stages of the maturity model (Adrodegari & Saccani, 2020). Service is being provided through maintenance and help with installation of the machine. However, after 1700 operating hours, maintenance is done preventive to see how the customer uses the machine and produce a service agreement. The goal for Kaltenbach is to first grow towards a full preventive manufacturer and then towards the last two stages: the predictive and proactive manufacturer.

Lastly, in 3.4 the importance for using the Internet of Things came forward. As stated in 2.5, Kaltenbach is currently testing software to obtain data from their machines from Docksters.IO. This is an important step towards becoming a predictive and proactive manufacturer as tracking and interacting are the IoT-

supported part of PSSs. Figure 9 - Framework of IoT-PSS in business modelsFigure 9 we can see that for a product-oriented PSS, tracking and interacting ensure high product quality and smart products, which is what Kaltenbach is trying to achieve now (Basirati et al., 2019).

4.2 Change of the business model canvas

This subsection shows the changes of the business model canvas when implementing servitization, so it shows how the value is created in the next level of servitization for Kaltenbach. All nine components of the business model canvas are elaborated per group to show how they would change for Kaltenbach in a new situation. The changes are shaped in a way that for every component of the business model it is clear what their task or influence is on relieving customers from certain actions. In Figure 10 at the end of this subsection the business model canvas as it would look like in the desired situation is visualized, where the cursive sentences are the additions to the business model canvas.

4.2.1. VALUE PROPOSITION

The value proposition shows the reason customers choose for Kaltenbach instead of competitors. The value proposition therefore looks as follows in the desired situation:

> The base of the value Kaltenbach offers still is about delivering full solutions with high-quality machines, as this is the base for implementing servitization. When the quality is not high enough, the expenses for the service and maintenance on these machines would exceed the turnover.
> Customers choose for Kaltenbach because they help customers to focus on their own primary processes by taking over certain tasks within the supply chain.
> The differentiated and personalized solutions lead to more loyal customers and longer-lasting relationships.
> The added value is created in the additional services rather than the one-time purchase of the machine. For customers this leads to guaranteed uptime and a decrease of the total cost of ownership, as the risks for the availability and reliability shift towards Kaltenbach.

4.2.2. KEY PARTNERS, ACTIVITIES & RESOURCES

The key partners of Kaltenbach are the sales centres, agents that enable the sales and suppliers. The suppliers are the companies that work with Kaltenbach to realize the solutions at the customer, like the companies that deliver service or the suppliers of spare-parts. When relieving customers through servitization, the changes for the partners in terms of activities and resources are:

> The way of promoting the solutions to the customers changes, because of what Kaltenbach can offer its (potential) customers. As the new situation for Kaltenbach is not solely about selling the machines and infrastructure, but about helping the customers to focus on their own primary process, the way the machines are promoted and marketed improves.
> New partners for extracting data from the machines need to be found and introduced, as transforming the data into information for solutions are needed to offer preventive and predictive maintenance.
> The service-agreements from the partners with the customers must be revised. The new service-predicting and supporting solutions support the change from reactive to proactive services. In the new service-contracts, content like preventive maintenance and providing customer-specific spare-parts packages for a certain periodic subscription should be added.
> The partners that provide service in name of Kaltenbach must accept and join the strategy-transition, because improved availability and readiness is expected from these companies. When the service-partners do not want to adapt to the new situation, alternative partners must be found.
> New activities focus more on proactive rather than reactive actions. It is important to monitor if the existing employees can adapt to the servitization strategy themselves. If not, resources like time and money must be used to train and coach them or new and more fitting employees must be found.

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- Systems like the ERP-system and a CRM-module must be adjusted, implemented and/or combined. This gives the management and the employees more insight in existing projects, the planning and recent customer contacts. This is an example of the indicator organisation that was mentioned in 3.2.1, because it was stated that there should be a complete overview on the situation and the transition towards servitizing the business.
- The tasks for service-employees change from reacting on failures to preventing failures. The field-personnel should recognize how the systems for predictive and preventive maintenance show what the upcoming failures look like and learn how to perform the preventive/predictive maintenance.

4.2.3. CUSTOMER RELATIONSHIPS, SEGMENTS & CHANNELS

The customers are an important factor in the desired situation because the value Kaltenbach offers changes when implementing servitization. This subsection explains the changes for the customers and the way the value is presented to them, which looks as follows:

- Customers profit from certain guaranteed performance and therefore commit for a longer period and are in closer contact with the company. The guaranteed performance should be offered in different service-levels, so the customer can choose to what degree and on what priority the services are offered.
- New customers can be attracted. Target customers that did not want to buy the machine with the corresponding services in the current situation, may now be convinced to let Kaltenbach help realize their solutions.
- The documenting of customer contacts in a CRM-module in combination with an adjusted ERP-system need to ensure imply that more customer-specific services and information can be shared with the customer.
- The channels through which Kaltenbach reaches its customers do not change, only the activities for service change for these channels. The existing channels like the sales centres and agents promote the new value proposition to existing and potential customers.

4.2.4. COST STRUCTURE & REVENUE STREAMS

The value transition also has influence on the costs and revenue for Kaltenbach. In the desired situation Kaltenbach needs to look at the subscription revenue model (Enders et al., 2008). This revenue model is necessary to shift towards the servitization strategy. The changes for the finances when implementing servitization look as follows:

- The costs involved in creating and executing the new service contracts increase as these contracts become more extensive and must guarantee a certain output for the customers.
- There should be enough resources and infrastructure available for delivering the promised service and maintenance. The creation of this infrastructure like more service and sales employees to create and execute the service-agreements. This also causes an increase in wages as it is likely that new employees must be acquired by Kaltenbach to focus on the tasks for servitizing the company.
- Manufacturing costs increase as more costs are made in the production phase, because the machines are adjusted for the extraction of data through sensors and the IoT.
- The revenue streams become more predictable and stable because of the subscription-based revenue model for offering maintenance and spare-parts.
- Kaltenbach now offers a more differentiated product. This means value-based pricing can be used to price the new service-agreements (Dholakia, 2016). The price of the services is not based on margins over the cost-price, but on the value it adds to the customers in terms of reduced downtime. This differentiation ensures revenue does not mainly come from the one-time sale of the product, as this is sensitive to competitive pricing.

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BUSINESS MODEL CANVAS

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENTS
The sales centres are important for making worldwide sales possible.	Research and development into improving existing components and developing new components.	Machine that is reliable and of highest quality to process steel.	Service-agreements on what spare-parts a customer can buy and what maintenance they want.	Companies that process steel (structures) for other companies.
In places where there are no sales centres, agents are placed who act as intermediaries.	The production of the machines, which happens mostly at the factory in Hengelo.	Multiple types of machines to serve as much potential customers as possible.	Personal assistance in deciding the best possible solution per customer.	Kaltenbach is the best option when it comes to shotblasting machines for steel.
The suppliers of raw materials are important for making production in Hengelo.	*Providing spare-parts, service and training on how to use the machine are offered in a proactive way instead of reactive.*	Complete solutions, so from the moment the steel enters the factory of the customer until the process is finished.	Reliable and trustworthy service-agreements for improving customer relationships.	*A larger group of target customers can be attracted because of the new value proposition.*
Companies that perform service and maintenance under the name of Kaltenbach.		*Risk for downtime shifts partially from customer to manufacturer based on a subscription instead of one-time purchase.*	*Customers are offered guaranteed performance so they will commit for a longer period of time.*	
New partners are attracted that enable supporting IoT-services.		*Relieving more time-consuming tasks from customers.*		
Improved availability and readiness are expected from all the partners and suppliers.	**KEY RESOURCES**	*Unplanned downtime will be reduced to a minimum.*	**CHANNELS**	
New partners to promote the machines are attracted as there is a new group of target customers.	Tangible assets like the production facility, the equipment to make the machines and inventory of parts.	*Extraordinary adherence to delivery dates and planning of the projects.*	Contact mostly through email or through phone where there are ambiguities.	
	Intangible assets like the distribution channels consisting of partners and sales centres and the service-level agreements.	*Documenting of contact with customers ensures more customer-specific service*	Two head offices in Lörrach and Hengelo from where sales and service are handled.	
	Human-based skills like project planning and service-provision.		Website with contact-form to order spare-parts.	
	New systems like CRM and ERP are introduced to enable servitization.		*Word-of-mouth advertising, fairs and sometimes pro-actively reaching out to target customers.*	

COST STRUCTURE	REVENUE STREAM(S)
Manufacturing costs like materials and labour to produce the machines. *Manufacturing costs increase in desired situation as more costs are made to implement IoT-sensors and the corresponding systems.*	Transaction revenue model as most of the revenue is generated through a one-time purchase.
Fixed production costs like the equipment to produce the machines and rent of the office.	*Service-provision and spare-parts add revenue after the initial transaction. Service-revenue was 5% of the total revenue, selling spare-parts contributes with 29% to the total turnover.*
Variable production costs like supplies, wages and utility costs.	*Revenue streams become more stable due to subscription-based sales.*
Increased costs for creating and executing new service contracts.	*Value-based pricing can be used to increase revenue from the differentiated product and service.*

Figure 10 - Desired BMC

4.3 Organisational factors

Next to the changes in the business model canvas, there are the organisational factors that Kaltenbach need to consider when implementing servitization. These organisational factors show what changes within the organization are needed to successfully implement the servitization strategy. The indicators specified in 3.2.1 show how organisational factors influence the process of implementing servitization. These indicators are: Vision and strategy, leadership, organization, human resources and sales and marketing. They are explained below:

› For Kaltenbach, the strategy changes in a way where they will offer to relieve tasks from customers and taking over risks in return for subscription-based income. This means the new business model should be evaluated and designed in cooperation with the employees, as they are the ones that must bear the changes to the company.

› Leadership is important because the changes that follow implementing servitization, change the way of conducting business as it has been done for a very long time. Strong leadership is essential in encouraging people to be part of the transition.

› The organisation of implementing servitization consists of assigning tasks, so it is clear who is responsible for specific parts. New partners should be attracted to guide the transition in becoming a preventive and predictive service-provisioner.

› Human recourses are an important factor for implementing servitization at Kaltenbach. As stated in 1.2, Kaltenbach is a mechanical oriented company and the human resources within the company are therefore also mostly mechanically oriented. The implementation of predictive maintenance calls for more technically oriented employees and employees that can shift to a new form of offering and selling products and services. This could imply that new employees with this background must be attracted or current staff must be retrained.

› In sales and marketing, the changes are in how the sales of the services and spare parts take place. The service level agreements must be checked and possibly revised to offer preventive and eventually also predictive maintenance. Kaltenbach changes from selling products to a more complete picture of selling solutions with integrated and extensive services. Through servitization the value proposition is customer-specific, so sales and marketing must adapt to make their tasks customer-specific.

4.4 Conclusion

In this section, a business model canvas for the desired situation was created. The changes in the value proposition consist of relieving tasks from customers and reducing their unplanned downtime through predictive and preventive maintenance. To do this, the partners and activities change along with this value proposition. This chapter was concluded by stating how organisational factors have influence on implementing the servitization strategy. Strong leadership and clear decisions on the strategy turn out to be vital in successful implementation, to make sure all the decisions made from the top are followed as intended. The desired situation for Kaltenbach therefore consists of a combination between becoming a company with preventive and predictive services to relieve certain tasks from customers.

5. SOLUTIONS

This section shows what solutions enable the transition from the current situation into the desired situation. This chapter therefore consists of solving steps 4, 5 and 6 of the Managerial Problem-Solving Method from Heerkens & van Winden (2017), which are solution generation, choice and implementation. In this research, the solution is not yet implemented, but a plan and model are introduced to guide Kaltenbach in the implementation phase.

5.1 Solution generation

The first subsection elaborates on three solutions that support solving the core problem, which was defined as: "The product-driven business model does not focus enough on the customers' needs." These three possible solutions came forward from analysing Section 4, about the desired situation. This was done by checking what changes could improve the customer involvement in the business processes. For the visualisation and operationalisation of the solutions, models are introduced but not yet elaborated, as we only elaborate on the solution that has the highest expected impact for Kaltenbach.

5.1.1. IMPLEMENTING A CRM-MODULE INTO THE ERP-SYSTEM

In the desired situation, Kaltenbach captures the needs for every customer separately, as servitization means differentiating the products you deliver and making them customer specific. To be able to offer preventive and predictive maintenance, the contact with customers should be optimized and kept up to date. This means the CRM-system should be upgraded together with the ERP-system to create a complete overview for the management. There are companies that offer an ERP-system with an integrated CRM-module. Through the CRM-module, departments can see the status and planning of a project, but also information on for example the ROI of and the contact with current customers. One of the things that can be automated within the ERP-system is the replenishment for the spare-parts. Now, the service-employees do this manually but when the safety-stock and the delivery time are combined, whereas the system can automatically order the spare-parts. The CRM-module could give insight in hierarchy and priorities and customer-specific information like the machines and the full solution the customer owns. In the CRM-module it should then be determined what a standard customer looks like, how the products look like and how a service-appointment is made and how it looks like.

To show how the combined IT-components of the company will look like, we could use a practice called Enterprise Architecture (EA). The definition of EA is: "The practice of analysing, designing, planning and implementing enterprise analysis to successfully execute on business strategies." (A. Aldea, Lecture EA Session 19 PDOB, 25-03-2020). The EA is based on a vision and certain starting points, principles and preferences. So to start with creating the EA, there are a few steps to consider:

- The aspects concerning the implementation of the CRM-module and the ERP-system and which we want to model
- What viewpoints to explore based on their purpose
- Decide on the level of detail that will be provided in the viewpoints
- Select the concepts we will use

IT-implementations that could be added in the EA are:

- Linking an inventory module for automatic replenishment of inventory (through combining safety stocks and delivery times) into the CRM-module.
- Determine priority on incoming tasks as new projects and service for existing customers.
- Customer information for all departments for a complete overview

5.1.2. REVISING THE SERVICE-CONTRACTS

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The structure and content of all the service-contracts change because tasks concerning the maintenance of the machine are taken over from customers. This means the contracts with suppliers become more extensive, as their contribution to Kaltenbach also changes from reactive to proactive. The wishes on the degree of this support are different for all customers, so different service-level agreements should be produced. The aspects of the current service-contracts will be adjusted and extended to the needs of the customers, but in this process, it is important to only make adjustments that Kaltenbach is able to fulfil. The current contracts are built up as follows:

- Content: states the machine type and activities during the service-appointment
- Maintenance: states how often/after how many hours the service-appointment is scheduled
- Minimum duration: states how long the contract lasts (often 60 months)
- Advantages: states the advantages of having Kaltenbach conduct the service
- Compensation: states a customer-specific price for the service-provision

These five points are sufficient for a service-contract, but they do not go in-depth into the services that are offered or the documentation of this maintenance. Therefore, there are some basic aspects that every contract after implementing this solution should contain, which are:

- What is being exchanged (specs)
- The conditions of the agreement (price, delivery, payment)
- When and where the service must be delivered
- Transfer of ownership/information
- Procedures for payments

Firstly, the specs of the contract might differ in small aspects, but the basic aspects of what is being exchanged at every customer, can be standardized. Therefore, there needs to be basic specifications every contract contains which can be complemented by personal needs. For some customers, the extra service consists of a specific package of spare parts and the corresponding installation or guidance, but for others it consists of much more IoT-supporting aspects like predictive maintenance. This must be specified containing every detail in the contracts with the suppliers and with the customers.

Secondly, for every different piece of service delivered to the customer, there is a different price. In the contract it should be clear what amount of risk Kaltenbach takes over from the customer and what the price for the customer is for relieving these tasks from the customer. For example, the costs that are determined in the service-contract should be disaggregated to show that for which the customer exactly pays.

Thirdly, the contract should state that when a service-appointment is requested, how much time it takes to fix the issue or to deliver the new parts, as the customer pays for minimized downtime of their machine. If Kaltenbach can promise a certain lead time on their service and spare parts, this is something that can be used to advertise to future customers.

Fourthly, the transfer of ownership changes in the new service contract. In the contract it should on one hand be stated what information from the customers is sent to Kaltenbach and how often this will be sent. On the other hand, customers might only want to purchase the spare-parts, so it should be included what the tasks for Kaltenbach are.

Lastly, in the new contracts it should come forward how and how much the customer pays for certain parts of service and spare parts. It also must become clear when this payment must be completed and whether there are possibilities for spreading the payment and extensive description on what is delivered for the payment.

As changing the service-contracts also changes the process within Kaltenbach and its contact with customer, this solution can be modelled and visualized by using Business Process Modelling, for which we use the Business Process Modelling Notation (BPMN). This method allows us to use the process analysis (as-is) as described above and give form to the process redesign (to-be) to eventually implement the new service contracts in the process realization. The method coordinates the execution of business processes and is used to acquire understanding of the business and organise business activities meaningfully.

5.1.3. EXTRACTING, STORING AND ANALYSING DATA USING IOT

For achieving the predictive and preventive stages of the maturity model, Kaltenbach must extract, store and analyse data from the machines. This is done through the IoT and can be supported by producing KPIs that are important to Kaltenbach and its customers. A good KPI is defined with SMART, which stands for (G. Sedrakyan, Lecture BPM Module 3, 15 February 2022):

- Specific: KPIs measure the areas that have the greatest impact on the business performance
- Measurable: the KPIs need to be identifiable and trackable
- Achievable: the KPIs should be realistic
- Relevant: the KPIs should link to strategic goals and objectives of a business
- Time-framed: the KPIs should have data that can be captured systematically so it enables measuring for specific time intervals relevant for the business goals

These KPIs will then be able to show real-time data to the customers about the performance and status of their machine. This can help the customer make decisions regarding their production process and possible maintenance jobs.

Examples of KPIs for Kaltenbach could be the following:

- Energy usage (per turbine)
- Average speed
- Production downtime
- Average current per operating mode

The tests with the IoT-module to enable this process, Docksters.IO, should be continued and extended because the possibilities of this module meet the requirements to enable the transition to the desired stages of the maturity model. The predictive services increase the product availability and focus on maximum uptime of the machine, which is why it is important to monitor and use the data from the machines.

5.2 Solution choice

In the previous subsection the solutions have been generated and explained, so in this subsection step 5 of the MPSM will be discussed: the solution choice.

5.2.1 PREPERATION

To make a weighted choice for one of the solutions, we use a method called the Analytical Hierarchy Process (AHP-method). The method was developed by Saaty & Katz (1990) and is used to quantify weights of decision criteria, which is why we use it to determine priorities for the solutions. This can be done manually, but in this research, a pre-programmed Excel-tool (XLSTAT, 2022) was used to determine the priorities. The method works as follows:

> Making a Solution Selection Matrix containing criteria on which the solutions are scored. In our case these criteria were:
> - Sigma: The amount of improvement in the output the solution generates

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- Time: The amount of time it would take to implement the solution
- Cost: The amount of resources/money required to implement the solution
- Other: The amount of risk, employee operability and customer satisfaction the solution generates
- Reproducibility: The degree in which the solution is reproducible in other parts of the Kaltenbach group

> Create pairwise comparisons for all these criteria, scoring them on relative importance compared to each other. The scores that can be given are between 1 and 9, where scoring a 1 states that the criteria are of equal importance and scoring a 9 means that one criterion has 'extreme importance' over the other. Only one side of the diagonal in the matrix must be filled in, as the other side of the matrix consists of the inverses of the other values. This results in a filled-in Solution Selection Matrix which can be found in Figure 11.

> The pre-programmed Excel-tool from XLSTAT (2022) calculates the mean priorities by criterion and solutions. This is done through calculating the geometric mean after which these means are used to get the mean priorities by criterion. These mean priorities show the relative importance when choosing a solution.

> The AHP-method also contains a consistency check. This check exists to see whether the participants fill in the matrix consistently. This means that the matrix filled in with Kaltenbach is compared to a randomly filled-in matrix, which should result in a highly inconsistent matrix. The rule of thumb is that the calculated consistency ratio should be below 10%. The Excel-file can calculate this automatically, so it will be elaborated on further into this subsection.

The Solution Selection Matrix was filled in during a session with Kaltenbach. Present in this session were Micha Ramaker and Richard Dofferhoff. The supervisor of this research, Stephan Toxopeüs could not be present during the session but approved the content and outcome afterwards. In this session, we first discussed the possible solutions as described in Chapter 5.1. Secondly, the criteria were determined and agreed on as it is important that all aspects of a solution that are important to Kaltenbach are represented. The Solution Selection Matrix can be found in Figure 11. This matrix shows some interesting things:

> The outcome is seen as more important than the time and costs to implement the solution, is equally important to the reproducibility of the solution and is way less important than the 'other' criterion.
> The time to implement the solution is seen as the least important criterion, as it scores only < 1.
> The costs are the second least important criterion for implementing the solution, as only implementing time scores lower. Kaltenbach stated that it is more important that the outcome and reproducibility are as good as possible than that the costs and time are as low as possible, as it will cost more time and money if the solution is not well-designed and implemented hastily.
> The 'other' criterion is scored as the most important criterion by Kaltenbach, which shows how important it is for the solution to be satisfactory and operable for the customers and the employees.
> Reproducibility is the second-most important criterion, which shows that it is important that the solution is not only good for Kaltenbach Hengelo but must be implementable at the full Kaltenbach group and its partners.

Criteria	Outcome	Time	Costs	Other	Reproducability
Outcome	1,00	5,00	3,00	0,14	1,00
Time	0,20	1,00	0,33	0,17	0,25
Costs	0,33	3,00	1,00	0,14	0,50
Other	7,00	6,00	7,00	1,00	3,00
Reproducability	1,00	4,00	2,00	0,33	1,00

Figure 11 - Solution Selection Matrix Criteria

In addition to this Solution Selection Matrix for the pairwise comparisons of the criteria, there are more Solution Selection Matrices. The criterion 'Other' consists of multiple subcriteria, which are shown in the

matrix in Figure 12. This matrix shows that Employee Operability and Customer Satisfaction have very strong to extreme importance over the Risk criterion. Next to that, the Customer Satisfaction of the solution is moderately more important than the Employee Operability, as it is scored a 3.

Subcriteria	Risk	Employee operability	Customer satisfaction
Risk	1,00	0,14	0,11
Employee operability	7,00	1,00	0,33
Customer satisfaction	9,00	3,00	1,00

Figure 12 - Solution Selection Matrix Risk

After filling in the matrices on the criteria, there is one last set of matrices to fill in before generating the AHP, which are the matrices that score the solutions per criterion. This means that for every criterion the solutions are scored relatively to each other. These matrices can be found in Figure 13 below.

Alternatives for criterion Outcome:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,11	0,11
Service-contracts	9,00	1,00	1,00
Implementing IoT	9,00	1,00	1,00

Alternatives for criterion Time :

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,13	0,33
Service-contracts	8,00	1,00	8,00
Implementing IoT	3,00	0,13	1,00

Alternatives for criterion Costs:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,11	0,33
Service-contracts	9,00	1,00	8,00
Implementing IoT	3,00	0,13	1,00

Alternatives for subcriterion Risk:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,13	0,50
Service-co	8,00	1,00	8,00
Implement	2,00	0,13	1,00

Alternatives for subcriterion Employee operability:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	8,00	8,00
Service-co	0,13	1,00	1,00
Implement	0,13	1,00	1,00

Alternatives for subcriterion Customer satisfaction:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,11	0,11
Service-co	9,00	1,00	5,00
Implement	9,00	0,20	1,00

Alternatives for criterion Reproducibility:

Alternatives	ERP-system	Service-contracts	Implementing IoT
ERP-system	1,00	0,11	0,11
Service-co	9,00	1,00	3,00
Implement	9,00	0,33	1,00

Figure 13 - Matrices of solutions relative to each other

The most important outcome this matrices show is that implementing the CRM-module into the ERP-system is not feasible now and therefore scores the lowest in all the matrices. For the criterion Outcome, implementing IoT and revising the service-contracts has the same priority, denoted by the 1 in the first matrix.

The Excel-file also calculated the consistency index and for Kaltenbach it is 7,48%, which shows that the values in the matrices are considered quite consistent and can be used to determine the solution in the next subsection.

5.2.2 SOLUTION CHOICE

The matrices that were shown in the subsection above are the design for the AHP-method as we processed it by using Excel. In this subsection we go further into the outcome of the AHP-method for prioritizing the solutions for Kaltenbach and make a weighted list of the solutions based on importance for Kaltenbach.

The first part of the output contains the mean priorities by criterion, which shows the results of the matrix described in Figure 11 above. The mean priorities by criterion can be found in Figure 14 below. This figure shows that the criterion 'Other' is seen as the most important criterion by Kaltenbach. The 'Outcome' and 'Reproducibility' can be considered equally important and the 'Time' and 'Costs' criteria can be considered as the least important criteria.

The second part of the output contains the mean priorities for the subcriteria of the criterion 'Other', which can be found in Figure 15 below. This figure shows that of all criteria, customer satisfaction on itself covers more than a third of all priorities. This means that Kaltenbach wants the solution to be the most improving for their customers before the time it takes to implement the solution or the reproducibility of the solution.

The third and last part of the output contains the mean priorities by alternative, which can be found in Figure 16. This figure shows how the percentages from Figure 14 are divided over the three different solutions. When you add up the percentages for each criterion it results in the percentages for the mean priorities by criterion. As we can see, revising the service-contracts has the highest percentage when compared to all criteria except employee operability. This is the case because improving the ERP-system is the solution which really contributes to employee operability but does not score good on the other criteria.

Now that we have summarized all the output from the AHP-method, we must draw a conclusion on what this means for step 5 of the MPSM, the solution choice. For this we will mostly use the output shown in Figure 16 as this shows how the solutions are scored for every criterion. The outcome of the AHP-method and therefore the prioritized list of solutions looks as follows:

1. Revising the service-contracts as tasks and responsibilities shift (by modelling responsibilities and content of contracts from current to desired)
2. Extracting, storing and analysing data from the machines using IoT (by generating SMART KPIs that can monitor performance and output)
3. Optimizing the ERP-system by combining it with a CRM-module (by modelling the changes of tasks and input/output when a new system is implemented)

Now that we have the prioritized list, with the solution about the service-contracts as most favourable, we elaborate on this solution in the next subsection.

Criteria	%
Outcome	16,94
Time	4,71
Costs	8,70
Other	53,14
Reproducibility	16,52

Figure 14 - Mean priorities by criterion

Other	%
Risk	3,02
Employee operability	15,66
Customer satisfaction	34,46

Figure 15 - Mean priorities criterion 'Other'

Crit./Alt.	ERP-system	Service-contracts	Implementing IoT
Outcome	0,89	8,02	8,02
Time	0,34	3,65	0,72
Costs	0,59	6,84	1,27
Other	14,56	27,55	11,03
Risk	0,24	2,38	0,39
Employee operability	12,52	1,57	1,57
Customer satisfaction	1,79	23,60	9,07
Reproducibility	0,86	10,44	5,22

Figure 16 - Mean priorities by alternative

5.3 Solution implementation plan

In this subsection, the operationalisation and implementation of the solution about the service-contracts is discussed. Full implementation of the solution is out of the scope of this research, which is why it is presented as a plan on the changes the solution imposes when implemented. As described in the previous subsection, the change of the service-contracts can be modelled through Business Process Modelling. By

using BPM, we can visualize the responsibilities for Kaltenbach and the customers and show how the provision of service and maintenance changes.

As described in 5.1.2, the service-contracts currently all include the same five components:

- Content: states the machine type and activities during the service-appointment
- Maintenance: states how often/after how many hours the service-appointment is scheduled
- Minimum duration: states how long the contract lasts (often 60 months)
- Advantages: states the advantages of having Kaltenbach conduct the service
- Compensation: states a customer-specific price for the service-provision

These components combined currently only consist of one page. This shows that all minimum requirements of a service-contract might be present, but customers do not know what to expect for this amount of money. For example, in one contract it is stated that Kaltenbach will perform:

- Verification of important functions
- Modify and optimize the machine
- Replacement of spare/wear-parts if necessary

In a service-contract that ranges from prices from €5k to €15k, customers might imply that it is not enough specification of the activities that take place. That is why the service-contract needs to be more extensive, with most importantly: Implementation of detailed information on what parts of the machine are checked and what is done with those parts. The contract should contain things like: confirmation of working turbines, checking how damaged the wear-parts inside the machine are, etc. Per customer it should be specified what parts of the machines are important for them to get checked at a service run.

When the mechanic from Kaltenbach has done the service-provision, there is no proof of documentation containing which parts were checked and/or replaced. Therefore, Figure 17 shows how the service-requests could go in the new situation. This figure contains a part where the mechanic makes a detailed report on what service he provided, so customers have proof of what is done and can review whether they are satisfied with the service-provision and that all the content from the service-contract has been executed.
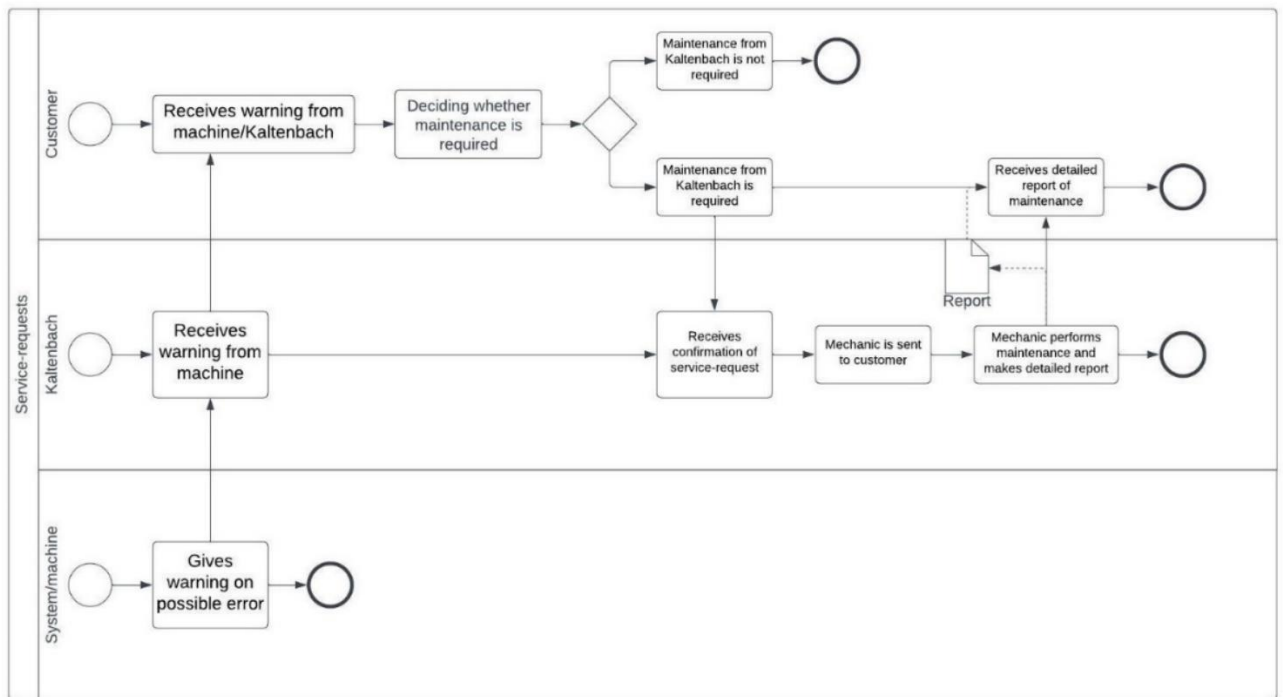
Figure 17 - Business Process of service-request

A more task-relieving example of the business process of a service-request works as follows: Kaltenbach receives an error-message from the machine for which they decide whether it needs a service-mechanic sent to the customer or the customer can fix it themselves. This is then communicated with the customer and a mechanic is sent to the customer or the customer is instructed on how to fix the issue themselves. This is visualized in Figure 18 below. In this example, Kaltenbach has more responsibilities in terms of service-provision so they must be able to live up to the content they promise in the contract. The customers will pay more for this type of service-provision but are relieved from determining themselves whether maintenance is needed or they can fix it themselves. Customers can therefore focus more on their own primary processes and let Kaltenbach take care of the machines.
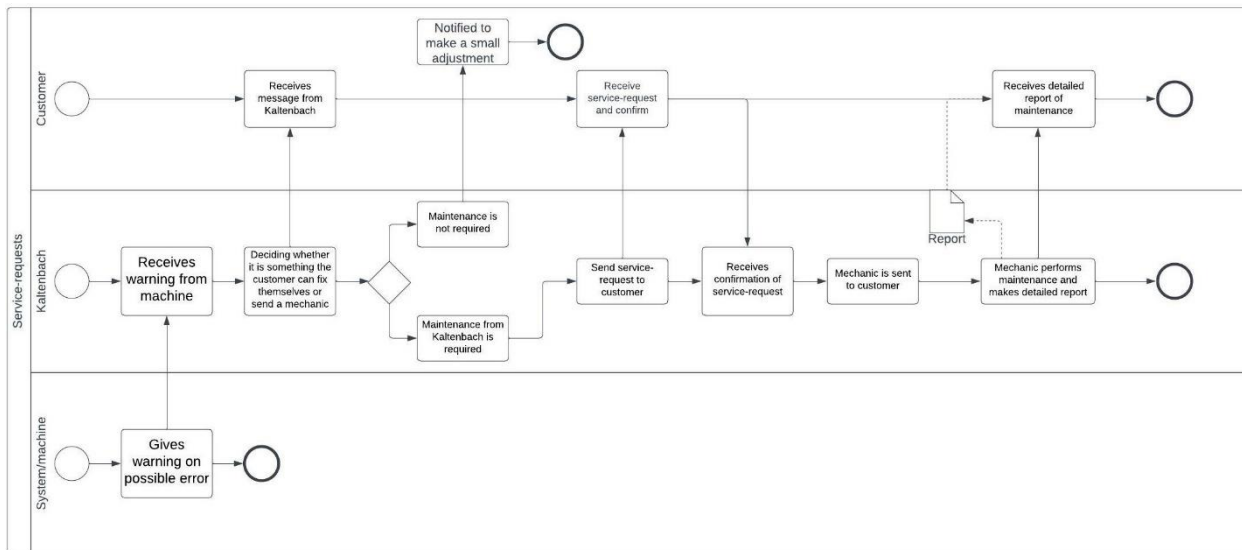
Figure 18 - BPMN of service-request in new contract

The five components of the current contracts can therefore now be revised and rewritten as follows:

- Content: machine-type, a list of machine-parts that will be checked and might be replaced
- Maintenance: customer-specific time indication on when to perform maintenance.
- Minimum duration: customers can choose how long they want the service-contract to last.
- Advantages: same advantages, except that Kaltenbach relieves more tasks so customers can focus on their own processes, a full report that shows what is done against what costs.
- Compensation: compensation is split into multiple parts where customers can see what builds up the compensation for the service-provision.

5.4 Organisational and cultural changes

After defining the processes and systems that change to reach the desired situation at Kaltenbach, this subsection shows the organisational and cultural challenges and factors that come with the implementation. The most important organisational factor for the management is to fully understand the shift towards servitization, so they can professionally guide all the departments in the transition. This is important because the employees must be convinced that the new strategy is an improvement for the company. The service-department is vital in making this transition run smoothly, as this is the solution that is going to be implemented.

The cultural challenges for Kaltenbach lie in the fact that the whole company needs to understand and encourage the changes within the organization. All the organisational indicators for implementing servitization from 4.3, can be summarized as follows: the management must have complete insight and understanding on what they want to change, how they want to do that and what the consequences within the company are. To change the organization this way, it must be assessed how Kaltenbach is going to do in this area. A lot of the work the different departments do is based on team-based management. Through observation, we can conclude that aspects like creativity and innovations work bottom-up at Kaltenbach, as departments must take their own decisions and have their own responsibilities. The management overlooks these processes but employees have the responsibility to calculate risks and make decisions based on their own findings.

5.5 Conclusion

In this subsection the solutions were generated, prioritized and elaborated so Kaltenbach can use the outcomes to support the change of the business model and the service contracts. The solution generation consisted of three possible solutions that came forward from the literature analysis from Section 294. These solutions and how they can be worked out are:

- Revising the service-contracts as tasks and responsibilities shift (by modelling responsibilities and content of contracts from current to desired)
- Extracting, storing and analysing data from the machines using IoT (by generating SMART KPIs that can monitor performance and output)
- Optimizing the ERP-system by combining it with a CRM-module (by modelling the changes of tasks and input/output when a new system is implemented)

By using the AHP-method and a session with employees from Kaltenbach, the solution selection matrices were filled in. The priority for the solutions was determined as the order they are presented above. In the solution implementation phase an example is given on how the service-provision could look like in the new situation, for example by giving the mechanics more responsibilities and taking over the tasks from the customers. The organisational and cultural challenges for Kaltenbach are that for a change of strategy like this, the complete company needs to understand and encourage the changes and opportunities that lie ahead.

6. CONCLUSION, DISCUSSION AND RECOMMENDATIONS

This section shows the conclusion of the research, where the steps taken towards the solutions are discussed. It also provides for a discussion on the research, where constraints and limitations are mentioned. The section ends with recommendations for further research, so Kaltenbach knows how they can follow-up this research. This is in line with solving step 7 (solution evaluation) of the Managerial Problem-Solving Method from Heerkens & van Winden (2017).

6.1 Conclusion

For this research, the goal was to support the transition from a product-driven business model to a customer-driven business model through servitization. This was achieved by using the Managerial Problem-Solving Method. This method presented a base which was followed to come up to the end-result. The core problem was identified as: 'the product-driven business model does not focus enough on the customers' needs.' First, the current business model and processes were examined in a current situation analysis. The business model has been visualized in a business model canvas, to show how the value for the customers is created and what resources and financial issues make that possible.

To find solutions on the main problem, the theoretical framework shows how a business model for a servitized company looks like. This resulted in different business models with different ways of providing in customer needs by providing more and extensive services. Then the organisational factors of implementing servitization were discussed, where it was found that strong leadership and a clear vision are vital for encouraging employees and customers of the change in strategy. The third part of the theoretical framework was about the different stages of being a service-driven company, which complemented the first part of the theoretical framework about the business models. At last, an important technical aspect of providing more service was discussed: the Internet of Things. This is an important factor in the type of services Kaltenbach can deliver to their customers because more information on the usage and state of the machines must be available. Input from customers completed the data-gathering phase, which showed that customers are satisfied with the current contact with the company and the service that is provided. Some improvements could be in offering proactive services or better bundling different groups of spare-parts.

The analysis as described above led to adjustments in the business model canvas per group of components, to keep it ordered. These adjustments and changes within the company lead to Kaltenbach being able to offer more services to let the customer focus on their own primal processes. These changes are summarized in the following three possible solutions:

- Change of the systems within the company, including combining the ERP-system and a CRM-module to increase total insights of the actions within the company.
- Change of content and structure of service-contracts due to changes in the services that Kaltenbach can provide.
- Implementation of data-extracting sensors and a module for including the Internet of Things in the transition to servitization.

These solutions were presented to Kaltenbach in a session to determine the priorities for the company. To prioritize the solutions we produced criteria to score the solutions, for which we first created pairwise comparisons for the criteria, to show the relative importance of the criteria. After that, the solutions were scored using these criteria which gave an answer on the importance of the solutions for Kaltenbach. This resulted in a prioritized list, as choosing for one solution does not mean the other solutions should not be looked at. The prioritized list of solutions is:

1. Revising the service-contracts as tasks and responsibilities shift (by modelling responsibilities and content of contracts from current to desired)

2. Extracting, storing and analysing data from the machines using IoT (by generating SMART KPIs that can monitor performance and output)
3. Optimizing the ERP-system by combining it with a CRM-module (by modelling the changes of tasks and input/output when a new system is implemented)

The core problem was: 'the product-driven business model does not focus enough on the customers' needs', and revising the service-contracts contributes on starting to solve this problem. Customers can be addressed more personally and data can be used more precisely to see what the customers want and to relieve the customers from certain tasks and examples have been given using the BPMN models in Figure 17 and Figure 18. This enables implementation of servitization, which is something to focus on in further research.

The conclusion on achieving the further stages of servitization is that Kaltenbach needs to digitize a lot of the processes. This is necessary to connect more machines and the data to Kaltenbach. By doing this, Kaltenbach can offer extended services that come with being a preventive and predictive manufacturer. The processes that change within the company are custom-made for Kaltenbach, as their processes and systems within the company have been used to form the solutions. However, similar manufacturing companies can use the outcomes on what processes and systems are important for implementing the servitization strategy at the company.

6.2 Discussion and recommendations

After concluding this research in the previous subsection, there are also some limitations of the research that must be discussed. Therefore, this subsection consists of limitations and recommendations for Kaltenbach in terms of this research and possibilities on further research.

6.2.1. DISCUSSION

The first point of discussion is that the solution choice and evaluation is done by service-employees. When implementing the solution, the input from other departments within Kaltenbach like finance, R&D or the field engineers should also be considered. These are the employees that work with the solution, so they should agree on the content and execution of the solution to avoid the risk that top-down management occurs here.

The second point of discussion is about customer-input on the specifications that are in the service-contracts. In this research it is assumed that the service-contracts are not specific enough because they only consist of a maximum of two pages, but it is not verified or validated with actual customers whether they experience this the same. The interviews with the customer only consisted of questions on their experience of Kaltenbach's customer service and delivery of spare parts, but could have been extended with engaging them in the process of constructing the new content of the contracts. This can also be used to determine the shift in responsibilities for performing certain tasks regarding the service-provision. Also with the implementation of IoT and data-sharing, it is important to consider the responsibilities that come with it.

The third discussion point is about the consistency of the AHP-method in the way it was conducted in this research. The session with Kaltenbach on determining the criteria and priorities of the solutions took place with two employees of the service-department. The hazard in only taking this into account is that they look at the topic while being focussed on the outcome for their department or responsibilities. The employees that took part in the session tried to include the benefits and disadvantages of the solutions in their thinking process, but it would contribute to the validation of the outcome to check it with more employees.

6.2.2. RECOMMENDATIONS

One of the recommendations for further research is to do more research on the performance-driven business model, where even more tasks are taken over by Kaltenbach. This eventually leads to delivering not only the maintenance/spare-parts as a service (subscription-based model), but also the complete machines. In combination with the research on the performance-driven business model, further study could be on the possibility to be able to provide all four different stages of the maturity model, for customers with different needs and wishes in terms of paying for the usage of the machines instead of buying the complete machine.

The second and last recommendation is about the outcome of determining the priorities with the AHP-method. In this session it came forward that the 'Other' criterion was scored as much more important than the other criteria. This is something that is important for future research on the topic and could even be verified and validated by conducting the AHP-method at more employees to see whether this is the same within the complete company.

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8.   APPENDICES

A. Number of machines sold per year
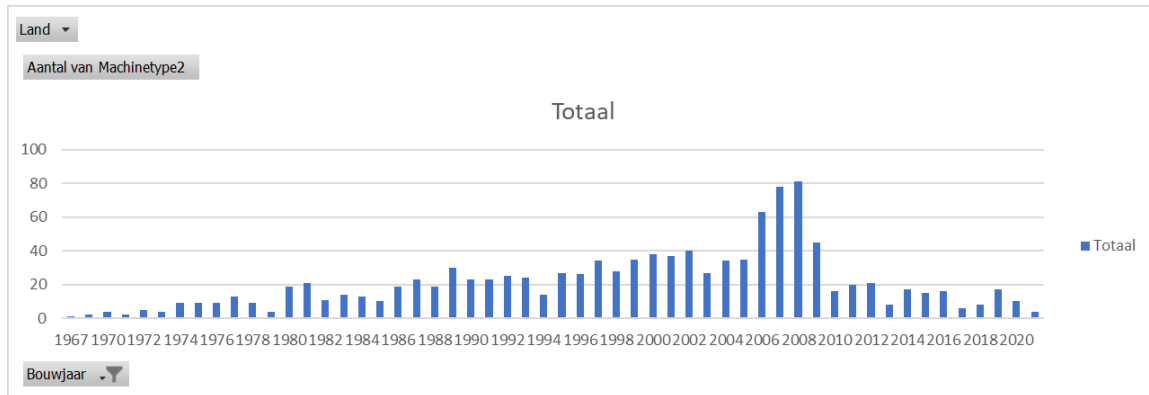
B. Maturity dimensions connected to the Business Model Canvas

BM component	MM dimension	Critical requirement
Value proposition	Capabilities	Capability to design specific value propositions to meet actual customer needs
		Capability to develop new service offerings that create new value for the customer
		Service logic translation capability
	Process management	Procedure and practices to define and formalize the key value sources for specific value propositions
		Procedure and practices to ease the determination of the value for the customer (e.g. total cost of ownership)
		Procedure and practices to manage service portfolio
	Tools	Specific tools and methods for service value proposition design
		Tools to ease the determination of the value of the new offering
	Organizational approach	Establishment of a customer-centric organization
Customer relationships	Capabilities	Relational skills of sales and marketing personnel
		Relational skills of service personnel
	Process management	Procedures and practices for managing customer feedbacks on product/service experience
	Tools	ICT systems/applications that support the automatization of relationships and collaboration between customers and providers
Customer segments	Capabilities	Capability to understand the customer's problem and interpret their real needs
		Capability to manage customer production processes data
		Capability to manage customer portfolio and identify customer segments
	Process management	Procedures and practices for assessing customer preferences and needs on product and process-related information (e.g. technical and technological, etc.)
		Procedures and practices for assessing customer preferences and needs on service-related information (e.g. services, financial aspects, risks, etc.)
Channels	Organizational approach	Establishment of an after-sales teams for different service categories
		Establishment of a field service organization
		Establishment of sales teams/key account managers to direct interface with important customers
Partnerships	Capabilities	Capability to select and evaluate suppliers'/partners' performances over time and their achievement of targets/expectations
	Process management	Procedures and practices for drawing-up business deals/agreement with key partner/suppliers
	Tools	ICT systems/applications that support supply chain management and collaboration activities with suppliers

BM component	MM dimension	Critical requirement
Key activities	Organizational approach	Establishment of dedicated team/roles/persons for new service development
		Establishment of a distinct service function with profit-and-loss accounting and responsibility for strategic service development
		Establishment of a distinct back- and front-office roles to improve or balance efficiency and effectiveness of service processes
	Performance management	Metrics to measure service-related activities operational performances (e.g. response time, quality, etc.)
		Metrics to measure product state and product-process performances
	Process management	Procedures and practices for development of new services
		Procedures and practices for total cost of ownership evaluation and assessment
		Procedures and practices for internal service-related processes (e.g. helpdesk) standardization
		Procedures for managing service delivery processes (e.g. technical assistance intervention)
		Procedures and practices for managing the integration between product and service development processes
		Procedures and practices for managing the involvement of different business functions in the product design and improvement
		Procedures and practices for aligning incentive and rewards systems of sales and marketing personnel to strategic service objectives
Key activities	Capabilities	Capability of technical office to design modular products and components (product-design phase)
		Capability of technical office to design reliable products anticipating potential causes of failure during the product-design phase
		Capability of technical office to design products in which components are easy to access/replace during technical assistance (design for serviceability)
		Capability of technical office to design products taking into account the need for disassembly/recovery/disposal/recycling at the end of the product lifecycle and the environmental impact (design for end-of-life)
		Capability of technical office to design products taking into account the economical impact of the product during the whole product lifecycle
		Capability of the deputed roles to design modular services (service-design phase)
		Capability to formalize and standardize services/new service offerings
		Capability to communicate and make tangible the service value to the customer (sales and marketing personnel)
		Capability to communicate and make tangible the service value to the customer (technical assistance personnel)
		Capability to organize, orchestrate and manage the after-sales activities
		Capability to internally coordinate sales and field service organizations
	Tools	Tools for supporting the product design accordingly to new service design requirements
		Tools for supporting the development of new services
		Tools for total cost of ownership evaluation and assessment
		Tools for supporting sales and marketing personnel (e.g. payback simulation tools)
		Tools for planning and managing maintenance activities (e.g. scheduling routine maintenance)
		Tools for supporting the development and delivery of maintenance activities

BM component	MM dimension	Critical requirement
Key resources	Organizational approach	Service business attractiveness and mind-set
		Service orientation and attitude of sales and marketing personnel
		Top management commitment: drive change and establish a service culture
		Open access to customers' installed base data (data availability)
	Capabilities	Capability to analyze data collected from the installed base for improving fleet management
		Capability to collect product and process-related data (e.g. usage, performance, health state)
		Capability to collect service-related data (e.g. reliability, failure)
		Capability to interpret product and process-related data
		Capability to interpret service-related data
		Capability to elaborate business plans and documents to acquire new financial resources
	Process management	Procedures and practices for data collection, interpretation and processing of product and process-related data
		Procedures and practices for data collection, interpretation and analysis of service-related activities
		Procedures to manage financial resources allocation
Key resources	Tools	Monitoring technologies on product/systems that support collection of service-related data (e.g. Maintenance activities)
		Monitoring technologies on product/systems that support collection of product and process related data (e.g. Product usage, performance,…stems/applications that support the collection of service-related data (e.g. Maintenance activities information)
		Ict systems/applications that support collection on product and process-related data (e.g. Product usage, performance, etc.)
		ICT systems/applications that support interpretation, analysis and reporting on product and process-related data
		ICT systems/applications that support interpretation, analysis and reporting on service-related data
Revenue model	Capabilities	Product-service solution pricing capabilities
		Capability to define reliable outcome expectations with the customer and define the corresponding metrics/parameters to evaluate the agreed outcome
Cost structure	Capabilities	Capability to evaluate operating and financial risks and manage uncertainty
		Capability to distribute risk to other network of partners
		Capability to design and implement safeguarding mechanisms (e.g. For financial and operating risks)
	Process management	Procedures and practices for financial risk evaluation
		Procedures and practices for operating risk evaluation
		Procedures and practices for customer's liability risk assessment
	Tools	Tools to support cost evaluation of the product-service solution
		Tools for reporting and cost accounting of service-related activities
	Performance management	Metrics to evaluate service-related activities costs
		Metrics to evaluate service-related activities costs
		Metrics to measure financial performances
		Metrics to evaluate fleet financial costs

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C. Calculations on service-turnover

In Hengelo, the service sales in 2021 are €800.000, on a total turnover of €17.500.000. This means that $(\frac{800.000}{17.500.000} * 100\% \approx)$ 5% of the revenue in Hengelo comes from service-provision. For Kaltenbach in total, the equation is as follows: $(\frac{3.200.000}{47.000.000} * 100\% \approx)$ 7%.

Spare-part sales are counted separately, the sales from those spare-parts are €5.100.000, which means they contribute with $(\frac{5.100.000}{17.500.000} * 100\% \approx)$ 29% to the total turnover in Hengelo. When adding the 5% turnover from service-sales to the 29% of spare-parts sales, we can conclude that 34% of the turnover comes from service and spare-parts and 66% through the transaction of selling the machines.

For Kaltenbach the turnover from spare-parts is €8.600.000 on a total turnover of €47.000.000. This means the contribution of these sales is $(\frac{8.600.000}{47.000.000} * 100\% \approx)$ 18%. Adding this number to the 7% for service turnover, gives 25%, which is therefore the contribution of spare-parts and service sales to the total turnover.

Initial Situation

Facts & Figures	KALTENBACH	GIETART
• Total turnover	47 Mio. €	17,5 Mio. €
• Service Sales	3,2 Mio. €	0,8 Mio. €
• Spare part sales	8,6 Mio. € (Ex Lörrach)	5,1 Mio. €
• Number of active mat. no. (3 years)	9.500 Mat.-Nr.	5.000 Mat.-Nr.
• ERP System(s)	SAP	baan
• Sales structure: Number of subsidiaries / resellers	10 Subsidiaries / 15 Reseller	
• Current calculation of spare parts prices (price groups / markups)	numerous mark ups / customer complaints (esp. tools)	
• Number of storage locations	Lörrach partly Subsidiaries not managed by HQ	Hengelo
• Stock separation Production vs. Service Parts	Production/Service Stock	Service Stock

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D. Business model canvas

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Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
Infrastructure		**Offering**	**Customers**	
	Key resources		Channels	

Cost structure		Revenue streams
	Finance	
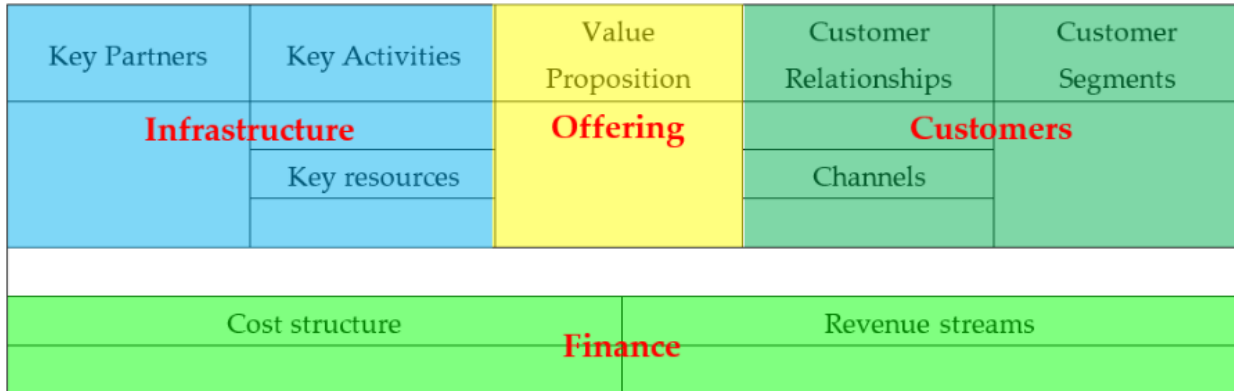
E. Customer pyramid for the Netherlands

Customer	Revenue 2021
Oostingh Staalbouw B.V.	€ 47.513,00
Douma Staal	€ 44.151,00
Vlietjonge staalhandel	€ 36.324,00
Heuvelman Staalhandel BV	€ 35.304,00
Kampstaal B.V.	€ 34.348,00
De Boer Staal B.V.	€ 27.418,00
The Coatinc Company	€ 23.300,00
KING PING BEDRIJFSIMPERIAALS	€ 17.416,00
Pacton B.V.	€ 15.917,00
STAALBOUW v.d. MOST B.V.	€ 11.512,00
H. Hardeman B.V.	€ 11.310,00
Hörmann Alkmaar BV	€ 11.019,00
Kverneland Group Nieuw-Vennep BV	€ 10.684,00
ThyssenKrupp Materials Nederland BV	€ 8.433,00
STC staal technisch centrum	€ 6.674,00
Moors Conserveringen B.V.	€ 6.002,00
Etaves B.V.	€ 5.238,00
Prins Staal Trade & Processing BV	€ 4.779,00
Brink Towing Systems	€ 4.646,00
Staalbouw Velp BV	€ 3.560,00
Hop Metaalconservering B.V.	€ 2.631,00
Snijcon	€ 1.971,00
Witte van Moort B.V.	€ 1.687,00
Joop van Zanten Staalservice	€ 1.633,00
Vekoma Rides Manufacturing B.V.	€ 1.177,00

Pyramid tiers:
- Top customers: • € 163.292,00
- Big customers: • € 102.482,00
- Medium-sized customers: • € 68.875,00
- Small and inactive: • € 45.312,00