

Challenges, Mitigation and Benefits of Outcome-based Contracts in Small and Medium-sized Machine Manufacturers: A Qualitative Exploratory Study

Mikko Uuskoski

Unit of Information and Knowledge Management,
Faculty of Management and Business, Tampere University, Tampere, Finland.
E-mail: mikko.uuskoski@tuni.fi

Sameer Mittal

Unit of Information and Knowledge Management,
Faculty of Management and Business, Tampere University, Tampere, Finland.
&
Institute of Management, JK Lakshmi Pat University, Jaipur, India.
Corresponding author: sameer.bansu@gmail.com, sameer.mittal@jkl.edu.in

Karan Menon

Unit of Information and Knowledge Management,
Faculty of Management and Business, Tampere University, Tampere, Finland.
E-mail: karan.menon@tuni.fi

Hannu Kärkkäinen

Unit of Information and Knowledge Management,
Faculty of Management and Business, Tampere University, Tampere, Finland.

(Received on June 18, 2023; Accepted on September 5, 2023)

Abstract

Outcome-based contracts (OBCs) offer machine outcomes while maintaining machine ownership with the manufacturer. To this end, the scientific literature lacks systematic studies on sharing insights from the perspective of small and medium-sized enterprise (SME) machine manufacturers (MMs) while implementing OBCs. We interviewed four SME MMs that have successfully offered OBCs. Further, we use exploratory multiple-qualitative case study research. We identified that SME MMs face various challenges, such as ownership of expensive machines, the long payback period of OBCs, protection of IP, the need for constant innovation, and delivering the required performance while offering OBCs. Further, we identified that SME MMs have identified ways to mitigate these challenges, such as involving third parties to own the machine and ensuring earnings by including separate contracts for other activities such as installation, maintenance, training of the employees working on machines, and logistics, to overcome the challenge of the long payback period of OBCs. Additionally, we identified various SME MM-related benefits from OBCs, such as entering competitive markets, optimizing the cost of operating the machine, novel efficient ways of selling and marketing machines, avoiding money laundering and legal issues, and reducing investment through recycling the machine and its components that SME MMs have while offering OBCs. We share insights into how SME MMs offer OBCs, which typically involve significant risks, by empirically studying the challenges, mitigation of challenges, and benefits of offering OBCs.

Keywords- Product-service systems, Outcome-based contracts, Servitization, Small and medium-sized enterprises, Manufacturing.

1. Introduction

Manufacturing enterprises that were previously selling only their machines have now started to offer outcomes with the help of outcome-based contracts (OBCs) (Schaefers et al., 2021). In OBCs, this outcome is in the form of the hours of machine availability, output units produced from the machine, and the savings/economy created by the OBCs (Böhm et al., 2016; Grubic and Jennions, 2018; Korkeamäki et al., 2022;

Neely and West, 2022; Lin et al., 2023; Shanmugam and Dhingra, 2023). Offering OBCs has many advantages from the perspective of manufacturing enterprises, such as becoming loyal suppliers (Baines et al., 2007), enhancing business knowledge (Solima et al., 2016), and having positive environmental impacts (Tukker, 2015). In the current study, we plan to understand what challenges and benefits small and medium-sized enterprises (SME) and machine manufacturers (MMs) have while offering OBCs.

The current scientific literature focuses on how large manufacturing enterprises offer OBCs. For example, there are articles that deploy the Business Model Canvas (BMC) to make decisions on items such as the value proposition, key partners, key activities, key resources, and customer segments while offering OBCs or designing the transition towards offering OBCs (Barquet et al., 2013; Adrodegari et al., 2017; de Olivera et al., 2018). Similarly, there are articles focusing on the importance of IoT and digitalization technologies while delivering OBCs (Grubic and Peppard, 2016; Rymaszewska et al., 2017; Paiola and Gebauer, 2020). Moreover, there are articles that study the operational practices (Korkeamäki et al., 2022; Baines and Lightfoot, 2013) and competencies (Rabetino et al., 2017; Gebauer et al., 2017; Visnjic et al., 2018) that support the delivery of OBCs. However, the challenges faced by organizations while offering OBCs and the mitigation of those challenges are not discussed. For example, when it comes to the ownership of the equipment, scientific literature suggests that the equipment is owned by MMs (Barquet et al., 2013; Adrodegari et al., 2017; Gebauer et al., 2017). However, for SME MMs, it would be a challenge to own the expensive machines during the initial phase and when the machines are not performing. For SME MMs to be successful while offering OBCs, it is critical to identify such challenges and various ways to mitigate them.

Extant literature has focused on large enterprises. Insights from large enterprises cannot be applied to SMEs, as SMEs have different resources, opportunities, and needs. For example, large enterprises have more financial resources (Mittal et al., 2018; Müller et al., 2018), and they have multiple businesses that run in parallel to ensure earnings. Likewise, the financial resources available to large enterprises support them in sustaining long payback periods in OBCs. On the other hand, SME MMs are typically highly specialized. As a result, the SME MMs are dependent on a single source of revenue, and for them to offer OBCs, it is complicated. Similarly, successful large enterprises have developed separate service units to offer OBCs (Lenka et al., 2018). However, adding a separate service organization will add complexity to the structures of SME MMs, creating high coordination costs and limiting flexibility. To generate returns, time is needed, and there will be a dead valley before OBC earnings reach investment-based model earnings.

Existing studies in the scientific literature do not share insights from SMEs that have successfully offered OBCs. There are studies (Zancul et al., 2016; Dahmani et al., 2020; Low et al., 2022) that consider the SME MMs' perspective while offering maintenance, renting, and leasing contracts. Similarly, servitization has been considered a competitive strategy for SMEs. As a result, frameworks and maturity models (Kowalkowski et al., 2013; Adrodegari et al., 2017; Adrodegari and Saccani, 2020; Kolagar et al., 2022) focusing on the design of servitization business models (BMs) have been proposed. Additionally, the capabilities and technologies required by SME MMs for servitization have also been proposed (Gebauer et al., 2012; Kanninen et al., 2017; Schroeder et al., 2020). Nevertheless, none of these studies focuses on identifying the challenges and benefits that SME MMs have while offering OBCs. Overall, the scientific literature presents only one case of a SME MM offering product-service systems (Adrodegari et al., 2017). The overview of challenges identified in this study (Adrodegari et al., 2017) is related to changes in customer conditions and service personnel and the estimation of cost calculations, and it was suggested that these risks can be mitigated by the length of the contract and a customer being penalized for changing the contract conditions. Similarly, the benefits of offering OBCs are related to the prediction of machine failure.

Overall, insights into SMEs specifically offering OBCs have not been discussed. In conclusion, this study addressed the following three main research questions:

RQ1: What are the critical challenges faced by small and medium-sized machine manufacturers when offering outcome-based contracts?

RQ2: How are the identified challenges mitigated by small and medium-sized machine manufacturers when offering outcome-based contracts?

RQ3: What are the benefits for small and medium-sized machine manufacturers when offering outcome-based contracts?

We provide insights into how SME MMs can successfully offer OBCs. Our insights are based on findings from four SME MMs that have successfully implemented OBCs. These insights were identified using an exploratory qualitative multiple-case study method. We investigate B2B MMs that are unique because they are involved in the manufacturing of sophisticated machines and face complications related to resource heterogeneity, adoption of technologies, and communication with stakeholders. Furthermore, SME MMs are even more interesting to study because they face challenges related to SMEs, B2B manufacturing enterprises, and the delivery of outcome-based contracts.

The remainder of this paper is organized as follows: section 2 presents the theoretical background of this study. section 3 describes the research methodology we followed in the study. In section 4, we present the results of our study and discuss the results in section 5. Finally, section 6 presents the conclusions, theoretical and managerial implications, limitations, and future research directions of our study.

2. Theoretical Background

According to the European Union, SMEs are defined as enterprises with fewer than 250 employees, an annual turnover of 50 million euros or less, or an annual balance sheet of less than EUR 43 million. SMEs have huge significance in the EU economy. For example, in Germany, SMEs account for up to 99.6 percent of enterprises, 59.4 percent of employees, and 35.9 percent of annual turnover (German Federal Ministry of Economic Affairs and Energy, 2014). However, despite the significance of SMEs, overall research on SMEs remains rare (Müller et al., 2018; Mittal et al., 2018).

2.1 Small and Medium-Sized Machine Manufacturers

Mittal et al. (2018) provide an illustrative and condensed description of manufacturing SMEs' main characteristics compared to large enterprises: these characteristics sum up to include eight overall clusters of characteristics. These include finance, technical resource availability, product specialization, standards, organizational culture, employee participation, alliances, and collaboration. Furthermore, SME MMs are often the suppliers of components and subsystems to larger companies. Thus, SME MMs experience difficulties moving downstream in the value chain because of potential competition with their larger customers, distributors, and installers (Gebauer et al., 2010).

Furthermore, the implementation of OBCs centrally deals with new ways of sharing risks and benefits. However, SME MMs lack resources, expertise, and risk-taking capability due to their small size compared to large companies (Müller et al., 2018). On the contrary, SME MMs might simultaneously benefit from their relative flexibility and potentially faster decision-making capability (Mittal et al., 2018) while offering OBCs. To sum up, SME MMs are truly different from larger companies in many important respects, and these differences make it difficult for SME MMs to directly use studies regarding BMs and new services that have been made in the context of large enterprises.

2.2 Servitization and Outcome-based Contracts

Servitization involves offering product-oriented, use-oriented, and result-oriented BMs (Tukker, 2004). Product-oriented, use-oriented, and result-oriented BMs are also referred to as product-service systems (Tukker, 2004). Product-oriented BMs cater to investment-based models, where the machine is owned by the customer and the customer pays for the additional services such as maintenance of the machine. Use-oriented BMs cater to renting and leasing services, where the machine is owned by the manufacturer and the customer pays for using the machine. Finally, there are result-oriented BMs, where ownership of the machine belongs to the manufacturer and the customer pays for the results, or outcomes, delivered by the machine. Result-oriented BMs are also referred to as performance-based contracts (Hypko et al., 2010b; Liinamaa et al., 2016) and outcome-based contracts (Grubic and Jennions, 2018).

Result-oriented BMs are further categorized as activity management/outsourcing services, pay-per-service units, and functional results (Tukker, 2004). In the pay-per-service unit, the customer pays for the time units (or the number of hours the machine is deployed for) and the number of output units produced by the machine. More recent studies have used the terms pay-per-use (Gebauer et al., 2017; Uski et al., 2022) and availability OBC (Böhm et al., 2016; Grubic and Jennions, 2018; Korkeamäki, 2021) when the customer pays for time units. For example, the number of hours a tractor is used to extract fruits and vegetables from the field. Whereas output OBC (Korkeamäki, 2021) and pay-per-output (Uski et al., 2022) are the terms used to denote the output units produced. For example, the number of copies photocopied using a photocopier machine. Finally, functional results consider the amount of added value (e.g., energy savings) that the provider brings from the customer's perspective. For example, the units of energy saved while using a generator are offered in OBC. Recent literature has used the terms economic OBC (Uski et al., 2022) and pay-per-outcome to denote functional results (Böhm et al., 2016; Grubic and Jennions, 2018; Korkeamäki, 2021).

In this study, we use OBCs to denote similar BMs and services. Furthermore, we categorize OBCs into availability, output, and economic OBCs. In scientific literature, OBCs are quite often referred to as BMs (Ng et al., 2009; Grubic and Jennions, 2018), even though related studies do cover some but not all the major aspects of a BM. For instance, considering BMC components, only the value proposition is usually covered by OBC-related studies, whereas aspects like cost structure, key partners, and customer segments are not usually covered.

2.3 Servitization in Small and Medium-Sized Machine Manufacturers

Only a few academic studies (Kowalkowski et al., 2013; Adrodegari and Saccani, 2020; Kolagar et al., 2022) address servitization from the SME perspective. Bhamra et al. (2018), noting the specific needs of SMEs for service and business model development, argue that customized information is required to implement product-service systems in SMEs. Overall, existing research on service models largely neglects how company size affects service development (Gebauer et al., 2020). For instance, Oliva and Kallenberg (2003) argue that companies must enter the service market by serving an installed base. However, SMEs often sell through distributors, deliver through installers, and have limited access to their installed bases.

2.4 Unique Challenges Faced by Small and Medium-Sized Machine Manufacturers

To our knowledge, the current scientific literature offers only one study (Adrodegari et al., 2017), focusing on the challenges faced by a Finnish SME MM while offering OBCs. These challenges were related to changes in customer conditions and service personnel, cost estimations, and customer interest in carrying the OBCs. Adrodegari et al. (2017) also suggested that these challenges were mitigated by penalizing customers for changing the initial contract conditions. Similarly, predicting failures was suggested as a benefit of SME MMs while offering OBCs (Adrodegari et al., 2017). However, the study (Adrodegari et

al., 2017) only presented a single case study focusing on SMEs offering economic OBCs only. The present study performed an in-depth qualitative analysis of four diverse SME MMs to share their challenges and the benefits that they faced during the successful implementation of OBCs.

3. Methodology

The scientific literature lacks studies on how manufacturing enterprises can design OBCs (Adrodegari et al., 2018; Bains and Lightfoot, 2014), and we did not find any studies focusing on the design of OBCs from the perspective of SMEs. Therefore, we selected a qualitative multiple-case study research method, an inductive research approach, as the way to deal with a topic requiring exploratory research (Meredith, 1998; Yin, 2003). Moreover, our research: i) focuses on a contemporary real-life topic; ii) consists of how and what research questions were asked; and iii) we, as researchers, did not have any control over the events that accompanied our research questions.

Case Selection: Since the objectives of our research and the exploratory nature of our empirical settings followed theoretical conceptualization based on non-probability sampling techniques rather than a statistical sampling logic, we employed a theoretical sampling approach (Gentles et al., 2015) to select different types of SME MMs. Furthermore, the convenience and accessibility of the company representatives also played an important role in identifying the companies (Mason, 2010). Therefore, our focus was to select companies that could depict a variety of situations and challenges faced when SME MMs offer OBCs. Moreover, we selected companies based on the following inclusion criteria: First, we selected SME MMs dealing in the B2B domain. Second, we selected companies that have implemented their OBCs for more than two years to ensure that the outcomes and benefits of OBCs are more evident.

We started identifying the companies by searching on Google for the SME MMs that have successfully offered OBCs. We shortlisted such companies by going through studies, websites, and reports available on Google to understand what kind of OBC these companies offered. Furthermore, we identified OBCs based on their definitions (see section 2.2). Finally, we invited people at the senior management level (e.g., director and CEO) of these shortlisted companies to participate in our research, and finally, representatives of four SME MMs agreed to participate.

Our four SME MMs were selected to be diverse in various important OBC-related aspects (see Table 1) based on: i) the type of enterprises, for example, machinery and equipment manufacturing, metal product manufacturing, and electronics inspection; ii) the type of OBCs they offered, for example, availability OBC, output OBC, and a hybrid of availability OBC and economic OBC; iii) primary function of the machine offered during OBCs, for example, producing industrial gases and metals, and inspecting electronics hardware and software; iv) the machine offered by companies was standardized, or both standardized and customized; and v) the machine criticality (highly critical vs. less critical) to the customer's operations.

Data Collection: Since the research questions of our study have so far been unexplored and our questions required follow-up queries, we used semi-structured interviews to collect data (Adams et al., 2015). We started with developing a list of broad interview questions to evoke insights regarding how the MMs make important decisions when it comes to offering OBCs. As identified in the previous studies (Lay et al., 2009; Hypko et al., 2010a), these decisions focus on aspects concerning ownership of assets involved in offering OBCs, design of their OBCs, operations of their OBCs, and recycling of their machines involved in offering. We asked questions related to these decisions in two phases. During the first phase, we asked the representatives of companies to share and briefly comment on who takes ownership of assets and the responsibilities related to various design, operations, and recycling decisions when it comes to offering

OBC (Appendix I). Whereas, during the second phase, due to the time limitation, we discussed the three most important decisions while offering OBCs that were identified by the company representatives.

To develop the interview questions, we considered the typology proposed by previous studies (Lay et al., 2009; Hypko et al., 2010) regarding the decisions that manufacturing enterprises consider while offering servitization concepts like performance-based contracts. Since the previous studies (Lay et al., 2009; Hypko et al., 2010) were done more than a decade ago, we also considered a few more decisions based on our understanding. For example, when it comes to ownership, we asked who owned assets such as the machine during and after its phase of use (Lay et al., 2009; Hypko et al., 2010), software, data, and raw materials. Similarly, regarding the design phase, we asked about the importance of various decisions and their responsibilities, such as the type of OBCs offered (Lay et al., 2009; Hypko et al., 2010), machine utilization level, installation and logistics of the machine, duration of the contract, contract handling responsibility, and terms of penalty. Moreover, we asked questions about the importance of operational decisions and their responsibilities, such as location of operation for the machine (Lay et al., 2009; Hypko et al., 2010), skills and training of personnel, manufacturing of end products by using machine, and machine maintenance. Finally, we also asked who took responsibility for recycling and scrapping the machine.

At the beginning, the scope of the study was explained to representatives of the companies. The interviews were conducted virtually via the Microsoft Team platform. In addition, we also video and audio recorded our interviews. Moreover, we used Thinktank, an online platform, to conduct interviews. Thinktank allowed the interview participants to write their responses regarding the questions, and we were also able to see the responses of the participants. Furthermore, at the end of the first phase, the company representatives could see all the responses and were able to modify them. Similarly, the Thinktank facilitated the representatives in identifying the three most important decisions from their company's perspective (as all the decisions were displayed together on their screens).

Table 1. Company background.

Background dimensions	Company A	Company B	Company C	Company D
Type of Enterprise	Machinery and Equipment Manufacturing	Metal Product Manufacturing	Fabricated Metal Product Manufacturing	Electronics Inspection
Size of Enterprise	SME	SME	SME	SME
Company started	2010	1972	1985	2018
Turnover	≈ 2.5 m€	≈ 6.6 m€	≈ 18 m€	≈ 6 m€
Type of OBC	Hybrid output OBC & economic OBC	Output OBC	Availability OBC	Output OBC
Years since OBC is offered	5	2	2	2
Primary function of the machine	Producing industrial gases	Processing metals	Metal and sheet metal processing	Inspection of electronic hardware and software
Standard/ Customized machine	Standard	Standard/Customized	Standard/Customized	Standard
Degree of machine criticality for customer	Less critical	Highly critical	Highly critical	Highly critical
Location (headquarters)	Northern Europe	Central Europe	Central Europe	Southeast Asia
Interview Representative	Director (Partners)	Director	Director	Founder and CEO
Mode of interview	MS Teams and ThinkTank	MS Teams and ThinkTank	MS Teams and ThinkTank	MS Teams and ThinkTank
Fleets	Not offering	Not offering	Not offering	Not offering
Movable/ Installed equipment	Installed	Installed	Installed	Plug and Play

Data Analysis: The transcripts during the current study were in the form of audio-video files, interview notes, responses on Thinktank, and websites and reports of the companies. For the analysis of companies, the recorded interviews and Thinktank responses were manually coded (Appendix II). We also contacted the company representatives after the interviews to discuss the preliminary results of our study and obtain more details on the incomplete information.

Since data from different sources, like interviews, responses on Thinktank, websites, and reports of the companies, converged towards the same results, triangulation was observed (Yin, 2003). Our research also satisfied construct validity, internal validity, external validity, and reliability (Yin, 2003). As the company representatives reviewed the final version of the case analysis, construct validity was satisfied. As the study was not causal in nature, internal validity was not required (Yin, 2003). The external validity was checked with the help of literal and theoretical replications during the research design phase. Finally, different members of the research team independently interpreted and analyzed the data and obtained the same results; therefore, reliability was also satisfied.

4. Results

In this section, we discuss the results. Section 4.1 presents the results related to the challenges faced by SME MMs while offering OBCs and the ways to mitigate these challenges. In section 4.2, the benefits received by SME MMs while offering OBCs are discussed. The company names were mentioned for a challenge, mitigation, or benefit when they directly referred to them. As the challenges, risks, and mitigations were not asked (refer to section 3: Data collection and analysis), at times company representatives did not suggest something as a challenge but implemented ways to mitigate those challenges.

4.1 Challenges Faced by SME MMs While Offering OBCs and How They Mitigate These Challenges

The challenges, mitigation ways, and company representative quotes corresponding to both the challenges and the mitigation ways have been presented in Table 2.

Ownership of expensive machines

Challenge (Companies A, B, C, D): The SME MMs stated having several financial limitations. Therefore, offering OBCs was found by all companies to require huge capital to finance expensive machines (see Table 2). As a result, it was experienced as a unique SME MM challenge to acquire the huge amount of capital to offer OBCs.

Mitigation (Companies A, B, C): The SME MMs stated that they have been trying to identify a third party that can own the expensive machines offered during the OBCs. When a financial instrument, such as a third party is involved in the ownership of expensive machines, SMEs can mitigate the risks of owning such machines. In this regard, two out of four of our companies (A, B) were already getting third-party financing while offering OBCs (see Appendix I), whereas the representative of Company C suggested that they were trying to identify a partner for financing. Further, company D self-finances its OBCs and recognizes that this is a risk because they are an SME (see Table 2).

Long payback periods of OBCs

Challenge (Company A, B, C, D): In investment-based models, MMs are paid to sell their machine. However, the transition towards OBCs is complicated, as the payback time is longer than that of investment-

based models. As a result, OBCs need long-term financing before the payback time is reached and profit starts to accumulate (see Table 2). For SME MMs, sustaining this long payback time is not easy.

Mitigation (Companies A, B, C, D): The SME MMs look for separate contracts, to ensure minimum earnings to mitigate the challenge of long payback periods in OBCs. These separate contracts as shown by all four companies, are related to activities such as installation of the machine, skill enhancement training of the personnel involved in operating the machine, machine logistics, and machine maintenance (see Appendix I). In this regard, all four companies used installation and maintenance as separate contracts. Skill enhancement and training of personnel are used by companies A, B, and C, and logistics are used by companies A, C, and D as separate contracts for earnings (see Table 2).

Customers not utilizing the machines

Challenge (Company D): In OBCs, the earnings of SME MMs depend on the customer's machine utilization. However, the OBCs do not work in favor of SMEs, as their earnings are reduced if customers do not utilize the machine (see Table 2).

Mitigation (Companies A, B, C): The penalty and contract duration terms are designed to guarantee minimum earnings for SME MMs. Penalty terms ensure that there is a minimum fee for SMEs to earn even when the customer is not using the machine (see Appendix I). Similarly, SME MMs use variable pricing strategies. In variable pricing, the machine usage level by the customer is continuously monitored, and if it is sufficiently high, then a new pricing favoring the SMEs is negotiated with the customer (see Table 2).

Similarly, the duration of OBCs is very long (see Appendix I). Companies B and C have contracts for 1-5 years. However, company A has a continuous contract that is automatically renewed after the end of each year. If the customer of company A wants to end the contract, the customer needs to inform company A one year in advance. Thus, it provides company A with sufficient time to identify a new customer.

IP Protection

Challenge (Company D): IP provides a competitive edge for technology-oriented companies. The IP might be in the software, hardware, or both. Technology-oriented companies are very protective of their IP, and they avoid dealing with customers in countries where the legal system is not very strong. Overall, SME MMs are selective in choosing customers while offering OBCs (see Table 2).

Mitigation (Company D): SME MMs have a strong legal contract for offering OBCs. A strong legal contract ensures that their IP cannot leave their grasp. Moreover, even if someone has copied their IP, they are ready to defend their own case. Furthermore, SME MMs only offer OBCs to customers located in countries with strong legal systems (see Table 2).

Need for constant innovation

Challenge (Company B): SME MMs, while offering OBCs, also face enormous competition from other SMEs and large enterprises. In this regard, they need to constantly innovate. Moreover, SMEs need to be careful to survive and avoid mistakes while offering OBCs. Consequently, they also need access to the data generated by the machine when it is with the customers.

Mitigation (Companies C, D): When SME MMs offer OBCs, they can access the machine data. Analysis of this data reveals how the customer has been using the machine. Thus, improvements and innovations can be implemented in the machines. These innovations will lead to customer satisfaction. Our data showed that all four companies had access to the machine-related data from the customer (see Table 2).

Table 2. Quotes related to the challenges faced and mitigation ways by the interviewed small and medium-sized machine manufacturers when it comes to offering outcome-based contracts.

#	Challenge faced	Challenge Related Quote(s) by Representative(s)	Mitigation of Challenge	Mitigation Related Quote(s) by Company Representative(s)
1	Ownership of expensive machine	Company D: ‘...OBC growth is limited, because we are SME, we need capital to execute OBC...’	Involve third party to own the expensive machine	Company A: ‘...(machine) owned by financing partner for some part of the duration of use...’ Company B: ‘...financial strength is different because we are SME, we cannot do OBC direct, our company and end customer needs the third part financing, at the moment we have worked through 3rd party financing, maybe in future other options...’ Company C: ‘.... our company owns the machine...trying to find a partner (third party) who will own the machine.... when turning from investment-based model to OBC turnover is dropping dramatically...’
2	Long payback period of OBCs	Company C: ‘...when turning from investment-based model to OBC turnover is dropping dramatically...’	Offer separate contracts to ensure minimum earnings	Company B: ‘.... we sell our machines with training included...it is limited period usually during the machine installation...we also have remote training or training for new employees...this is important for us...’
3	Customers not utilizing the machines	Company D: ‘.... if the customer is not using machine, you are not earning anything, minimum is not enough...’	Defining penalty terms and contract duration to ensure minimum earnings	Company C: ‘...if customer is using machine a lot that will be divided for months.... if customer does not use machine a lot there will be a discussion about increased price...they do not have fixed minimum price for contract...’
4	IP Protection	Company D: ‘...machine consists of two parts...hardware part and software part (license model) problem some of these technologies can be copied...’	Designing strong legal contract	Company D: ‘.... make sure that legal paper is good, not easy for SME. (we offer OBC) in countries where legal system is strong...target is larger companies to minimize risks...’
5	Need for constant innovation	-	Get access to the machine-related data	Company D: ‘.... keeping the ownership of machine, we can do continuously improvements to machine and keep customer satisfaction at the highest level, no permissions needed (for data) etc. Customer loved when we do new improvements to the machine, and we don’t charge it...’ Company C: ‘...this is what we want to learn from each customers data to make our machine better...’
6	Offering required performance	Company D: ‘...if installation doesn’t work, we cannot make money...’	Taking responsibility of activities like training, maintenance, and installation, and getting access to data	Company B: ‘...it (installation) is the heart of the business delivery...you can fulfill your contract...and after installation has done you are basically out of risk and responsibility...this is critical in terms of machinery business...’ Company B: ‘...we sell our machines with training included...it is limited period of time usually during the machine installation...we also have remote training or training for new employees...this is important for us...’ Company B: ‘...it is written in the manuals what kind of components (raw material) you can process with our machines.... customers have specific instructions for this...’ Company B: ‘...(data) this is relevant for customers and our company in order to see the behavior of parts and life stand and stuff like that...but it can be shared by customer only, so it does not belong to us...the third party does not care about the shape of the product...they care about the performance of the machine...they care about use-based data...’

Delivering the required performance

Challenge (Company D): If the stipulated performance is not delivered in OBCs, then the SME MMs are penalized. At times, the use of incorrect raw materials, incorrect installation, improper maintenance, or

customers not taking proper care of the machine can lead to a failure to deliver the required performance (see Table 2).

Mitigation (Companies A, B, C, D): When SME MMs offer OBCs, they ensure delivery of performance by following various measures. First, they maintain the responsibility for activities such as installation, maintenance, and skill enhancement training for personnel. Our data showed that the responsibility for installation and maintenance belonged to all four companies. The responsibility for skill enhancement and training of employees using the machine was with companies A, B, and C. The machine in company D did not require any training as it only required switching on and off. Furthermore, detailed instructions regarding authorized raw materials that can be processed with the machine and how the process takes place are also mentioned by the SME MMs to avoid maintenance (see Table 2).

Moreover, SME MMs also have access to data. The data allows them to see how various parts of their machine behave and when they need to be repaired or replaced. These measures of predictive maintenance also ensure the delivery of the required performance. All four companies had access to the data generated by the machine at the customer’s location (see Table 2).

4.2 SME MMs Benefits While Offering OBCs

The challenges, mitigation ways, and company representative quotes corresponding to both the challenges and the mitigation ways have been presented in Table 3.

Table 3. Quotes related to the benefits by the interviewed small and medium-sized machine manufacturers when it comes to offering outcome-based contracts.

#	Benefits	Benefit Related Quote(s) by Company Representative(s)
1	Entering competitive markets	Company A: ‘...machine is so much more expensive than competitor’s machine that it is not possible to sell it as an investment product...customers didn’t believe performance level enough in the beginning to pay such a high price for the machine...with OBC it is possible... third party financing is used to finance machines...’
2	Sales and marketing of OBCs	Company B: ‘...third party financing is one more sales tool to get more business...’
3	Optimizing the cost of operating the machine	Company B: ‘...(data) this is relevant for customers and our company in order to see the behavior of parts and life stand and stuff like that...but it can be shared by customer only, so it does not belong to us...the third party does not care about the shape of the product...they care about the performance of the machine...they care about use-based data...’ Company B: ‘...it is written in the manuals what kind of components (raw material) you can process with our machines... customers have specific instructions for this...’ Company D: ‘... training of personnel is very important to keep machine up and running...’ Company D: ‘... if installation doesn’t work, we cannot make money...’Benefits related to avoiding money laundering and legal issues Company D: ‘... make sure that legal paper is good, not easy for SME... Used in countries where legal system is strong...’ Company D: ‘... risk managing/funding asset...you have to select/check customer carefully... target is larger companies to minimize risks... down payment is used to minimize risks...’
4	Reducing the investment through recycling the machine and its components	Company D: ‘... machine components (sophisticated electronic parts) are reused, mechanics (mechanical parts) not normally reused...’ Company D: ‘... machine comes back, refurbish, and sold again as OBCs...’

Benefits related to entering competitive markets

With the help of our data, we observed that one of the studied companies (Company A) considered OBCs a boon to bring its machine to market. Selling expensive machines through the investment-based model was a challenge for SME MMs. Moreover, the presence of competitors with lower prices further magnified

the challenge. However, with OBC, it was possible for customers to use third-party financing and prefer using a machine with higher output as compared to the competitor's machine.

Benefits related to sales and marketing of OBCs (Company B)

With the help of the data collected from the four companies, we also found that one of the studied companies (Company B) observed benefits related to the growth of their OBC. OBCs can open opportunities for niche markets and customer segments that are not available when SME MMs offer investment-based models. The OBCs provide an additional new sales channel when third-party financing is used. The financing company acts as an additional sales channel (see Table 3).

Benefits related to optimizing the cost of operating the machine (Companies A, B, C, D)

Offering OBC allows SME MMs to optimize the cost of operating the machines. The operating cost of the machine was optimized during OBCs for the following two reasons: First, while offering the OBC, the SME MMs had access to the data produced during the operations performed by the machine. Access to data allows the analysis of data and the study of the entire machine and its different parts. This ensures that the machine is utilized in the most efficient manner. The data collected from all four companies revealed that they had access to machine-related data generated at the customer's location (see Table 3).

Second, SME MMs that offer OBCs spend less on maintenance-related activities. While offering OBCs, the authorized materials that need to be used with the machine are stated in the manuals (see Table 3). Similarly, SME MMs train the employees of their customers who will be working with the machine. This training also reduces the chances of machine breakdown due to improper use by employees (see Table 3). Further, the correct installation of the machine is necessary for the proper functioning of the machine involved during OBCs. As a result, SME MMs also take responsibility for installing machines at the customer's location. Thus, maintenance-related issues are reduced because of the installation of the machine (see Table 3).

Offering OBCs does not involve any one-time payment for the machine by the customer. Rather, it involves continuous, periodic payments by the customers. As a result, there may be default customers who are unable to pay the required amount. Further, it is troublesome from a financial and resource perspective for SMEs to fight legal battles. Therefore, SME MMs offer their OBCs to large companies located in developed countries where the legal system is strong. Similarly, SME MMs also check customer profiles carefully and ask them for down payments (see Table 3).

Benefits related to reducing the investment through recycling the machine and its components

SME MMs use sophisticated machine components when offering OBCs. In investment-based models, these components must be sourced from suppliers. However, when offering OBCs, SME MMs can get the machine back once the contract is over. Based on the machine and its components, either they can offer the entire machine or some of its components in their existing OBCs, or they may repair the machine and offer it in their next OBCs. Thus, OBCs reduce the investment involved in offering a machine by recycling the machine and its components (see Table 3).

5. Discussion

Below, we present a discussion of our results in sections 5.1 and 5.2, respectively. We discuss the presence of several factors related to the challenges, mitigation, and benefits from the perspective of offering OBCs. Whereas the theoretical and managerial implications are presented in sections 5.3 and 5.4.

5.1 SME MMs Challenges and Mitigation of These Challenges While Offering OBCs

We found that there are major challenges and their mitigation ways that were considered critical by the studied SME MMs while offering OBCs (RQ1 and RQ2). These challenges are critical because all the diverse companies studied and those working with different business logics identified them. Therefore, these challenges might also be significant for other SME MMs and should be investigated further. Furthermore, through interviews, we found that SME MMs were able to mitigate these challenges by employing various strategies.

Ownership of the expensive machine

Due to the cost of the machine, owning the machine is a challenge for any company offering OBCs. However, with the help of our analysis in the current study, we identified that owning an expensive machine is a very critical challenge for the SME MMs offering OBCs. Moreover, we also observed that all four case companies have deployed various approaches to mitigate the challenge. For example, both company A and a third party partially own their machines. While, for company B, a third-party completely finances their machines. Company C owns the machine for now; however, they are actively looking for a third party to own the machine. Finally, company D owns the machine. However, due to being in a developing country, it is difficult for them to find third-party financiers who understand OBCs and are ready to own expensive machines. The main source of earnings for company D was through the licensing of their software; therefore, they were able to survive the challenge of owning the expensive machine. The challenge of owning an expensive machine may not be that critical for large enterprises, as the financial resources are available to them (Mittal et al., 2018). Likewise, due to available assets and negotiation powers, it is easier for large enterprises to get loans at a comparatively lower interest rate (Dietrich, 2012). In addition, the large enterprises may not involve third parties to avoid sharing the profits that OBCs will make. Furthermore, to get legal and tax advantages and for easier bookkeeping purposes, the large enterprises may even create a separate division or a subsidiary company for financing their OBCs (Lenka et al., 2018). Large enterprises might need the support of third parties when they are offering fleets of machines in their OBCs. On the other hand, SME MMs cannot even think of offering fleets of machines without getting support from third parties. Overall, owning an expensive machine while offering OBCs is a very critical challenge for SME MMs, and the four companies studied have suggested ways to mitigate this challenge.

Long payback period of OBCs

Longer payback periods become a major challenge while offering OBCs, as the cash flow during the transition phase is slower and reaching break-even takes longer. Moreover, for SME MMs, it becomes even more critical to generate earnings during the initial period of offering OBCs. However, SME MMs can also start by offering a hybrid of investment-based models and OBCs to ensure earnings. Once they start earning from OBCs, they can make a smoother transition towards offering pure OBCs. Further, when the machines have a longer lifetime and it takes a few years to achieve break-even point, the SME MMs need to make a tradeoff. This tradeoff is between minimizing risks by involving a third party to own the machine and sharing a major proportion of profits with them and maximizing risks by not involving a third party to own the machine and getting all the profits. Large enterprises have multiple businesses running (Muller et al., 2018), and therefore, they can wait for longer payback periods in OBCs. In this regard, all our interviewed SME MMs started to serve separate contracts for services like maintenance, installation, and training to ensure constant earnings. Overall, the long payback period is a very critical challenge for the SME MMs offering OBCs, and the four studied companies have suggested various ways to mitigate this challenge.

Customer Not Utilizing the Machine

The earnings in OBCs are based on the outcome delivered by the machine. If the machine is not being utilized, it will not produce any outcome and there will be no earnings. Thus, further building the limitations

of finances (Mittal et al., 2018) and limited sources of income (Muller et al., 2018) from the perspective of SME MMs offering OBCs. The studied SME MMs have started to use variable pricing strategies to overcome this challenge. In the variable price strategy, the customer pays a minimum fee even when they are not utilizing the machines, and if the customers use the machine, then they need to pay based on the output. Further, some SME MMs (e.g., companies' B and C) may offer customized machines, where the role of their machines would be very critical for customer operations, thus reducing the chances of machines not being utilized. Likewise, SME MMs can also focus on serving multiple customers at the same time to enhance the utilization of their machines. For example, their machine can be transported to different locations during the day to serve multiple customers. Therefore, this important problem of machines not being used by the customer will not be faced when machines are of a movable nature. However, the machine would not be able to serve multiple customers if it were installed at the customer's premises.

IP Protection

IP plays a critical role in offering OBCs, as it helps in monitoring the machine. IP can take many forms, such as hardware, software, data, and technology. SME MMs like Company D also want to protect their IP while offering OBCs by taking ownership of various forms of IP. If their IP is in conflict, then the SME MMs will face issues related to their limited financial resources (Mittal et al., 2018) and the specialized expertise (Mittal et al., 2018; Lenka et al., 2018) in their own field. This might not be a challenge for large enterprises, SME MMs who do not have their IP in machines, or SME MMs like company A that have patented their IPs and are located in places where there are strong regulations to protect IP. Therefore, company A did not consider IP a critical challenge, whereas company D, even after having patented their IPs because of their location, considered IP protection a major challenge. Further, ownership of IP can also protect SME MMs from third parties who are ready to finance and own the machine.

Need for Constant Innovation

Additionally, interviews with the representatives of the companies' C and D led to the identification that SME MMs also face tough competition from other SMEs and large enterprises, and they need to find novel ways to be more innovative and competitive. Further online connectivity of machines ensures data collection and analysis in real-time. Analyzing the data produced by their machines can lead to further improvements in the design of the machine and software features. The improvements and innovations in the machine will improve the machine's performance and reduce the cost of operations from both the customer's and SME MM's perspectives. Thus, the SME MMs offering OBCs would be able to differentiate themselves based on the costs. In investment-based models, SME MMs did not have access to data, but OBCs facilitate access to data and customer feedback. Thus, leading to innovations in machines. In investment-based models, the SMEs face the issue of accessing the data related to machines (Chan and Chung, 2002), and their research department is also not that active (Lenka et al., 2018). However, by offering OBCs, the SME MMs can overcome these limitations and become more competitive.

Delivering The Required Performance

Limited financial resources (Mittal et al., 2018) and limited information accessibility (Chan and Chung, 2002) make it challenging for SME MMs to deliver the required performance. If this performance is not delivered, then the SME MMs will be penalized. SME MMs take responsibility for installation (companies A, B, and C; company D's machine is plugged) and maintenance (all four companies), training the customer employees working with the machine (companies A, B, and C) to ensure that the machine is handled with care. In addition, SME MMs avoid maintenance by mentioning detailed instructions regarding the type of raw materials that can be processed by the machine and how the raw material needs to be processed. Further, the SME MMs, while offering OBCs, can, with the help of data analysis, perform preventive maintenance

and avoid machine downtime to deliver the required performance. As discussed earlier, all these responsibilities that SME MMs have also come with earnings.

5.2 SME MMs Benefits While Offering OBC

We also identified various benefits for SME MMs while offering OBCs (RQ3). These benefits were not observed by the studied SME MMs while they were offering machines in investment-based models.

Benefits related to entering competitive markets

In investment-based models, there are limited revenue sources. Similarly, external funding and innovation that can happen through the use of cutting-edge technology and data analysis in OBCs are comparatively slow. Thus, SMEs find it difficult to compete with large enterprises and enter competitive markets. However, while offering OBCs, SMEs can enter competitive markets (markets dominated by incumbents) with machines that are expensive and high-end in terms of technology through OBCs by overcoming finance (and other) key challenges through mitigation efforts mentioned in RQ1 and RQ2, respectively.

Benefits related to a novel way of sales and marketing of their OBCs

Traditionally, because of the limited availability of financial resources and personnel, SMEs find it difficult to find new customers by improving their sales and marketing strategies. However, with the help of the current research, we identified that even third parties can join hands with SME MMs (e.g., company B) towards the sales and marketing of their OBCs by spreading in niche markets. The customized machines produced for niche market customers reduce competition as there will not be other MMs producing such a customized machine. Moreover, the niche market will lead to long-term, loyal customers. Thus, guaranteeing the cash flows. As third parties have financed the equipment, they will also try their best to find new customers.

Benefits related to optimizing the cost of operating the machine

In investment-based models, where the customer owns the machine, the collaboration between the MM and the customer is minimal to the extent of making deals for purchasing, and thus, optimizing the cost of operating the machine is very complicated. However, in OBCs, the MMs are responsible for the additional activities required to deliver the outcome of the machine. With the help of our four SME MMs, we identified that SME MMs can optimize the operating cost of machines using the following approaches: analyzing their machine-related data, training employees and customers who will be working with the machine, and maintaining the responsibility of machine installation and machine maintenance. However, if a machine (e.g., company D) does not require installation, training of employees and software maintenance can be done remotely. Furthermore, if this machine is movable, then the manufacturer's trained employees can take care of all these responsibilities and transport it to the customer's site to deliver the required outcome. Overall, the cost of operations can be optimized while offering OBCs.

Benefits related to avoiding money laundering and legal issues

In addition, offering OBCs creates a comparatively long-term relationship between the customer and manufacturer as compared to investment-based models. Therefore, we also identified that SME MMs (e.g., company D) may reduce their risks of offering OBCs by not offering OBCs to other SMEs and large enterprises that are established in countries where the legal system is not strong and asking customers to make down payments. Large enterprises may not need to follow these ways of offering OBCs. As large enterprises have the funds and networks to sustain legal and money laundering issues. Thus, OBCs offer unique ways for SME MMs to avoid money laundering and legal issues.

Benefits related to reducing investment through recycling the machine and its components

As SME MMs can get their machine back once the contract is over (e.g., company D). If the machine cannot be offered in the next OBC, they may use sophisticated electronic components for another machine. Similarly, they can refurbish the mechanical parts of the machine and use it to offer OBC to the next customer. This recycling of machine and its components also leads towards IP protection and sustainability. SME MMs do not have this benefit when they offer investment-based models, as they may not be able to control the reverse supply chain of the machine and its components.

5.3 Theoretical Implications

Overall, with the help of the current research, we identified the challenges, ways of mitigating the identified challenges, and the unique benefits that SME MMs have when they offer OBCs. The existing scientific literature on OBCs mostly focuses on large enterprises (Barquet et al., 2013; Gebauer et al., 2017). We add to the previous study (Adrodegari et al., 2017) by focusing on OBCs offered by SME MMs.

The previous study suggested that SME MMs offering OBCs face challenges related to changes in customer conditions and service personnel, cost estimations, and customer interest, whereas we identified that SME MMs face various other challenges, such as ownership of expensive machines, long payback period of OBCs, protection of IP, the need for constant innovation, and delivering the required performance while offering OBC. Similarly, the previous study also suggested that their identified challenges can be mitigated by penalizing customers for changing the contract conditions initially present in the contract. However, our studied SME MMs mitigated their challenges by involving third parties to own the machine, offering separate contracts to ensure earnings, keeping ownership of IP, getting access to data for innovation, and taking responsibility for activities like maintenance, installation, and training to ensure the required performance. Finally, a previous study suggested that SME MMs, by offering OBCs, can predict failures. Whereas we identified that SME MMs can also have benefits such as entering competitive markets, optimizing the cost of operating the machine, finding novel and efficient ways of selling and marketing machines, avoiding money laundering and legal issues, and reducing investment through recycling the machine and its components while offering OBCs.

5.4 Managerial Implications

The current research can also help the managers of SME MMs that plan to offer OBCs. The identified challenges and their mitigation ways will inform the managers regarding how they can overcome those challenges. Furthermore, the managers can evaluate if the challenges and mitigation ways apply to their organization. For example, it might be difficult for an SME MM to find a third party to own their expensive machine; similarly, there might be a machine that does not need to be switched on and off, thus not requiring maintenance and installation. In such cases, the manager of an SME MM needs to identify alternate options for owning the machine and offer separate contracts. Furthermore, the identified benefits can also motivate the managers of SME MMs to offer OBCs to get unique competitive advantages and create new customers.

6. Conclusions

We identified that despite being diverse in many aspects, such as the nature of the company, type of OBC offered, and criticality of the machine, we found the presence of several factors, such as limited financial resources, limited negotiation powers, limited employee skills, limited sources of income, limited expertise, and limited information accessibility, that affect SME MMs when they offer OBCs. Thus, demonstrating that company size matters when SME MMs are offering OBCs. Despite all the limitations, we show four successful SME MMs that were able to successfully offer OBCs and mitigate the challenges faced while offering OBCs. Moreover, we also identified unique benefits that SME MMs gained while offering OBCs.

We conclude that there are critical challenges faced by SME MMs when offering OBCs. In more detail, we identified SME MMs specific challenges when offering OBCs (RQ1) that were related to the ownership of expensive machines, the longer payback period of OBCs, customers not utilizing the machine, protecting IP, the need for constant innovation, and delivering the required performance while offering OBCs. Based on our analysis, we also identified that some of these challenges, like ownership of the expensive machines and the long payback period while offering OBCs, were more critical for SME MMs. Owning the expensive machines becomes a challenge, as SMEs have limited financial resources (Mittal et al., 2018) and limited negotiation powers and assets (Dietrich, 2012), so owning such expensive machines and securing loans from financial institutes becomes difficult. Moreover, as SMEs have limited financial resources (Mittal et al., 2018) and limited sources of income (Muller et al., 2018), the long payback period while offering OBCs also becomes a challenge for SME MMs. Large enterprises may also face the identified challenges; however, due to the availability of financial resources, assets, high negotiation powers, and multiple businesses running in parallel, these challenges might not be that critical for them.

We further conclude that the mitigation ways identified (RQ2) in the current study provide a unique outlook towards solving the critical challenges identified in RQ1. These mitigation ways include involving third parties to own the expensive machines, ensuring earnings by including separate contracts for other activities such as installation, maintenance, training of employees working on machines, and logistics to overcome the challenge of a long payback period, designing favorable terms for penalties and contract duration to ensure utilization of machine, developing strong legal contracts to protect their IP, getting access to machine-related data for constant innovation, and taking responsibility for various activities such as installation and maintenance to ensure that the machine is able to offer the required performance. Based on our analysis, we also identified that some of these identified mitigation ways such as involving third parties to own the expensive machines and ensuring earnings by including separate contracts for various activities such as installation, maintenance, and training of employees, seemed to be more critical for SME MMs. When third parties or the financing partners are ready to own such expensive machines the SME MMs can overcome the limitations regarding financial resources, negotiation powers, and assets. Additionally, SME MMs, while serving separate contracts for additional activities and by offering hybrid investment-based models and OBCs, can ensure earnings and thus overcome their limitations related to financial resources and limited sources of income. However, since large enterprises do not have financial limitations, they have assets and negotiation powers, and they have multiple businesses running in parallel, the identified mitigations might not always be deployed by large enterprises.

Moreover, we also identified unique benefits that SME MMs can have while offering OBCs. These benefits are unique as they can only be observed when SME MMs offer OBCs. These benefits are related to entering competitive markets, optimizing the costs of machine operations, finding novel ways of sales and marketing of machine, avoiding money laundering and risk issues, and reducing investments through recycling machine and its components. Some of the benefits that are unique for SME MMs include entering competitive markets and novel ways of sales and marketing. SMEs can enter competitive markets dominated by incumbents with machines that are expensive and high-end in terms of technology through OBCs by overcoming finance and other key challenges identified in RQ1 and overcoming them through mitigation efforts mentioned in RQ 2. Similarly, in OBCs, third parties support sales and marketing and can help SME MMs enter niche markets. Entering niche markets will allow SME MMs to build brand loyalty and long-term customers (Galvão et al., 2018). Thus, ensuring constant cash flow for financially constrained SME MMs.

6.1 Limitations and Future Work

Although in our current research we studied four diverse SME MMs, there are many other SME MMs that exist, and the strategies for risk mitigation and overcoming challenges might be relevant for them to a different degree. As a result, future studies should identify the unique ways for risk mitigation and overcoming challenges that are followed by them while offering OBCs. Similarly, future research can focus on studying the unique benefits and advantages that other SMEs receive while offering OBCs. Additionally, a comparative study leading to similarities and differences between OBCs is offered by SME MMs, and large enterprises should also be studied. Finally, all four companies studied offered a machine that needed to be installed at the customer’s site. In the future, SME MMs offering movable machines can also be studied for comparison.

The challenges and their mitigation strategies identified in the current research were critical because they were faced by different types of companies that worked with different business logic. Therefore, these challenges and their mitigation strategies achieved for SME MMs should be studied in future research. Similarly, identifying the unique benefits and advantages offered by OBC also leads to optimization of the cost of operations and sustainability. Such benefits can also motivate managers of SME MMs to offer OBCs.

Conflict of Interest

We do not have any competing interest.

Acknowledgements

This work was supported by Business Finland under Grant number 545/31/2020.

Appendix I: Category of Interview Questions and Answers of the Case Companies

Question categories	Specific questions under each category	Answers (Company)		
Who owns the following:	Machine (during phase of use)	SMMI (A, C, D)	Customer (B)	Third Party
	Machine (after phase of use)	SMMI (A, B, C, D)	Customer (A)	Third Party
	Software	SMMI (A, B, C, D)	Customer (A)	Third Party
	Production Data	SMMI (A)	Customer (B, C, D)	Third Party
	Maintenance Data	SMMI (A, D)	Customer (B, C)	Third Party
	Raw materials	SMMI (A, D)	Customer (B, C)	Third Party
Design of OBC	Machine utilization level	High (A)	Customer (B)	Flexible (C)
	Installation	SMMI (A, B, C, D)	Customer	Third Party (A)
	Logistics	SMMI (A, C, D)	Customer (B)	Third Party
	Duration of contract	1-5 years (B, C, D)	>5 years	Continuous (A)
	Contract handling responsibility	SMMI (A, C, D)	Customer	Third Party (B)
	Terms of penalty	Minimum Fee (A, B, D)	Customer	Variable Pricing ©
Operational decisions	Skills and training of personnel	SMMI (A, B, C)	Customer (D)	
	Manufacturing of end-product	SMMI (C, D)	Customer (A, B)	
	Maintenance of machine	SMMI (A, B, C, D)	Customer	
Recycling	Scrapping, Upgrading	SMMI (A, B, C, D)	Customer (D)	

Appendix II: Coding of the Transcripts

We followed the steps (Smith et al., 2009) for manual coding of the transcripts.

Identifying broad themes: Three researchers started coding by identifying the broad themes by reviewing the transcripts and the research objectives; thus, three broad themes emerged. These themes were related to the challenges faced by the case companies, the methods followed by the case companies to mitigate the challenges, and the benefits that our case companies had while offering OBC. Initially, two researchers independently identified the data from transcripts of one case company for all three broad themes. Subsequently, the issues faced during coding and the meaning of each broad theme were clarified. Once the coding process was unanimously agreed upon, the two independent researchers coded the remaining three cases, and the third member reviewed the data present in the file of each case company for potential issues. At the end of this step, we had one file for each broad theme.

Decisions within each broad theme: Two researchers independently considered the first broad theme, that is, the challenges faced by case companies while offering OBC. After going through the file representing this broad theme, our research team decided to consider six themes: ownership of the machine, long payback periods, customers not utilizing the machine, protecting their IP, the need for constant innovation, and delivering the required performance. Since the broad theme of mitigating the challenges was related to the first broad theme, the first two broad themes were merged. Similarly, while considering the broad theme of benefits related to offering OBC or case companies, the following four themes were suggested: optimizing the cost of operating the machine, sales of OBC, identifying customers for offering OBC, and recycling the machine and its components.

Identifying similar traits: We observed that similar decisions influenced more than one broad theme. Therefore, two researchers discussed decisions that overlapped or were similar and were present in more than one broad theme. Finally, after being satisfied with the relevance of the decisions, they were either removed from one of the broad themes or kept in both broad themes. Finally, all the decisions and data for a broad theme were placed in a single Excel file.

Assessing content within a broad theme: We deployed both within-case and cross-case analyses to analyze our data (Yin, 2003; Anderson et al., 2010). We identified that some decisions pertaining to a broad theme were agreed upon by all four case companies, whereas decisions related to some broad themes were agreed upon by only three or two case companies. At times, decisions related to a broad theme were agreed upon only by a single company. This agreement depended on the nature of the industry and the business logic followed by the case company.

References

- Adams, W.C. (2015). Conducting semi-structured interviews. In: Newcomer, K.E., Hatry, H.P., Wholey, J.S. (eds) *Handbook of Practical Program Evaluation* (pp. 492-505). <https://doi.org/10.1002/9781119171386.ch19>.
- Adrodegari, F., & Sacconi, N. (2020). A maturity model for the servitization of product-centric companies. *Journal of Manufacturing Technology Management*, 31(4), 775-797. <https://doi.org/10.1108/jmtm-07-2019-0255>.
- Adrodegari, F., Bacchetti, A., Sacconi, N., Arnaiz, A., & Meiren, T. (2018). The transition towards service-oriented business models: A European survey on capital goods manufacturers. *International Journal of Engineering Business Management*, 10, 1847979018754469. <https://doi.org/10.1177/1847979018754469>.
- Adrodegari, F., Sacconi, N., Kowalkowski, C., & Vilo, J. (2017). PSS business model conceptualization and application. *Production Planning & Control*, 28(15), 1251-1263. <https://doi.org/10.1080/09537287.2017.1363924>.

- Anderson, K.J.B., Courter, S.S., McGlamery, T., Nathans-Kelly, T.M., & Nicometo, C.G. (2010). Understanding engineering work and identity: A cross-case analysis of engineers within six firms. *Engineering Studies*, 2(3), 153-174. <https://doi.org/10.1080/19378629.2010.519772>.
- Baines, T. S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Tiwari, A., Alcock, J.R., Walto, I.M., & Wilson, H. (2007). State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 221(10), 1543-1552. <https://doi.org/10.1243/09544054JEM858>.
- Baines, T., & W. Lightfoot, H. (2013). Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services. *International Journal of Operations & Production Management*, 34(1), 2-35. <https://doi.org/10.1108/IJOPM-02-2012-0086>.
- Barquet, A.P.B., De Oliveira, M.G., Amigo, C.R., Cunha, V.P., & Rozenfeld, H. (2013). Employing the business model concept to support the adoption of product-service systems (PSS). *Industrial Marketing Management*, 42(5), 693-704. <https://doi.org/10.1016/j.indmarman.2013.05.003>.
- Bhamra, T., Hernandez, R.J., Rapitsenyane, Y., & Trimmingham, R. (2018). Product service systems: A sustainable design strategy for SMEs in the textiles and leather sectors. *She Ji: The Journal of Design, Economics, and Innovation*, 4(3), 229-248. <https://doi.org/10.1016/j.sheji.2018.07.001>.
- Böhm, E., Backhaus, C., Eggert, A., & Cummins, T. (2016). Understanding outcome-based contracts: Benefits and risks from the buyers' and sellers' perspective. *Journal of Strategic Contracting and Negotiation*, 2(1-2), 128-149. <https://doi.org/10.1177/2055563616669740>.
- Chan, M.F.S., & Chung, W.W.C. (2002). A framework to develop an enterprise information portal for contract manufacturing. *International Journal of Production Economics*, 75(1-2), 113-126. [https://doi.org/10.1016/S0925-5273\(01\)00185-2](https://doi.org/10.1016/S0925-5273(01)00185-2).
- Dahmani, S., Boucher, X., Gourc, D., Peillon, S., & Marmier, F. (2020). Integrated approach for risk management in servitization decision-making process. *Business Process Management Journal*, 26(7), 1949-1977. <https://doi.org/10.1108/BPMJ-07-2019-0279>.
- de Oliveira, M.G., de Sousa Mendes, G.H., de Albuquerque, A.A., & Rozenfeld, H. (2018). Lessons learned from a successful industrial product service system business model: Emphasis on financial aspects. *Journal of Business & Industrial Marketing*, 33(3), 365-376. <https://doi.org/10.1108/JBIM-07-2016-0147>.
- Dietrich, A. (2012). Explaining loan rate differentials between small and large companies: Evidence from Switzerland. *Small Business Economics*, 38(4), 481-494. <https://doi.org/10.1007/s11187-010-9273-8>.
- Galvão, M.B., De Carvalho, R.C., Oliveira, L.A.B.D., & Medeiros, D.D.D. (2018). Customer loyalty approach based on CRM for SMEs. *Journal of Business & Industrial Marketing*, 33(5), 706-716. <https://doi.org/10.1108/jbim-07-2017-0166>.
- Gebauer, H., Arzt, A., Kohtamäki, M., Lamprecht, C., Parida, V., Witell, L., & Wortmann, F. (2020). How to convert digital offerings into revenue enhancement - Conceptualizing business model dynamics through explorative case studies. *Industrial Marketing Management*, 91, 429-441. <https://doi.org/10.1016/j.indmarman.2020.10.006>.
- Gebauer, H., Haldimann, M., & Saul, C.J. (2017). Competing in business-to-business sectors through pay-per-use services. *Journal of Service Management*, 28(5), 914-935. <https://doi.org/10.1108/josm-07-2016-0202>.
- Gebauer, H., Paiola, M., & Edvardsson, B. (2010). Service business development in small and medium capital goods manufacturing companies. *Managing Service Quality: An International Journal*, 20(2), 123-139. <https://doi.org/10.1108/09604521011027561>.
- Gebauer, H., Paiola, M., & Edvardsson, B. (2012). A capability perspective on service business development in small and medium-sized suppliers. *Scandinavian Journal of Management*, 28(4), 321-339. <https://doi.org/10.1016/j.scaman.2012.07.001>.

- Gentles, S.J., Charles, C., Ploeg, J., & McKibbin, K.A. (2015). Sampling in qualitative research: insights from an overview of the methods literature. *The Qualitative Report*, 20(11), 1772-1789. <https://doi.org/10.46743/2160-3715/2015.2373>.
- Grubic, T., & Jennions, I. (2018). Do outcome-based contracts exist? The investigation of power-by-the-hour and similar result-oriented cases. *International Journal of Production Economics*, 206, 209-219. <https://doi.org/10.1016/j.ijpe.2018.10.004>.
- Grubic, T., & Peppard, J. (2016). Servitized manufacturing firms competing through remote monitoring technology: An exploratory study. *Journal of Manufacturing Technology Management*, 27(2), 154-184. <https://doi.org/10.1108/jmtm-05-2014-0061>.
- Hypko, P., Tilebein, M., & Gleich, R. (2010). Clarifying the concept of performance-based contracting in manufacturing industries: A research synthesis. *Journal of Service Management*, 21(5), 625-655. <https://doi.org/10.1108/09564231011079075>.
- Kanninen, T., Penttinen, E., Tinnilä, M., & Kaario, K. (2017). Exploring the dynamic capabilities required for servitization: The case process industry. *Business Process Management Journal*, 23(2), 226-247. <https://doi.org/10.1108/bpmj-03-2015-0036>.
- Kolagar, M., Reim, W., Parida, V., & Sjödin, D. (2022). Digital servitization strategies for SME internationalization: The interplay between digital service maturity and ecosystem involvement. *Journal of Service Management*, 33(1), 143-162. <https://doi.org/10.1108/josm-11-2020-0428>.
- Korkeamäki, L. (2021). Further semiotic perspectives on the outcome-based vs performance-based semantic dispute. In: Kohtamäki, M., Baines, T., Rabetino, R., Bigdeli, A.Z., Kowalkowski, C., Oliva, R., Parida, V. (eds) *The Palgrave Handbook of Servitization* (pp. 137-147). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-75771-7_9.
- Korkeamäki, L., Sjödin, D., Kohtamäki, M., & Parida, V. (2022). Coping with the relational paradoxes of outcome-based services. *Industrial Marketing Management*, 104, 14-27. <https://doi.org/10.1016/j.indmarman.2022.04.005>.
- Kowalkowski, C., Witell, L., & Gustafsson, A. (2013). Any way goes: Identifying value constellations for service infusion in SMEs. *Industrial Marketing Management*, 42(1), 18-30. <https://doi.org/10.1016/j.indmarman.2012.11.004>.
- Lay, G., Schroeter, M., & Biege, S. (2009). Service-based business concepts: A typology for business-to-business markets. *European Management Journal*, 27(6), 442-455. <https://doi.org/10.1016/j.emj.2009.04.002>.
- Lenka, S., Parida, V., Sjödin, D.R., & Wincent, J. (2018). Exploring the microfoundations of servitization: How individual actions overcome organizational resistance. *Journal of Business Research*, 88, 328-336. <https://doi.org/10.1016/j.jbusres.2017.11.021>.
- Liinamaa, J., Viljanen, M., Hurmerinta, A., Ivanova-Gongne, M., Luotola, H., & Gustafsson, M. (2016). Performance-based and functional contracting in value-based solution selling. *Industrial Marketing Management*, 59, 37-49. <https://doi.org/10.1016/j.indmarman.2016.05.032>.
- Lin, J.J., Lin, Y.K., Yeng, L.C.L., & Yeh, R.H. (2023). An outcome-based maintenance contracting model by considering multi-criteria and risk equilibrium. *Annals of Operations Research*, 1-20. <https://doi.org/10.1007/s10479-023-05331-4>. (In press).
- Low, M.P., Seah, C.S., Cham, T.H., & Teoh, S.H. (2022). Digitalization adoption for digital economy: An examination of Malaysian small medium-sized enterprises through the technology–organization–environment framework. *Business Process Management Journal*, 28(7), 1473-1494. <https://doi.org/10.1108/bpmj-06-2022-0282>.
- Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. In *Forum qualitative Sozialforschung/Forum: qualitative social research* (Vol. 11, No. 3). Art. 8, <https://doi.org/10.17169/fqs-11.3.1428>.

- Meredith, J. (1998). Building operations management theory through case and field research. *Journal of Operations Management*, 16(4), 441-454. [https://doi.org/10.1016/S0272-6963\(98\)00023-0](https://doi.org/10.1016/S0272-6963(98)00023-0).
- Mittal, S., Khan, M.A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49, 194-214. <https://doi.org/10.1016/j.jmsy.2018.10.005>.
- Müller, J.M., Buliga, O., & Voigt, K.I. (2018). Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technological Forecasting and Social Change*, 132, 2-17. <https://doi.org/10.1016/j.techfore.2017.12.019>.
- Müller, J.M., Buliga, O., & Voigt, K.I. (2018). Fortune favors the prepared: How SMEs approach business model innovations in industry 4.0. *Technological Forecasting and Social Change*, 132, 2-17. <https://doi.org/10.1016/j.techfore.2017.12.019>.
- Neely, A., & West, S. (2022). Aligning performance metrics in outcome-based contracts. *California Management Review*, 64(3). <https://doi.org/10.1016/j.omega.2020.102343>.
- Ng, I.C.L., Maull, R., Yip, N. (2009). Outcome-based contracts as a driver for systems thinking and service-dominant logic in service science: Evidence from the defence industry. *European Management Journal* 27, 377-387. <https://doi.org/10.1016/j.emj.2009.05.002>.
- Oliva, R., & Kallenberg, R. (2003). Managing the transition from products to services. *International Journal of Service Industry Management*, 14(2), 160-172. <https://doi.org/10.1108/09564230310474138>.
- Paiola, M., & Gebauer, H. (2020). Internet of things technologies, digital servitization and business model innovation in BtoB manufacturing firms. *Industrial Marketing Management*, 89, 245-264. <https://doi.org/10.1016/j.indmarman.2020.03.009>.
- Rabetino, R., Kohtamäki, M., & Gebauer, H. (2017). Strategy map of servitization. *International Journal of Production Economics*, 192, 144-156. <https://doi.org/10.1016/j.ijpe.2016.11.004>.
- Rymaszewska, A., Helo, P., & Gunasekaran, A. (2017). IoT powered servitization of manufacturing - an exploratory case study. *International Journal of Production Economics*, 192, 92-105. <https://doi.org/10.1016/j.ijpe.2017.02.016>.
- Schaefers, T., Ruffer, S., & Böhm, E. (2021). Outcome-based contracting from the customers' perspective: A means-end chain analytical exploration. *Industrial Marketing Management*, 93, 466-481. <https://doi.org/10.1016/j.indmarman.2020.06.002>.
- Schroeder, A., Naik, P., Ziaee Bigdeli, A., & Baines, T. (2020). Digitally enabled advanced services: A socio-technical perspective on the role of the internet of things (IoT). *International Journal of Operations & Production Management*, 40(7/8), 1243-1268. <https://doi.org/10.1108/IJOPM-03-2020-0131>.
- Shanmugam, R.K., & Dhingra, T. (2023). Outcome-based contracts–Linking technology, ownership and reputations. *International Journal of Information Management*, 70, 102624. <https://doi.org/10.1016/j.ijinfomgt.2023.102624>.
- Smith, A.D., Plowman, D.A., Duchon, D., & Quinn, A.M. (2009). A qualitative study of high-reputation plant managers: Political skill and successful outcomes. *Journal of Operations Management*, 27(6), 428-443. <https://doi.org/10.1016/j.jom.2009.01.003>.
- Solima, L., Della Peruta, M.R., & Maggioni, V. (2016). Managing adaptive orientation systems for museum visitors from an IoT perspective. *Business Process Management Journal*, 22(2), 285-304. <https://doi.org/10.1108/bpmj-08-2015-0115>.
- Tukker, A. (2004). Eight types of product–service system: Eight ways to sustainability? Experiences from SusProNet. *Business Strategy and the Environment*, 13(4), 246-260. <https://doi.org/10.1002/bse.414>.

- Tukker, A. (2015). Product services for a resource-efficient and circular economy—a review. *Journal of Cleaner Production*, 97, 76-91. <https://doi.org/10.1016/j.jclepro.2013.11.049>.
- Uski, V.M., Kukkamalla, P.K., Kärkkäinen, H., & Menon, K. (2022). Capability framework implementing pay-per-outcome business model in equipment manufacturing companies. *Journal of Business Models*, 10(1), 30-41. <https://doi.org/10.54337/jbm.v10i1.6785>.
- Visnjic, I., Neely, A., & Jovanovic, M. (2018). The path to outcome delivery: Interplay of service market strategy and open business models. *Technovation*, 72-73, 46-59. <https://doi.org/10.1016/j.technovation.2018.02.003>.
- Yin, R.K. (2003). Designing case studies. In Maruster. L., & Gijnsberg, M.J. (eds) *Qualitative Research Methods* (Vol. 5, No. 14, pp.359-386). Sage Publication, London.
- Zancul, E.D.S., Takey, S.M., Barquet, A.P.B., Kuwabara, L.H., Cauchick Miguel, P.A., & Rozenfeld, H. (2016). Business process support for IoT based product-service systems (PSS). *Business Process Management Journal*, 22(2), 305-323. <https://doi.org/10.1108/bpmj-05-2015-0078>.



Original content of this work is copyright © International Journal of Mathematical, Engineering and Management Sciences. Uses under the Creative Commons Attribution 4.0 International (CC BY 4.0) license at <https://creativecommons.org/licenses/by/4.0/>

Publisher's Note- Ram Arti Publishers remains neutral regarding jurisdictional claims in published maps and institutional affiliations.