

# Capabilities toward adoption of outcome-based contracts

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## Abstract

**Purpose** – Manufacturing enterprises have started to offer the “outcome” derived from machines with the help of outcome-based contracts (OBCs). Offering OBCs leads to benefits such as increased revenues, stronger customer relationships and sustainability. However, implementing OBCs requires critical capabilities. Existing literature has focused on identifying these necessary capabilities, but the prioritization and interrelationships among them remain unexplored. This study aims to address this gap.

**Design/methodology/approach** – Our study employs a hybrid analytical hierarchy process and interpretative structural modeling approach to prioritize and map interrelationships among OBC-related capabilities within small and medium-sized enterprises (SMEs).

**Findings** – The findings highlight the importance of digitalization capabilities such as data privacy and security, remote monitoring, and data analytics; and organizational and governance capabilities, including quantifying, controlling, and monitoring risks, teamwork, and leadership, are highlighted.

**Research limitations/implications** – We quantitatively prioritize OBC capabilities and establish their level-wise structural interrelationships, which will facilitate a more effective and efficient implementation of OBCs. Due to the emergent nature of OBCs, our study could identify just one SME case company meeting our selection criteria.

**Originality/value** – Existing OBC literature focusses on the design of OBCs in large companies. Similarly, earlier capability-related OBC literature is oriented toward identifying the OBC capabilities to perform specific functions. However, in the current study, we propose a systematic decision-making approach that comprehensively prioritizes and identifies the interrelationships among the capabilities necessary to provide OBCs, thus complementing the existing scientific literature on OBCs. In addition, we focus on SMEs, that have specific limitations and characteristics.

**Keywords** Capabilities, Outcome-based contracts, Digitalization, Data analytics, Analytical hierarchy process, Interpretative structural modelling

**Paper type** Research paper

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## 1. Introduction

An increasing number of manufacturing enterprises are shifting their focus from solely selling their machines to providing the derived “outcome” of these machines (Helander and Moller, 2007). This operational logic is referred to as outcome-based contracts (OBCs). While traditional investment-based models focus on selling machines to customers, OBCs redefine the role of machine manufacturers (MMs) by making them responsible for delivering specific outcomes such as the availability of tractor hours and economic savings generated while using a machine. In OBCs, the MMs’ assume responsibility for various machine-related tasks, including maintenance, repairs, and personnel (Hypko *et al.*, 2010). This allows customers to focus on their core business activities. Furthermore, benefits such as increased revenues, stronger customer relationships, and sustainability (Eggert *et al.*, 2014; Lightfoot *et al.*, 2013) serve as a driving force to embrace OBCs. However, the process of offering OBCs demands critical capabilities that must be both identified and adopted.

Overall, the existing literature on OBCs focuses on their design. Specifically, approaches like the Business Model Canvas (BMC) (Adrodegari *et al.*, 2016, 2017) and the morphological box method (Hypko *et al.*, 2010) have been used to conceptualize OBCs. The BMC provides a strategic overview from nine perspectives, including value proposition, customer segments, and revenues. In contrast, the morphological box method explores different concrete OBC design options for profit and value creation (Uuskoski *et al.*, 2023). Additionally, some studies have proposed maturity models (Adrodegari *et al.*, 2017) to assess how well OBCs are prepared to deliver the desired outcomes.

When it comes to the discussion of capabilities while offering OBCs, the existing scientific literature has primarily focused on the identification of specific capabilities needed for implementing OBCs in selected industries. For example, OBC capabilities have been studied from aspects like customer relationships (Korkeamäki and Kohtamäki, 2020; Visnjic *et al.*, 2018), value networks (Ng and Nudurupati, 2010), contracting (Liinamaa *et al.*, 2016), digitalization (Chen *et al.*, 2023; Heirati *et al.*, 2024), organizational and governance capabilities (Bag *et al.*, 2024; Brekke *et al.*, 2024) and financing (Korkeamäki and Kohtamäki, 2019; Rapaccini, 2015).

However, prior to the adoption of capabilities, it is important to prioritize the capabilities based on their interrelationships. This prioritization is essential for achieving the overall goal of successfully implementing OBCs, as the capabilities with greater driving power should be prioritized (Gulla and Gupta, 2012; Mızrak Özfırat *et al.*, 2014). By focusing on these key capabilities early, organizations can establish a foundation that facilitates the development of other capabilities with less driving power. This is because there are complex interrelationships among the capabilities (Tseng and Lee, 2014; Kumar *et al.*, 2023). Moreover, setting up over-ambitious goals and simultaneous development of all capabilities could potentially lead to financial setbacks and unfavorable outcomes (Münch *et al.*, 2022). Especially for resource-constrained SMEs, focusing on capability development is crucial for successful servitization and competitiveness. Research in this area can guide informed decision-making and support systematic capability development, helping SMEs overcome common challenges in offering OBCs.

Overall, the existing literature does not propose a systematic decision-making approach for prioritizing and identifying the interrelationships among the capabilities necessary to provide OBCs. However, prior studies (Kumar *et al.*, 2022, 2023) have employed mixed methods to prioritize and establish interrelationships among various barriers, drivers, or capabilities, in the domains such as digital resilience for SMEs and food supply chains. According to such investigations, such methods could potentially yield improved long-term planning and expedited strategic decision-making. To overcome this research gap, we have the following research questions.

- RQ1.* What are the critical capabilities (for MMs) based on their respective impact on the overall adoption of OBCs and why?

RQ2. How do the OBC capabilities interrelate among each other?

RQ3. What can be a level-wise structural model of OBC capabilities based on their relative driving and dependence power?

To address the research questions, a mixed-method approach was used. First, a literature review identified the necessary capabilities for offering OBCs. These were presented to two senior managers from a North-European SME MM, followed by two interview rounds. In the first round, managers ranked capability dimensions using the analytic hierarchy process (AHP) to identify the most critical ones (RQ1). In the second round, they explored the interrelationships among capabilities in the top dimensions (RQ2 and RQ3) using Interpretive Structural Modeling (ISM). AHP and ISM were complemented by qualitative interviews to explain why some capabilities are more critical and how they interrelate.

The subsequent sections of the paper are organized as follows: Section 2 presents the background of our research. Section 3 outlines the research methodology utilized. Section 4 provides the background of the case company. Sections 5 and 6 present the results and the discussion respectively. Lastly, Section 7 presents the conclusions including theoretical and managerial implications, limitations, and prospects for future research stemming from our study.

## 2. Background

### 2.1 Outcome-based contracts

Product-service systems (PSS) are a popular framework to define and categorize the different degrees of servitization (Tukker, 2004). According to the PSS framework, the transition from offering pure products toward offering pure services involves product-oriented, use-oriented and result-oriented services (Tukker, 2004). Product-oriented services include investment-based models, where the customer retains machine ownership and pays for additional services such as maintenance and repair of the machine. Use-oriented services include renting and leasing services, in which the customer pays to use the machine, whereas the manufacturer owns the machine. Finally, in result-oriented services, the customer pays for the Münch results, whereas machine ownership belongs to the manufacturer. Result-oriented services are also referred to as outcome-based contracts (Liinamaa *et al.*, 2016).

Furthermore, result-oriented services can be categorized as activity management/outsourcing services, pay-per-service units and functional results (Tukker, 2004; Korkeamäki, 2021). In activity management partial activity or activities of an organization are taken care of by the third party, e.g. catering and security services. In pay-per-service units, the customer pays for: (1) the number of hours they use the machine referred to as pay-per-use and availability OBC; and (2) the number of output units produced by the machine referred to as pay-per-output and output OBC. Finally, the functional results or the economic OBCs consider the amount of added value (e.g. energy savings) and economic savings created by the machine for the customer.

### 2.2 Capabilities required for offering OBCs

Scientific literature presents studies from the perspective of identifying the capabilities for a specific purpose such as contracting or digitalization. Similarly, there are studies focusing on understanding the capabilities required for adopting specific technologies such as IoT and ICT (Neirotti *et al.*, 2018; Sunday and Vera, 2018). There is one recent study (Uski *et al.*, 2022) that conducted a literature review to propose a framework consisting of 36 OBC-related capabilities. Furthermore, based on the similarities among the identified capabilities, they were categorized under seven dimensions. The capability framework is presented in Table 1. Our work extends this list by incorporating capabilities recommended by Sjödin (2021).

| Dimension                   | Capability                                                                                 | Reference                                                       |
|-----------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Customer relationship       | Capability to establish trustworthy relationships with customers                           | Korkeamäki and Kohtamäki (2020)                                 |
|                             | Capability for transparent interorganizational communication                               | Korkeamäki and Kohtamäki (2020)                                 |
|                             | Capability to co-develop with customers                                                    | Schaefers <i>et al.</i> (2021)                                  |
|                             | Capability to co-product with customer                                                     | Schaefers <i>et al.</i> (2021)                                  |
|                             | Capability to communicate new roles and responsibilities between the customer and supplier | Hou and Neely (2018)                                            |
|                             | Capability to understand customer needs                                                    | Hou and Neely (2018), Visnjic <i>et al.</i> (2018)              |
| Value network               | Capability to understand customer processes in-depth                                       | Korkeamäki and Kohtamäki (2020), Schaefers <i>et al.</i> (2021) |
|                             | Capability to convince customer about the value of pay-per-x business model                | Korkeamäki and Kohtamäki (2020), Schaefers <i>et al.</i> (2021) |
| Digitalization              | Capability to identify and analyze relevant partners                                       | Ng <i>et al.</i> (2013)                                         |
|                             | Capability to evaluate partner's performance                                               | Hou and Neely (2018)                                            |
|                             | Capability to orchestrate the value network partners                                       | Hou and Neely (2018)                                            |
|                             | Capability for remote monitoring                                                           | Grubic and Peppard (2016)                                       |
|                             | Capability to convince the customer to share data                                          | Grubic and Peppard (2016), Sjödin (2021)                        |
|                             | Data analytics capabilities                                                                | Grubic and Peppard (2016), Sjödin (2021)                        |
| Organization and governance | Capability to ensure data privacy and security                                             | Grubic and Peppard (2016), Sjödin (2021)                        |
|                             | Capability to simulate equipment performance                                               | Grubic and Peppard (2016)                                       |
|                             | Capability to prioritize customer issues over internal issues                              | Ng <i>et al.</i> (2010)                                         |
|                             | Capability to quantify, control, and monitor risks                                         | Ng <i>et al.</i> (2010)                                         |
|                             | Capability to quickly react to fast-changing situations                                    | Ng <i>et al.</i> (2010)                                         |
|                             | Capability to establish a continuous learning culture                                      | Ng <i>et al.</i> (2010)                                         |
|                             | Capability to lead                                                                         | Ng <i>et al.</i> (2010)                                         |
|                             | Capability to work in teams                                                                | Ng <i>et al.</i> (2010)                                         |
| Contracting and legal       | Capability for marketing people to understand technicalities                               | Schaefers <i>et al.</i> (2021)                                  |
|                             | Capability to create value-based contracts                                                 | Ng and Nudurupati (2010)                                        |
|                             | Capability to negotiate value-based contracts                                              | Liinamaa <i>et al.</i> (2016)                                   |
|                             | Capability to manage IP and tacit knowledge                                                | Liinamaa <i>et al.</i> (2016)                                   |
| Service development         | Capability to manage value-based contracts during contracts' life-cycle                    | Liinamaa <i>et al.</i> (2016)                                   |
|                             | Capability to quantify the value provided by the offer                                     | Liinamaa <i>et al.</i> (2016), Rapaccini (2015)                 |
|                             | Distribution logistics capability                                                          | Korkeamäki and Kohtamäki (2019)                                 |
|                             | Installation and maintenance capability                                                    | Korkeamäki and Kohtamäki (2019)                                 |
|                             | Dissemble and recycling capabilities                                                       | Schaefers <i>et al.</i> (2021)                                  |
|                             | Capability to design services                                                              | Schaefers <i>et al.</i> (2021)                                  |
| Financing                   | Capability for preventive maintenance                                                      | Schaefers <i>et al.</i> (2021)                                  |
|                             | Capability to finance non-ownership business model                                         | Rapaccini (2015)                                                |
|                             | Capability to calculate PSS life-cycle cost                                                | Rapaccini (2015)                                                |
|                             | Capability to convince financial partners                                                  | Korkeamäki and Kohtamäki (2019)                                 |

**Table 1.**  
Capability framework **Source(s):** Authors' own work

Since OBCs require a strong relationship between the MMs and the customers, there is a requirement of *customer relationship capabilities* that addresses how the shift toward a service-oriented nature alters the customer relationship when offering OBCs (Schaefers *et al.*, 2021; Visnjic *et al.*, 2018). The *customer relationship capabilities* help companies build and maintain customer relationships, including establishing trust, understanding customer needs and processes and collaborating effectively with customers (Korkeamäki and Kohtamäki, 2020; Schaefers *et al.*, 2021). In OBCs, the customer is paying for measurable outcomes, and therefore, *digitalization capabilities* become essential for facilitating efficient measurement of these outcomes and optimizing equipment performance, as well as for understanding how technology and data are used to offer OBCs. *Digitalization capabilities* include functionalities such as remote monitoring, data analytics, data security, and equipment performance simulation (Grubic and Peppard, 2016; Sjödin, 2021; Chen *et al.*, 2023).

Additionally, since payments depend on achieved outcomes, OBCs inherently entail risks. To manage these risks, complex contracts are developed. Therefore, specific *contracting and legal capabilities* that enable companies to construct, negotiate, and manage contracts as well as intellectual property (IP) have also been recognized in the scientific literature (Linamaa *et al.*, 2016; Ng and Nudurupati, 2010). Moreover, in OBCs, the MMs are more actively involved during customer processes (Yang *et al.*, 2018), however, they often lack the required capabilities. As a result, certain responsibilities, such as installation, maintenance, or deinstallation, are often outsourced to entities within their value network (Ng *et al.*, 2013; Hou and Neely, 2018). In this context, *value network capabilities* are imperative for identifying, evaluating, and orchestrating partners within the value network that support OBCs (Hou and Neely, 2018; Ng *et al.*, 2013).

Furthermore, since ownership of the machine remains with the MMs in OBCs, the financial risks are increased (Korkeamäki and Kohtamäki, 2019; Tukker, 2004). To mitigate the financial risks, MMs often engage third-party financiers to assume ownership of the machine. Thus, there is a need for *financing capabilities* as well (Korkeamäki and Kohtamäki, 2019; Rapaccini, 2015). Furthermore, in order to mitigate risks associated with the promised outcomes and optimize equipment performance, MMs need to be flexible and react quickly toward customer needs. Consequently, studies have identified the need to develop *organizational and governance capabilities* (Ng *et al.*, 2010). This includes capabilities linked to risk management, teamwork, leadership, and a customer-oriented approach in the provision of OBCs (Ng *et al.*, 2010; Schaefers *et al.*, 2021). As the operational logic of OBCs is service-oriented, research studies have also been directed toward understanding how MMs transform themselves toward service development. These studies have highlighted that a successful transition to offering OBCs necessitates changes in how companies provide services that include machine operations, maintenance, and deinstallation (Korkeamäki and Kohtamäki, 2019; Linamaa *et al.*, 2016). Therefore, companies need to develop new *capabilities for service development*.

### 2.3 Research gap

Overall, the existing scientific literature identifies the capabilities required for offering OBCs (see section 2.2). However, no studies have comprehensively examined these OBC-related capabilities. Our study seeks to clarify how OBC capabilities can be prioritized and how they interact with one another. We first compare all OBC capability dimensions to identify and prioritize the most critical ones. We then investigate the interrelationships among these prioritized dimensions, exploring how different capabilities influence each other. For instance, one capability might facilitate the adoption of another, while another might not. In such cases, the capability that supports the adoption of others should be prioritized. Establishing clear interrelationships among capabilities can help reduce overall investments, enhance employee skills, and improve decision-making, thereby addressing a few challenges faced by SMEs (Mittal *et al.*, 2019). Our study focuses on OBC capabilities

### 3. Methodology

To address the research questions of this study, an integrated (hybrid) multi-criteria decision-making (MCDM) approach has been employed. An inductive approach was used because OBCs in SMEs are relatively a new topic (Uuskoski *et al.*, 2023), and existing scientific literature lack studies that examine the capabilities required for OBCs and establish the interrelationships among these capabilities (Argyropoulou *et al.*, 2024). As quantitative techniques alone may not delve deeply into understanding the context, qualitative case study interviews were also conducted (Yin, 2003). The initial step involved a systematic literature review to identify the capabilities and dimensions of OBCs. Thirty-six capabilities across seven dimensions (Table 1) were considered for further analysis. However, due to the impracticality of considering all 36 capabilities for the case company, the AHP was employed to reduce the crucial dimensions for OBCs (Kabra *et al.*, 2023). Moreover, AHP was deployed because it is a practical method that supports group members to use their experience and knowledge while making decisions to reach toward a consensus (Saaty, 1980). As a result, two dimensions were selected, encompassing a total of eleven capabilities. Subsequently, these eleven capabilities were modeled using the ISM approach, leading to the development of a multi-level capability framework (Kumar *et al.*, 2023). ISM was deployed because it can simplify complex situations in simpler forms while considering the perspective of various group members. The comprehensive methodology employed in this integrated research is based on the following three steps:

Step 1: Identifying the case company.

Step 2: Prioritization of capability dimensions (see section 2.2) using AHP.

Step 3: Establishing interrelationships among the capabilities (for the prioritized dimensions) using ISM.

#### 3.1 Analytic hierarchy process (AHP)

AHP, a widely used MCDM approach, is applied in this research to shortlist OBC dimensions based on priority vector values due to its ability to incorporate subjective judgments and ease of computation. First, based on the expert's opinion, the dimensions were pairwise compared (Matrix A) by following Saaty's nine-point scale (Saaty, 1980, 1990). Relative weights of dimensions were calculated through the eigenvalues and eigenvectors method. All AHP models follow  $AW = \lambda_{max}W$ , where: A is the pairwise comparison matrix,  $\lambda_{max}$  is the largest eigenvalue of A (where  $\lambda_{max} \geq n$ ),  $n$  is the order of matrix A and W is its right "eigenvector" such that  $W = (w_1, w_2, w_3, \dots, w_n)^T$ . It computes the priority vector, i.e. relative priority of each dimension. Additionally, the consistency ratio (CR) is calculated to ensure the informational bias obtained from the experts' opinions is within an acceptable range.  $CR = CI/RI$ , where CI denotes the consistency index  $CI = (\lambda_{max} - n)/(n - 1)$  and the RI represents the random consistency index whose value depends on the value of  $n$ . A consistency ratio of less than 0.20 is considered suitable (Ho *et al.*, 2005; Wedley, 1993). Finally, it calculates the relative importance of each decision criterion.

#### 3.2 Interpretive structural modelling (ISM)

The ISM method developed by Warfield (1982) thinking establishes the interrelationship among variables based on the organized, experienced and constructive thinking of experts (Kumar *et al.*, 2023). The ISM model is created using the steps outlined below:

Step 1: Identifying the variables that have an impact on the system being studied.

Step 2: Create a structural self-interaction matrix (SSIM) by selecting a contextual relationship with symbols V, A, X, and O (these symbols are used when “i” leads to “j,” “j” leads to “i,” “i” and “j” leads each other and “i” and “j” are not related to each other, respectively) that demonstrates the interdependence of all possible pairs of elements.

Step 3: Create a reachability matrix (RM) from SSIM by replacing “V,” “A,” “X” and “O” by “1” and “0” as per the following substitution rules:

- For input “V,” (i, j) and (j, i) become 1 and 0, respectively.
- Similarly, for input “A,” (i, j) and (j, i) become 0 and 1, respectively.
- For input “X,” both (i, j) and (j, i) become 1.
- Finally, for input “O,” both (i, j) and (j, i) become 0.

The final RM is then created from the initial RM using the transitivity principle. ISM makes the fundamental assumption that the contextual relation is transitive. It states that a variable X must be linked to Z if there is a relation between X and Y and Y is also related to Z.

Step 4: Use MICMAC analysis to classify variables according to their driving and dependent powers.

Step 5: Assign the levels to the RM that was obtained in step 3.

Step 6. Develop a directed graph based on the relationships in the RM.

Step 7. Examine the ISM model created in step 6 for conceptual consistency gaps and any necessary adjustments.

### 3.3 Qualitative interviews

We supplemented AHP and ISM interviews with qualitative interviews to explore the rationale behind adopting OBC-related capabilities, examining the relative importance and interrelations of different capability dimensions (Yin, 2003). Prior to the interviews, we presented the purpose, methodology, and dimensions to participants (Table 1). Interviews were conducted virtually via Microsoft Teams, with video and audio being recorded. Additionally, the post-interview audio content was transcribed into text using the Otter.ai application. The transcripts from the first and second interviews spanned 14 and 17 pages, respectively.

The study data comprised recorded audio-video files, interview notes, transcripts, company documents, and relevant online resources. During this analysis, the transcripts were subject to manual coding by two members of our research team who also participated in the interviews. These transcripts were systematically categorized based on the dimensions and their respective capabilities. The coded data were independently reviewed by three members of the research team, culminating in the creation of a within-case analysis for the interviewed company. The achievement of triangulation was possible as the data from diverse sources converged toward consistent outcomes (Yin, 2003).

Our research also satisfied the construct validity, internal validity, external validity, and reliability (Yin, 2003). Industry representatives reviewed the final version of the case analysis; thus, construct validity was satisfied. As the study was not causal in nature, internal validity was not required (Yin, 2003). The external validity was verified through literal and theoretical replications during the research design. Finally, since different members of the research team interpreted the data independently and obtained the same results, reliability was also satisfied.

#### 4. Case description

In this study, our focus was on investigating OBC-related capabilities within SMEs. To facilitate this, we employed the theoretical sampling method (Eisenhardt and Graebner, 2007) to identify: (1) an MM that offers OBCs in business-to-business markets, (2) a non-movable, capital-intensive machine and (3) an SME with limited resources for capability development. Given the novelty of the OBC phenomenon, companies fulfilling these criteria were scarce. Consequently, we adopted a single case study approach to delve deeply into the understanding of OBC capabilities (Eisenhardt and Graebner, 2007).

A case company, pseudonym “AirCo,” was selected for this study. AirCo fabricates non-movable machinery for industrial gas production. AirCo’s operational approach mirrors that of other manufacturers of non-movable, capital-intensive industrial equipment, which are designed to produce fundamental utilities like electricity (e.g. generators), water (e.g. pumps), heat (e.g. boilers), and energy (e.g. turbines).

Founded in 2010 in Northern Europe, AirCo differentiated itself by adopting OBCs instead of traditional investment-based models. This aspiration prompted AirCo to leverage cutting-edge technology to offer OBCs. This was considered a breakthrough in an industry traditionally characterized by conservatism and aversion to risk. Furthermore, AirCo’s establishment coincided with the increasing adoption of IoT technologies in equipment, leading the company to integrate remote monitoring technology into its machinery. AirCo concurrently operates two distinct OBC business models: (1) within the availability OBCs, customers pay based on the cubic meters of industrial gases generated using the equipment, and (2) within the economic OBCs, customers pay for the saved energy through the machine’s operation.

SMEs in general have limited resources and personnel, with individuals frequently fulfilling multiple roles and responsibilities (Mittal *et al.*, 2019). Likewise, AirCo has less than 40 employees, and there are only a few people who have comprehensive knowledge of AirCo’s operations, evolution, and critical OBC-related decisions. As a result, we conducted interviews with two senior managers at AirCo—the CEO and CTO – both of whom have been with the company since its inception. The CEO had extensive knowledge of capabilities related to the company’s external relations, specifically customer relationships, value networks, contracting and legal aspects, as well as financing capabilities. Whereas the CTO’s emphasis lays more on AirCo’s internal capabilities, namely digitalization and service development. Nevertheless, both individuals were intricately involved in the development and evolution of these capabilities. Considering that the CEO (Respondent 1) and the CTO (Respondent 2) together have a complete understanding of the OBC capabilities, a limited number of interviewees was deemed the most effective strategy.

#### 5. Results

The results of Interviews 1 and 2, where AHP and ISM were applied, are being complemented with the qualitative results in Sections 5.1 and 5.2 respectively. Moreover, both Sections 5.1 and 5.2 also include the results of the qualitative quotes (see Appendix for quotes) to enhance the understanding of the findings of AHP and ISM.

##### 5.1 Results of interviews

Table 2 shows the pairwise comparison of dimensions and priority vector. The value of CR is found to be 0.152 which is less than the critical value (0.20). Dimension “digitalization” has the highest priority (0.334) followed by “organization and governance” (0.278) and other dimensions have relatively less value of priority. Therefore, “digitalization” and “organization and governance” were shortlisted for further analysis. Below, we present the

[illegible]

results of qualitative data to further investigate why the “digitalization” and “organization and governance” dimensions held the highest priority from AirCo’s standpoint.

*5.1.1 Digitalization.* Overall, the dimension corresponding to the digitalization capabilities was considered most critical, as they can help in getting real-time information for monitoring and regulation of the machine and its components. Should the machine and its components fail to operate correctly, the expected outcomes in the OBCs would remain undelivered. Moreover, in the absence of digitalization capabilities, there will be no data to monitor the performance of the machine and its components. In instances where uncertainties arise and inquiries are directed to customers regarding the machine, they may not know the required details. Consequently, providing OBCs without digitalization capabilities would present challenges. Furthermore, through the utilization of digitalization capabilities, it becomes possible to visualize the various OBC-related Key Performance Indicators (KPIs), offering insights into potential risks that may arise. Moreover, the visualization of OBC-related KPIs enhances the probability of engaging third parties in the financing of OBCs and sharing the associated risks.

Digitalization enables the use of AI and ML models to autonomously and accurately detect machine faults, which would otherwise require a costly team of skilled professionals to identify manually. However, with AI and ML models, a less skilled team can conduct an audit to ensure that the machine is appropriately connected and operational. Should the need for scaling OBCs arise, the models developed through digitalization capabilities will facilitate a more efficient scaling process.

*5.1.2 Organization and governance.* Organization and governance capabilities can foster the assembly of a team proficient in comprehending the mechanics of OBCs, making the OBCs less risky for customers. Additionally, the presence of a dependable team capable of mitigating these risks and subsequently delivering the KPIs inherent to OBCs is very important. Furthermore, the experience individuals accumulate while working with OBCs holds greater significance than the specific skills they possess. This accumulated experience aids in demonstrating to customers that the scalability of their OBCs is a viable option when needed.

*5.2 Results of ISM*

During ISM the experts were prompted to develop contextual relationships, resulting in the creation of anSSIM for the identified capabilities. This SSIM was subsequently transformed into binary form using the conversion rule yielding the IR (Table 3). Then transitivity was examined, leading to the development of the RM, depicted in Table 4. The \* marked cells in

**Table 3.**  
Initial reachability  
matrix

| Variables | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 |
|-----------|----|----|----|----|----|----|----|----|----|-----|-----|
| C1        | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 0   |
| C2        | 0  | 1  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1   | 1   |
| C3        | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 1   |
| C4        | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 0   |
| C5        | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1   | 1   |
| C6        | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0   | 0   |
| C7        | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 0  | 0  | 0   | 0   |
| C8        | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | 0   | 1   |
| C9        | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1   | 1   |
| C10       | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1   | 1   |
| C11       | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | 0   | 1   |

**Source(s):** Authors’ own work

| Variables               | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | Driving power |
|-------------------------|----|----|----|----|----|----|----|----|----|-----|-----|---------------|
| <i>C1</i>               | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 1*  | 10            |
| <i>C2</i>               | 0  | 1  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 8             |
| <i>C3</i>               | 1  | 1* | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 11            |
| <i>C4</i>               | 1  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1   | 1*  | 10            |
| <i>C5</i>               | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 7             |
| <i>C6</i>               | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0   | 0   | 1             |
| <i>C7</i>               | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 0  | 0  | 0   | 0   | 2             |
| <i>C8</i>               | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | 0   | 1   | 4             |
| <i>C9</i>               | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1   | 1   | 6             |
| <i>C10</i>              | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1   | 1   | 6             |
| <i>C11</i>              | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 0  | 0   | 1   | 4             |
| <i>Dependence Power</i> | 3  | 4  | 1  | 3  | 5  | 11 | 10 | 9  | 7  | 7   | 9   |               |

**Source(s):** Authors' own work

**Table 4.**  
Final reachability  
matrix

Table 4 indicate transitivity elements where cell values were changed from “0” to “1.” Finding the relationships between each capability and its appropriate level will reveal the hierarchy of capabilities. Level partitioning was performed by identifying the reachability and antecedent sets for each barrier. Barriers with matching reachability and intersection sets were assigned top-level status. These top-level barriers, which don’t aid others, were removed, and the process repeated until all were assigned. Eight levels were identified using the level partitioning method, as outlined in Table 5. Utilizing the final RM and level partitioning, a hierarchical-level framework is developed in the form of a digraph where capabilities are connected to each other. Figure 1 depicts the final digraph that represents the relationships among capabilities across varying levels.

Secure access to data during customer operations is essential for providing OBCs. Once data security is ensured, capabilities like remote monitoring and performance simulation can be developed. Additionally, data privacy and security contribute to fostering trustworthy relationships, allowing data access within different MM units and between the MM and the customer. As a result, data security plays a pivotal role in driving the development of other capabilities such as remote monitoring, equipment performance simulation, and effective teamwork.

The capabilities for remote monitoring and simulating equipment performance complement each other. Remote monitoring enables us to control and analyze the current behavior of the machine and its components, while simulation allows us to forecast how the

| Elements(i) | Reachability set ( $R_i$ ) | Antecedent set ( $A_i$ )          | Intersection set ( $R_i \cap A_i$ ) | Level (k) |
|-------------|----------------------------|-----------------------------------|-------------------------------------|-----------|
| 1           | 1, 4                       | 1, 3, 4                           | 1, 4                                | 7         |
| 2           | 2                          | 1, 2, 3, 4                        | 2                                   | 6         |
| 3           | 3                          | 3                                 | 3                                   | 8         |
| 4           | 1, 4                       | 1, 3, 4                           | 1, 4                                | 7         |
| 5           | 5                          | 1, 2, 3, 4, 5                     | 5                                   | 5         |
| 6           | 6                          | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 | 6                                   | 1         |
| 7           | 7                          | 1, 2, 3, 4, 5, 7, 8, 9, 10, 11    | 7                                   | 2         |
| 8           | 8, 11                      | 1, 2, 3, 4, 5, 8, 9, 10, 11       | 8, 11                               | 3         |
| 9           | 9, 10                      | 1, 2, 3, 4, 5, 9, 10              | 9, 10                               | 4         |
| 10          | 9, 10                      | 1, 2, 3, 4, 5, 9, 10              | 9, 10                               | 4         |
| 11          | 8, 11                      | 1, 2, 3, 4, 5, 8, 9, 10, 11       | 8, 11                               | 3         |

**Source(s):** Authors' own work

**Table 5.**  
Level partitions

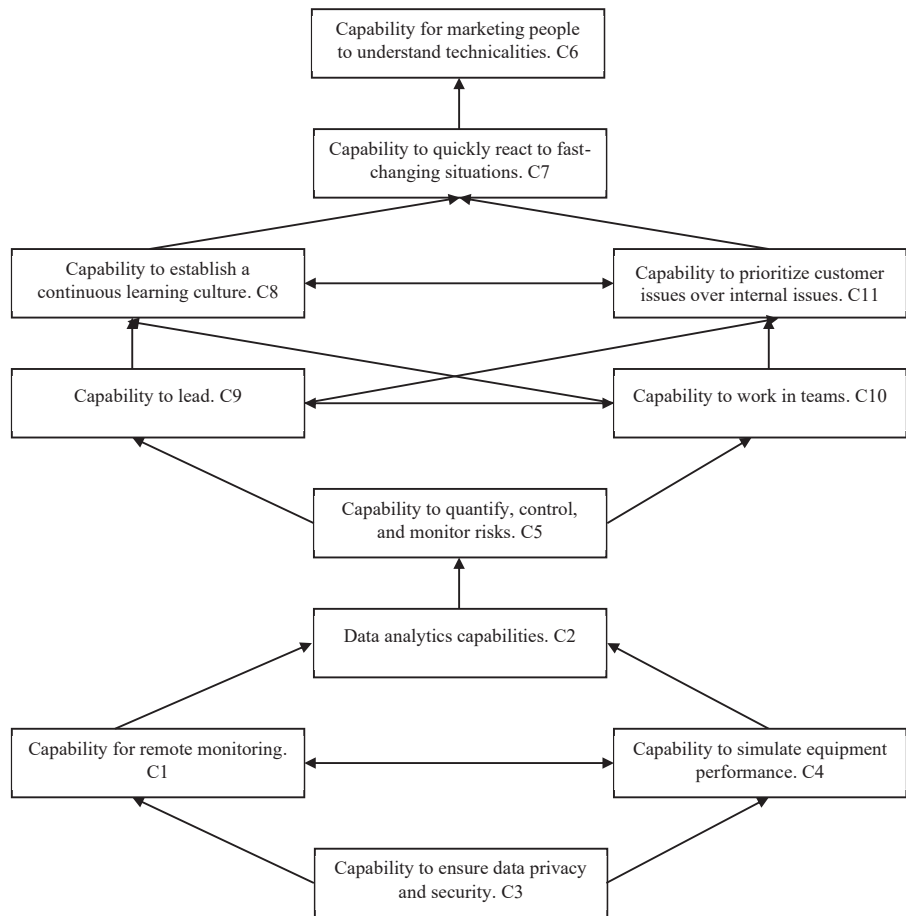


**Figure 1.**  
ISM digraph

**Source(s):** Authors' own work

machine and its components will operate in the future. Collectively, the capabilities of remote monitoring and simulating equipment performance contribute to the development of data analytics capabilities. When data collected through remote monitoring is compared with the results of equipment performance simulation, we can enhance the accuracy and relevance of the data that requires analysis.

Furthermore, data analytics capabilities may lead to the creation of a data-driven model. With the help of such a model, the different risks around the OBCs can be quantified, controlled, and monitored. This model can be developed even before physically visiting the customer's site. Remote monitoring capabilities aid in understanding physical parameters like temperature and pressure. Consequently, we can quantify and monitor the risks faced during OBCs. Subsequently, by quantifying these risks, it becomes possible to prioritize more critical risks over those that are less critical.

OBCs can be complex to grasp, and certain team members might learn through visualization based on parameters. Nonetheless, many individuals learn through hands-on experience and active involvement. In this context, simulation can serve as a tool allowing

people to manipulate different parameters and gain insights into the various risks encountered during OBCs, as well as how to mitigate them. Once data security is established, the companies can teach their teams regarding how to manage the fleets and machines. It is only after reaching a certain level of data security that the role of leadership comes into the picture.

Successful offering of OBCs requires a leader who can inspire individuals to cultivate a shared culture and deliver the desired outcomes. However, leadership also entails providing solutions for addressing the frequently encountered risks during OBCs. When everyone conducts their separate analyses, arriving at a collective decision becomes challenging. Therefore, it is essential to recruit the right individuals and foster a common understanding of objectives and the requirements to achieve the objectives. Furthermore, the organizational culture reflects the functioning of the leadership team, as they determine the actions and parameters guiding decision-making. Additionally, understanding the roles and responsibilities of team members is crucial, enabling prompt contact with the appropriate person when issues arise.

When individuals from the marketing department have access to simulations, understanding the technical aspects of OBCs becomes more straightforward. Consequently, they become better equipped to promote and sell OBCs to customers. Understanding, analyzing, and promptly addressing OBC-related issues faced by customers is crucial. To effectively address customer concerns, a team that recognizes and leverages the strengths of its members is essential.

### *5.3 MICMAC analysis*

Furthermore, an MICMAC analysis was conducted to assess the driving and dependency power of each capability, and the results were plotted on a graph (Figure 2). On the X-axis, the dependency power is represented, while the Y-axis represents the driving power. The capabilities were categorized into four clusters – autonomous, driving, linking, and dependent – based on their driving power and dependence power.

## **6. Discussion**

This section is divided into two Sections 6.1 and 6.2, which present the rationale behind the results obtained in Table 2 and Figure 2.

### *6.1 Digitalization and organizational and governance dimensions*

MMs prioritize digitalization because, unlike in investment models where earnings come from machine sales, OBCs require delivering agreed outcomes (Grubic and Peppard, 2016; Sjödin, 2021). A single component failure can prevent outcome delivery, leading to lost earnings and potential penalties. Furthermore, for efficiently offering OBCs it is particularly important to have the proper technology and data-driven models, as real-time information of how machine monitoring and performance is required. Therefore, relying solely on customer perceptions rather than data insights may not aid MMs in making informed decisions during OBC offerings. Additionally, without comprehensive data, visualizing OBC-related KPIs becomes challenging. As a result, the absence of digitalization capabilities could hinder the ability to convince third-party financiers to take ownership of the machines.

Moreover, digitalization capabilities are deemed more critical than organization and governance capabilities for two reasons. First, the intelligent models developed through digitalization capabilities can identify faults in the machines or their components. Addressing such faults might require significant financial resources to employ a considerable number of highly skilled and trained individuals. Furthermore, relying on

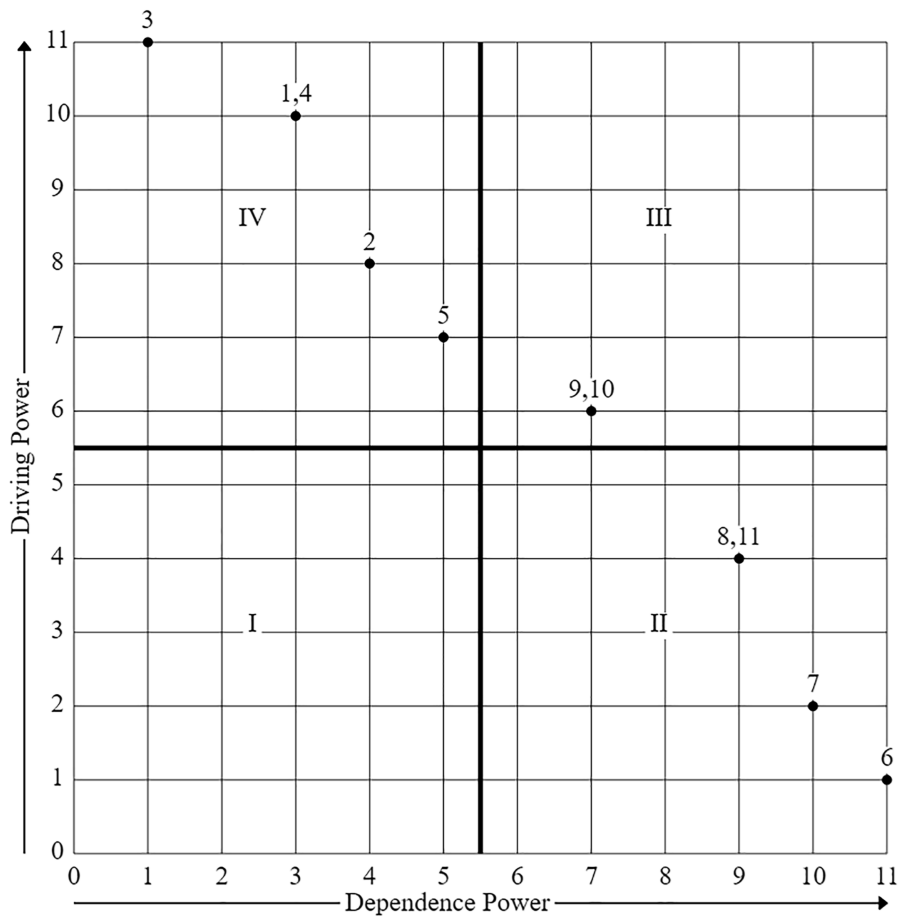


**Figure 2.**  
MICMAC analysis

**Source(s):** Authors' own work

human evaluation might not yield results as precise and rapid as those suggested by the models. Second, if MMs aim to scale their OBCs, these models will offer greater flexibility and robustness in adapting to quick scaling compared to the process of recruiting more employees and training them.

When the risks associated with OBCs are quantified, the leadership group and the team need to address those risks. In this context, the team members might not require high-level skills since the intelligence obtained through skills can be substituted by the model. However, the experience of the leadership and team members remains crucial. This experience assists in addressing risks based on past instances of issues and their subsequent resolution. Furthermore, when the leadership group understands the expertise of their team members the relevant expert can be contacted whenever a specific risk arises.

However, organization and governance capabilities in OBCs are also critical. They revolve around developing a team and leadership that can identify solutions to understand the desired outcomes expected by the customers and understand the parameters required to develop an intelligent model for OBCs. For instance, individuals must identify the

type of OBCs that align with customer requirements and can be effectively delivered by the MMs, thus overcoming the risks encountered during OBC provision. Moreover, the experience of individuals working with OBCs aids in recognizing potential risks and challenges associated with OBC offerings. This recognition facilitates the proposal of suitable solutions and clauses, such as fixed payments regardless of machine usage, that support MMs' earnings during unfavorable scenarios, such as when the customer doesn't use the machine (Hou and Neely, 2018; Ng *et al.*, 2013).

## 6.2 Digitalization and organizational and governance capabilities

Our data has revealed that all four of the digitalization capabilities were perceived to possess higher driving power and lower dependence power when compared to the organization and governance capabilities (see Figure 1).

The capability to ensure data privacy and security was deemed critical, as it serves as a driving factor for all other digitalization, organization, and governance capabilities necessary for offering OBCs. Given the increasing frequency of cyber-attacks, customers are becoming more concerned about the privacy of their data. Furthermore, this data may also contain IP, including sensitive information related to the customer's processes. Any breach of this IP could result in the loss of competitive advantage from the customer's perspective. If the customer's data security is compromised, establishing a trustworthy relationship between the MM and the customer becomes challenging. In such cases, it would be difficult for cross-functional teams involving personnel from both the MM and the customer's operations to effectively collaborate and deliver the required outcomes in OBCs. Conversely, if trust is established, data related to the machine and its components can be shared and analyzed, facilitating a successful OBC-related collaboration.

Moreover, the remote monitoring capability enables the real-time collection of data related to physical parameters such as temperature and pressure. Once these parameters and their corresponding data are known, a model can be developed. This model, in turn, allows for the identification of the outcomes that can be achieved using OBCs. This model can be validated with the help of the capability to simulate equipment performance, where data regarding the machine's previous usage is shared. Furthermore, the simulation capabilities enable the exploration of various configurations for achieving the desired outcome. Among these configurations, the one with the best optimal solution for delivering the outcome can be identified. Hence, the remote monitoring capability and the capability to simulate equipment performance complement each other, and together drive the data analytics capability.

Once the model is validated, data analytics capabilities can help identify the outcome that can be delivered using the machine. The capability to simulate equipment performance based on the pre-shared customer data can help to identify the risk factors that might be faced while offering OBCs. This provides a clearer understanding of the pricing that the customer should be charged. Moreover, understanding the risks from the customer's perspective will assist in prioritizing how the outcome should be delivered to the customer. Additionally, understanding the customer's viewpoint on risks will aid in prioritizing these risks using the capability to quantify, control, and monitor risks. For instance, mitigating the risk of a customer not using the machine offered in OBCs could involve including a clause for a minimum price that the customer must pay, even if the machine remains unused (Paiola *et al.*, 2022).

OBCs are still new to the industry, and due to the inherent risks in OBCs, convincing customers to opt for them is not easy. If marketing professionals can utilize the simulating equipment performance capability to demonstrate how the model works and how the MM's team can swiftly respond to overcome those risks, a compelling argument can be made to convince customers to choose OBCs. Similarly, considering that various OBCs might

encounter different risks, it is crucial to foster a continuous learning culture. Given the multitude of risks associated with OBCs, prioritizing customer issues over internal issues faced by the MM is important.

## 7. Conclusions

MMs are increasingly interested in offering OBCs, however, providing OBCs is complex and requires systematic capability development. In this context, there are two studies ([Uski et al., 2022](#); [Sjödin, 2021](#)) that categorize the identified capabilities into seven dimensions: contracting and legal, customer relationship, digitalization, financing, organization and governance, service development, and value network. In our present study, we employed AHP to determine the most crucial dimensions and subsequently utilized ISM to prioritize the capabilities within these critical dimensions. Additionally, we leveraged expert quotations to gain an in-depth understanding of the reasons underlying the critical nature of the identified dimensions and capabilities. This investigation into critical dimensions and capability prioritization was conducted from the perspective of an SME MM that specializes in offering industrial gases through OBCs.

We propose a capability framework focusing on digitalization, and organization and governance capabilities, that aims to facilitate the provision of OBCs and serves as a resource for MM managers and researchers seeking to identify the most crucial capabilities for adopting OBCs (RQ3).

Using ISM, we developed a hierarchical model of OBC capabilities (RQ2 and RQ3) based on their driving and dependence power in digitalization and organization and governance dimensions. The resulting structural model comprises 11 capabilities distributed across eight levels. Among these, the lowermost levels include digitalization capabilities with higher driving power and lower dependence, warranting prioritization. Specifically, capabilities such as ensuring data privacy and security, simulating equipment performance and remote monitoring were identified as critical. On the other hand, organization and governance capabilities, such as enhancing marketing personnel's understanding of technicalities and swift response to dynamic situations, demonstrated higher dependence and lower driving power in the structural model.

### 7.1 Theoretical implications

Existing OBC literature ([Hypko et al., 2010](#); [Hou and Neely, 2018](#)) is, in overall, focussed on the design of OBCs from the perspective of large companies. Moreover, earlier capability-related OBC literature is oriented toward identifying the OBC capabilities to perform specific functions. For example, scientific literature has focused on exploring the qualitative aspects of OBCs, such as the required capabilities and the barriers encountered during OBC implementation ([Grubic and Peppard, 2016](#); [Sjödin, 2021](#); [Schaefers et al., 2021](#); [Korkeamäki and Kohtamäki, 2019](#); [Ng et al., 2013](#)), and the identification of decision criteria and options in OBC offerings ([Hypko et al., 2010](#)). Our study introduces a systematic approach to prioritize and identify interrelationships among necessary OBC capabilities. This study complements the existing works by introducing a comprehensive capability framework tailored for offering OBCs. We utilized the AHP to identify the most critical dimensions and the ISM technique to establish interrelationships among these capabilities. Our quantitative prioritization and capability interrelationship establishment, along with qualitative insights, offer novel contributions to the literature. Our mixed-method approach addresses a significant gap by providing a more nuanced understanding of the relative importance and hierarchical nature of different capabilities. In addition, our study focuses on SMEs, which share many specific limitations and characteristic features compared to large companies,

such as resource and capability limitations (Mittal *et al.*, 2019), which have not been studied from these perspectives. Establishing the prioritization and interrelationships among the capabilities complements the existing scientific literature on OBCs. When the findings of previous studies are considered together with the findings of our study the OBCs can be developed in a more effective manner. Furthermore, our study confirms the findings of previous studies (Bag *et al.*, 2024; Brekke *et al.*, 2024), according to which for successful offering of servitization BMs like OBCs organization capabilities need to be given priority before adopting other capabilities. Moreover, this unique template can be adapted and applied by other studies where OBCs are being offered, potentially across various sectors, while modifying the required capabilities to fit specific contexts.

### 7.2 Managerial implications

We introduce a comprehensive decision-making framework tailored for MM managers, facilitating the identification of the most crucial capabilities for effective OBC adoption (RQ3). Through this adoption framework, managers operating within utility industries such as industrial gases, electricity, water, heat, and energy, and dealing with similar technology maturity levels, can systematically prioritize the sequence of capability development. This optimization empowers them to efficiently allocate resources and tackle challenges inherent in OBC implementation while simultaneously building the necessary capabilities. This prioritization and capability establishment process holds relevance for SMEs grappling with limited resources. With the aid of prioritization and interrelationships, these SMEs gain clarity on where to start their capability development journey. Our findings emphasize the critical importance of digitalization and organizational and governance capabilities. Workshops can be organized within the MMs offering OBCs to identify critical capabilities using the template suggested in the current article. Moreover, managers should focus on building cross-functional teams, fostering a culture of continuous learning, and developing comprehensive risk assessment and mitigation strategies to support successful OBC implementation.

### 7.3 Limitations and future work

Our study focused solely on a single SME case study that offers OBCs. In future, multiple SMEs offering OBCs can be studied. Furthermore, the findings could be contrasted with those of larger companies to determine whether similar priorities and interrelationships are observed among the OBC-related capabilities. Additionally, the industry's nature and the underlying business logic might impact the prioritization and interrelationships within these capabilities. Moreover, future research can conduct deductive research to identify the extent of the interrelationships between the capabilities found during the current research.

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### Further reading

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## Appendix

| Theme                                                                  | Respondent quotes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Criticality of Digitalization Capabilities                             | <i>"... digitalization is extremely important to be able to sell OBCs ... the machine provider needs to take a risk of the equipment ... i.e. providing the service (of machine) and to be able to take the risk you need to have full understanding how the machine is doing ... without full understanding and even a control on the machine, how it operates and what's the performance of the machine and there the digitalization is a fundamental enabler ..."</i> - Respondent 1                                                                                                           |
| Absence of Digitalization Capabilities                                 | <i>"... through digitalization only we can get the real view (of OBC performance) ... otherwise we need to actually ask questions check (with the customer) what has happened ... then if there are open spots, we have to sit together with customer to understand what has happened ... most probably they (customer) would not even know ..."</i> - Respondent 2                                                                                                                                                                                                                               |
| Digitalization Capabilities to Visualize KPIs                          | <i>"... to make profit out of the business ... digitalization is quite crucial as you got a clear view, you see the KPIs and how it's performing and what are the risks for the financing ... otherwise we are all only working with the with solid steel components ... if we don't have the digitalization we might fail to make financing more attractive for the financing companies to produce more a with the smaller risk ..."</i> - Respondent 2                                                                                                                                          |
| AI- and ML-based models incorporated using Digitalization Capabilities | <i>"... we employee people who do not possess that deep understanding of the business (OBCs) ... we need people who can deeply analyze and understand the model ... then we develop digitalization capabilities so that we can recognize those cases (faults) automatically and do require big team for the audit purposes and not so high-level people ... I try to make that (machine) automatic somewhere in the middle of the day for my budget, so do towards to the digitalization, most probably the bit more important to do all the time focus to digitalization ..."</i> - Respondent 2 |
| Scaling OBCs using Digitalization Capabilities                         | <i>"... the only way how we can scale up is the way that we do the digitalization (capabilities) ... to understand what the right choice is for the customer for the new conditions you need to develop a new system which is most energy efficient system ... with digitalization you can set the parameters and understand when you need to do a service ..."</i> - Respondent 2                                                                                                                                                                                                                |
| OBCs become less risky with organization and governance capabilities   | <i>"... these organizational governance aspects are all the ways of making business models (OBCs) less risky and, and therefore, more attractive to financiers ..."</i> - Respondent 1<br><i>"... we need to have a good organization who to rely on and service needs to be in line that the units are really giving the KPIs what we promise like an event even but it to hire to aid the service deployment ..."</i> - Respondent 2                                                                                                                                                            |
| Significance of experienced individuals in OBCs                        | <i>"... it starts from the people and the experience of the people is more important than the skilled people itself because I think that we need to any case scale that we need to be able to scale that to our partners (business) as well ..."</i> - Respondent 2                                                                                                                                                                                                                                                                                                                               |

**Table A1.**  
Respondent quotes  
based on the dimension  
and capability themes  
(continued)

| Theme                                                                                                   | Respondent quotes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Criticality of data privacy and security capability                                                     | <p>“... data security like in everywhere personal security counters accurate it's so fundamental need and it comes back to trusting and you don't trust it, there's you're somehow secured it nothing if nothing basically, it's so fundamental matter that nothing really works well if you don't trust that you're secure ...” – Respondent 1</p> <p>“... data privacy is quite a bit has been quite an important at the beginning that we can make the communication part and we can access all the units with safely and then we can make the remote monitoring and simulation options ...” – Respondent 2</p> <p>“... RandD people currently drive the work, and it is actually a cross functional as people from business and IT are involved, and since the data is originated from the customers operation so it's cross functional overall and outside the borders of the company as well ...” – Respondent 1</p> <p>“... as the teams are working outside ... we need to address with downloads as well that that they are working with the data with secure way or for example, in the future can provide the data for their components that they can already do such analysis for the components what they are responsible for ...” – Respondent 2</p> |
| Criticality of remote monitoring and equipment performance simulation capability                        | <p>“... we cannot do monitoring from the simulation, but at the other end from the simulation we can find something what we cannot find from the remote the remote monitoring ... so that's they are very supportive for each other ...” – Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Remote monitoring and equipment performance simulation capabilities lead to data analytics capabilities | <p>“... simulation capabilities make the way for the data analytics and to improve so, I will say that we require it to know to how to simulate the system and then we can make better data analytics of course, there are other ways as well but if you just compare these two once the relation is like this yeah the in the future on said the data ...” – Respondent 2</p> <p>“... we need remote monitoring so that way we can develop the data analytics and without them by having a good overview for the product, first manually or the more analog way we can basically automate this is with analytics ... so we'll think that it's so firstly remote monitoring then the data analytics ...” – Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Data analytics capability led to the capability to quantify control and monitor risks                   | <p>“... the presence of data analytics capabilities will help in quantifying the risk ... when we get more data we get a better model ... with data analytics we can model the different risk factors for different customers already beforehand, hopefully not when we are on site ... now the biggest challenge is that we had a lot of data to collect but you should be able to bake it in into easy understandable and such a format that was supporting these functions, so I'll say that we need the data analytics to boost this can be quite a symbol even by da still it needs to be in reporting format basically definitely data same here yeah check could help get help with the fast reaction ...” – Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

Table A1.

(continued)

| Theme                                                                                    | Respondent quotes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Remote monitoring capability led to the capability to quantify control and monitor risks | <p>“... we need remote monitoring to quantifying and monitoring the risks for example the temperatures that customers are not operating in such conditions what we knew that they it's going to limit the lifetime or something like ...”- Respondent 2</p> <p>“... starts from the understanding of the risk space ... our mindset is fully customer driven ... we prioritize everything ... but if we don't understand risks, then we can make false decisions about prioritization ...”- Respondent 1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Equipment simulation capability can lead to better visualization                         | <p>“... while training people we need to understand that they got different ways to learn and to teach many guys we can lay certain quality parameters in their mind and they can see the output but it might be difficult in the written way to give a view ... while simulation is such a tool where the people can by themselves, for example, what it means if they tweak some input value or something ...” - Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Data security capability drives the capability to lead                                   | <p>“... we wouldn't secure or sure about security that would lead a completely another style of fleeting basically. So, I will say that we first start from the from the security we would need to have a certain way or in a certain level when we can just start working with the way like we like to do otherwise we should change our way to lead our team and the business ...” - Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Capability to lead drives the continuous culture ...                                     | <p>“... to lead anyone is the worst in this business model if you or they have a feeling that risks are not under control ...”- Respondent 1</p> <p>“... if you try to do the risk management afterwards it becomes very hard for the leadership as well ... that's for the teamwork that everybody doing their own analysis and using a common analysis so that there's a common view with which is basically our fundamental. I'm most probably the guy who is well known for bringing up some risks and if that's a not in a common kind of understanding, it's very hard to try to lead or work in a team ... moreover you hire the right person while offering OBCs ...” - Respondent 2</p> <p>“... the culture is a result of leadership basically ... leadership is telling you what is right and wrong ...” - Respondent 1</p> <p>“... when people are not responsible, they don't really care so basically we need to know who will be in charge with the cost-wise operation needs ... to be able to see the operations and therefore as a leader we need to pay attention to know your team ...” - Respondent 2</p> |
| Simulation drives marketing                                                              | <p>“... we actually see that with our simulation tool that's a good training tool when the guys are marketing ...” - Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Team understand customer issues                                                          | <p>“... we need to do an internal get along as well ... on the of the day it is important to understand how quickly we can respond or react to some customer issues, for example, we deal with all the customers with the same hourly-based priority ... so we need to immediately manage the problem and think about is the level of the problem ...” - Respondent 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Source(s): Authors' own work

Table A1.