Journal of Business Models, Vol. 13, No. 1, pp. 89-118

JOURNAL OF BUSINESS MODELS

The Role of Operational Capabilities and Design Decisions in Collaborative Pay-per-outcome Business Models: The Case of the Finnish Indoor Environment Quality Equipment Industry

Authors

Veli-Matti Uski[1], Sameer Mittal[2], Prasanna Kumar Kukkamalla[1], Mia Ala-Juusela[3], Hannu Kärkkäinen[1], Karan Menon[4]

Abstract

Purpose: The purpose of this paper is to explore how the operational capabilities for pay-per-outcome business model are deployed in the context of indoor environment. In the past decade, product–service systems have attracted interest from various industries as firms seek new ways to create competitive advantage. The transition towards more advanced services in product–service systems require novel operational capabilities. However, the operational capabilities that have a significant impact on the successful implementation of pay-per-outcome business models have not been studied comprehensively hitherto.

Design/Methodology/Approach: To address this gap, we deployed a single case study design involving four firms as embedded units of analysis. The goal of the firms was to provide a range of integrated technologies and equipment designed to monitor, control, and enhance indoor environment by utilizing collaborative pay-per-outcome business models.

Findings: The findings indicated that different key design decisions impact ordinary capabilities. The decision to transfer ownership while retaining operational responsibility creates a hybrid model where control over the performance remains with the firms, but financial and legal ownership lies with the customer. Due to these key decisions, three novel operational capabilities were needed: 'contracting capabilities towards third parties', 'capability to train the usage of pay-per-outcome business models' and 'remote support capability'.

Originality/Value: This research contributes to business model literature by empirically identifying the operational capabilities required to implement collaborative pay-per-outcome business models and their interrelation with the key decisions.

Keywords product–service system, indoor environment quality, operational capabilities, result-oriented services, pay-per outcome, collaborative business models

[1] Unit of Information and Knowledge Management, Tampere University
[2] Institute of Management, JK Lakshmipath University
[3] VTT Technical Research Centre of Finland
[4] School of Economics, Innovation and Technology, Kristiania University

Please cite this paper as: Uski, V.-M., Mittal, S., Kukkamalla, P. K., Ala-Juusela, M., Kärkkäinen, H., Menon, K., (2025). The Role of Operational Capabilities and Design Decisions in Collaborative Pay-per-outcome Business Models: The Case of the Finnish Indoor Environment Quality Equipment Industry, *Journal of Business Models*, Vol. 13, No. 1, pp. 89-118, DOI 10.54337/jobm.v13i1.8005.

1. Introduction

The purpose of this paper is to explore how the operational capabilities that significantly impact the successful implementation of a collaborative pay-per-outcome business model are operationalized within four firms. The strategic decision to move from offering product-oriented business models towards offering result-oriented business models (Adrodegari *et al.*, 2017), such as pay-per-outcome business models, has become relevant in many investment-heavy manufacturing industries (Agostini and Nosella, 2021; Alabdulkarim *et al.*, 2014; Boehmer *et al.*, 2020; Dmitrijeva *et al.*, 2020; Menon *et al.*, 2019). However, implementing pay-per-outcome business models is challenging and requires investments in novel capabilities related to the skills, resources and technologies (Korkeamäki *et al.*, 2021).

Each firm has its own operations strategy, which determines the set of operational capabilities a firm requires for offering its products and services (Hayes and Wheelwright, 1985). Operational and other ordinary capabilities refer to an organization's ability (consisting of routine activities, administration, and basic governance) to execute its strategic objectives through efficient and effective utilization of resources to deliver products or services in accordance with customer requirements (Slack and Lewis, 2015; Teece, 2018). Therefore, when a firm changes its operations strategy and moves towards pay-per-outcome business models, it needs to acquire a new set of capabilities to respond to changing responsibilities towards the customer (Van Tonder et al., 2023; Yang et al., 2018). When designing pay-per-outcome business models, a firm must make critical decisions related to ownership, responsibility allocation, payment models, operation locations, and the exclusivity of equipment use (Hypko *et al.*, 2010). These critical decisions lead to various operational capability needs (Calabrese *et al.*, 2022; Ferreira Junior *et al.*, 2022; Jovanovic *et al.*, 2019; Uski *et al.*, 2022). Existing literature has identified various pay-per-outcome service-related operational capabilities, such as customer relationship (Hou and Neely, 2018; Korkeamäki and Kohtamäki, 2020; Schaefers *et al.*, 2021), contracting (Liinamaa *et al.*, 2016), value networks (Batista *et al.*, 2017; Ng and Nudurupati, 2010), digitalisation (Grubic and Peppard, 2016; Manresa *et al.*, 2021) and financing (Korkeamäki and Kohtamäki, 2019; Rapaccini, 2015).

However, the above mentioned studies have focussed on single types of operational capabilities only, without considering how they relate to the key decisions a firm must make to offer pay-per-outcome business models (Calabrese *et al.*, 2022; Ferreira Junior *et al.*, 2022; Jovanovic *et al.*, 2019; Uski *et al.*, 2022). Understanding how the key decisions (Hypko *et al.*, 2010) relate to operational capabilities will help a firm, towards better comprehending the efforts required to implement pay-per-outcome business models. This is particularly important when capabilities are sourced from various firms in order to provide collaborative business model (Coombes, 2023). Setting over-ambitious objectives during service implementation can lead to negative outcomes (Münch *et al.*, 2022).

To address this research gap, we studied the transition of four traditional product-oriented firms (referred as Alpha, Beta, Gamma, and Delta) towards forming a one collaborative product–service system business model in the indoor environment quality context. This collaborative model involves offering a range of integrated technologies and equipment designed to monitor, control, and enhance indoor environment quality — including advanced HVAC systems, air purification devices, environmental sensors, automation and control systems, and indoor construction solutions — delivered through pay-per-outcome business models. In our case study, all four firms provided their specialized expertise to the collaborative business model, including equipment manufacturing, measurement technology, indoor environment quality automation, and indoor construction knowledge. Providing indoor environment quality services effectively requires the integration of all four types of expertise. We used the morphological analysis, which Hypko *et al.* (2010) have used in similar context, to identify the operational capabilities that arise from the key decisions related to offering pay-per-outcome business models. Morphological analysis involves breaking down a complex problem into its core components and examining the relationships and configurations between them (Hypko et al., 2010). To address the research gap, we framed the following research questions:

1. *How do key design decisions influence the allocation of responsibilities during the solution lifecycle when offering indoor environment quality using collaborative pay-per-outcome business models?*
2. *What new operational capabilities are required by firms to implement collaborative pay-per-outcome business models for delivering indoor environment quality, and how are these capabilities operationalized?*

To answer the above question, we conducted a single case design with the four firms as embedded multiple units of analysis using a qualitative case study research approach (Yin, 2017). To understand the operational capabilities required for offering collaborative pay-per-outcome business models, we conducted interviews with four firms attending this collaborative model. These firms play key roles in providing indoor environment quality solutions using collaborative pay-per-outcome models. We applied semi-structured interviews and used morphological analysis, as employed by Hypko *et al.'s* (2010) to guide the process of identifying operational capabilities emerging from key decisions in the collaborative pay-per-outcome business model design.

Existing studies have not empirically identified the capabilities required to implement collaborative pay-per-outcome business models specifically, nor they have investigated how these capabilities relate to the key decisions. This research contributes to the business model literature by identifying the operational capabilities required, their relation to key decisions, and how they are operationalized to implement collaborative pay-per-outcome business models.

The rest of this paper is structured as follows. Section 2 provides the theoretical background related to pay-per-outcome capabilities and introduces the characteristics of the indoor environment quality context. In section 3, we explain the methodology followed in the current research. In section 4, we describe and discuss the findings of the current research, and finally, section 5 presents the theoretical and practical implications, as well as the limitations and future work stemming from the current research.

2. Theoretical background

2.1 Organisational capabilities and operational capabilities

Organizational capabilities support a firm's efficient utilization of its resources, enabling it to perform activities required to achieve its goals and create value for customers (Teece, 2018; Wu et al., 2010). These organization-specific, complex social processes transform inputs into outputs and can be divided into first-order (operational and other ordinary capabilities) and second-order (dynamic capabilities) (Teece, 2018; Wu et al., 2010).

First-order (operational and other ordinary capabilities, later operational capabilities) capabilities enable a firm to perform its routine activities — such as designing plant layouts, managing distribution logistics, and executing marketing campaigns — to deliver products or services in accordance with the customer requirements (Kanninen et al., 2017; Slack and Lewis, 2015; Teece, 2018). Furthermore, operational capabilities include both staff and line activities (activities that are directly involved in producing and delivering the organization's primary products or services); however, they are not limited to the production activities alone but involve all operations within an organisation (Cepeda and Vera, 2007; Slack and Lewis, 2015). Operational capabilities are used to perform routine operational activities to provide existing products and services to the same customer segments with the same level of resources and skills (Wu *et al.*, 2010).

Second-Order (Dynamic) capabilities refer to the organization's ability to improve and renew its existing activities and support the renewal of its *operational capabilities* (Cepeda and Vera, 2007; Teece, 2018). While dynamic capabilities focus on change and innovation, our study concentrates on first-order operational capabilities that enable a firm to perform day-to-day routine activities and operations (Kanninen et al., 2017; Slack and Lewis, 2015; Teece, 2018). In this context, an operational capability is defined as a capability used to provide existing products or services to existing customers repeatedly over time without relating to the renewal of capabilities, resources, or ecosystem features.

2.2 Operational capabilities required for pay-per-outcome business models

A Product–Service System can be considered as a value proposition offered using a combination of both products and services (Barrar and Ruiz-Benitez, 2023; Baines *et al.*, 2007; Tukker, 2004). According to Tukker (2004), a Product–Service System can be divided into three broad categories: product-oriented, use-oriented, and result-oriented business models. Product-oriented business models focus on product sale, and services such as maintenance and repair are add-ons to the product (Tukker, 2004). In use-oriented business models, the ownership of the product remains with the supplier, and the customer pays only for the use of the product (Alabdulkarim *et al.*, 2014; Menon *et al.*, 2022; Tukker, 2004). In result-oriented business models, the ownership of the product remains with the supplier, who is also bound to offer certain results (Grubic and Jennions, 2018; Tukker, 2004; Korkeamäki, 2021).

Pay-per-outcome business models can be considered the most advanced result-oriented business models in which the customer pays for the achieved outcome or result (e.g. energy savings) (Tan and Yavuz, 2015). At times, these pay-per-outcome business models are also referred to as performance-based contracts (Hypko *et al.*, 2010; Korkeamäki, 2021; Liinamaa *et al.*, 2016) or outcome-based contracts (Batista *et al.*, 2017; Ng and Nudurupati, 2010; Ng *et al.*, 2009).

While studies like Gebauer et al. (2017) focus on the operational capabilities required for use-oriented business models, these capabilities alone are not sufficient for offering pay-per-outcome business models. Yang *et al.* (2018) described how the responsibilities in different supply chain phases are distributed among the supplier and customer in archetypical result-oriented business models. According to Yang *et al.* (2018), in pay-per-outcome business models, the supplier is responsible for equipment operations and performance delivery, whereas in use-oriented business models, the supplier is not responsible for performance. These differences in operations logic lead to different types of capabilities (Calabrese *et al.*, 2022; Ferreira Junior *et al.*, 2022).

A few studies, such as those by Hou and Neely (2018), Manresa *et al.* (2021) and Visnjic *et al.* (2018)) provide overviews of capabilities needed for pay-per-outcome business models but often lack specificity. For example, Hou and Neely (2018) studied the risk related to offering pay-per-outcome business models and identified capabilities such as the capability to deliver pay-per-outcome business models or the capability to contract pay-per-outcome business models. However, they neither explained these capabilities nor discussed the mechanism through which these emerge in organisations. Similarly, Manresa *et al.* (2021) highlighted the positive impact of organizational, digital, and financing capabilities on offering pay-per-outcome business models but did not focus on individual operational capabilities. Moreover, Visnjic *et al.* (2018) identified that the shift towards offering pay-per-outcome business models requires capabilities related to understanding the customer, operating in the value network, and identifying accountabilities. Moreover, some other studies, like Uski *et al.* (2022), have considered the comprehensive view for these capabilities and identified 36 separate capabilities, such as the capability to co-develop with customers, which can assist an organisation in offering pay-per-outcome business models.

Other studies focus more deeply on specific capabilities required for pay-per-outcome business models. Due to the change in the ownership structure while offering pay-per-outcome business models, as compared to traditional business models, the supplier needs new capabilities related to financing the equipment and understanding the lifecycle costs of equipment operations (Rapaccini, 2015). As the customer pays only for the outcome, depending on how they use the equipment, contracts become more complex due to the need to specify detailed performance metrics, usage conditions, and responsibilities for maintenance and repair (Liinamaa et al., 2016). These contracts must clearly define the expected outcomes, usage parameters, and the associated payments, which are contingent on achieving specific performance targets. Additionally, they often include clauses for penalties, bonuses, and contingencies to account for various usage scenarios and potential risks (Liinamaa et al., 2016). In this regard, Liinamaa *et al.* (2016) identified two contracting-related capabilities, namely capability for outcome-based contracting and capability to quantify the value provided by the offer. Changes in customer-supplier relationships (Yang *et al.*, 2018) also require new capabilities, as explored by Korkeamäki and Kohtamäki (2020) and Schaefers et al. (2021). To understand this changing relationship, Korkeamäki and Kohtamäki (2020) studied the risk transfer between the supplier and customer and what capability requirements that brings. Similarly, Schaefers *et al*. (2021) focussed on the new capabilities required due to changes in customer relationships while offering pay-per-outcome business models.

The transition towards pay-per-outcome business models often requires expanding the value network, necessitating capabilities like value network orchestration (Batista *et al.*, 2017; Korkeamäki and Kohtamäki, 2019; Ng and Nudurupati, 2010). Measuring equipment outcomes efficiently demands remote monitoring technologies, leading to new digitalization-related capabilities (Grubic and Peppard, 2016). These digitalisation-related capabilities allow the suppliers to remotely track the performance which enable charging the customer, and to ensure the availability of the equipment in order to avoid penalties of unplanned downtime (Grubic and Peppard, 2016). Finally, to ensure equipment availability and performance, organizations need to be more flexible and responsive to customer issues, requiring new organizational and governance-related capabilities (Ng *et al.*, 2009).

Table 1 presents the operational capabilities found in the literature, categorized according to dimensions suggested by Uski *et al*. (2022).

Author	**Industry**	**Capabilities**	**Type of capabilities**
Schaefers et al., 2021)	Compressed air systems, Industrial gas supply, beverage filling machinery	Capability to co-develop with customers; Capability for co-production with customers; Capability for in-depth understanding of the customer environment; Capability to convince customer about the value of outcome-based business model; Capability for reverse logistics and remanufacturing; Capability for predictive maintenance;	Service development and customer relationship perspective
Manresa et al., 2021	Various equipment manufacturing industries	Organizational governance capabilities; Digital capabilities; Financing capabilities;	Digitalization and organizational capability perspective
Hou and Neely 2018	Wide range of industries, such as industrial equipment manufacturing and services, media, IT, telecommunications, aerospace and defense, air transport communications	Capability to communicate new roles and responsibilities among customers' business models; Capability to understand the customer needs; Capability to evaluate partner's performance; Capability to orchestrate the value network of partners;	Customer relationship and contracting perspective
Liinamaa et al. 2016	Logistics equipment manufacturer	Capability for outcome-based contracting; Capability to quantify the value provided by the offer;	Contracting perspective

Korkeamäki and Kohtamäki, 2020	Energy industry	Capability to establish trustworthy relationships with customers; Capability for transparent interorganizational communication; Capability for in-depth understanding of the customer environment; Capability to convince customer about the value of outcome-based business model;	Co-production perspective
Korkeamäki and Kohtamäki, 2019	Energy industry	Capability for installation and maintenance service procedures; Capability to convince financial partners;	Co-production and financing perspective
Rapaccini, 2015	Heavy equipment manufacturing	Capability to finance outcome-based services; Capability to calculate life-cycle cost of product–service systems; Capability to quantify the value provided by the offer;	Finance perspective
Visnjic et al., 2018	Various manufacturing sectors, transportation providers, utility equipment and services providers, construction and maintenance services providers, IT hardware (computer), software and consulting services providers, and consulting services and solutions provider	Capability to understand the customer needs; Capability for co-production with customer/third parties;	Service development perspective
Batista et al., 2017	Defense	Capability to co-develop with customers; Capability for co-production with customers; Capability to communicate new roles and responsibilities among customers' business models;	Customer relationship and value network perspective
Grubic and Peppard, 2016	Various manufacturing sectors	Capability for remote monitoring; Capability to convince the customer to share data; Data-analytics capabilities; Data infrastructure capabilities; Capability to simulate equipment performance;	Digitalization perspective
Ng and Nudurupati, 2010	Defense	Capability to communicate new roles and responsibilities among customers' business models; In-depth understanding of customer processes; Capability to co-develop with customers;	Customer relationship and value network perspective

Ng et al., 2009	Defense	Capability for risk management; Capability for quick response time for maintenance;	Organizational capability perspective
Uski et al. 2021	Various industries	Reviews of all above pay-per-outcome papers	Contracting, digitalization, financing, organization and governance, service development

Table 1. Pay-per-outcome business model capabilities

Although numerous studies have focused on specific operational capabilities required for implementing pay-per-outcome business models, they often do not address how these capabilities are operationalized based on business model design decisions. Hypko *et al*. (2010) developed a conceptual model of a morphological analysis a method used for exploring all possible solutions to a multi-dimensional, non-quantifiable problem. In our study, we used the same approach to map the key decisions related to the ownership, responsibilities, payment model and location of operations while offering pay-per-outcome business models. The key decisions suggested by Hypko *et al*. (2010) are as follows:

(1) Ownership during the contract period

(2) Ownership after the contract period

(3) Responsibility for maintenance personnel

(4) Responsibility for operation personnel

(5) Payment model

(6) Location of operations

(7) Exclusiveness of operations

All these decisions affect the nature of the activities that a supplier must perform, leading to the requirement of different types of capabilities (Hypko *et al.*, 2010). We did not consider the criteria *performance provider's background* suggested by Hypko *et al.* (2010) in our study, because we focused on firms comprising solely of manufacturers. By examining operational capabilities through these key decisions, we can better understand the specific capabilities needed and the effort required to develop collaborative pay-per-outcome business models.

3. Methodology

A single case study design with four firms as embedded multiple units of analysis (Yin, 2017) was deployed for this study. This qualitative approach was selected for three reasons: (i) the contemporary and real-world nature of the topic,(Flyvbjerg, 2006; Zainal, 2007) where indoor environment quality was offered to the customers with collaborative business model of a four firms using various operational capabilities as the case studies are particularly well-suited for investigating complex, real-world phenomena in depth, as emphasized by (Yin, 2017), ii) Our aim was not only to address the research question but also provide valuable insight to the broader understanding of operational capabilities in the context of indoor environment quality (Handfield and Melnyk, 1998; Miles et al., 2020; Yin, 2017). The case study method allows for an in-depth exploration of operational capabilities and their implementation in a real-world setting, providing rich insights that other methods may not capture (Yin, 2017). iii) The authors of the paper did not have any control and influence (Yin, 2017) over the identification and implementation of the operational capabilities required for monetising indoor environment quality, aligning with the inherent nature of case studies to observe and analyze phenomena within their natural context (Yin, 2017).

To identify the operational capabilities that support the offering of a holistic indoor environment quality solution, we conducted an embedded single case study research (Yin, 2017). Our focus was on capabilities that have a significant impact on the successful implementation of pay-per-outcome business models, specifically in the context of indoor environment quality. Since we studied the required operational capabilities in novel pay-per-outcome business models offering indoor environment quality, where the relevant cases are exceedingly rare, we deployed a single study method (Yin, 2017). To identify the operational capabilities required for offering indoor environment quality as pay-per-outcome business models, we used the conceptual model of morphological analysis (Hypko et al., 2010) to identify the key decisions related to pay-per-outcome business models. Based on these decisions, we could identify how the ownership, responsibilities, payment model and location of operations are related to various capabilities.

To answer our research question, we followed the four-step methodology depicted in Figure 1.

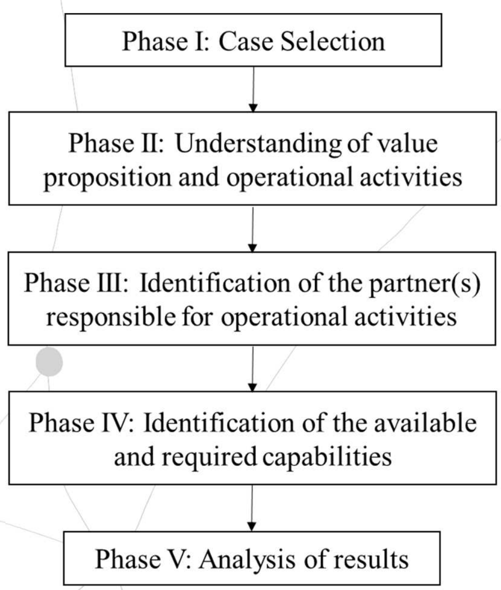

Figure 1. Research process

Phase I: Case selection. The success and failure experiences of retrospective cases provide insights for the current study (Voss et al., 2002). In this research, these insights demonstrated how four industrial-firms could offer indoor environment quality through collaborative pay-per-outcome business model. The firms are presented in Table 2. The firm Alpha, with a long history of manufacturing and selling mechanical ventilation equipment and associated control systems, led and orchestrated the collaborative business model. During the business model development, Alpha collaborated with three other firms—Beta, Gamma, and Delta— each contributing different and complementary strengths while targeting the same customer segment. Beta has a history in designing and installing indoor environment quality infrastructure in new buildings and surveying indoor environment quality problems in existing buildings. Gamma specialises in indoor environment quality measurement technologies, providing new ways to measure and analyse indoor environment quality. Delta provides indoor environment quality control and automation systems and is responsible for controlling the equipment manufactured by Alpha. These four firms do not have overlapping capabilities related to indoor environment quality but support each other to provide a holistic indoor environment quality solution. Previously, a customer needed to buy the technologies separately from each firm, but now the firms decided to offer the service through one customer channel. Thus, the unit of analysis in our study is the four complementary firms, collectively developing a collaborative pay-per-outcome offering for indoor environment quality.

In summary, the firms provide a full lifecycle solution for indoor environment quality, starting from the target setting, analysis of the current situation in case of an existing building, refurbishment project to improve the quality of the indoor environment and continuous service to maintain the indoor environment quality at the agreed-upon level. All firms have previous experience of manufacturing various aspects of offering indoor environment quality; however, this collaboration is unique (Seawright and Gerring, 2008; Yin, 2017) because it is for the first time that all firms are offering holistic indoor environment quality solutions together collaborative business model. There are firms which individually contribute on one part of indoor environment quality, such as optimising the temperature, but these sub-optimisations do not ensure the optimum overall indoor environment quality (Gómez-Romero et al., 2018). To the best of our knowledge, this is the first time that indoor environment quality if offered through collaborative pay-per-outcome business models. The participants were the champions involved in the planning of offering indoor environment quality, thus minimising the loss of information that could happen due to the change in personnel (Mittal et al., 2020). The current fields, roles of each firm and participants from each firm are presented in Table 2.

Phase II: Understanding value proposition and operational activities. During phase II, we conducted a workshop with the firms in which we used Hypko *et al.'s* (2010) morphological analysis to guide our discussion. The main objective of the workshop was to understand the value propositions and the operational activities offered by the firms. Additionally, we went through the documents shared by the firms to understand these value propositions and operational activities (Saunders et al., 2009).

The firms identified that poor indoor environment quality decreases productivity, causes sick leaves, and increases energy consumption, which can be costly, especially in user-intensive buildings such as offices and schools. However, none of the suppliers in the field currently provide comprehensive indoor environment quality solutions. Current offerings focus on parts of the solution; therefore, there is much scope of improvement in customer premises.

Company	Company field	Role	Designation of Respondent	Years in Firm	Date of Interviews
Alpha	Indoor environment equipment	Collaboration orchestrator Machine builder	CEO	21 years	15.10.2021 04.11.2021 10.11.2021
Beta	Indoor environment design	Design, Construction, Installation	Technical manager	5 years	15.10.2021 4.11.2021 10.11.2021
Gamma	Indoor environment measurements	Provider of measurement technology	COB	3 years	15.10.2021 04.11.2021 10.11.2021
			CEO	1 year	15.10.2021 04.11.2021 10.11.2021
			CTO	3 years	15.10.2021 04.11.2021 10.11.2021
Delta	Indoor environment automation	Indoor environment control and automation system provider	COO	1 year	15.10.2021 04.11.2021 10.11.2021
			Product owner	1 year	15.10.2021 04.11.2021 10.11.2021

Table 2. Background of firms and interviewed respondents

To respond to this customer issue, the firms decided to establish a collaborative business model to *help real estate owners of user-intensive buildings to offer a healthy, safe, and productive indoor environment*. Firms promised to identify and fix indoor environment quality problems and offer new equipment and automated control systems to keep the indoor environment quality at an agreed-upon level. The firms decided to offer this good indoor environment quality as a service. According to the participants, they decided the customers pay only based on the indoor environment quality level. Firms would constantly measure different indoor environment quality-related variables (such as CO_2 level), as well as energy consumption, and by controlling the equipment, ensure that those variables will stay within the accepted target levels. The customers would pay only based on how well the indoor environment quality is maintained.

Since the implementation of the pay-per-outcome business models, like the one the firms were thriving, changed the operations and responsibilities within the supply chain (Hypko et al., 2010; Yang et al., 2018), we asked how the indoor environment quality equipment implementation and operations worked. We found that the firms offering indoor environment quality executed their service in four unique steps, which they referred to as survey, development, certification, and on-going service (Table 3). Together with the participants, we identified how Hypko *et al.*'s (2010) key decisions relate to these four steps. During the survey phase, the requirements of the customer were identified. During the development phase, the firms together designed and installed a variety of indoor environment quality equipment for the building and disposed the old, redundant equipment. After installation, the firms granted a certificate for the customer's building to state its new indoor environment quality level. After this, the firms dealt with the operations and maintenance services required to maintain the customer's indoor environment quality parameters at the desired level.

Steps	Definition	Aspects/ Activities
Survey	Identification of customer needs and requirements	Conducting the survey
Development	Design and installation of new equipment	Design of solution, logistics and installation, contract handling, training workshop to use the equipment
	Disposal of old equipment	Deinstallation of old equipment (recycling, scrapping, modernization, reselling), ownership of equipment (during disposal)
Certification	Granting certificate to state indoor environment quality level	Granting the certificate
On-going service	Operations and maintenance	Ownership of equipment (during use), production and maintenance software, production and maintenance data, use of equipment (for production), maintenance of equipment

Table 3. Four steps and corresponding activities to offer indoor environment quality

Phase III: Identification of the partner responsible for operational activities. During this phase, we conducted another workshop with the firms and prepared a design for data collection using Hypko *et al.'s* (2010) morphological analysis and the activities outlined in Table 3. Since only the development and on-going service required actionable operational capabilities to complete the step, the focus was only on development and the on-going service phases. We interviewed the partner responsible for performing a particular activity and why that activity was important from the perspective of offering indoor environment quality.

Phase IV: Identification of the available and required capabilities. During phase IV, we conducted workshops to identify the capabilities required to perform the activities. We also discussed which capabilities they already possessed and which ones they needed to develop to perform the activities corresponding to offering indoor environment quality. In addition, we also asked which of the required capabilities can be reconfigured from an already existing capability base to fulfil the new capability needs (Grant, 1996; Teece, 2018).

Phase V: Analysis of findings. All interviews were conducted virtually using the Microsoft Teams platform. At least three members of our research team were present in each interview. Each discussion with the firms lasted between 60 and 90 min, and all of them were recorded. The transcripts during the current study were the audio–video files, the notes taken by the members of the research team during the discussion, the documents shared by the case firms and the websites and articles uploaded online by the case firms. The audio–video files were transcribed and translated into English. For data analysis, the recorded discussion was manually coded into capabilities presented in section 4.2 using the capabilities identified in the literature.

Since data from all the diverse sources — interviews, websites, and reports shared by firm representatives — converged towards the same findings, we observed triangulation (Yin, 2017). Additionally, the other four important criteria of construct validity, internal validity, external validity and reliability (Yin, 2017) were also satisfied by our research. The industry representatives reviewed our last version of the case analysis, therefore satisfying the construct validity requirement. As our study was not causal in nature, internal validity was not required (Yin, 2017). We also investigated literal and theoretical replication to satisfy the external validity requirement. Furthermore, as different members of our research team separately interpretated the data and ended up with the same findings, the reliability requirement was also satisfied.

4. Findings and discussion

2.3 Characteristics of the indoor environment quality services

The roots of indoor environment quality business are grounded in the heating, ventilation, and air conditioning (HVAC) equipment industry. Traditionally, this industry has focussed on ensuring adequate levels of thermal comfort and air quality in a specific space (Li *et al.*, 2011). Recently, the focus has shifted towards broader environmental conditions, such as acoustic and visual qualities (e.g. lighting) and how they affect human comfort, wellbeing and productivity (Piasecki *et al.*, 2020). Optimising indoor environment quality, can lead to energy savings in buildings and create more productive working environments (Gómez-Romero et al., 2018; IEA, 2019). indoor environment quality can include all stages, from designing indoor environment quality equipment for a building to operating the equipment inside the building (Gómez-Romero et al., 2018).

Offering indoor environment quality as a service is complicated due to the challenges faced in quantifying indoor environment quality improvements (Rasmussen, 2014). Few conceptual studies have suggested how indoor environment quality can be offered using Product–Service System business models (Gómez-Romero et al., 2018; Halleberg and Martinac, 2020; Leoni et al., 2020), such as use-oriented business models (Laing and Kühl, 2018). However, the focus of previous studies has been on the technical improvements in indoor environment quality, such as the optimal temperature required for a productive working environment, while the discussion about services has left only conceptual recommendations rather than any evidence. To the best of our knowledge, no empirical study has focussed on identifying operational capabilities in the indoor environment quality context from the perspective of offering pay-per-outcome business models. Therefore, this study selects the indoor environment quality setting as a case context to address this gap.

4.1 Responsibilities during the solution lifecycle

The key design decisions made by the firms significantly influence the allocation of responsibilities during the solution lifecycle when offering indoor environment quality using pay-per-outcome business models. Table 4 summarizes the responsibilities and needed capabilities identified in the case study.

#	Activity	Responsible			Capabilities required from supplier firms
		Customer	Supplier	Third Party	
1	Design of solution		x		Capability to understand the customer needs Capability for in-depth understanding of the customer environment Capability to overall understand how indoor environment quality can be controlled Capability to simulate equipment performance
2	Logistics and installation		x		Capability to convince customer about the value of outcome-based service Capability for risk management Capability to quantify the value provided by the offer Capability for outcome-based contracting Capability to establish trustworthy relationships with customers Capability to train the usage of outcome-based services
3	Deinstallation of old machine, recycling (scrapping, modernization, reselling),	x	x		-
4	Ownership of machine (during use)	x			-
5	Operation and maintenance software	x			-
6	Operation and maintenance data	x	x		Capability to convince the customer to share data. Data infrastructure capabilities Data-analytics capabilities
7	Use of machine (for operation)	x	x		Capability for remote monitoring Capability for co-production with customer/third parties Capability to orchestrate ecosystem partners
8	Maintenance of machine		x	x	Capability for quick response time for maintenance Contracting capabilities towards 3rd parties Remote support capability Comprehensive maintenance capability Capability to evaluate partner's performance

Table 4. Firms responsibilities for performing the operational activities and related capabilities required to provide the services

4.1.1 Design of solution

The firms decided to retain responsibility for design-related activities, as the design of indoor environment quality solutions provides a competitive advantage.

'...the responsibilities within firms will depend on the characteristics of the project, if structural change must be done [Beta] will be responsible, if indoor environment quality equipment must be designed [Alpha] will be the best and so forth....' (GAMMA, CTO)

By keeping design responsibilities internal, the firms leverage specialized expertise, ensuring innovation and maintaining control over the quality of solutions. This aligns with the literature, which emphasizes the importance of design capabilities in creating unique value propositions (Ng and Nudurupati, 2010). The decision reinforces the need for cohesive collaboration between the firms to deliver high-quality indoor environment quality solutions.

4.1.2 Logistics and installation

The firms will offer design to facilities as an easy end-to-end solution which enables improvements in indoor environment quality.

'...the design and installation will be a service package...including all the production activities, materials and installations related to the system...' (ALPHA, CEO).

Although third parties will be responsible for some activities (e.g. the logistics of the materials), the overall responsibility for logistics and installation will remain within the firms. Retaining overall responsibility for logistics and installation allows the firms to ensure seamless integration and high service quality. This decision emphasizes the importance of coordination and control in delivering complex services (Batista et al., 2017). By managing these activities, the firms can maintain standards and timelines, which is critical in pay-per-outcome models where performance outcomes directly affect revenue. This allocation of responsibilities demonstrates how strategic choices shape operational dynamics within the firms.

4.1.3 Operation and Maintenance

The participants stated that once the equipment and technologies are installed at the customers' sites, they become an inseparable part of the building. Once the contract period is over, the cost of deinstallation is higher than the value of the equipment and, therefore, not removed. Additionally, the building cannot function without the equipment. Therefore, the ownership of the equipment will be transferred to the customer after the installation.

'...anyway, the lowest risky model for us is that the customers buy the equipment...and I am sure that big customers want to own the equipment, because if the equipment is not

part of the building, it might be a problem when the customer is trying to sell the building...' (ALPHA, CEO).

Despite transferring ownership, the firms retain responsibility for operating the equipment, remotely monitoring indoor environment quality and controlling automation systems. indoor environment quality equipment are highly automated machines which rarely require any human interactions. The firms' responsibility is to monitor the indoor environment quality and equipment performance remotely and to control the automation system parameters if necessary. One feature of the indoor environment quality equipment is that they are often used around the clock.

One feature of the building industry is that the customers (i.e., the building owners) have other property maintenance needs besides the indoor environment quality equipment. Traditionally, a third party is responsible for the basic maintenance of the indoor environment quality equipment, and the firms do not plan to change this market dynamic.

'...specific mechanical maintenance, such as changing the filters is the responsibility of the customer or customer's contracted maintenance firm....' (ALPHA, CEO).

However, the firms must be able to help the maintenance firm to succeed.

'...we need to have some sort of remote support capability since it might be that the maintenance guy knows where the machine is but does not know what to do to with it....' (GAMMA, CEO).

Therefore, the maintenance responsibility of the machine is divided between the customer and supplier; thus, the role of contracts is emphasised.

'...the contractual technique is central in this service...if the maintenance firm has neglected its responsibilities...it does not affect our billing but if the decreased [indoor environment quality] is a result of our actions then the customer price will decrease accordingly....' (ALPHA, CEO)

The decision to transfer ownership while retaining operational responsibility creates a hybrid model where control over performance remains with the firms, but financial and legal ownership lies with the customer. This arrangement reduces the financial burden and risk for the firms, as they do not need to finance the equipment. However, it necessitates robust operational capabilities in remote monitoring and control to ensure service levels are met. Additionally, relying on third-party maintenance introduces the need for effective coordination and communication mechanisms. This aligns with literature on hybrid business models and emphasizes the importance of aligning ownership structures with operational capabilities (Baines and W. Lightfoot, 2013). It also underscores the significance of relational capabilities to manage external partners (Ulaga and Reinartz, 2011).

4.1.4 Deinstallation

The responsibility for the deinstallation of the equipment will remain with the customer. However, for convenience, the industry practice has been that the supplier of the new equipment manages the deinstallation of old equipment.

'…the customer has the responsibility of deinstallation and recycling since the customer owns the equipment but, in reality, in this industry, the supplier who will deliver the next machine to the building will handle the disposal and recycling of the machines… so, in that sense it can be us as well…' (ALPHA, CEO).

Therefore, the deinstallation of the new equipment at the end of its lifecycle is beyond the scope of the collaborative pay-per-outcome business model contract; however, deinstallation of the old equipment is included in the new service contract for offering indoor environment quality.

This decision reflects an industry norm where equipment is so integrated into the building that it becomes impractical to remove. By assigning deinstallation responsibility to the customer, the firms avoid potential costs and logistical challenges associated with end-of-life equipment handling. However, this may limit opportunities for reverse logistics and remanufacturing, which are often associated with circular economy practices. It highlights a divergence from literature advocating supplier responsibility in product lifecycle management to enhance sustainability (Schaefers et al., 2021). This choice underscores the importance of context-specific considerations when designing collaborative business models and allocating responsibilities.

4.2 New operational capabilities required to offer pay-per-outcome business models

The design decisions and resulting responsibility allocations necessitate the development of specific operational capabilities within the firms to implement collaborative pay-per-outcome business models effectively. In this section we introduce and discuss the new operational capabilities, which have not been mentioned in previous literature. The comparison of capabilities in the existing literature and in this study is presented in Table 5.

Group of results	Needed capability	Identified in the literature	Identified in the study
Common capabilities between the previous literature and this study	Capability for understanding customer needs	x	x
	Capability for in-depth understanding of the customer environment	x	x
	Capability for simulating equipment performance	x	x
	Capability for convincing the customer about the value of the pay-per-outcome services	x	x
	Capability for risk management	x	x
	Capability for quantifying the value provided by the offer	x	x
	Capability for pay-per-outcome contracting	x	x
	Capability for convincing the customer to share data	x	x
	Capability for establishing trustworthy relationships with customers	x	x
	Data infrastructure capabilities	x	x
	Data-analytics capabilities	x	x
	Capability for remote monitoring	x	x
	Capability for co-production with customer/third parties	x	x
	Capability for quick response time for maintenance	x	x
	Capability to overall understand how indoor environment quality can be controlled	x	x
	Comprehensive maintenance capability	x	x
	Capability for evaluating a partner's performance	x	x
	Capability for orchestrating ecosystem partners	x	x
New required capabilities found	Capability to train the usage of pay-per-outcome services	-	x
	Contracting capabilities towards third parties	-	x
	Remote support capability	-	x
Less relevant capabilities	Capability to co-develop with customers	x	-
	Capability for reverse logistics and remanufacturing	x	-
	Capability to finance pay-per-outcome services	x	-

Table 5. Results table

4.2.1 Contracting capabilities towards third parties

Outsourcing maintenance to third parties requires specialized contracting capabilities to manage these relationships and ensure alignment with the firms' goals in collaborative pay-per-outcome business model. In addition to customer related contracts, the participants recognised that they also need more complex contracts with these third parties. As the maintenance of the system is partially outsourced, they need to ensure that third parties know their responsibilities and how, for example, neglecting maintenance affects each party.

'...we could have bonus model for third parties so we can motivate them as well...' (GAMMA, CTO)

'...we already have contracts with third parties, but this should be adapted to this new business model...' (ALPHA, CEO)

This capability is critical because the performance of third-party maintenance providers directly affects indoor environment quality outcomes and, consequently, the firms' revenue under the collaborative pay-per-outcome model. Effective contracts need to define responsibilities, performance metrics, incentives, and penalties to ensure third parties are motivated to maintain desired service levels. This extends existing literature that primarily focuses on customer-supplier relationships by emphasizing the importance of managing third-party partners within an collaborative business models (Visnjic et al., 2018). It reflects the necessity for the firms to develop capabilities in crafting complex contracts and managing relationships beyond traditional dyadic interactions.

4.2.2 Capability to train the usage of pay-per-outcome services

As the firms cannot control everything happening within the customer's premises, the firms should be able to train and motivate the customer to use the system in a way that generates the best outcome.

'... we need new training capabilities so we can motivate the customer and third parties to contribute to the outcome and to show that this is beneficial for them as well...we don't exactly know how the customer should be trained but most probably we have the skills and resources to do this...' (ALPHA, CEO)

This capability addresses the challenge of aligning the actions of multiple stakeholders towards achieving optimal indoor environment quality outcomes. Training enhances the understanding and cooperation of customers and third parties, facilitating better utilization and maintenance of the systems. It highlights the shift from product-centric to service-centric capabilities, where knowledge transfer and co-creation become vital (Batista *et al.*, 2017; Korkeamäki and Kohtamäki, 2019; Ng and Nudurupati, 2010). By developing this capability, the firms can improve service quality and customer satisfaction, which is crucial for the success of collaborative pay-per-outcome business models.

4.2.3 Remote support capability

Providing remote support is critical for addressing maintenance issues promptly, especially when relying on third parties with varying levels of expertise. The participants recognised that they need to be able to support maintenance activities remotely, especially since the system they offer might be too complex to be managed by traditional maintenance firms.

'...we can't assume that third parties could do all the needed maintenance...so the consortium needs to have remote support capabilities...' (BETA, Technical Manager)

'... we have individual skills around the different firms to do this but no specialized support for this collaborative business model...' (ALPHA, CEO)

The remote support capability allows the firms to monitor system performance continuously and provide immediate assistance when issues arise. This is essential in a collaborative pay-per-outcome model where revenue depends on consistent service outcomes (Tukker, 2004). The remote support leverages digital technologies and IoT to enable real-time diagnostics and support, aligning with literature on digital capabilities (Grubic and Peppard, 2016) although remote support is more organizational capability than alone digital capability. The remote support capability enhances operational efficiency and reduces downtime, which is critical for maintaining customer satisfaction and profitability. By investing in remote support, the firms can mitigate risks associated with third-party maintenance and ensure service levels are met, directly addressing the operationalization aspect of the second research question.

4.3 Capabilities deemed less relevant in the context

In addition to new capabilities required in this context we found few capabilities that the previous studies have raised but remain to be less relevant in this specific context.

4.3.1 Financing Capabilities

Financing capabilities were not prioritized because equipment ownership transfers to the customer, reducing the financial burden on the firms.

'...the lowest risky model for us is that the customers buy the equipment...' (ALPHA, CEO)

This contrasts with other pay-per-outcome models where the supplier retains ownership and requires significant financing capabilities to support capital investments (Rapaccini, 2015). By transferring ownership, the firms avoid the need for substantial financial resources and associated risks. These finding highlights how key design decisions influence the relevance of certain capabilities, providing insight into the first research question about how design decisions affect capability requirements. It emphasizes that not all capabilities emphasized in literature are universally applicable, underscoring the importance of context in operational capability development.

4.3.2 Reverse Logistics and Remanufacturing Capabilities

Since the customer owns the equipment and is responsible for its end-of-life handling, reverse logistics and remanufacturing capabilities were not considered necessary.

'...the customer has the responsibility of deinstallation and recycling since the customer owns the equipment...' (ALPHA, CEO)

This diverges from models that emphasize supplier responsibility in product lifecycle management to enhance sustainability (Schaefers et al., 2021; Yang et al., 2018). It reflects a strategic choice to focus resources on capabilities more directly tied to service delivery and performance outcomes. This finding illustrates how key design decisions impact capability needs, by showing that operational capabilities are shaped by key strategic choices.

4.3.3 Co-development with Customers

Co-development capabilities were as well one that were not highlighted by participants. Most likely the reason is due to customers' limited expertise or interest in indoor environment quality systems. It might be that the customers do not have relevant knowledge or interest in indoor environment quality that they could be involved in the development.

While co-development is often advocated in pay-per-outcome literature to enhance value co-creation (Batista et al., 2017), in this context, the lack of customer engagement in development processes suggests that co-development capabilities are less critical. This may be due to the technical complexity of indoor environment quality systems or the customers' preference to rely on expert suppliers. This finding suggests that capabilities must be tailored to the specific context and customer base, providing nuanced insight into the operational capabilities required.

4.4 Discussion of the findings

The interplay between key design decisions, responsibility allocation, and operational capabilities is clear in this study. The firms' strategic choices about ownership, maintenance responsibilities, and customer engagement directly shape the capabilities they need to develop.

By choosing to transfer equipment ownership to customers and outsource maintenance, the firms reduce financial and operational risks but require capabilities in contracting, training, and remote support to ensure service levels are supported. The absence of certain capabilities, such as financing and reverse logistics, further illustrates how design decisions filter the capability requirements. The relation between operational capabilities and the designed pay-per-outcome business model is illustrated in Figure 2.

These findings highlight that operational capabilities cannot be considered in isolation even in highly specialized business models; they are deeply interconnected with strategic decisions and the specific context of the industry. The findings demonstrate that the successful implementation of pay-per-outcome business models depends on aligning business model design with operational capability development. This addresses both research questions by showing that key design decisions influence responsibility allocation (RQ 1) and determine the specific operational capabilities required and how they are operationalized (RQ 2).

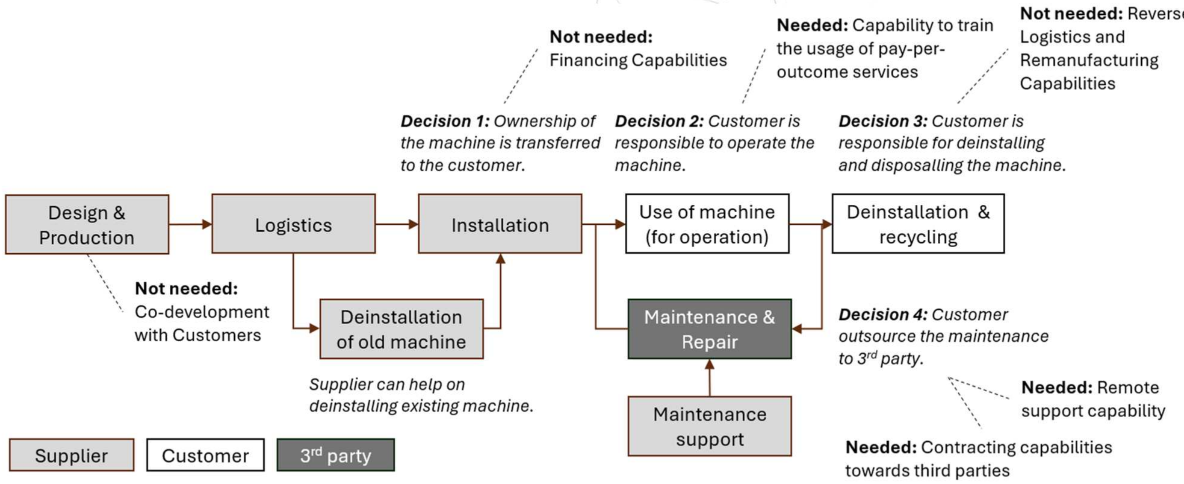

Figure 2. The relation between operational capabilities and the designed pay-per-outcome business model

Moreover, the study provides empirical evidence of how capabilities are shaped by design decisions within collaborative business model of four firms. It also adds to business model literature by showing that capability requirements are not one-size-fits-all but are contingent upon specific business model choices and industry contexts. The identification of novel capabilities and the recognition of less relevant ones underscore the importance of context-specific research and the need for firms to tailor their capability development accordingly.

5. Conclusion

This study demonstrated how indoor environment quality can be offered using collaborative pay-per-outcome business models. Overall, we identified that there are responsibilities related to operational activities that need to be performed either by the customer or the firms, or they need to be outsourced to a third party. Similarly, we identified more comprehensively the operational capabilities required to complete the operational activities that the firms are responsible for. We showed how different key decisions related to collaborative pay-per-outcome business models affect capability needs. In sections 5.1 and 5.2, we present the theoretical and practical contributions of the current research. Section 5.3 presents the limitations and the future research directions arising from the current research.

5.1 Theoretical contributions

This study contributes to the existing business model literature streams by identifying new operational capabilities that enable the implementation of pay-per-outcome business models. This incremental study adds to the literature streams by more comprehensively validating the relevant operational capabilities required to support the implementation of pay-per-outcome business models in the indoor environment quality context and how they relate to key decisions (Hypko et al., 2010).

This study provides insights by identifying operational capabilities that ensure the successful implementation of collaborative pay-per-outcome business models. This study builds on previous studies that have focussed on operational capabilities in use-oriented business models (Gebauer *et al.*, 2017; Möller and Shahnavaz, 2020; Sousa-Zomer *et al.*, 2018) or have vaguely focussed on single types of operational capabilities required to implement pay-per-outcome business models (Gebauer et al., 2017; Grubic and Peppard, 2016; Hou and Neely, 2018; Korkeamäki and Kohtamäki, 2020; Liinamaa et al., 2016; Möller and Shahnavaz, 2020; Rapaccini, 2015; Schaefers et al., 2021; Sousa-Zomer et al., 2018; Story et al., 2017). This adds to the literature stream by gathering pay-per-outcome capabilities from the scattered literature and creating a more comprehensive picture of the capabilities. Compared to the identified operational capabilities in the preceding literature, we found new operational capabilities, such as ‘contracting capabilities towards third parties’, ‘capability to train the usage of pay-per-outcome business models’ and ‘remote support capability’. In addition, we identified that some capabilities identified in the literature might not be relevant in every context, such as financing capabilities (Rapaccini, 2015), capabilities related reverse logistics and remanufacturing (Schaefers et al., 2021) or co-develop capabilities with the customers (Batista et al., 2017; Ng et al., 2009; Schaefers et al., 2021).

Also, our research builds on the understanding of operational and other ordinary capabilities (Teece, 2018). We demonstrated how operational capabilities can be derived from the conceptual model of morphological analysis (Hypko et al., 2010) and how the key decisions related to this model lead to different capability needs.

Our research adds as well to the business model literature (Foss and Saebi, 2018, 2017) by illustrating how capability requirements are contingent upon specific business model choices and industry contexts. By examining the implementation of pay-per-outcome business models in the indoor environment quality context, we highlight that operational capabilities cannot be considered one-size-fits-all. The study shows that key design decisions filter the capability requirements, emphasizing the need for context-specific research in business model innovation. The findings contribute to understanding how firms operationalize collaborative pay-per-outcome business models, particularly in industries where quantifying outcomes is complex, thus addressing calls for more empirical studies in this area (Foss and Saebi, 2017).

5.2 Managerial implications

The current study also offers implications for business practitioners involved in innovating their business model towards pay-per-outcome, especially in the indoor environment quality context. First, this study helps business practitioners understand structural and responsibility-related questions which affect the feasibility of pay-per-outcome business models while offering indoor environment quality. With the help of study, practitioners can understand how to divide their businesses’ operational activities into smaller blocks to which individually they can define the responsible side and based on that identify which operational capabilities the organisation must acquire to succeed.

Second, this study helps practitioners understand how capabilities are operationalised to monetise indoor environment quality through pay-per-outcome business models. With the help of this study, practitioners can analyse how ready their organisation would be to order pay-per-outcome business models and how much effort it would need.

5.3 Limitations and future research directions

The primary limitation of our study pertains to its contextual specificity. Conducted as an embedded single case study within the context of indoor environmental quality, the identified operational capabilities may not be statistically generalizable beyond this specific setting. However, following Yin's (2017) principle of analytical generalizability, our findings offer valuable theoretical insights into the operational capabilities associated with pay-per-outcome business models. While the study consolidates operational capabilities from existing literature relevant to such models, it may not encompass all capabilities essential across diverse applications. Moreover, certain capabilities that are unaffected by the implementation of pay-per-outcome business models were not examined here. Given that the feasibility of different result-oriented business model types might vary across industries and product types (Uski et al., 2022b), future research might explore these capabilities in other sectors, such as the automotive industry. Such comparative studies could extend the theoretical understanding of collaborative pay-per-outcome business model capabilities across different industry contexts.

Another limitation is related to the cross-sectional nature of the study. Since the collaborative pay-per-outcome business model of the four firms is still in the emerging phase, we could not study how it will eventually succeed. Therefore, a longitudinal study is needed to investigate how the capabilities evolve over time and if there can be other relevant operational capabilities once the business is scaled.

Acknowledgements

This work was funded by Business Finland BF/Future Spaces (33250/31/2020).

References

Adrodegari, F., Saccani, N., Kowalkowski, C., Vilo, J., 2017. PSS business model conceptualization and application. Production Planning & Control 28, 1251–1263. https://doi.org/10.1080/09537287.2017.1363924

Agostini, L., Nosella, A., 2021. Industry 4.0 and business models: a bibliometric literature review. BPMJ 27, 1633–1655. https://doi.org/10.1108/BPMJ-03-2021-0133

Alabdulkarim, A., D. Ball, P., Tiwari, A., 2014. Influence of resources on maintenance operations with different asset monitoring levels: A simulation approach. Business Process Management Journal 20, 195–212. https://doi.org/10.1108/BPMJ-12-2012-0135

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, 2–35. https://doi.org/10.1108/IJOPM-02-2012-0086

Baines, T.S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J.R., Angus, J.P., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, 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, 1543–1552. https://doi.org/10.1243/09544054JEM858

Barrar, H., Ruiz-Benitez, R., 2023. Exploratory study of the impact of the supply chain on integrated product-service systems design. Business Process Management Journal 29, 262–284. https://doi.org/10.1108/BPMJ-08-2022-0374

Batista, L., Davis-Poynter, S., Ng, I., Maull, R., 2017. Servitization through outcome-based contract – A systems perspective from the defence industry. International Journal of Production Economics 192, 133–143. https://doi.org/10.1016/j.ijpe.2016.12.005

Boehmer, J.H., Shukla, M., Kapletia, D., Tiwari, M.K., 2020. The impact of the Internet of Things (IoT) on servitization: an exploration of changing supply relationships. Production Planning & Control 31, 203–219. https://doi.org/10.1080/09537287.2019.1631465

Calabrese, A., Dora, M., Levialdi Ghiron, N., Tiburzi, L., 2022. Industry's 4.0 transformation process: how to start, where to aim, what to be aware of. Production Planning & Control 33, 492–512. https://doi.org/10.1080/09537287.2020.1830315

Cepeda, G., Vera, D., 2007. Dynamic capabilities and operational capabilities: A knowledge management perspective. Journal of Business Research 60, 426–437. https://doi.org/10.1016/j.jbusres.2007.01.013

Coombes, P., 2023. Operationalizing Collaborative Business Models: A Practitioner Capabilities Lens. Journal of Business Models 11. https://doi.org/10.54337/jbm.v11i2.7475

Dmitrijeva, J., Schroeder, A., Ziaee Bigdeli, A., Baines, T., 2020. Context matters: how internal and external factors impact servitization. Production Planning & Control 31, 1077–1097. https://doi.org/10.1080/09537287.2019.1699195

Ferreira Junior, R., Scur, G., Nunes, B., 2022. Preparing for smart product-service system (PSS) implementation: an investigation into the Daimler group. Production Planning & Control 33, 56–70. https://doi.org/10.1080/09537287.2020.1821402

Flyvbjerg, B., 2006. Five Misunderstandings About Case-Study Research. Qualitative inquiry 12, 219–245.

Foss, N.J., Saebi, T., 2018. Business models and business model innovation: Between wicked and paradigmatic problems. Long Range Planning 51, 9–21. https://doi.org/10.1016/j.lrp.2017.07.006

Foss, N.J., Saebi, T., 2017. Fifteen Years of Research on Business Model Innovation: How Far Have We Come, and Where Should We Go? Journal of Management 43, 200–227. https://doi.org/10.1177/0149206316675927

Gebauer, H., Saul, C.J., Haldimann, M., Gustafsson, A., 2017. Organizational capabilities for pay-per-use services in product-oriented companies. International Journal of Production Economics 192, 157–168. https://doi.org/10.1016/j.ijpe.2016.12.007

Gómez-Romero, J., Molina-Solana, M., Ros, M., Ruiz, M., Martin-Bautista, M., 2018. Comfort as a Service: A New Paradigm for Residential Environmental Quality Control. Sustainability 10, 3053. https://doi.org/10.3390/su10093053

Grant, R.M., 1996. Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration. Organization Science 7, 375–387. https://doi.org/10.1287/orsc.7.4.375

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, 154–184. https://doi.org/10.1108/JMTM-05-2014-0061

Halleberg, D., Martinac, I., 2020. Indoor Climate as a Service: a digitalized approach to building performance management. IOP Conf. Ser.: Earth Environ. Sci. 588, 032013. https://doi.org/10.1088/1755-1315/588/3/032013

Handfield, R.B., Melnyk, S.A., 1998. The scientific theory-building process: a primer using the case of TQM. Journal of operations management 16, 321–339.

Hayes, R.H., Wheelwright, S.C., 1985. Restoring Our Competitive Edge: Competing through Manufacturing. Administrative Science Quarterly 30, 305. https://doi.org/10.2307/2393118

Hou, J., Neely, A., 2018. Investigating risks of outcome-based service contracts from a provider's perspective. International Journal of Production Research 56, 2103–2115. https://doi.org/10.1080/00207543.2017.1319089

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, 625–655. https://doi.org/10.1108/09564231011079075

IEA, 2019. Multiple Benefits of Energy Efficiency [WWW Document]. URL https://www.iea.org/reports/multiple-benefits-of-energy-efficiency

Jovanovic, M., Raja, J.Z., Visnjic, I., Wiengarten, F., 2019. Paths to service capability development for servitization: Examining an internal service ecosystem. Journal of Business Research 104, 472–485. https://doi.org/10.1016/j.jbusres.2019.05.015

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, 226–247. https://doi.org/10.1108/BPMJ-03-2015-0036

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. Springer International Publishing, Cham, pp. 133–147. https://doi.org/10.1007/978-3-030-75771-7_9

Korkeamäki, L., Kohtamäki, M., 2020. To outcomes and beyond: Discursively managing legitimacy struggles in outcome business models. Industrial Marketing Management 91, 196–208. https://doi.org/10.1016/j.indmarman.2020.08.023

Korkeamäki, L., Kohtamäki, M., 2019. Ecosystem of outcome-based contracts: A complex of economic outcomes, availability and performance. Procedia CIRP 83, 170–175. https://doi.org/10.1016/j.procir.2019.02.142

Korkeamäki, L., Kohtamäki, M., Parida, V., 2021. Worth the risk? The profit impact of outcome-based service offerings for manufacturing firms. Journal of Business Research 131, 92–102. https://doi.org/10.1016/j.jbusres.2021.03.048

Laing, S., Kühl, N., 2018. Comfort-as-a-Service: Designing a User- Oriented Thermal Comfort Artifact for Office Buildings 18.

Leoni, P., Geyer, R., Schmidt, R.-R., 2020. Developing innovative business models for reducing return temperatures in district heating systems: Approach and first results. Energy 195, 116963. https://doi.org/10.1016/j.energy.2020.116963

Li, J., Wall, J., Platt, G., 2011. HVAC control strategies for thermal comfort and indoor air quality. International Journal of Advanced Mechatronic Systems 3, 24. https://doi.org/10.1504/IJAMECHS.2011.040160

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

Manresa, A., Prester, J., Bikfalvi, A., 2021. The role of servitization in the capabilities – performance path. CR 31, 645–667. https://doi.org/10.1108/CR-01-2020-0017

Menon, K., Kärkkäinen, H., Mittal, S., Wuest, T., 2019. Impact of IIoT Based Technologies on Characteristic Features and Related Options of Nonownership Business Models, in: Fortin, C., Rivest, L., Bernard, A., Bouras, A. (Eds.), Product Lifecycle Management in the Digital Twin Era, IFIP Advances in Information and Communication Technology. Springer

International Publishing, Cham, pp. 302–312. https://doi.org/10.1007/978-3-030-42250-9_29

Menon, K., Mittal, S., Kärkkäinen, H., Kuismanen, O., 2022. Systematic Steps Towards Concept Design of Pay–per-X Business Models: An Exploratory Research, in: Canciglieri Junior, O., Noël, F., Rivest, L., Bouras, A. (Eds.), Product Lifecycle Management. Green and Blue Technologies to Support Smart and Sustainable Organizations, IFIP Advances in Information and Communication Technology. Springer International Publishing, Cham, pp. 386–397. https://doi.org/10.1007/978-3-030-94399-8_28

Miles, M.B., Huberman, A.M., Saldaña, J., 2020. Qualitative data analysis: a methods sourcebook, Fourth edition. ed. SAGE, Los Angeles.

Mittal, S., Khan, M.A., Purohit, J.K., Menon, K., Romero, D., Wuest, T., 2020. A smart manufacturing adoption framework for SMEs. International Journal of Production Research 58, 1555–1573.

Möller, H., Shahnavaz, T., 2020. Use-Oriented Business Model for Consumer Durables: an Exploratory Case Study on Business Model Capabilities.

Münch, C., Marx, E., Benz, L., Hartmann, E., Matzner, M., 2022. Capabilities of digital servitization: Evidence from the socio-technical systems theory. Technological Forecasting and Social Change 176. https://doi.org/10.1016/j.techfore.2021.121361

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

Ng, I.C.L., Nudurupati, S.S., 2010. Outcome-based service contracts in the defence industry – mitigating the challenges. Journal of Service Management 21, 656–674. https://doi.org/10.1108/09564231011079084

Piasecki, M., Radziszewska-Zielina, E., Czerski, P., Fedorczak-Cisak, M., Zielina, M., Krzyściak, P., Kwaśniewska-Sip, P., Grześkowiak, W., 2020. Implementation of the Indoor Environmental Quality (IEQ) Model for the Assessment of a Retrofitted Historical Masonry Building. Energies 13, 6051. https://doi.org/10.3390/en13226051

Rapaccini, M., 2015. Pricing strategies of service offerings in manufacturing companies: a literature review and empirical investigation. Production Planning & Control 26, 1247–1263. https://doi.org/10.1080/09537287.2015.1033495

Rasmussen, J., 2014. Energy-efficiency investments and the concepts of non-energy benefits and investment behaviour. Presented at the ECEEE Industrial Summer Study, Arnhem, p. 12.

Saunders, M.N.K., Lewis, P., Thornhill, A., 2009. Research methods for business students, 5th ed. ed. Prentice Hall, New York.

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

Seawright, J., Gerring, J., 2008. Case-Selection Techniques in Case Study Research: A Menu of Qualitative and Quantitative Options. Political research quarterly 61, 294–308.

Slack, N., Lewis, M., 2015. Operations strategy, Fourth edition. ed. Pearson, Harlow, England ; New York.

Sousa-Zomer, T.T., Magalhães, L., Zancul, E., Cauchick-Miguel, P.A., 2018. Exploring the challenges for circular business implementation in manufacturing companies: An empirical investigation of a pay-per-use service provider. Resources, Conservation and Recycling 135, 3–13. https://doi.org/10.1016/j.resconrec.2017.10.033

Story, V.M., Raddats, C., Burton, J., Zolkiewski, J., Baines, T., 2017. Capabilities for advanced services: A multi-actor perspective. Industrial Marketing Management 60, 54–68. https://doi.org/10.1016/j.indmarman.2016.04.015

Tan, B., Yavuz, Y., 2015. Modelling and analysis of a business model to offer energy-saving technologies as a service. International Journal of Production Research 53, 7118–7135. https://doi.org/10.1080/00207543.2015.1055343

Teece, D.J., 2018. Business models and dynamic capabilities. Long Range Planning 51, 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

Tukker, A., 2004. Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet. Bus. Strat. Env. 13, 246–260. https://doi.org/10.1002/bse.414

Ulaga, W., Reinartz, W.J., 2011. Hybrid Offerings: How Manufacturing Firms Combine Goods and Services Successfully 19.

Uski, V.-M., Kukkamalla, P.K., Kärkkäinen, H., Menon, K., 2022a. Capability Framework Implementing Pay-Per-Outcome Business Model in Equipment Manufacturing Companies. Journal of Business Models 10, 12. https://doi.org/10.54337/jbm.v10i1.6785

Uski, V.-M., Kukkamalla, P.K., Kärkkäinen, H., Menon, K., Mittal, S., Khan, M.A., Wuest, T., 2022b. Review of PPX Business Models: Adaptability and Feasibility of PPX Models in the Equipment Manufacturing Industry, in: Canciglieri Junior, O., Noël, F., Rivest, L., Bouras, A. (Eds.), Product Lifecycle Management. Green and Blue Technologies to Support Smart and Sustainable Organizations, IFIP Advances in Information and Communication Technology. Springer International Publishing, Cham, pp. 358–372. https://doi.org/10.1007/978-3-030-94335-6_26

Van Tonder, C., Sandra Hasanefendic, Bart Bossink, Chris Schachtebeck, Cecile Nieuwenhuizen, 2023. Internal organizational factors driving digital transformation for business model innovation in SMEs. Journal of Business Models 11. https://doi.org/10.54337/jbm.v11i2.7403

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

Voss, C., Tsikriktsis, N., Frohlich, M., 2002. Case research in operations management. International journal of operations & production management 25.

Wu, S.J., Melnyk, S.A., Flynn, B.B., 2010. Operational Capabilities: The Secret Ingredient: Operational Capabilities. Decision Sciences 41, 721–754. https://doi.org/10.1111/j.1540-5915.2010.00294.x

Yang, M., Smart, P., Kumar, M., Jolly, M., Evans, S., 2018. Product-service systems business models for circular supply chains. Production Planning & Control 29, 498–508. https://doi.org/10.1080/09537287.2018.1449247

Yin, R.K., 2017. Case study research and applications: design and methods, Sixth edition. ed. SAGE, Los Angeles London New Delhi Singapore Washington DC Melbourne.

Zainal, Z., 2007. Case study as a research method. Jurnal kemanusiaan 9, 1–6.