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TBS Education

Book of Abstracts

OmniaScience

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Foreword

Welcome to 10th International Conference on Business Servitization

This book of abstracts summarizes the proceedings of the **10th International Conference on Business Servitization (ICBS 2023)**, held at TBS Education – Barcelona, Spain. On this edition, the conference places a special emphasis on the focal theme: AI Platforms for Digital Servitization and Solution Delivery.

Manufacturers of capital goods are moving from selling products to providing solutions. They depart from the traditional concept of designing, manufacturing, and selling products to offering higher-value customized solutions in response to specific customer problems. Consequently, the ability to transition from product to solution delivery is increasingly important for the competitiveness of manufacturers. Digitalization has facilitated the delivery of service-based solutions by enabling productive capabilities through distance monitoring, control, optimization, and automation. In this way, servitization represents an accessible means of customization for manufacturers that allows them to more easily transition from a product to a solution business model. Digital servitization can thus permit manufacturers to obtain competitive advantages by introducing product-services systems on the firm's data-driven knowledge of its customers.

Among the digital technologies that are increasingly changing production and the competitive landscape, artificial intellegence is becoming the new operational foundation of business, altering how firms interact with technology. Broadly speaking, AI can support three essential servitization needs for customized & scalable solution delivery: automating business processes, providing cognitive insight through data analysis, and stimulating cognitive engagement through AI recommendation and collaboration systems that increase personalization. As such, AI algorithms provide internal (to the company) and external (to the customer) benefits in a servitization path.

AI platforms can be a fundamental factor for manufacturers in this process since they facilitate the implementation of AI-enabled functions by simplifying AI adoption. As such, AI platforms can facilitate, to a large extent, the digital servitization and consequent solution delivery capacity of manufacturing firms. They can do so since AI platforms can be used to automate the typical tasks requested in digital servitization. These platforms can significantly help increase the diffusion of AI applications and the development of data-driven models and advanced services in the digital servitization domain, allowing manufacturers to open up new solution delivery capabilities and attain better economic and competitive outputs.

This year's edition of the International Conference on Business Servitization (ICBS) aims at debating and shaping such critical questions for the future development of the field. Accordingly, the focus of this year is set at the intersection of three increasingly essential topics for servitization that have not yet been sufficiently linked in academia: AI platforms, digital servitization, and solution business models.

ICBS is a conference traditionally targeted to business professionals, policy makers and researchers. While the focus of this year's conference will be "AI Platforms for Digital Servitization and Solution Delivery", as in previous editions the organizers also endeavour to connect works related to other relevant issues linked with servitization such as: business engineering, strategy, business models, international business, operations management and supply chain management. The conference will engage current research on the emerging field of servitization, which focuses both on theoretical developments and on practical applications of the methods and techniques. The conference aims to provide a platform to the researchers and practitioners from both academia as well as industry to meet & share the cutting-edge developments in the field of servitization.

Topics

Special sessions on specific topics are also encouraged. Topics of interest mainly include, but not limited to:

AI, Servitization & Solution

- AI potential for servitization-based solution delivery
- AI platforms supporting the servitization of manufacturing companies
- AI for autonomous service-based solutions
- AI for digital service innovation
- AI and digital servitization as tools and methods for maintenance services
- Digital servitization for solution delivery

- Servitization for customization with scale
- The economic consequences of AI and servitized-based solution delivery
- The production economics of AI, industry 4.0, and digital technologies
- Smartness and problem-solving in manufacturing, logistics, and services
- Platform as a Service (PaaS) for servitization
- Practical implementations of digital servitization
- Field data and information management for advanced services development
- Future directions for AI-based servitization research
- Critical assessments of AI potential for servitization-based solution delivery
- Case Studies bringing insight to the research at the intersection between AI platforms, digital servitization, and solution business models

Business models and strategy

- Partnerships, strategic alliances, outsourcing, joint-ventures, M&As and servitization.
- Advanced business services and collaborative practices in business model innovation.
- The internationalization of product-service offering.
- Digital service innovation.
- Financial, legal and risk aspects of services.
- Talent management, human resources, and recruitment needs.
- Resilience, agility, ambidexterity and other firm capabilities.

Supply chain management and marketing

- Servitization and collaborative supply chain management.
- Internet of things and linking channels.
- Product-service innovation processes and organizational performance indicators.
- Servitization and customer value perception.
- Green Supply chain management and product-service innovation
- Servitization role on business ecosystems and networked production systems

Business engineering

- Industry 4.0 - Hybridization of the physical and digital worlds.
- Internet of things, Cloud Computing, and Sensors enabled services.
- Service system and Service network design.
- Tools and toolkits for engineering servitization processes.
- Smart manufacturing, big data and machine learning for services development.

Territorial Servitization

- Economic assessment of the impact of collaborative product-service innovation on the firm and territorial competitiveness.
- What are the antecedents, moderators/mediators, and outcomes of knowledge-intensive service-manufacturing collaborations on organizational resilience and performance?
- Conceptualization and provision of evidence on collaborative approaches to cluster and industrial district policies formed by multi-sector, including manufacturing and service, firms.

- Do KIBS firms offer opportunities for local manufacturing SMEs to outsource service provision? And for multinationals to reshoring their production to the home country? Which is the relevance of geographical distance when it comes to transferring knowledge from service to product firms?

Ferran Vendrell-Herrero, Director Scientific Committee
Yancy Vaillant, Conference Chair

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Ph.D. Lorea Narvaiza, Deusto University

Index

Session 1

Session 2

Session 3

Session 4

Session 5

Session 6

Session 7

Session 8

Session 9

Session 10

Session 11

Session 12

Session 13

Session 14

ABSTRACTS OF PAPERS

PRESENTED AT

10TH INTERNATIONAL BUSINESS SERVITIZATION CONFERENCE

Session 1

Digital Servitization and Advanced Technologies

Co-Chairs: Rodrigo Rabetino & Marin Jovanovic

(venue: TBS Conference room 703 -7th floor)

The Role of Artificial Intelligence in Product-Service Innovation (PSI) – A Computational Literature Review

Rimsha Naeem
Marko Kohtamäki
University of Vaasa, Finland

Abstract

This study proposes a computational literature review (CLR) with a topic modeling approach for a clear view of Artificial Intelligence (AI) research translation into Product Service Innovation (PSI). It will focus on providing a structured literature review of AI as a contributor and an enabler in Product-Service Innovation (PSI). The Latent Distinct Allocation (LDA) technique is employed using a machine learning approach for topic modelling and manual content analysis to review selected 180 articles from 1983 to 2023. We strive to answer 1) What are the trends that the publications follow? 2) What is the topic distribution and its evolution? 3) What is the network among topic coherence? and we expect to find the diminishing topic trends and the emerging topic trends in relation to accelerated time. Furthermore, find critical gaps among the saturated topics and trends and suggest future research directions accordingly. This will establish a substantial research promise to put the focus on AI and Product-Service Innovation.

Keywords: Artificial Intelligence (AI), Product Service Innovation (PSI), Computational Literature Review (CLR), Latent Distinct Allocation (LDA).

Introduction

Artificial Intelligence (AI) has become rapidly evolved in the year 2023 and the results are staggering for extensive usage of AI in industry, but AI has not completely evolved in terms of business models and is in a fluid and effervescent phase (Ferràs-Hernández, Nylund & Brem, 2023). AI has been considered a "contributor" to new product-service development and as the "facilitator" enables the capacity to integrate and combine data in new ways, where instead of creating a new organization or business model, AI helps redesign services to make them further useful (Brem, Giones & Werle, 2023). For this, the firms need customized service base augmented innovation through a servitization model (Queiroz, Mendes, Silva, Ganga, Cauchick Miguel & Oliveira, 2020). The innovation as data, concept is applied to gain a competitive advantage using Product-Services Innovation (PSI) providing the opportunity for data-sharing knowledge and externalizing risks (Bustinza, Gomes, Vendrell-Herrero & Baines, 2019). This research will comprise of computational literature review, where we take support from machine learning and do content analysis based on that augmentation (Antons, Breidbach, Joshi & Salge, 2023). As we expect the data set to be smaller, the LDA technique will be able to provide greater reliability as the code can be rerun on the same articles and results will remain identical (Asmussen & Møller, 2019). This is an unsupervised machine learning that is used to extract topics (topic modelling) (Blei, Ng & Jordan, 2003). We intend to find critical gaps among the saturated topics and trends and strive to answer the following:

1) What are the trends that the publications follow?
2) What is the topic distribution and its evolution?
3) What is the network among topic coherence?

Expected Findings and Implications

We expect to find the diminishing topic trends and the emerging topic trends in relation to accelerated time. Furthermore, find critical gaps among the saturated topics and trends and suggest future research directions accordingly. We anticipate that in coming years AI will become a strategic technology. Therefore, companies are going to need a better understanding of the field for AI as a contributor as well as facilitator in Product-Service Innovation to generate new competitive advantages.

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Exploring the Capabilities of AI Platforms, Digital Servitization, and Solution Business Models: A Meta Literature Review Applying the Generative AI ChatGPT-4

Leon Marcel Adler

University of Leipzig

Abstract

Digitization and servitization are compelling companies to adopt new solutions business models by rethinking the way they create, deliver, and capture value to gain a competitive advantage. Traditional strategies and tools for product companies to address industry-specific disruptions are no longer applicable in many cases. Therefore, our study examines literature reviews using the ChatGPT-4 generative AI platform with respect to three insufficiently linked topics for servitization: AI platforms, digital servitization, and solution business models. We combine the compiled literature review with a longitudinal single case study spanning three years in the healthcare industry and will triangulate the findings with the perspectives of headquarters, their market organizations, and customers. Our result will be a meta-literature review that derives capabilities from action areas of the linked literature themes. For managers, this study will offer an overview and recommended actions and their implications for capabilities and processes.

Keywords: AI platforms, digital servitization, solution business models, ChatGPT-4.

Research Motivation

Digital technology such as Artificial Intelligence (AI) creates key radical opportunities with digital servitization (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019) by inherently incorporating AI into traditional product-oriented business models. For example, AI is predicted to transform the ways manufacturing firms create, deliver, and capture value (Sjödin, Parida, Palmié & Wincent, 2021).

Currently, generative AI platforms such as ChatGPT-4 are already demonstrating that they can improve customer service by helping customer service agents respond to customer inquiries faster and more accurately (Chowdhury, Awais & Aktar, 2023). A recent study conducted by Stanford University and MIT found that customer service agents who were given access to generative AI tools became, on average, 14% more productive than those who didn't, with the least skilled reps benefiting the most (Brynjolfsson, Li & Raymond, 2023).

While research on digital servitization as emerged over the last decades, the research on AI platforms, digital servitization and solution business models seems insufficient. At the same time, research must also evolve methodologically and adopt newer methods, such as generative AI. Researchers will have to apply more (mixed-) methods, with more rigor, to solve complex problems. To investigate this literature linkage and to demonstrate the applicability of AI platforms for research and practice, we raise the following research question:

What are the capabilities of the linked topics AI platforms, digital servitization and solution business models in academia?

Contribution to Theory and Practice

We follow the call from the 10th ICBS to shed light on the linkage of AI platforms, digital servitization, and solution business models in academia and contribute to the increasing research body of AI for digital servitization (Sjödin et al., 2021). In particular, we address the research gap on how AI capabilities can be developed in manufacturing firms (Sjöding et al., 2021) by identifying capabilities derived from the areas of action in this linked literature stream. This study is intended to result in a detailed knowledge of the capabilities required for design and implementation, and thus contribute to a successful digital servitization strategy.

Methodology

The methodology combines a systematic literature review (Tranfield, Denyer & Smart, 2003) with a longitudinal single case study (Yin, 2009). The case study is part of a larger service innovation project, spanning a three-year period, to transform a healthcare services manufacturer into a PSSS provider. We selected literature reviews that contained one of the following keywords in their title, keywords, or abstract (Newbert, 2007): 'AI platform*' OR 'digital servitization' OR 'solution business model*'. Based on this literature set, we started with predefined questions systematically applying ChatGPT-4 (Figure 1). The next step will be to validate the

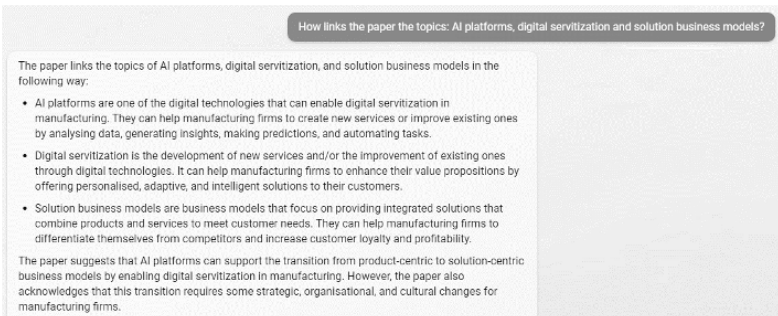

Figure 1. Paschou, Rapaccini, Adrodegari & Saccani (2020) queried by Microsoft ChatGPT-4.

capabilities in semi-structured interviews. While most servitization research currently focuses on the production perspective, this study triangulates the headquarters perspective with that of its market organizations and customers.

Expected Results

According to the research questions, the expected results will serve three purposes. First, we linked the topics of AI platforms, digital servitization, and solution business models in academia, and derived three linkages to answer the research question: AI platforms, solution business models, and ecosystems. We recognized that digital servitization in this context should be seen as an overarching strategy that is influenced by these three linkages. Second, we derived 4 areas of action consisting of targets, capabilities, tools and processes, and examples: Design, governance, orchestration, and evolution (see table 1).

Third, we emphasize that researchers will apply more (mixed-) methods, with more rigor, to solve complex problems. The research will aim to demonstrate the applicability of a generative AI platform such as ChatGPT-4 with a focus on its reproducibility. We assume that the quantitative analysis will show that human monitoring and evaluation are essential for using ChatGPT-4 for this purpose. However, it has the potential, in mixed-methods research, to make studies even more robust.

Literature Linkages	Areas of Action	Design	Governance	Orchestration	Evolution
Ecosystems	Target	• Creating and managing a network of interdependent actors that collaborate to deliver value to customers	• Establishing and enforcing rules, norms and practices that coordinate and regulate the interactions among different actors	• Managing and coordinating the interactions and relationships among various parts of an ecosystem	• Process of change in the structure and function of an ecosystem over time
	Capabilities	• Leveraging the capabilities, resources, and relationships of different ecosystem partners	• Ensure alignment of interests, incentives and values among ecosystem partners, as well as to foster trust, collaboration and innovation	• Sharing knowledge and resources and innovating in ways that benefit the whole ecosystem	• New interactions, new adaptations, and new ecosystem services
	Tools and Processes	• Applying design principles and tools to understand customer needs, define ecosystem strategy, design ecosystem offerings, and build ecosystem platforms	• Decision making, conflict resolution, value distribution, data sharing, quality control, performance measurement	• Align the interests, incentives and values of the ecosystem partners, as well as to foster trust, collaboration and innovation within the ecosystem	• Adapting and transforming the logic and mechanisms of how value is created, delivered and captured through solution offerings
	Examples	• Problem definition, value proposition, partner identification, role definition, governance model, openness level, customer journey, service blueprint, platform architecture	• Customer demand, technological disruption, market competition, network effects, coordination costs, trust issues	• Platform creation, network expansion, value proposition enhancement, and governance model design	• Natural selection, genetic variation, environmental change, matter and energy input
Solution Business Models	Target	• Creating and implementing value propositions that integrate products and services to meet customer needs and generate revenue streams	• Implementing rules, roles, responsibilities and relationships that guide and monitor the creation, delivery and capture of value through solution offerings	• Managing and coordinating the activities, resources and capabilities of various actors	• Ecological genetics, evolutionary ecology, ecosystem phenotypes
	Capabilities	• Conceptual framework that describes how a provider creates, delivers and captures value through its solution offerings	• Align the interests and expectations of various stakeholders	• Achieve synergy, efficiency and effectiveness by leveraging the complementary strengths and competencies of different partners and platforms in a solution ecosystem	• Achieve sustainable competitive advantage and performance by exploiting new opportunities, overcoming challenges and satisfying customer needs
	Tools and Processes	• Value proposition design, customer segmentation, revenue model design, cost structure design, service delivery system design, performance measurement system design	• Governance structure design, governance mechanism design, governance role assignment, governance performance evaluation, governance adaptation and improvement	• Network design, partner selection, platform development, value co-creation, resource integration, service innovation,	• Framework that describes how a solution business model changes over time along different dimensions and stages
	Examples	• Business model canvas, value proposition canvas, service blueprint	• Contracts, incentives, standards, audits, feedback loops	• Ecosystem mapping, network analysis, platform architecture, service orchestration	• Value proposition design, value network design, revenue model design, cost model design, value creation process design, value delivery process design
AI Platforms	Target	• Type of service platform that use artificial intelligence to provide various functionalities and services to users and developers	• Framework that manages an organization's use of AI with a large set of processes, methodologies and tools	• Managing the set of tools, processes, data and talent related to the application of AI	• Create more intelligent, adaptive and human-like systems that can solve complex problems and create value for various domains
	Capabilities	• Architecture, Functionalities, Interfaces	• Risk management, regulatory compliance and ethical usage of AI	• Helps enterprises operationalize AI by automating data preparation, model building and deployment, insight generation and explanation	• Supports the development, deployment and improvement of AI solutions by providing data, algorithms, tools and infrastructure
	Tools and Processes	• UX design, prototyping, testing, feedback	• Data provenance, model documentation, audit trails, explainability, transparency, fairness, robustness, security and safety	• Data pipelines, model repositories, experiment tracking, hyperparameter tuning, model serving, monitoring and debugging	• Data collection and preprocessing, algorithm development and testing, model training and evaluation, model deployment and integration, model monitoring and updating
	Examples	• Microsoft AI, Google Cloud AI, IBM Watson, Amazon Web Services AI	• Trust-based, human-centric, value-driven	• Run:ai, Kubeflow, Mlflow	• Google Cloud AI Platform, Amazon SageMaker, Microsoft Azure Machine Learning

Table 1. Identified areas of action from literature linkages.

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IoT Platforms and/or AI Platforms for Transitioning Towards a Solution Business Model

Esteban Lafuente

Department of Management, Polytechnic University of Catalonia (UPC Barcelona Tech), Spain

Yancy Vaillant

Department of Strategy, Entrepreneurship and Innovation, TBS Education, France

Abstract

Digitalization has played a key role in enabling the delivery of service-based solutions by facilitating customer-oriented needs-finding and personalized problem-solving capabilities. Internet-of-Things (IoT) and Artificial intelligence (AI) are decisive technologies in this process. This study evaluates how the use IoT and AI platforms impact solution delivery business models among servitized and non-servitized businesses. By running regression models on a sample of 213 businesses for 2023, it was found that the use of IoT platforms, rather than AI platforms, are found to significantly assit companies down all four solution delivery continua: *customer embeddedness, offer integratedness, operational adaptiveness, and organizational networkedness*. Additionally, results indicat that the combined use of IoT platforms when servitizing leads to greater customer embeddedness, whereas the use of AI platforms among servitized firms significantly contributes to improving *operational adaptiveness*.

Keywords: AI platforms, IoT platforms, servitization, solution delivery, solution business model.

Extended Abstract

Manufacturers are increasingly pushed to transition from a standardized product business model towards a solution model that offers greater customization and responds to the specific needs of each customer (Storbacka, Windahl, Nenonen & Salonen, 2013). In this business model, the manufacturer ceases to sell products and begins to sell business solutions for its customers, shifting from transactional, temporary relationships to continuous relationships in which customers pay for solutions delivered based on the problem-solving benefits obtained from the use they make of the supplier's products (Smith, 2013). To transition to such a high value-added solution business model, firms must first develop certain capabilities linked to data collection and processing that enable needs-finding and problem identification together with solution ideation, creation and implementation capacities (Vendrell-Hererro, Vaillant, Bustinza & Lafuente, 2022).

Technological advances linked to the internet of things (IoT) have allowed for greater information availability and affordability (Ganotakis, Hsieh & Love, 2013) whilst artificial intelligence (AI) capabilities have permited the effective process of this information enabling rising market orientation and potential solution delivery of manufacturers (Na, Kang & Jeong, 2019). Such technologies are no longer reserved for the hi-tech segment of industry, but competitive pressures and the value-added potential that they offer has led there influence to perculate throughout most productive sectors. To democratize and facilitate access to these technologies by companies that may not otherwise have the technical and human capital capabilities to do so, various pre-configured and easily implementable IoT and AI platforms have entered the market.

In the case of IoT, these platforms, such as *Thingworx, Mindsphereo, Fogwing, AWS, or SAP Leonardo* among many others, help ease the connectivity, device management, application

enablement, and data collection associated with IoT for companies (Wamba, Queiroz, Guthrie & Braganza, 2021). In the case of AI, easily calibratable platforms such as *SAS*, *Watson (IBM), Azure (Microsoft),TensorFlow,* or *Google AI Platform*, among many others can be used to automate the typical tasks necessary for smart production (Cenamor, Sjödin & Parida, 2017), such as data management, cleansing, normalization, ingestion, selection of the most appropriate algorithms, verification, training, validation, etc. (Barbieri, Rapaccini, Adrodegari, Saccani & Baccarin, 2021). The implementation of these platforms within industry can significantly simplifying the adoption of IoT and AI technologies and help increase the diffusion of related applications (Mucha & Seppälä, 2020). Such platforms can contribute to the development of data-driven models allowing manufacturers to open up new solution delivery capabilities and attain better economic and competitive outputs.

The principles of the solution business model requires allocating resources, time, and significant upfront investments in developing crucial capabilities across four essential continuums for a successful transition towards customer oriented solution delivery (Storbacka et al., 2013).

Firstly, *customer embeddedness* is a critical continuum in the shift towards a successful solution-based business (Storbacka et al., 2013). Customer embeddedness occurs when the exchange with customers becomes relational, with the solution being developed, sold, and delivered through a collaborative process with the customer (Storbacka et al., 2013). Achieving customer embeddedness involves fully understanding and addressing the unique business concerns of the customer to provide a tailored value proposition (Anderson & Narus, 1991).

Secondly, *offer integratedness* refers to the manufacturer's ability to consistently deliver value over time, enabling the provision of integrated solutions that enhance customization cost recovery (Johansson, Krishnamurthy & Schlissberg, 2003). An integrated offer creates switching barriers for customers as they cannot easily separate the interdependent product-service system that creates value beyond the individual components (Storbacka, 2011). Greater levels of integratedness of products enable manufacturers to become performance providers, actively involved in the customer's technical operations and long-term system optimization (Helander & Möller, 2007).

Thirdly, manufacturers need *operational adaptiveness* to successfully transition to a solution-based model, even if it means sacrificing economies of scale and repetition, to respond rapidly to fluctuating customer requirements (Storbacka et al., 2013). Exceling in solution delivery requires maximizing returns from integrating components and tailoring solutions to specific product-service systems through longer product lifespans (Vendrell-Herrero et al., 2022; Visnjic, Jovanovic, Neely & Engwall, 2017).

Lastly, *organizational networkedness* involves harmonization processes across organizations, which becomes increasingly important as solution integratedness grows, as buyer-supplier networks become more interdependent (Cheng, Chaudhuri & Farooq, 2016). This networkedness relies on activity system value creation generated from cooperation along the value chain to optimize the value-added provided through increased solution delivery (Zhou, Yan, Zhao & Guo, 2020). The longevity of the product-service system, which serves as the foundation for this networkedness, largely determines the symbiotic fit and value-generating potential of the resulting servitized solution delivery (Davies, Brady & Hobday, 2007; Visnjic et al., 2017).

The objective of the study is therefore to test whether IoT and AI platforms are useful tools for industrial firms transitioning towards a solution delivery business model. More specifically, the study attempts to identify the differentiated role of these platforms in each of the four solution business model continuums mentioned above and to see if the impact of these platforms interact with the servitization strategy implementation of the observed companies. To do so, the study makes use of a self-devised survey from 2023 covering 213 different Spanish firms.

Results show how the use of IoT platforms, rather than AI platforms, are found to significantly assit companies down all four solution delivery continua. However, the combined use of AI platforms when servitizing significantly contributes to improving *operational adaptiveness*, whereas IoT platforms crossed with servitization leads to greater *customer embeddednes*s.

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Artificial Intelligence (AI) as a research phenomenon in digital servitization literature – Expanding the relationship and highlighting future research perspectives

Josip Marić

EM Normandie Business School, Paris (France)

Mirjana Pejić-Bach

Faculty of Economics and Business, University of Zagreb, Zagreb (Croatia)

Abstract

Artificial Intelligence (AI) is an emerging disruptive technology that has been receiving an increased amount of attention from the mainstream media and scholar communities as a consequence of profound benefits and challenges it holds for the businesses and society in general. Although it is relatively known as a research phenomenon in business and management literature, we have noted discreet relationship between AI and the publications linked to Digital Servitization (DS) and Digital Service Innovation (DSI). In our study, based on a systematic literature review of a volume of scholar work (N=111) related to DS and DSI, collected through Scopus scholar database, we analyse the nature of the research on AI, industrial context, and technological narrative related to this technological innovation. Insights from this study are expected to contribute to better guiding future studies from DS and DSI perspective, provide practical implications for DS and DSI scholars, assess the possibilities AI bring for servitization theory, such as platformization of AI-based solutions for manufacturing companies, or the adoption of AI for novel products and services by the industrial sector. Finally, this study supports the findings with

the use of software-enhanced visuals emerging from the textual analysis of the literature corpus.

Keywords: digital servitization, digital services innovation, artificial intelligence, literature review.

Servitization and learning

Joan Freixanet

Saint Petersburg University, Russia

Josep Rialp

Autonomous University of Barcelona, Spain

Ferran Vendrell-Herrero

University of Edinburgh, UK

Abstract

This research explores the relationship between servitization and learning in the context of exporting. Servitization involves transforming product-based businesses into service-oriented enterprises by integrating value-added services. While servitization has been studied in various dimensions, its connection with learning has received limited attention. The study employs a two-stage statistical approach to estimate the impact of servitization on learning. Preliminary findings indicate a positive association between servitization and learning in terms of export breadth but a negative relationship in terms of export depth. The study emphasizes the multifaceted nature of the relationship and its implications for firms' competitiveness.

Keywords: Servitization, learning-by-exporting, export breadth, export depth.

Executive summary

Servitization of manufacturing refers to the transformation of traditional product-based businesses into service-oriented enterprises (Rabetino, Harmsen, Kohtamäki & Sihvonen, 2018). It involves integrating value-added services, such as maintenance, repair, and upgrade options, alongside the sale of physical products. The shift towards servitization has garnered significant attention due to its potential to enhance competitiveness and establish sustainable business models (Baines, Ziace Bigdeli, Bustinza, Shi, Baldwin & Ridgway, 2017). This study explores the concept of servitization and investigates its relationship with learning, specifically in the context of exporting.

While servitization has been extensively studied in various dimensions, such as its impact on technological innovation (Vendrell-Herrero, Bustinza, Opazo-Basáez & Gomes, 2023) and financial performance (Visnjic-Kastalli & Van Looy, 2013) , the connection between servitization and learning has received limited attention, with only Valtalkovski's work (2017) addressing this relationship. This research gap is intriguing, given that servitization involves acquiring knowledge from consumers and downstream agents like retailers.

To examine the effect of servitization on learning, the focus is placed on a specific aspect known as "learning by exporting" (Freixanet and Federo, 2023). This concept involves acquiring knowledge and capabilities through engagement in international markets. Firms that participate in exporting gain exposure to new environments, customer preferences, and competitive landscapes, stimulating learning and fostering innovation.

Methodologically, this study employs a novel two-stage statistical approach to estimate the impact of servitization on learning. Initially, the probability of innovation is estimated using a standard model that includes control variables such as research and development (R&D) investment, firm size, industry characteristics, and firm age. Subsequently, a variable related to internationalization, either the number of countries in which firms operate (breadth) or the intensity of their exports (depth), is introduced. Both the internationalization variables and control variables are lagged by one period to account for time effects (Vendrell-Herrero, Darko, Gomes & Lehman, 2022). By comparing the odds ratios (probability of innovating versus not innovating) for both models, the learning effect associated with internationalization for each firm can be quantified. This empirical approach contributes significantly to the existing literature. In the second stage, the estimated learning effect is used as the dependent variable, with servitization (service sales over total sales) as the independent variable.

This study utilizes a dataset comprising 929 firms with 1425 observations for the years 2011 and 2015, operating in machinery, transport, electronics, and components industries. The data is sourced from the Survey on Business Strategies (SBS), an institutional database specifically focused on Spanish manufacturing firms (Freixanet & Rialp, 2022). The SBS database provides a suitable framework for investigating the interplay between servitization, innovation, and exports.

Preliminary findings indicate a positive association between servitization and learning by exporting, specifically in terms of export breadth. This suggests that firms engaged in servitization strategies and operating in multiple international markets are more likely to acquire knowledge, adapt to diverse business contexts, and foster innovation. Conversely, a negative relationship is observed between servitization and learning in the context of depth, implying that focusing on a specific market hampers learning for servitized manufacturers.

Based on these results, it is theorized that the relationship between servitization and learning in the context of export breadth and depth is multifaceted. Servitization, closely associated with innovation, influences learning potential differently depending on the specific internationalization strategy employed. For learning from foreign markets, servitized firms, being closer to the technological frontier, have less potential to acquire specialized knowledge (Salomon & Jin, 2008). Thus, they tend to gain additional knowledge through expansion into multiple markets (breadth) rather than through high export intensity in a few markets (depth). Conversely, non-servitized firms, further from the technological frontier, may acquire more general knowledge through export depth. Learning by doing, which involves volume and repetition, is more relevant for depth and less so for breadth (Andersson & Lööf, 2009; Wang & Ma, 2018). However, servitized firms face challenges in exploiting repetition due to the need for customization in their services. Regarding learning from customers, servitized firms, with closer relationships to customers, are expected to benefit more, particularly in the context of export breadth where heterogeneous demands can be leveraged (Ariu, Mayneris & Parenti, 2020).

Understanding the connection between servitization and learning has significant implications for businesses aiming to enhance their competitive advantage. Embracing servitization strategies and actively engaging in multiple international markets enable firms to access valuable learning opportunities that drive innovation and ensure long-term sustainability. Policymakers and industry practitioners should recognize the potential benefits of servitization and promote policies that encourage knowledge exchange, collaboration, and internationalization in multiple markets to foster learning and stimulate economic growth.

In conclusion, while servitization has been extensively studied in various dimensions, the connection between servitization and learning remains underexplored. This research seeks to address this gap by focusing on the effect of servitization on learning through exporting. Initial findings suggest a positive association between servitization and learning by exporting, particularly in terms of the number of international markets. This research contributes to the growing body of knowledge on servitization and highlights the importance of learning for firms in today's competitive global marketplace.

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Session 2

Industry and Sector-specific Perspectives on Servitizacion

Co-Chairs: Paul Mathyssens & Tuomas Huikkola

(venue: TBS Executive room 702 -7th floor)

The use of green hydrogen and its relationship with Human Capital, Corporate Social Responsibility and the degree of digitization in companies in the naval sector

Jesús García López

Polytechnical University of Cartagena

Lorena Para

González University of Murcia

Carlos Arsenio Mascaraque Ramírez

Polytechnical University of Cartagena

Abstract

From the point of view of economy and profitability, the development of bioenergy fuels is one of the alternatives that will allow us to immerse ourselves in an economy with less dependence on traditional fuels such as oil, a sustainable and clean energy alternative capable of emerging increase its use is Green Hydrogen (GH). The objective of this article is to measure the relationship between GH-based technologies and the fulfilment of the Sustainable Development Goals (SDGs) on business results, as well as their relationship with Human Capital (HC), the degree of digitalization of the company, business performance and Corporate Social Responsibility (CSR). To get this aim, a survey has been sent to managers of different consolidated companies in the naval and fishing sector with questions based on the Literature in order to quantify the relationships between the different constructs. The data are analysed using SmartPLS software from a gender perspective.

Keywords: Green Hydrogen, Environmental Management, Human Capital, Corporate Social Responsibility, Digitalization.

Introduction

Given the current context of society, where the demand for energy in the world is increasing and the unstoppable growth of the population that is subject to an unsustainable lifestyle increases climate change by leaps and bounds with its respective consequences (Viton, 2021), exploiting the planet's natural resources and polluting the atmosphere, it is clear that society needs to look for alternatives to traditional fossil fuels and develop sustainable and clean processes, since there is scientific evidence on the increase in global temperature and the potential effects on the climate derived from this phenomenon (Vieir, Arzeno, de Oliveira & Troncoso, 2023).

In this context, the investigation of different roles of GH is a key factor for the energy sector (Saavedra Jurado, 2023), which is projected as a technology associated with electricity generation and which is also seen as a clean and efficient fuel to power vehicles and industrial processes being even more important in industries highly dependent on fuels (Díaz Zepeda, 2022).

Digitalization should be a fundamental element for the hydrogen economy in order to accelerate and reduce risk during innovation and development that allows a better and faster extension and optimization of the hydrogen value chain (Litvinenko, Bowbrik, Naumov & Zaitseva, 2022). Digitalization will make it possible to overcome many difficulties in the research of the hydrogen value chain, maximize its commercialization and supply chains and incentivize its production and economy (Elavarasan, Pugazhendhi, Irfan, Mihet-Popa, Khan & Campana, 2022).

Cséfalvay (2019) highlight that digitalization, automation and robotization have a significant impact on the transformation of the labor market. New technologies and ICTs are changing the traditional routines of workers in many professional sectors.

On the other hand, CSR is considered an asset of great value that must be managed strategically and transversally, since it currently affects the prestige of most companies, which always drives their proper functioning (El Badri & Aasri, 2022).

Goals

The main objective of this article is to evaluate the level of development of the use of GH in the different companies of the naval and fishing sector, as well as the use of techniques and digital resources in the different areas of the company and the importance of Environmental Management (EM), CSR and proper HR management, focusing on the ecological transition of companies in the naval and fishing sector, considering the relationship between GH-based technologies and the fulfilment of the SDGs on business results, as well as their relationship with HC, the degree of digitalization of the company, business performance and CSR.

Methodology

It is intended to measure the relationship between the following constructs:

- The use of HV,
- the degree of digitization,
- the CSR,
- the EM level,
- HC management, and
- the performance of different companies in the naval and/or fishing sector.

To this end, a survey has been sent to different companies in the sector with a size of at least 50 workers and minimum age of 5 years with which they intend to measure a series of parameters.

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Designing Advanced Digital Servitization Business Models: The case of Autonomous Ships

Håkon Sandvik

University of South-Eastern Norway

Abstract

The present paper aims at understanding how advanced digital servitization business models can be designed. The ongoing research follows an exploratory in-depth case study of a leading maritime technology provider engaged in digital servitization toward autonomous solutions. Data is analysed according to a thematic analysis approach and guided by theory. The preliminary findings reveal four business model design categories: Directing Value Focus, Solution Configuration, Ecosystem Planning, and Incentive Formulation. Findings implicate that technology providers emphasize business model themes over elements in the early stages of business model design. Further the design choices for the elements seems to be moderated by consideration of barriers and future scaling potential. Finally, the business model design process therefore seems to be a continuous iteration between business model vision (ideal) and confrontation with actual implementation.

Keywords: Digital Servitization, Business Model Design, Smart Solutions, Autonomous solutions.

Introduction

Traditional industries undergo digital servitization as technology providers leverage digitalization to build services into their products, creating smart solutions i.e. product-service-software systems (PSSS) with various level of advancement ranging from monitoring, control, optimization, and autonomous functions (Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022). Despite the hype surrounding the advanced technologies underpinning the transition, there is need to understand how companies manage the transition to successfully commercialize advanced and smart solutions. Indeed, while research highlights the need to mature technology, ecosystems and business models to advance digital servitization toward smart and autonomous solutions (Kohtamäki et al., 2022; Thomson, Kamalaldin, Sjödin & Parida, 2021), research has suggested a multitude of potential business model types for autonomous solutions (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019; Leminen, Rajahonka, Wendelin, Westerlund & Nyström, 2022), and has only started to delineate how they can be constructed (Thomson, Sjödin, Parida & Jovanovic, 2023). While business model innovation has already been a topic in management for twenty years (Foss & Saebi, 2017), it exploded with Zott and Amit (2010)'s business model design framework which was broadly adopted outside of digital servitization. In short, their framework views business models as "activity systems that transcends firm boundaries" (Zott & Amit, 2010, p. 1). They suggest two sets of parameters to consider when innovating business models. The first, design elements, refer to the content, structure, and governance, that makes up the business model architecture. The second parameter, design themes, refer to the sources of the activity systems value creation, whether it derives from novelty, lock-in, complementation or efficiency.

Despite the framework's popularity in adjacent fields, the framework has not been used to shed light on the design of digital servitization business models. This is problematic as the framework might be the perfect tool to understand how advanced digital servitization business models can be designed. Similarly, the complexity of the advanced digital servitization context might potentially yield theoretical insights on business model design processes. Therefore, the current paper aims to fill these gaps by adopting their activity system approach to business model design for autonomous solutions.

Methods

The research is an exploratory in-depth case study of a global maritime technology provider engaged in digital servitization toward autonomous solutions (Yin, 2014). The research draws from an evolving data set where the main type of data is collected through 28 in-depth interviews with top level managers and supported by secondary sources such as documents and media files. The data is analyzed following a thematic analysis approach (Braun & Clarke, 2006). This is a highly iterative process going forth and back

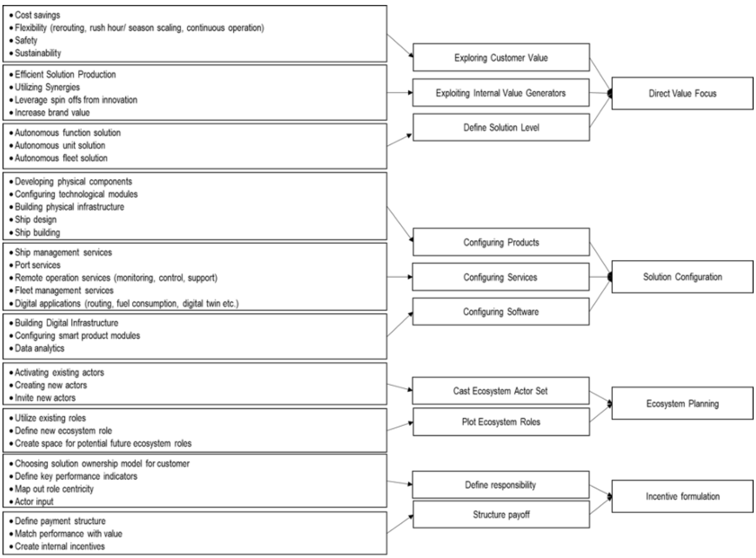

Figure 1. Preliminary Data Structure.

between raw data, coding, and literature. The early stage preliminary data structure is presented as suggested by Gioia, Corley and Hamilton (2013) in Figure 1.

Preliminary Findings

In the following subsections I briefly outline the preliminary findings of business model design considerations for advanced digital servitization.

Directing Value focus

MarineCo Started their business model design process by exploring the overarching value focus for autonomous solutions. This defines the business model type as it sets the premise for subsequent business model configuration choices and involves the themes *exploring customer value, exploiting internal value drivers, and define solution level.* MarineCo explored what type of value customers are willing to pay for. These values can be combined depending on the business model design. Similarly, they assessed how value could be generated internally and how the solutions drive value for the company. As different solution levels provide different value affordances, defining solution level is a key step in directing value focus.

Solution Configuration

The first key element to designing an autonomous solution business model is configuring solution. In this design step the key activities to develop and operate the solution is defined, it details what set of activities the solution consists of to ensure value production. When configuring solution, three main activity themes must be combined: Configuring products, configuring services and configuring software.

Ecosystem Planning

The second key element to designing autonomous solution business models is ecosystem planning. Here, MarineCo structured the activities by defining an *ecosystem role plot* and *casting ecosystem actor set*. The roles serve specific functions by performing bundles of activities; thus roles have heterogenous centricity to the overall business model. By casting an actor set to perform the roles, MarineCo seek to design ecosystem positions. For autonomous ships, both new (e.g. remote operating center) and old roles (e.g. ship building) are required, and can be assumed by both new (e.g. telecom) or traditional actors (ship yards).

Incentive formulation

The third key element of creating business models for autonomous solutions is incentive formulation. These are governing mechanisms aimed at aligning the ecosystem to function as a coherent value producing system. Two design themes constitute incentive formulation: *Define Responsibility* and Structure Payoff. In the first, the boundary conditions for responsibilities between actors at are defined at the activity level. New thinking regarding ownership models for the solution as well as performance indicators of roles and their importance is considered. To structure payoffs, technology providers match the responsibilities and performance fulfilment with economic payoffs. As such, the value capturing potential is delineated in this step.

Potential Implications and future work

So far, the ongoing analysis has detailed how MarineCo engage in business model design for autonomous solutions. One interesting observation is that they approach business model design with by first delineating the value drivers which implies choosing business model type, and then configuring the specific elements of the business model. Theoretically, this implies that MarineCo combined

Zott and Amit (2010)'s design parameters: elements and themes, with a primary focus on the themes.

Further when specifying the design elements through solution configuration, ecosystem planning and incentive design, MarineCo's design choices was seemingly moderated with respect to current market barriers and future scaling potential (Figure 2).

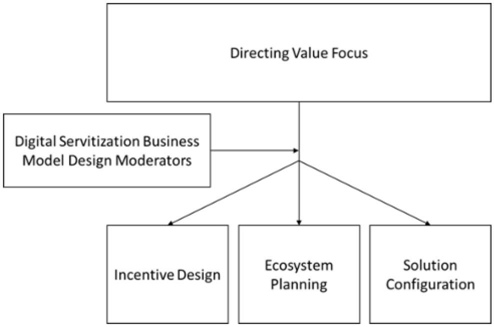

Figure 2. Advanced digital servitization business model design consideration framework.

For example, despite the shift to a servitization logic implies focus on value creation, MarineCo's business model remained a traditional focus on cost savings to accommodate customers traditional mind-set. Similarly, while working on pilot projects, they made strategic ecosystem planning decisions beyond pilot scope (creating a new role, activating actor, taking position) to enable future market scaling.

Finally, the preliminary analysis captured early-stage design considerations for autonomous solution business models. While MarineCo emphasized visons of advanced servitized business models (ideal), the actual choices imply an iterative and continuous process going back and forth between iterations of envisioned advanced autonomous services and more traditional practical implementation (Figure 3).

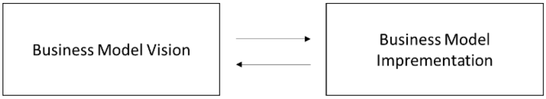

Figure 3. Interative and continous business model design process.

However, acknowledging this research is early stage, both the findings and its contributions will likely change as the study proceeds, and should be treated as preliminary results.

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From Waves to Bytes: Exploring the integration of digital servitization and autonomous ships in the maritime sector

Hao Rong

Instituto Superior Técnico, Universidade de Lisboa

Yueling Zhou

School of Business and Economics, Universidade NOVA de Lisboa

Abstract

The rapid digitization of industries and economic sectors is driving the emergence of novel Product-Service Systems (PSS), revolutionizing customer/supplier relationships and introducing new value propositions. To successfully introduce PSS to the market, companies need to establish enabling ecosystems, often leveraging existing business ecosystems. This study focuses on servitization in the maritime industry, examining how to develop service design routines to facilitate digital servitization and achieve positive growth outcomes. Furthermore, the analysis explores the creation, delivery, and capture of value in the context of autonomous ships in the maritime industry, thereby shaping the ecosystem formation around PSS. The findings highlight that the servitization of autonomous ships provides a range of safety-enhancing features and services that leverage technology, data analytics, and proactive maintenance. These advancements contribute to the prevention of accidents, early detection of potential issues, data-driven risk assessment, and improved emergency response, collectively raising the overall safety standards in maritime traffic.

Keywords: Maritime industry, Digital servitization, Value creation, Maritime autonomous ship.

Introduction

The advent of digitalization is compelling manufacturing companies with product-oriented approaches to embrace, conceive, and provide innovative smart, connected products and services that redefine their competitive landscape (Porter & Heppelmann, 2015; Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). In recent years, there are various literatures has been analysing the role of digitalization in the servitization of manufacturing firms under the topic of digital servitization (Coreynen, Matthyssens & Van Bockhaven, 2017; Kamalaldin, Linde, Sjödin & Parida, 2020; Vendrell-Herrero & Wilson, 2017), which emphasizes the interplay between digitalization and servitization (Gebauer, Paiola, Saccani & Rapaccini, 2021).

A growing literature has been analysing the role of digitalization in the servitization of manufacturing firms under the heading digital servitization (Gomes, Lehman, Vendrell-Herrero & Bustinza, 2021). Digital servitization emphasizes value creation through the interplay between products, services, and software (Holmstrom & Partanen, 2014). Practical examples of PSS include analytical services, product lifecycle maintenance and optimization services, site and fleet management systems, etc. Thus, given the scope of the new routines and activities that these companies need to introduce and revise, most digital servitization initiatives fail to generate the promised value.

Maritime transportation represents more than 80 percent of the global merchandise trade by volume (United Nations Conference on Trade and Development (UNCTAD), 2019). The central role of maritime transportation in the world's logistic system is evident in the statistical estimates from International Maritime Organization (IMO): around 90% of world trade is carried by sea and the trade volume are still growing at a rate even faster than global economy.

Additionally, the maritime industry is actively developing technologies relevant to smart and autonomous ships that apply the Internet of Things, big data, artificial intelligence, etc. In the near future, autonomous ships are expected to be commercialized (Negenborn, Goerlandt, Johansen, Slaets, Valdez Banda, Vanelslander et al., 2023). As such, maritime traffic is expected to increase due to higher maritime traffic, advancements in technology, and marine developments for the transition to environment friendly energy sources. Maritime autonomous ships in servitization refer to the integration of autonomous or self-driving capabilities in ships, combined with service-oriented business models. In this context, servitization involves not only the delivery of autonomous ships as a product but also the provision of associated services and value-added solutions throughout the lifecycle of these ships (Tsvetkova, Hellstrom & Ringbom, 2021).

We address the following research question: *how MASS will enable new business models and what will be the potentially create value for maritime industry?*

Methodology

This study aims to investigate the servitization of maritime autonomous ships, examining the integration of autonomous technology and service-oriented business models in the maritime industry. The data for this study are collected through desktop analysis of secondary sources, including scientific literature, news and trade magazines, and industry reports on the challenges of introducing maritime autonomous ships. We have focused on organizations listed as leaders in maritime technology, such as ABB Marine and Ports, DNV GL, Kongsberg, Rolls Royce Marine, etc. Thematic analysis and statistical techniques are employed to analyse the collected data and identify patterns and trends.

Findings and Conclusions

Introducing MASS has the potential to change the business logic behind sea logistics. As several interviewees indicated, it can enable "distributed economies" (Johansson, Kisch & Mirata, 2005) and "network effects" (Katz & Shapiro, 1985) through coordinating many smaller vessels delivering goods from the origin port to the destination port, which also can save time. Current logistics aim rather for "economies of scale" through increasing vessel size and enlarging the capacity of ports and fairways, through so-called hub-and-spoke transportation systems. According to the analysis of this study, distributed economies in the context of shipping would have implications for shipbuilding (smaller vessels) and cooperation between actors in the value chain (integrating production planning with logistical planning more transparently).

The main contribution concerning the maritime autonomous ships in maritime industry towards digital servitization as follows:

Increase transparency: The increased level of digitalization in autonomous shipping necessitates a greater emphasis on data sharing and transparency within the shipping ecosystem. This shift towards increased transparency brings about notable benefits for various actors, such as enhanced logistical efficiency, expedited ship turnaround times, and optimized shipping operations. However, it also brings about changes in how certain actors operate and interact with one another. Additionally, the increased transparency in the logistics chain has the potential to alter the power dynamics within the industry, potentially tilting the balance of influence towards the shipper.

Risk management: Autonomous ships equipped with advanced navigation and collision avoidance systems present opportunities for effective risk management in maritime operations. By using real-time data, sensors, and artificial intelligence, these sophisticated systems have the capability to detect and response to potential hazards with great efficiency. These systems can help prevent collisions, navigate through congested waterways, and mitigate the risk of accidents (Xu, Rong & Guedes Soares, 2019; Rong, Teixeira & Guedes Soares, 2022). Moreover. The extensive data generated by autonomous ships during their operations can be harnessed through servitization to enhance risk management practice. This data-driving approach empowers maritime stakeholders to proactively identify areas where safely improvements can be implemented, facilitating target interventions, and enhance overall safely in maritime operations.

Value creation: Autonomous ships can create value through fuel savings and subsequent emission reductions, as their adaptability to slow steaming and optimal navigation contributes to enhanced efficiency. Furthermore, the advent of autonomous shipping may attract individuals possessing distinct values, skills, and job expectations. Consequently, automation generate novel employment prospects, including roles like high-skilled route operators, diverse pilot profiles, and riding gangs. Additionally, MASS might create more value if implemented with smart ports and intelligent fairways. Greater automation in ports would unleash the value potential of MASS.

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Territorial servitization and regional resilience in the EU regions

Eduardo Sisti

Orkestra – Basque Institute of competitiveness

Deusto Business School - University of Deusto

Arantza Zubiaurre

Deusto Business School - University of Deusto

Kristina Zabala

Deusto Business School - University of Deusto

Abstract

The effects of territorial servitization on the resilient character of regions is an important matter to study (Lafuente, Vaillant & Vendrell-Herrero, 2019; Vendrell-Herrero, Lafuente & Vaillant, 2020). So, the aim of the research is to examine the influence of different combinations of territorial servitization on the resilience of EU regions during the period 2008-2018. The research is carried out with a quantitative approach through the application of panel data regression techniques. The data compilation makes it possible to have a database of 201 EU administrative regions (NUTS-2 and NUTS-1) from 2008 to 2018.

Keywords: Territorial servitization, resilience.

Introduction

The different economic responses among territories in the face of external shocks is a great research concern in what has come to be known as resilience (Martin, 2012; Martin & Sunley, 2017; Martin & Sunley, 2015). Into such "fluourishing" field of study, the configuration of the industrial structure (in various forms as indicators of specialization, diversity, embeddedness, etc.) has been pointed out as a critical determinant (Kitsos, Grabner, Carrascal-Incera, 2023).''Territorial servitization'' (Lafuente et al., 2017; Vendrell-Herrero et al., 2020; Gomes, Bustinza, Tarba, Khan & Ahammad, 2019) as a reality that establishes a reinforcing circle between manufacturing and KIBS could also affect the resilience of regions.

Servitization is a theoretical paradigm that stresses the process that manufacturing firms follow to renovate their value proposition by managing the transition from products to services (Vandermerwe & Rada, 1988; Bellandi & Santini, 2019). Into this process, the role of knowledge intensive business services (KIBS) is significant to transfer specialized knowledge (Bustinza, Gomes, Vendrell-Herrero & Baines, 2017). At territorial level, this synergetic relation (Lafuente, Vaillant & Vendrell-Herrero, 2017; Vendrell-Herrero et al., 2020) is expected to contribute into their modernization and renewal paths (Corrocher & Cusmano, 2014; Horvath & Rabetino, 2018; Gebauer & Binz, 2019) as well as their resilience (Bellandi & Santini, 2019; Vendrell-Herrero et al., 2020; Ariu, 2016). However, the manufacturing context is complex; for example, in terms of technological intensity, the sophistication and capabilities needed to compete in biotechnology and metallurgy are not the same. Also, the KIBS' sector is heterogeneous (Miles, Lafuente & Vendrell-Herrero, 1995; Haas & Lindemann, 2003; Bhom & Thomi, 2003; Koch & Stahlecker, 2006; Gallego & Maroto, 2013; Wrywich, 2019). So, there is a research gap about how the effects of the combination of manufacturing and KIBS buffer (resistance phase) and retrieve (recovery phase) the regional economies. The only empirical approach, at least to our knowledge, that approach in some sense such issue is the one conducted by Vaillant, Lafuente and Vendrell-Herrero (2023) on a sample of 17 Spanish regions between 2006 and 2012. So, building in those authors, the article addresses the following general research question: Does territorial servitization affect regional resilience?

The aim of the research is to examine the influence of different combinations of territorial servitization on the resilience of EU regions during the period 2008-2018. The research is carried out with a quantitative approach.

Data & methods

Data

Data compilation, for the period 2008-2018 and EU regions, has been carried out using two main sources. First, employment at 2-digit NACE come from a database of the ECCP project. Second, GDP and other indicators come from Eurostat. To measure the resistance and recovery, the database is split in two subsamples: 2008-2012; and 2013-2018.

Variables

Dependent variables. Resilience is calculated following Lagravinesse (2015). The resistance indicator is calculated as the quotient between the difference in the regional growth rate and the aggregate growth rate, and the absolute value of the aggregate growth rate. Meanwhile, the recovery indicator measures the ratio between the regional growth rate and the aggregate growth rate. Finally, the two indicators are binarized.

Independent variables. Following Vaillant, Vendrell-Herrero & Lafuente (2023) approach to identify product-service innovation ecosystems (PSI), different binary variables have been calculated to approximate different nfigurations" of territorial servitization.

Method

The empirical evaluation is carried out using panel data models, using these specifications:

$$Resistance_{rt} = \alpha + \beta_1 TerritorialServitization_{rt-1} + \beta' X'_{rt-1} + \sigma_{rt} + \epsilon_{rt}$$
$$Recovery_{rt} = \alpha + \beta_1 TerritorialServitization_{rt-1} + \beta' X'_{rt-1} + \sigma_{rt} + \epsilon_{rt}$$

The dependent variable is either resistance (2009 to 2012) or recovery (2013 to 2018) in both forms as a continuous variable (applying a linear regression panel model) and as the binarized variables (applying a binary outcome panel data model), for each region r and in each year t.

Results

Work in progress.

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Digital servitization in European manufacturing companies: AI challenges perspective

Jana Kunecová

Andrea Bikfalvi

Pilar Marques

Universitat de Girona

Juraj Šebo

Technical University of Košice

Jasna Prester

University of Zahreb

Iztok Palčič

University of Maribor

Abstract

This article investigates the current state of digital servitization and artificial intelligence (AI) adoption in European manufacturing companies. The study aims to determine the level of digital servitization, the adoption rate of AI technologies, and the barriers to AI adoption. Additionally, it explores whether the level of adoption and perceived barriers differ between companies offering digital services and those offering services without digital support. The research also considers geographical, firm size, and sectorial variations in digital servitization. The empirical evidence is drawn from the European Manufacturing Survey (EMS) 2021, focusing on manufacturing establishments with at least 20 employees from Spain, Croatia, Slovakia, and Slovenia. The expected results will contribute to the understanding of digital servitization and AI adoption, revealing insights into the relationships between digital servitization and firm size, sectoral characteristics, and country. Furthermore, the study will shed light on the perceived barriers to AI adoption among European manufacturing companies and determine if they differ between adopters and non-adopters of digital services.

Keywords: Digital servitization, artificial intelligence, artificial intelligence barriers, European Manufacturing Survey.

Introduction and purpose of the study

Firms are gradually switching from product- to service-oriented business strategies over the last decade. Servitization is increasingly being regarded through the lens of digital advancements.

The expansion of information and communication technology as well as its subsequent digitalization offers a plethora of chances to engage with purchasers more closely, offering a combination of a dematerialized experience as a service and a tangible product (Manresa, Prester & Bikfalvi, 2021). The digital component has gradually but firmly entered the realm of servitization, either as digital technology that facilitates servitization or as digital services, a relatively new type of service (Vilkas, Bikfalvi, Rauleckas & Marcinkevicius, 2022). Digital servitization is the use of digital technologies to provide manufacturing enterprises in the service ecosystem with innovative, value-creating, and revenue-generating options by taking advantage of the opportunities provided by digital technologies such as Internet of things, digital platforms, remote monitoring, big data analytics or artificial intelligence (AI) in operations to migrate from standalone goods to digital product-service solutions (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2022).

One central tenet of digital servitization is that digital technologies such as AI provide radical opportunities for servitization to create and capture value from new revenue streams as well as to differentiate from competitors by taking on greater responsibility for supporting customer outcomes (Sjödin, Parida, Palmié & Wincent, 2021). Examples of the benefits for the manufacturers include cost reduction, improved service quality, increased coordination and efficiency, and increased delivery efficiencies. For example, investment in AI technologies can enable enhanced digital customer services such as fleet management and site optimization by monitoring, analyzing, controlling, and automating the performance of connected equipment (Sjödin et al., 2021). However, while full-scale AI implementation is still uncommon among industrial manufacturers, understanding the challenges of using AI within the fundamental processes of the business model is essential.

The current study provides insight into the current state of digital servitization and AI adoption in European manufacturing companies. contributing to the research stream of digital servitization and AI and further our understanding of the current state of these technologies.

Methodology

The empirical evidence comes from the European Manufacturing Survey (EMS) 2021, an international survey combining innovation, production, organizational, and technological innovation in manufacturing. The Spanish, Croat, Slovak and Slovenian sub-samples comprise manufacturing establishments with at least 20 employees are used for this analysis. A specific set of questions about different services offered are included, distinguishing between the services that are provided digitally. The 2021 EMS edition includes questions related to AI adoption and AI barrier perception.

Results

Results will be delivered in the form of descriptive analysis. For the analysis, we will test for significant differences between various groups using bivariate statistics. Differences between a servitilization and digital servitilization adopter will be studied for AI adoption, AI barriers, the size of the company, sector, and geographical location.

Expected results should confirm or contradict the differences in the studied variables and also show if those differences are similar to the differences found between servitization adopters and nonadopters in previous studies (Dachs, Biege, Borowiecki, Lay, Jäger & Schartinger, 2014).

Contribution

This study provides comprehensive insights into digital servitization and AI adoption in European manufacturing companies. First, it quantifies the level of digital servitization and AI adoption, giving valuable information on the current landscape of digital transformation in the manufacturing sector. Second, it examines the perceived challenges and barriers to AI adoption, offering a thorough understanding of the factors impeding the integration of AI into the business model. Additionally, the study investigates how digital services shape AI adoption patterns and contextual factors associated with digital servitization. This research makes several important contributions to the literature, informing policymakers, practitioners, and researchers to make informed decisions and develop effective strategies to leverage digital servitization and AI technologies in the manufacturing sector.

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Session 3

Keynote speaker #1 and Opening

Exploring AI Capabilities in Operations Management: Going from a bibliometric analysis to Empirical Studies

(Samuel Fosso Wamba, TBS Education)

Chair: Yancy Vaillant

(Aula Magna -7th floor)

Session 4

Challenges and Barriers in Servitization

Co-Chairs: Glenn Parry & Shawn West

(venue: TBS Conference room 703 -7th floor)

Tensions in inter-firm collaboration for digital servitization in the agricultural machinery industry

Guilherme Sales Smania

Glauco Henrique de Sousa Mendes

Federal University of São Carlos, São Carlos, Brazil

Abstract

Agricultural machinery manufacturers increasingly rely on the ecosystem to offer digital services such as remote product reconfiguration and predictive analytics. However, despite the mutual benefits and values generated by inter-organizational relationships in digital servitization ecosystems, inter-firm collaboration can instigate tensions among ecosystem actors and prevent them from achieving the expected goals. Thus, ecosystem actors adopt strategies to mitigate these tensions and promote successful collaboration. This study aims to investigate tensions and coping strategies associated with inter-firm collaboration for digital servitization in the agricultural machinery industry. A case study was carried out in two digital servitization ecosystems, in which managers from manufacturers, technology providers, service partners and customers were interviewed. Findings highlight eight tensions and eight coping strategies in inter-firm collaboration for digital servitization. This study contributes to existing knowledge on digital servitization by shedding light on the tensions that undermine inter-firm collaboration and strategies to deal with them.

Keywords: Digital servitization, inter-firm collaboration, tensions, agricultural machinery industry.

Introduction

Agricultural machinery manufacturers are moving towards digital servitization and implementing embedded systems in smart farm equipment to address the farmer's need for more efficient operations (Smania, Mendes, Godinho Filho, Osiro, Cauchick-Miguel & Coreynen, 2022). As a result, it opens opportunities for providing smart services based on real-time data collection, remote product reconfiguration, and predictive analytics (Porter & Heppelmann, 2014). To leverage smart services, inter-firm collaboration within the ecosystem is crucial, which requires a multi-actor approach for digital servitization (Kolagar, Parida & Sjödin, 2022). Nevertheless, inter-firm collaboration instigates tensions among ecosystem actors. These tensions arise when the implementation of digital servitization collides with the other actors' strategies (Stegehuis, von Raesfeld & Nieuwenhuis, 2023). For instance, while manufacturers need data to provide more customized services, customers are often reluctant to share it as they consider data crucial to their business (Eggert, Winkler, Volkmann, Schumann & Wüunderlich, 2022). Thus, ecosystem actors must identify and address these tensions to promote successful inter-organizational relationships and leverage digital servitization (Galvani & Bocconcelli, 2022). The investigation of tensions in inter-firm collaboration has theoretical and practical contributions, as it responds to calls for more research on the phenomenon in the digital servitization context (Tóth, Sklyar, Kowalkowski, Sörhammar, Tronvoll & Wirths, 2022) and helps managers to act on factors that prevent them from co-creating value in the ecosystem (Galvani & Bocconcelli, 2022). Given this scenario, this study investigates the tensions in digital servitization ecosystems and explores coping strategies to mitigate them. To that end, we conducted a case study at two ecosystems led by Brazilian agricultural machinery manufacturers implementing digital servitization.

Research methodology

A case study was conducted at two ecosystems led by Brazilian agricultural machinery manufacturers. Primary data were collected through interviews with managers from the manufacturers and some technology providers, service partners, and customers. In addition, secondary data were collected through documents provided by informants and publicly available materials. Content analysis techniques were employed to analyze the data using the NVivo Plus 11 software. First, a within-case analysis was performed to configure each ecosystem (i.e., the service offerings and inter-organizational relationships). Second, a cross-case analysis was carried out to uncover patterns and differences related to tensions in inter-firm collaboration and coping strategies.

Findings

The cross-case analysis highlights eight tensions in inter-firm collaboration for providing digital services in the agricultural machinery industry. In the manufacturer-technology provider collaboration: i) outsourcing dilemma, ii) lack of control over service delivery, and iii) lack of clarity about the capabilities provided. In the manufacturer-service partner collaboration: iv) low qualification of the partner's workforce, v) high turnover of the partner's workforce, and vi) partner's lack of commitment to selling digital services. Finally, in the manufacturer-customer collaboration: vii) sharing information with competitors in the platform, and viii) information leakage. The following coping strategies were identified to deal with these tensions: i) risk assessment, ii) improving quality control, iii) transparency, iv) training, v) financial incentives, vi) open communication across the ecosystem, vii) protection of proprietary information, and viii) controlling access. Based on these findings, the study provides a framework linking each tension with its coping strategy.

Theoretical and practical contributions

This study contributes to theory on digital servitization in several ways. First, it provides a new perspective for inter-firm collaboration since the literature has predominantly highlighted the bright side of ecosystems. Second, it answers calls for more research on tensions in digital servitization by mapping the tensions arising from the collaboration among manufacturers, technology providers, service partners, and customers for digital servitization in agribusiness. Third, it suggests coping strategies and relates them to tensions in a conceptual framework. For practice, it helps managers identify and address the tensions that negatively affect the provision of smart solutions in digital servitization ecosystems.

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How disruptive technology adoption and policies affect firm growth and productivity?

Neha Bhardwaj Upadhayay

Université Paris Est Créteil

Silvia Rocchetta

Dublin College University

Shivam Gupta

NEOMA Business School

Abstract

This study examines the intersection of disruptive technologies, innovation, public policy, and sustainable supply chain management in the context of the automotive industry. The research framework integrates stakeholder theory, resource-based view (RBV), and the theory of disruptive debottlenecking to analyze the impact of policy interventions and disruptive technology adoption on firm performance. The study utilizes the difference-in-differences (DiD) method, a quasi-experimental approach, to compare changes in outcomes between firms that have adopted disruptive technology innovation (treated group) and those that have not (control group). Preliminary analysis based on secondary panel data of global automotive firms shows that the operational revenue of treated firms has witnessed an upward trend. The study aims to highlight the role of policy interventions and disruptive technologies, such as AI platforms, in enabling digital servitization and facilitating the transition to solution business models in manufacturing. The results will contribute to the discourse on leveraging disruptive technologies to transform business models and achieve competitive advantages in the era of digitalization.

Keywords: Difference-in-differences, Disruptive Technologies, Disruptive Technology Policy, automotive.

Introduction & theoretical perspectives

Designing efficient and resilient sustainable supply chains is crucial for accelerating the transition to a circular economy. To support this transition, national and international bodies have initiated large-scale projects supported by new legislations and directives that address environmental concerns. These projects focus on studying and promoting opportunities for greater recycling, remanufacturing, and reuse (Genovese, Ponte Cannella & Dominguez, 2023).

However, there is a need for further research on the intersection of circular economy, sustainable-oriented innovation, and external factors that influence the implementation of sustainable processes and technology, particularly in small and medium-sized enterprises (SMEs) in developing countries.

The rise of the circular economy (CE) movement has prompted scholars in various fields to bridge the gap between theory and practice. Disciplines such as design, environmental economics, industrial ecology, and operations management have recognized the importance of theory in explaining phenomena and defining disciplinary boundaries. In the field of operations management, there is a growing call for researchers to integrate a strong societal component and leverage new technologies to drive business model innovation. However, there is a research gap in terms of theory-based empirical and analytical studies related to emerging technologies like AI, 5G, augmented reality, blockchain, and digital twins.

Motivated by these developments, the current study adopts multiple theoretical constructs to develop a research framework that explores the intersection of disruptive technologies, innovation, public policy, and sustainable supply chain management. The study begins by incorporating the stakeholder theory and the resource-based view (RBV) of the firm into the analysis of public policy. While these theories have distinct trajectories, the stakeholder theory adds a sustainability aspect to inform RBV. The stakeholder approach suggests that enterprises should consider the interests of all stakeholders to gain a competitive advantage, while the RBV argues that firms can differentiate themselves through rare, valuable, inimitable, and non-substitutable resources. Additionally, recent studies have proposed a theory of disruptive debottlenecking, where technology enables functionalities, removes constraints, and addresses internal limitations.

Model specification and estimation technique

In this study, we deploy one of the most popular techniques used in policy impact evaluation which is so far unexplored in management literature. This technique is called the difference-in-differences method and is a quasi-experimental approach that compares the changes in outcomes over time between a treatment and control group. The natural experiment method makes use of naturally occurring phenomena that may induce some form of randomization across individuals in the eligibility or the assignment to treatment (Blundell & Dias, 2009).

We develop a model where DTst denotes a dummy for the treatment, i.e. innovation in Disruptive Technologies by automotive firms globally.

$$Y_{ist} = \gamma_s + \lambda_t + \beta D_{st} + e_{ist}$$

Using this it is evident that

$$E(Y_{ist}/s = DTfirms, t > 2018) - E(Y_{ist}/s = DTfirms, \leq 2018) = \lambda_{t>2018} - \lambda_{t\leq 2018}$$

$$E(Y_{ist}/s = non - DTfirms, t > 2018) - E(Y_{ist}/s = non - DTfirms, \leq 2018) = \lambda_{t>2018} - \lambda_{t\leq 2018}$$

$$= \lambda_{t>2018} - \lambda_{t\leq 2018} + \beta$$

Hence, the population difference-in-difference is:

$$E(Y_{ist}/s = non - DTfirms, t > 2018) - E(Y_{ist}/s = non - DTfirms, \leq 2018) = -$$

$$E(Y_{ist}/s = DTfirms, t > 2018) - E(Y_{ist}/s = DTfirms, \leq 2018) = \beta$$

Therefore, the identification in the difference-in-difference model in our research problem can be visualized as in Figure 1.

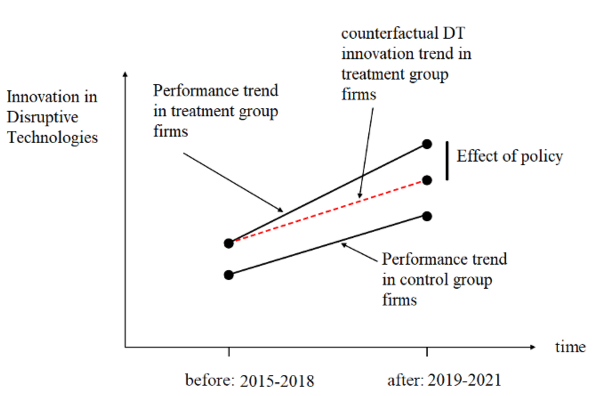

Figure 1. Effect of policy through differences in differences.

The key identifying assumption in DiD models is that the treated firms (innovating in Disruptive Technologies) have similar trends to the control firms in the absence of the treatment, i.e. the policy changes. The data visualization in this section compares the performance variables of firms that have adopted disruptive technology innovation (treated group) with those that have not (control group) in the year 2018. We choose 2018 for the following reasons: In Europe, key policies related to disruptive technologies were discussed from 2014 onwards, with the European Commission formulating a research and innovation strategy focused on digital future. Major European economies like France and Germany implemented technology policies during this period. In the United States, Innovation Roundtables were held to foster collaboration between the government and private sector in areas such as IoT, block-chain, AI, and digital payments. The balance table shows statistically significant differences in key characteristics between firms with and without disruptive technology innovation, with treated group firms generally larger in size.

The DiD approach can be a powerful tool in measuring the average effect of the treatment on the treated. It does this by removing unobservable individual effects and common macro effects by relying on two critically important identifying assumptions of (i) common time effects across groups, and (ii) no systematic composition changes within each group. (Blundell & Dias, 2009).

Initial analysis and preliminary results

Our empirical analysis is based on secondary panel data comprised of global firms spread over 91 major economies. This data is primarily sourced from Orbis Bureau Van Djik (BvD). We choose firms in the automotive industry with NAICS codes 3361, 3362 and 3363 and this search criterion gives us about 29 thousand firms globally.

	(1)	(2)	(3)
Variable	**non-DT Firms**	**DT firms**	**Difference**
Sales	22.996	25.131	2.135***
	(1.868)	(2.034)	(47)
Operating Revenue (Turnover)	22.773	24.877	2.105***
	(1.538)	(2.115)	(34)
Total Assets	22.531	25.004	2.473***
	(1.713)	(2.102)	(39)
Market Capitalization	32.387	34.289	1.902***
	(1.743)	(1.779)	(166)
Research & Development expenditure	20.315	23.217	2.901***
	(2.169)	(2.303)	(169)
Debt	21.921	24.168	2.247***
	(2.510)	(3.085)	(230)
Patents published	26.425	1,928.817	1,902.392***
	(61.180)	(19,008.072)	(227.514)
Patents pending	11.229	780.532	769.303***
	(32.484)	(7,851.145)	(114.151)
Patents Granted	17.636	741.920	724.285***
	(32.428)	(6,560.017)	(83.844)
Age	20.189	22.983	2.79***
	(19.512)	(23.491)	(410)
Size (no. of employees)	161.363	3,385.339	3,223.97***
	(755.577)	(21,968.947)	(137.560)
Firms	26,490	2,585	29,075

Table 1. Descriptive Analysis & Balance Tables.

Progress and preliminary findings

Our preliminary estimates based on multiple linear regression with fixed effects present the following interpretations based on the database of about 29 thousand firms:

1. The Operational Revenue (OR) of firms with DT (dummy for the treatment, i.e. innovation in Disruptive Technologies) is witnessing an upward trend,

2. The policies implemented in 2018 could have brought changes that led to an increase in OR of the firms in our sample. (Difference between the 2 groups prior to intervention/policy),

3. The DiD estimator captures the effect of 2018 policy changes across groups, i.e. the effect of policy on OR pre and post treatment. In other words, what we see is that the average OR of the treated (DT) and non-treated (non DT) firms pre-treatment (during and before 2018) is more than average OR post treatment (after 2018). Simply put, the policy of 2018 closed the gap in OR between treated and non-treated firms.

Way forward

Our research, which utilizes DiD analysis, focuses on the effect of policy interventions and disruptive technology adoption on firm performance in the automotive sector. The role of policy interventions and disruptive technologies, such as AI platforms, in enabling digital servitization and facilitating the transition to solution business models in manufacturing will be highlighted as our results develop further.

We will discuss how the policy changes implemented in 2018, could have influenced the adoption of disruptive technologies, including AI platforms, by manufacturers in the automotive sector. The potential of these technologies to overcome the scalability limitations of traditional manufacturing models, enables manufacturers to scale and customize simultaneously.

Our results will also carve the trajectory fo research that emphasizes the role of digital servitization, enabled by AI platforms, in facilitating the delivery of service-based solutions in a more direct and integrated manner. We propose to discuss how AI algorithms and autonomous analytical capabilities can support the customer-embeddedness and offer-integratedness required for customized service-augmented innovations.

By connecting our research on the impact of disruptive technologies and policy interventions to the expectations of the conference regarding AI platforms, digital servitization, and solution business models, we can contribute to the discourse on how manufacturers can leverage these technologies to transform their business models and achieve competitive advantages in the era of digitalization.

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Digital servitisation, barriers for SMEs, insights from a Case Study

Alberto De la Calle

Immaculada Freije

University of Deusto

Abstract

Digital servitization is opening new fields for the competitive development of manufacturing companies. This study explores the challenges and opportunities that small and medium-sized enterprises (SMEs) face when embracing digital servitization in the capital goods industry. SMEs in this sector are shifting from traditional product-focused models to offering customized solutions that address specific customer needs. By leveraging digital technologies such as data collection, remote monitoring, and automation, these SMEs are looking to improve their service offerings and create new business models. Through a case study approach focused on an SME specializing in the sale of air conditioning equipment for hotels, offices, and hospitals, we examine the strategic adoption of digital technologies for servitization. The company uses data collection to improve energy efficiency and provide advisory services to minimize incidents and ensure equipment reliability for its customers. In addition, they explore emerging technologies such as augmented reality for helpdesk and preventative maintenance, and blockchain for data reliability. The findings shed light on the challenges that SMEs in the air conditioning industry face during their digital servitization journey. Furthermore, the study identifies the strategies employed by this SME to overcome these challenges and successfully integrate digital technologies into their service offerings. This research contributes to existing knowledge on digital servitization and offers

practical implications for SMEs, industry professionals, and policymakers to effectively adopt digital technologies and leverage them to gain competitive advantage.

Keywords: Digital servitization, SME, Case study, Capital goods industry, Strategy, Innovative business models.

Objective /rationale

In recent decades servitisation has been of growing interest to academics, managers, and policymakers, because of its great potential to improve the competitiveness of manufacturing companies as well as to open up new business opportunities. At the same time, society in general and industry in particular have witnessed an unprecedented evolution in information and communication technologies (ICTs), leading to increasing digitisation in all areas. From the confluence of these two remarkable trends emerges the so-called digital servitisation (DS) referring to the use of digital technologies in the processes and offerings related to servitization (Paschou, Rapaccini, Adrodegari & Saccani, 2020; Tronvoll, Sklyar, Sörhammar & Kowalkowski, 2020; Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Favoretto , Mendes, Oliveira, Cauchick-Miguel and Coreynen (2022) in their bibliographic review of this specific topic set 2017 as the time at which many studies have started to focus directly on DS as the main unit of analysis (e.g., Bustinza, Vendrell-Herrero, Gomes, Lafuente, Opazo, Rabetino & Vaillant, 2018; Vendrell-Herrero, et al., 2017) rather than focusing on the use of digital technologies to enable services in product companies.

Moreover, the literature highlights that DS creates challenges for firms that go far beyond the incorporation of new technologies, involving relevant changes in value creation pathways (Paschou et al., 2020; Rabetino, Kohtamäki, Brax, & Sihvonen, 2021; Sjödin, Parida, Kohtamäki, & Wincent, 2020). New digital technologies have made it possible to improve processes in the interests of greater efficiency and productivity, both in terms of their effects on the company itself and on the value delivered to the customer. But in addition to this trend from which no one is spared to some extent, the new digital technologies have opened up new opportunities to develop new business models for the same product-market areas as well as to generate entirely new business opportunities not previously explored.

In fact, digitalization is an important enabler of servitization (Coreynen, Matthyssens, Vanderstraeten & Van Wittteloostuijn, 2020) and moreover, in recent years, the exponential advance of new technologies such as the Internet of Things (IoT), big data, and cloud computing has led to the emergence of innovative business models.

But if the transition from manufacturing to services is a process that poses significant and demanding challenges for companies, digital servitisation is no less so. Even more so if we consider SMEs, the most numerous in the economy, which are faced with less access to skills and capabilities in general and digital capabilities in particular. Lerch and Gotsch (2015), distinguish different phases about the complexity of capabilities and the transformation achieved, from the mere use of ICT to improve services to the development of digitised product-service systems. Logically, the challenges that companies will face will be very different.

However, there is still a lack of knowledge of service and industry practices (Bigdeli, Kapoor, Schroeder & Omidvar, 2021). Most of the research approach is based on a theoretical perspective. Recent research establishes that it is key to understand the phenomenon in practice, identifying the profound changes required in business logic (Gebauer, Artz, Kohtamäki, Lamprecht, Parida, Witell et al., 2020; Kohtamäki, Parida, Patel & Gebauer, 2020; Rabetino et al., 2021; Tronvoll et al., 2020).

Consequently, we study the phenomenon in practice to go deeper into the specific peculiarities, challenges, and opportunities SMEs are facing in adopting digital servitization practices.

Methods / Results / Findings

As our objective is to analyse a complex phenomenon involving the interaction of factors in its natural context, the most appropriate research strategy is the case study (Yin, 2018). Using a case study methodology, this research aims to provide a comprehensive description of the process involved in developing digital servitization within a specialized SME in the capital goods industry. The study examines the challenges, barriers, and leverage points encountered during the implementation of DS, as well as the adoption of new business models. In-depth interviews with key stakeholders, were conducted to gain valuable insights into the transformative effects of DS and its impact on the company's operations, performance, and competitive position.

In recent years, the SME company have strategically focused on servitisation through digital technologies. They have taken advantage of data collection to: not only improve energy efficiency but also to advise on how to make the best use of the equipment in order to minimise incidents and guarantee its reliability, which is something essential for its clients particularly for the segment of the hotels.

They are also starting to test augmented reality to help technicians with technical assistance and blockchain to provide reliability in the data supplied by the client.

The findings of this case study offer valuable insights into the growing body of knowledge on digital servitization, enabling SMEs to make informed decisions and navigate the complexities associated with integrating digital technologies into their service offerings and developing new and innovative business models. Moreover, this study provides SMEs with a preliminary understanding of the potential impacts of adopting digital servitization strategies on their company, guiding them in assessing the transformative effects and potential benefits that can be realized.

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The Digital Servitization of manufacturing companies: an international observatory

Federico Adrodegari, Nicola Saccani, Laura Scalvini

University of Brescia and Research Center on Innovation and Service Management in Industrial Firms (ASAP)

Giuditta Pezzotta, Veronica Arioli

University of Bergamo and Research Center on Innovation and Service Management in Industrial Firms (ASAP)

Slavko Rakic, Ugljesa Marjanovic

University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia

Shaun West, Oliver Stoll

Lucerne University of Applied Sciences and Arts, Luzern, Switzerland

Stefan A. Wiesner

BIBA - Bremer Institut für Produktion und Logistik GmbH, Bremen, Germany

Marco Bertoni

Blekinge Institute of Technology, Karlskrona, Sweden

David Romero

Tecnológico de Monterrey, Mexico City, Mexico

Mario Rapaccini

University of Florence and Research Center on Innovation and Service Management in Industrial Firms (ASAP)

Abstract

The phenomenon of "Servitization" and "Digitalization" is significantly transforming businesses (Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Despite their distinct origins, these two research areas have recently converged, leading to the emergence of Digital Servitization in the literature (Kohtamäki, Parida, Patel & Gebauer, 2020; Paschou, Rapaccini, Adrodegari & Saccani, 2020). While it is widely acknowledged that the adoption of advanced technologies like the Internet of Things (IoT), Cyber Security, and Cloud Computing has facilitated the uptake of innovative services by manufacturing companies (Baines, Ziaee Bigdeli, Bustinza, Shi, Baldwin & Ridgway, 2017; Romero, Gaiardelli, Pezzotta & Cavalieri, 2019), the implementation of Digital Servitization lacks comprehensive documentation (Pirola, Boucher, Wiesner & Pezzotta, 2020). Several studies have focused on identifying the challenges and barriers associated with the Digital Servitization process (Chirumalla, Leoni & Oghazi, 2023). However, these authors also emphasize the need for quantitative evidence to support the transformation towards Digital Servitization (Paschou et al., 2020; Pezzotta, Arioli, Adrodegari, Rapaccini, Saccani, Rakic et al., 2022).

To shed light on the current state of Digital Servitization strategies in the manufacturing sector, the ASAP Service Management Forum and IFIP WG5.7 Special Interest group on Service Systems Design, Engineering and Management have established the "Digital Servitization Observatory" research initiative. The aim of this observatory is to provide a comprehensive overview of the journey towards Digital Servitization, including the challenges and best practices encountered by businesses during their transformation processes.

This study adopts an exploratory survey approach. The questionnaire was developed by a group of international experts who defined its structure based on an analysis of the Industry 4.0 and Product-Service System literature. Consequently, the survey is divided into two parts: the first part, which is compulsory, focuses on the service portfolios of businesses and their main characteristics, while the second part, optional, primarily targets companies already engaged in digital servitization transformation.

This section explores the level of adoption of Industry 4.0 technologies in service delivery and the specific actions taken by businesses to support their Digital Servitization transformation process.
The survey collected 314 responses, with 165 respondents completing the second part of the questionnaire (53% of the total sample). The respondents mainly consist of Directors, Managers, and Staff, with an average of 20 years of experience and a diverse range of business functions. The respondent companies primarily belong to the Industrial sector, with an equal distribution across different sizes. Geographically, half of the sample is located in Western Europe, followed by East Europe (38%) and the Americas (11%).
The exploratory survey provides insights into the current service offerings of businesses and their adoption of digital technologies to enable these (digital) services. The findings reveal that companies, while still predominantly product-centric (relying on product sales as the main revenue source), have diversified service portfolios. Among the service offerings, transactional services are the most widely adopted, followed by multi-year services. The size of the company appears to influence the diversification of service portfolios, as smaller enterprises have more limited offerings compared to medium and large companies. However, smaller companies manage to generate higher revenues from service sales, despite their more limited-service portfolios. Consequently, the diversification of service offerings does not necessarily impact revenue generation. Additionally, a comparison of service portfolios and revenue streams between the three main industrial sectors in the sample (Industrials, Consumers, and IT & Communication services) indicates that industrial enterprises, despite offering a wide range of services, contribute less to total revenue production than the other two sectors. This is unexpected, especially considering the expertise of industrial enterprises in providing transactional services. The IT & Communication service sector stands out as it is capable of providing multi-year services to a significant extent and generating revenue from their sales.
Among the Industry 4.0 technologies, the (Industrial) Internet of Things, Cyber Security, and Cloud Computing are the most adopted

in service offerings. Consequently, the adoption of Industry 4.0 technologies for enabling services is still in its early stages, as companies have yet to embrace more complex digital technologies. Only large companies are beginning to adopt advanced technologies such as Big Data Analytics, Artificial Intelligence/Machine Learning, Simulation, and Mixed Reality. In contrast, small businesses are primarily considering the adoption of the three most sought-after technologies. This difference can be attributed to limited financial resources, a lack of digital resources and skills, and challenges in networking with other businesses compared to medium and large enterprises.

The development of competences is recognized as a crucial factor in implementing digital services, and the majority of respondent companies have already developed new competences either internally or through external sources, thereby overcoming this significant challenge. However, the survey highlights a lack of integration at the ecosystem level, indicating that broadening the service perspective to encompass the entire ecosystem is a challenge for the coming years. Digital technologies offer the potential to extract, share, and analyze product information and customer preferences. Leveraging this data can lead to the design of new advanced services or the improvement of existing ones. However, the extraction and utilization of useful information from this data remain significant challenges for the surveyed companies.

Finally, the survey reveals that Digital Servitization presents an important opportunity for companies to align with sustainable goals. However, only a few respondents have established metrics for assessing the environmental dimension, making these companies an interesting sample for further research. In light of these findings, it would be interesting to explore potential correlations among the perceived barriers and to analyze if these barriers are equally perceived across different company sizes. Therefore, future developments of this study will involve statistical analysis to delve deeper into these aspects.

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Session 5

Business Models and Innovation in Servitizations

Co-Chairs: Marco Opazo & Ferran Vendrell-Herrero

(venue: TBS Executive room 702 -7th floor)

Structuring the servitization journey – A socio-technical methodology for developing platform-based smart PSS

Julian Kurtz*, Patrick Meyer, Nina Lugmair, Angela Roth
Friedrich-Alexander-Universität Erlangen-Nürnberg
*Corresponding author

Research in progress

Abstract

The increasing use of digital technologies is leading to new business models bundling tangible products, intangible services and digital technologies into smart product-service systems (smart PSS). Manufacturing firms are shifting their focus from selling products to selling smart PSS. This so-called servitization is a complex strategic shift in which firms increasingly base their business model on digital platform technology. There is a lack of research on methodologies that support firms on their servitization journey. Following an action design research approach, this paper provides a methodology to support servitization journeys by structuring platform-based smart PSS development. The methodology is based on a hybrid stage-gate process that includes structural elements such as synchronisations points, deliverables, and functional roles. It also proposes tools that can be used during the development of platform-based smart PSS, as well as KPIs to measure the progress of the development. This study aims to provide a basis for future research to bridge the last mile of transferring theoretical servitization knowledge into practice by applying contextualised insights from a practical perspective for the structured development of platform-based smart PSS.

Keywords: Servitization, Digitalisation, Smart Product-Service Systems, Socio-technical Systems, Action Design Research.

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Motivation

Servitization describes a strategic shift by firms to bundle additional service offerings with existing product offerings to provide business models of product-service systems (PSS) (Vandermerwe & Rada, 1988). Current research generally lacks in-depth knowledge for the practical application and actual implementation of the complex servitization shifts to bridge the last mile from bringing theoretical knowledge to practical application (Baines, Bigdeli, Sousa & Schroeder, 2020). Methodologies are needed to enable firms to embark on servitization shifts and to support individual firms' servitization shifts (Rabetino, Kohtamäki, Brax & Sihvonen, 2021). Furthermore, existing servitization research has mainly focused on technical approaches rather than social approaches and a combined socio-technical approach (Kapoor, Bigdeli, Schroeder & Baines, 2022). Therefore, applying a socio-technical perspective to the development of servitization shift methodologies enable addressing "the issues business practitioners are facing in the real world" (Li, Rich, Found, Kumar & Brown, 2020, p. 2).

In addition, under the influence of digitalisation, PSS business models are evolving into smart product-service systems (smart PSS), with digital platform technology becoming increasingly important for the realisation of smart PSS (Jovanovic, Sjödin & Parida, 2022). Platform-based business models mediate between different user groups such as providers, partners and customers, facilitating interaction, and reducing transaction costs (Srinivasan, 2021). Platform technology can reduce complexity by, e.g., simplifying the service delivery processes of smart PSS (Eloranta, Ardolino & Saccani, 2021). To realise this potential, several problems need to be addressed. First, research on building platform-based smart PSS is still in its infancy (Rabetino et al., 2021), as insights into the processes of servitization shifts towards platform-based smart PSS are scarce (Tian, Coreynen, Matthyssens & Shen, 2022). Secondly, the applicable principles for platform design are scarce (Abdelkafi, Raasch, Roth & Srinivasan, 2019) leading to a lack of replications of established platform-based smart PSS (Vaillant, Lafuente & Vendrell-Herrero, 2023).

In order to address these problems and develop a methodology to approach servitization, this research follows the research question:

From a socio-technical perspective, how can platform-based smart PSS be developed to support a structured servitization process?

The aim of this research is to develop a methodology that enables manufacturing firms to approach the servitization shift in a structured way. The methodology is developed together with practitioners based on the specific use case of developing a platform-based smart PSS in manufacturing industry.

Research Design

To develop a methodology that applies a socio-technical perspective to the development of platform-based smart PSS in a structured way, an action design research (ADR) approach is conducted following the organisation-dominant BIE (building the

IT artefact, intervention in the organisation and evaluation) (Sein, Henfridsson, Purao, Rossi & Lindgren, 2011). ADR is fruitful to "make theoretical contributions and assist in solving the current and anticipated problems of practitioners" (Sein et al., 2011, p. 1).

The manufacturer accompanied during the ADR process produces personal protective equipment (PPE) products. The problem formulation of the ADR process was practice-oriented as the investigated firm has no knowledge about the actual end-use of its PPE-products. With the help of a platform-based smart PSS to be developed, the firm aims to achieve stronger customer intimacy, knowledge about the end-use of its products, potential for new business models, and differentiation as an innovative first mover from competitors in the market. The developed smart PSS is based on a digital platform that enables the firm to offer new digital products and services. A match between the individual PPE and the corresponding user of the PPE can be mapped via the platform-based smart PSS by providing a continuous customer journey, starting with the PPE customer need and ending with the PPE receipt. Furthermore, with the help of the platform-based smart PSS, specific customer needs are identified in order to configure and individualise the PPE across the entire PPE portfolio of the firm and to ensure the selection of the required PPE.

Data is collected over a period of 18 months while working together with the firm on the development of the platform-based smart PSS. This research therefore responds to calls for longitudinal studies of the pathways required for the adoption of joint process, product and service innovations (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2022). Throughout the building, intervention and evaluation phases up to the reflection and learning phase of the ADR process 16 substantive workshop sessions were conducted so far. The existing ideas and results were challenged in pre- and post-workshop meetings to improve the design of the platform-based smart PSS to be developed (Sein et al., 2011). In addition, there were regular bi-weekly consultations on the current status of the project and additional data was collected by meeting minutes, corporate documents, and archival records.

Data analysis was started during the development process and is still ongoing. In order to formalise the learnings, a methodology for the structured development of smart PSSs is the outcome of the ADR activities applying a socio-technical perspective. Further formalisation and evaluation can be done by deriving design principles for structuring smart PSS development.

Initial Results

The methodology contains a generic structure for a smart PSS development process including product development, service development and digital technology development, all structured at different process stages. The structure follows agile development phases including gates (Cooper & Sommer, 2018; Rummel, Hüsig & Steinhauser, 2022), that are oriented towards the responsibilities of different functional roles (Smith, Erwin & Diaferio, 2005), and the deliverables to be derived in the individual process stages (Too & Weaver, 2014). It seems that this enables a flexible approach that at the same time allows for selective structuring. In addition, various innovation tools have been developed and applied to the support joint development of products, services and digital technologies at different stages in the smart PSS development process. In addition, key performance indicators are currently being developed to measure the smart PSS development process success.

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Dynamic capabilities for digital servitization in the Finnish power electricity sector: A microfoundational approach

Rodrigo Rabetino

University of Vaasa, Finland

Marko Kohtamäki

University of Vaasa, Finland

Nayeem Rahman

University of Vaasa, Finland

Tuomas Huikkola

University of Vaasa, Finland

Abstract

The paper combines digital servitization research with the business model innovation and dynamic capabilities literature. Business model (re)configuration processes towards digital servitization call for developing and applying particular dynamic capabilities (based on specific microfoundations), which are at the core of the study's inquiry. Building on a case study of three established companies in the Finnish power electricity sector, the paper focuses on the dynamic capabilities and their microfoundations required for digital servitization-related business model innovation. Thus, this study complements earlier research on digital servitization strategies, revenue models, and business model configurations. Among the main findings, the study concludes that sensing, seizing/configuring, and reconfiguring interact rather than being subsequent and based on strictly linear processes. People have a key role and impact on the microfoundations of the dynamic capabilities embedded in organizational routines. Finally, business model configurations

during digital servitization enable strategic fit between servitization strategies and changing conditions in the business environment.

Keywords: Dynamic capabilities; microfoundations; digital servitization; business model innovation.

Introduction

Smart connected products transform firms and competition (Porter & Heppelmann, 2014). Still, as digital technologies become accessible, business model innovation (BMI) emerges as a source of competitive advantage (Rachinger, Rauter, Müller, Vorraber & Schirigi, 2019). Increasingly often in different industries, digitally-enabled BMI involves services and materializes in product-service-software offerings, a transition from products to smart solutions, known as digital servitization (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019; Münch, Marx, Benz, Hartmann & Matzner, 2022).

Digital servitization requires DC (Coreynen, Matthyssens, Vanderstraeten & van Witteloostuijn, 2020; Smith et al., 2010; Teece, 2018), materialized in their Microfoundations to support successful BMI (Ott & Eisenhardt, 2021). Although research on DC (Coreynen et al., 2020; Linde, Sjödin, Parida & Gebauer, 2021) or BMI in digital servitization exists (Chen, Visnjic, Parida & Zhang, 2021; Linde, Sjödin, Parida & Wincent, 2020; Linde et al., 2021; Tian, Coreynen, Matthyssens & Shen, 2021), not many studies focus on DC in the context of BMI for digital servitization (Hasselblatt, Huikkola, Kohtamäki & Nickell, 2018; Linde, Frishammar & Parida, 2021), calling for further research (Hsuan, Jovanovic & Clemente, 2021).

We address the following research question: what are the Microfoundations of dynamic capabilities that enable business model innovation for digital servitization? Thus, the present study complements previous research on digital servitization strategies

(Mosch, Schweitl & Obermaier, 2021; Paiola & Gebauer, 2020), revenue models (Linde, Frishammar, et al., 2021), and BMI (Jovanovic, Sjödin & Parida, 2021; Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022).

Theoretical background

Digitalization as an enabler of servitization-related BMI

Data enable value creation and revenue generation opportunities through BMI, opening enormous opportunities for offering integrated products-service solutions (Kiel, Arnold & Voigt, 2017). Thus, IoT (Naik, Schroeder, Kapoor, Ziaee Bigdeli & Baines, 2020; Rymaszewska, Helo & Gunasekaran, 2017) and AI (Sjödin, Parida, Palmié & Wincent, 2021) enable digital servitization and unlock BMI (Linde, Frishammar, et al., 2021) but disrupt the entire organization as firms must reconfigure organizational structures, capabilities, processes, routines, and resources (Coreynen, Matthyssens & von Bockhaven, 2017; Huikkola, Kohtamäki & Rabetino, 2016). Consequently, digital servitization has substantial organizational consequences and may impact all the BM dimensions (Arnold et al., 2016).

DC for BMI: a mifrofoundational approach

Organizational change is determined by the existing DC (Teece et al., 1997), which are typically organized in three clusters (e.g., sensing, seizing, and reconfiguring) embedded in organizational routines and managerial cognition (Teece, 2007). Managerial skills and organizational structures, processes, and practices (Eisenhardt & Martin, 2000; Teece, 2007) provide microfoundations for DC (Schilke et al., 2018). Microfoundations, such as affective, cognitive, and behavioral skills (Helfat & Peteraf, 2015; Martins et al., 2015), or such as management's leadership and ability to develop and refine

DC	Microfoundations
Sensing	Technological and market scanning
	Discussing new ideas across the organization systematically
	Staff training and supporting experiential learning
Seizing	Strategizing rounds in response to industry trends
	Rising commitment to the strategic vision
	Strengthening an innovation culture
	Creating idea assessment guidelines and decision-making structures
	Promoting and handling open conflicts
	Engaging with developing markets and technologies early
	Developing innovative business models
	Piloting, prototyping, and scaling business opportunities
Transforming	Connecting organizational functions and redesigning the organization
	Adjusting and streamlining resources and operations
	Aligning company culture and behavior with strategy
	Promoting strategic coherence, continuity, and flexibility
	Demonstrating top management's leadership and stressing commitment to change

Table 1. Microfoundations of dynamic capabilities for BMI towards digital servitization.

BMs (Teece, 2018) and perform the required organizational change are key. Felin, Foss, Heimeriks, and Madsen (2012) identify individuals, social processes, and structure as the three primary groups of micro-level components underlying routines and capabilities.

Methodology

The paper includes a qualitative exploratory multiple-case study. Using purposeful sampling (Patton, 2015), we conducted 12 interviews with business developers from three medium-sized Finnish energy utilities that have proved successful in bringing innovative digital service-based business models to market. After transcribing and coding the interviews and we follow (Gioia, Corley, & Hamilton, 2013) to create the data structure and guide the analysis and conceptualization.

Findings and Conclusions

Table 1 describes the key findings concerning the microfoundation of DC for BMI towards digital servitization.

DC and their microfoundations seem vital for managing BMI (Best et al., 2020; Vallaster et al., 2019). BMI calls for particular dynamic capabilities (and microfoundations) as firms must reconfigure resources, capabilities, routines, and practices (Huikkola et al., 2016). Sensing, seizing/configuring, and reconfiguring interact in non-linear processes. Thus, during seizing/configuration, there is a need for more exploration and sense, and during transformation/reconfiguring, companies must rethink configurational aspects and explore further. Moreover, meta-capabilities such as leadership unity (Doz & Kosonen, 2010) are relevant for seizing/configuring and transforming/reconfiguring (e.g., dialoguing, revealing, aligning, and integrating). Different components of strategic agility, such as strategic sensitivity (Doz & Kosonen, 2010), are present in the sensing (e.g., anticipating and reframing) and seizing of business models (e.g., experimenting and abstracting). During exploration, companies often have specific default configurations in mind. Notably, configuring new business models (seizing) requires acknowledging strategic choices, building commitment to the vision, structuring decision-making, fostering an innovation mindset, managing conflicts, and searching for scalability opportunities. Overall, the role of people is crucial (individual tactics, mental processes, and behaviors) and impacts the microfoundations of the DC (Helfat & Peteraf, 2015; Lenka et al., 2018).

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A comparative case study of digital service innovation journeys: A wicked problem perspective

Bieke Struyf

University of Antwerp

Paul Matthyssens

University of Milano - Bicocca

Abstract

Objective: The goal of this paper is (1) to gain understanding in how managers experience and perceive digital service innovation (DSI) complexity, (2) to apply a wicked problem lens to decipher DSI complexity, and (3) to learn from DSI champions how interdependent DSI challenges can effectively be managed throughout the DSI journey.

Design/methodology/approach: We develop a comparative, multiple case study of 4 Belgian-based manufacturing companies identified by industrial experts as DSI champions. The empirical data was gathered through a combination of semi-structured interviews, industry expert exchanges, online workshops and secondary data sources which were compared and contrasted for validation. Critical incident technique supported us in the collection and exploratory analysis of the data.

Findings: In applying a wicked problems lens we perceive how the digitalization paradox is enhanced by uncertainty of the business environment and additional complexity stemming from emotional upheaval generated by the radical nature of DSI implementation. The cases show the wicked problem nature of the DSI implementation process experienced by the case companies.

Originality/Value: With this study, we introduce a new lens through which to explore DSI. Furthermore, we contribute to the

unravelling of the digitalization paradox and uncover potential pathways out. Propositions and suggestions for future research are formulated.

Digital service innovation as a complex undertaking

Manufacturers increasingly look toward digital service innovation (DSI) as an answer to rising market demands and competitive pressure (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019, Raddats, Kowalkowski, Benedettini, Burton & Gebauer, 2019, Sklyar, Kowalkowski, Tronvoll & Sörhammar, 2019, Eloranta, Ardolino & Saccani, 2021). Digital service innovation (DSI) combines both technological and service innovation logics, leading to digital servitization and other innovative, digitally-enabled business models (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2021; Raddats et al., 2019; Vendrell-Herrero, Bustinza, Opazo-Basáez & Gomes, 2023). Through differentiation, radical DSI and more incremental digital servitization (DS) are said to generate additional revenue streams and a strengthened competitive position (Parida Sjödin & Reim, 2019, Gebauer, Paiola, Saccani & Rapaccini, 2021, Paschou, Rapaccini, Adrodegari & Saccani, 2020).

Recently, DSI and DS literature point toward the complexity of the strategy as a (partial) explanation for its ongoing implementation challenge (Eloranta et al., 2021, Sjödin, Parida, Jovanovic & Visnjic, 2020, Paiola & Gebauer, 2020, Struyf, Galvani, Matthyssens & Bocconcelli, 2021). Opazo-Basáez et al. (2021) suggests technological innovation and digital servitization are closely interrelated in highly innovative manufacturing contexts. According to Raddats, Naik and Bigdeli (2022) DSI, using digital technologies, focuses on more radical innovations in manufacturers' service offerings creating new value for manufacturers and their customers. Sjödin, Parida, Kohtamki and Wincent (2020) describe DS as the transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies (p. 479). This definition illustrates the complex, multidimensional nature of DSI in which decisions on technology, strategy, and a multitude of diverse partners need to come together for firms to be successful.

To embrace the complexity in DSI/DS journeys, we agree with Struyf et al. (2021) that a new thinking frame is needed which explicitly recognizes complexity as an active element in the DSI/DS journey and which supports a different managerial mode. Sjödin, Parida, Kohtamäki et al. (2020) also pointed toward the need for a more stepwise and iterative approach that breaks complex systems into smaller, more manageable parts, stating that digital service innovation requires new ways of working to enable experimentation, exploration, and fast fail approaches (p. 479). We believe, that a holistic, long-term perspective recognizant of future uncertainty and interdependencies between value creating partners on the one hand, and a cyclical, hands-on approach enabling progress through small, iterative rounds, on the other, is required in DSI journeys. Hence, we adhere to the complex adaptive systems perspective which assumes that systems evolve in an emergent and intentional way (Stacey, 1995).

Complication and course of action

In this work, we develop a comparative, multiple case study of four best practice cases (coined "DSI champions") which DSI journeys we explore through a wicked problem lens (Struyf et al., 2021). By observing the experience and management of DSI challenges through this alternative viewpoint, we aim to answer the following questions:

RQ1: How does the wicked problem nature of DSI implementation present itself? How do managers perceive and experience the wicked problem nature of DSI implementation?

RQ2: Which capabilities and mechanisms enable DSI champions to effectively handle the experienced wicked problem?

Findings

Managers described DSI implementation as an incomprehensible, unpredictable challenge which was not entirely within their control and which brought along an emotional journey including intense and continuous effort. The digitalization paradox is enhanced by uncertainty of the new business environment and additional complexity stemming from emotional tensions due to the radical nature of DSI implementation. DSI champions manage this disparity by building an iterative approach based on (1) future-orientation and a long-term, out-of-the box perspective on ROI, (2) cross-border collaborations, (3) change management and 4) digital belief, enthusiasm, and resilience. These capabilities and mechanisms make the managerial DSI experience a complex challenge in which intentional actions and emergent events intertwine, leading to an emotional journey requiring a continuous team effort. The cases illustrate also how positive emotions such as passion, excitement and interest propelled DSI journeys forward, whereas negative feelings of fear and anxiety had a more ambiguous effect. In line with Bustinza, Gomes, Vendrell-Herrero and Tarba (2018) and Tronvoll, Sklyar, Sörhammar and Kowalkowski (2020), the cases illustrate the key role change management plays in DSI. I

Contribution

We contribute to the DSI and DS literature by providing deeper understanding of the tensions underlying the digitalization paradox and identifying capabilities and mechanisms DSI champions use to effectively manage these challenges (Gebauer, Fleisch, Lamprecht & Wortmann, 2020, Tronvoll et al., 2020). Furthermore, in discovering the value of the wicked problem lens for DSI, we open a new research avenue that might lead to pinpointing original managerial approaches that fit the complexity of DSI implementation (Paiola & Gebauer, 2020, Eloranta et al., 2021). Additionally, the explication of assumptions underlying complex adaptive systems theory supports the clarification of the emergent nature of DSI and offers researchers a thinking frame in which an active, hands-on approach and a holistic, long-term perspective coincide (Sjödin, Parida, Kohtamäki et al., 2020b, Stacey, 1995). Finally, zooming in on the perception and experience of the managers enabled us to gain a rich picture of the emotional upheaval involved in DSI, which seemed to add an additional layer of complexity to its implementation (Huy, 1999, Hodgkinson & Healey, 2014). This highlighted the importance of certain personal characteristics of digital pioneers to making DS work (Huy & Zott, 2019). Several propositions for future research and practical implications follow from the account.

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Linking Manufacturing Ecosystems Theory with Servitization: A 'nested' solutions-based approach

Harry Sminia, Steve Paton, Aylin Ateş

Strathclyde Business School

Abstract

Vandermerwe and Rada (1988) identified servitization as manufacturing companies making the shift from selling purely goods to selling bundles of goods, services, support, and knowledge. This shift represents a customer-centric approach where a focus on delivering features and functionality within a tangible product is replaced with a focus on delivering value in use. This shift usually represents a strategic change in a company's operations (Baines & Lightfoot, 2014) and is often driven by new technology (Xu, Motta, Tu, Xu, Wang & Wang, 2018). More recently digitalization has introduced a new technology pathway for manufacturers to extend their servitization strategy (Coreynen, Matthyssens & Van Bockhaven, 2017). As digital servitization is a relatively new area of study, business models for the deployment of digital product service bundles have still to be characterised (Paschou, Rapaccini, Adrodegari & Saccani, 2020).

This paper seeks to address this gap by using manufacturing ecosystems theory developed by Sminia, Ates, Paton and Smith, (2019); Sminia, Ates, Paton and Smith (2022); Paton, Ates, Sminia and Smith (2023), and Ates, Paton, Sminia and Smith (2023) within a case-based approach to analyse the strategic development and operational implementation of a digitally enabled servitization business model by a manufacturing company.

Rooted in literature on business ecosystems (Teece, 2016), innovation ecosystems (Jackson, 2011), and platform ecosystems (Adner, 2017), manufacturing ecosystems theory departs from these

approaches by being both processual and solutions-based. It is processual because the basic unit of analysis is activity rather than actors. It is solutions-based because these activities are further conceptualized as developing and deploying solutions to problems within an inherently dynamic environment. A manufacturing ecosystem is defined as a combination of activities that together generate complex functionality that represents value in use. This complex functionality embodied in the form of a product/service bundle represents a complex solution to a complex problem. Complexity means that the overall functionality of the product/ service bundle requires many different smaller problems to be dealt with to combine into an overall larger solution.

Our case study concerns a Scottish manufacturing firm, JWF Process Solutions Ltd, which over three years transformed from a firm that configures, installs, and maintains flow measurement equipment into a firm that utilizes digital flow measurement technology to offer flow and content data on a subscription basis. This case study specifically focuses on the use of the servitized business model to deploy a constituent solution into a complex product service bundle within several locations with its launch customer: the National Health Service. Interestingly, the opportunity to develop this new digital solution appeared as a result of imperatives set by the Covid-19 crisis. Constant reliable information about oxygen status was not available in Scottish hospitals pre-Covid as real-time information was not actively gathered. Hospitals relied on regular oxygen deliveries from specialized firms where logistics were determined by historical usage.

The complex functionality that features within this case is embodied in 'intensive care units.' These are hospital wards in which specialist medical care is being practiced as a complex solution to treat severely ill patients. This treatment requires many different smaller constituent solutions to come together as a combination of medical process, staff knowledge/skills and specialist equipment. One of these constituent solutions is the steady flow of oxygen –especially for Covid patients– which in turn requires a sub-constituent-solution of keeping track of how much oxygen is being used to make sure that the hospital does not run out.

This specific sub-constituent-solution is provided by JWF by way of a subscription service. It includes system design and installation, the installation itself, a computer tablet with an app that provides a visualisation of the telemetry, the oxygen-flow measurement equipment including the transducer and analogue to digital convertor, maintenance by which JWF guarantees a constant reliable data stream and the data itself which is processed by JWF into actionable information and transmitted using the Internet. This solution offered by JWF is an 'ideal-type' example of digital servitization because it represents "The adoption or increase in use of digital or computer technology by an organization, industry, country" (OED online, 2023).

Because manufacturing ecosystems theory sees the overall functionality of the product/service bundle generated by an ecosystem as requiring many different smaller problems to be dealt with, we can distinguish between various constituent solutions and sub-solutions as activities in a nested system (cf. Holm, 1995), which all make contributions that add up to the overall solution. In this way, we can identify actors as suppliers or as complementors depending on the way in which their constituent solutions add to the overall solution. With JWF identified as a supplier offering a specific constituent solution to the complex functionality that is an intensive care unit by way of oxygen data, we can also analyse the detail of the various constituent sub-solutions that JWF puts together to generate their data subscription service.

Furthermore, we recognize that with the complex solution generated by the ecosystem as well as with every sub-system there are always three aspects that come into play. First, here is the configuration of all the capabilities that are necessary and need to be combined to generate the overall complex solution. Second there is the governance arrangement by which all activities that generate constituent solutions and sub-solutions are coordinated. And third there is the appropriation regime that allocates costs to and distributes value among the many activities that combine to make the overall solution. All three aspects feature co-opetition in that collaboration is required to bring capability together, to coordinate activities, and to generate value, while various actors involved in these activities also compete about who is allowed to contribute which capability, who is providing the coordination, and where costs are incurred, and revenues gained.

The paper will track and analyse the development of JWF's oxygen-flow data subscription service within the intensive care unit ecosystem as it was functional in Scotland among NHS hospitals, in terms of developing and adding a new constituent solution into the overall set-up with JWF dealing with the capability, governance and appropriation dynamics regarding the whole system as well as pertaining its own sub-system of organizing itself and its dealings with their suppliers and complementors in re-organizing their activities and relationships to be able to deliver this new service. We will conclude that this new constituent solution became part of generating the complex functionality of intensive care units because of its practicality as a solution within the nested system of constituent solutions, with this practicality a function of how well a solution links up with other constituent solutions in terms of capability, governance, and appropriation to assemble into an ecosystem that delivers value in use. We will also argue that this practicality is highly contextual in terms of place and time.

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Session 6

Firm capabilities and tensions in servitization

Co-Chairs: Heiko Gebauer & Håkon Sandvik

(venue: TBS Conference room 703 -7th floor)

How does digital economy promote creative industries development in China? Empirical evidence from 31 provinces in China

Xiaodi Zhao, Lei Shen

Donghua University

Abstract

This paper investigates how digital economy affects creative industries development in China. Specifically, we construct an evaluation system of China's digital economy level from four perspectives: Digital Infrastructure, Digital Industry Development, Digital Innovation Capability and Digital finance. Meanwhile this paper constructs an evaluation system for the development level of China's creative industries based on the concept of creative industries. then We draw upon a panel data set containing 31 Chinese provinces from 2011 to 2019, measuring the development of the digital economy and creative industries in China at the provincial level. An econometric model constructed for empirical analysis seeks to reveal the mechanisms and impacts of the digital economy on creative industries within a unified framework. The results demonstrate that the digital economy can directly drive creative industries development, and innovation efficiency are significant mediating mechanisms. In addition, this paper also investigates the spatial spillover effect of the digital economy on the development of creative industries. The results indicate that the digital economy has a positive spatial spillover effect on the development of creative industries.

Keywords: Digital economy, Creative industries, Innovation efficiency.

Introduction

This paper focuses on three research questions. The aim is to investigate the relationship between digital economy and creative industries and validating the mediating effect of innovation efficiency on them. If the mediating effect of innovation efficiency can be empirically validated, then it is theoretically possible to answer the important question of how the digital economy promotes the development of creative industries. Moreover, this paper reveals the spatial spillover effects of digital economy on creative industries development.

Theoretical framework and hypotheses

This study demonstrates the influential mechanisms of the digital economy on creative industries development.

Hypothesis 1: The digital economy directly contributes to the development of creative industries.

Hypothesis 2: The digital economy can drive creative industries development by increasing innovation efficiency.

Hypothesis 3: Digital economy has a spatial spillover effect on creative industries development.

Methodology

Explanation of variables

Explained variable

The UK's Department for Digital, Culture, Media and Sport (DCMS) classifies creative industries, including advertising and marketing; architecture; design and designer fashion; film, TV, video, radio and photography; IT, software and computer service; music, performing and visual arts; publishing. With reference to the above definitions and classifications, we have constructed a measurement system for the development of China's creative industries.

Core explanatory variable

This paper adopted the development level of the digital economy as the core explanatory variable. Referring to other scholars' research on digital economy measurement (Ma et al., 2022), we investigate the digital economy from four dimensions: Digital Infrastructure, Digital Industry Development, Digital Innovation Capability and Digital finance.

Mediating variable

This paper adopted innovation efficiency (IN) as the mediating mechanism of the digital economy affecting creative industries.

Control variables

The following control variables were added to the model: (1) economic development (ED); (2) industrial structure upgrading (IS); (3) level of opening up (OP), and (4) Science, technology and innovation capacity (SC).

Model construction

Direct effect model:

$$Cre_{it} = \alpha_0 + \beta_1 Dig_{it} + \beta_2 Controls_{it} \gamma_i + \sigma_t + \epsilon_{it}$$

Where t represents the year; i represents the province; Cre represents the level of creative industries development; Dig represents the level of digital economy development; $Controls$ represents a series of control variables; β represents the regression coefficients of the effects of each explanatory variable on the development of creative industries; γ represents region fixed effect; σ represents time fixed effect, and ϵ represents a random error term.

Mediating effect model:

$$Cre_{it} = C + \alpha Dig_{it} + \gamma Controls_{it} + \gamma_i + \delta_t + \mu_{it}$$

$$In_{it} = C + \eta Dig_{it} + \omega Controls_{it} + \gamma_i + \delta_t + \mu_{it}$$

$$Cre_{it} = C + \Theta Dig_{it} + \lambda In_{it} + \epsilon Controls_{it} + \gamma_i + \delta_t + \mu_{it}$$

Where In_{it} represents the mediating variable, α represents the impact effect of digital economy on creative industries, ω represents the impact effect of digital economy on innovation efficiency, Θ represents the direct impact of the digital economy on the creative industries, and λ represents the impact of innovation efficiency on the creative industries based on controlling for the effect of the digital economy on the creative industries. If the coefficient α is significant, and both η and λ are significant, the existence of a mediating effect is confirmed; If the coefficient Θ is significant, there is a partial mediating effect; if Θ is not significant, there is a complete mediation effect.

Spatial Durbin model:

$$Cre_{it} = C + \kappa WCre_{it} + \sigma_1 WDig + \rho Dig + \sigma_2 WControls + \sigma Controls + \gamma_i + \delta_t + \mu_{it}$$

In the model, W represents the geographic distance spatial weight matrix.

Data description

The empirical analysis was taken from a panel data set of the 31 Chinese provinces for the period 2011–2019. Considering the availability of data, our study does not cover Hong Kong, Macao, Taiwan. The data comes mostly from the China Statistical Yearbook of Culture and Related Industries, China Statistical Yearbook and statistical yearbooks of each province. In particular, the digital high-tech penetration mainly calculated the keywords of Internet of Things, big data, artificial intelligence, cloud computing, block chain, ICT industry, virtual reality and other keywords appearing in the business scope of listed companies to reflect the penetration level of high technology, and then aggregated to the provincial scale.

Conclusions

First, the results of the baseline regression indicate that the digital economy can significantly improve creative industries' development. Second, the results were confirmed to be robust and reliable through a series of robustness tests. Third, the empirical results of the mediating effect model show that innovation efficiency plays a partial mediating role between digital economy and creative industries development. in other words, digital economy can promote creative industries' development through the mediating mechanism of innovation efficiency. Fourth, the digital economy has a positive spatial spillover effect on creative industries development.

What comes first the chicken or the egg? Uncovering how digital servitization unfolds

Ferran Vendrell-Herrero

University of Edinburgh, UK

Lorena Para-González

University of Murcia, Spain

Carlos Mascaraque-Ramírez

Universidad Politécnica de Cartagena, Spain

Dr. Joan Freixanet

Saint Petersburg University, Russia

Abstract

This article examines two potential pathways for digital servitization, namely standardization and adaptation. The standardization pathway argues that digital transformation allows servitized firms to standardize their service-based business models, leading to scalability. Conversely, the adaptation pathway suggests that highly digitalized firms can customize their digital offerings to cater to diverse customer needs. The study investigates the effectiveness of these pathways and their long-term viability. Through a survey of 127 Spanish companies using Partial Least Squares Structural Equations Modeling (PLS-SEM) and single- and multi-mediation models, the results indicate the existence of both pathways. However, the standardization pathway contributes more to performance than the adaptation pathway. The findings underscore the importance of standardization and challenge the notion of extensive customization in digital servitization.

Keywords: Servitization, Digital Transformation, Digital servitization, scalability, customization.

Background

Digital Servitization is an expanding concept (Paschou, Rapaccini, Adrodegari, & Saccani, 2020). It brings together two seemingly unrelated business trends, Digital Transformation and the integration of product and service offerings (i.e., Servitization), to propose a superior business model (Coreynen, Matthyssens & Van Bockhaven, 2017; Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Previous studies have provided numerous examples of successful combinations of these trends (Gebauer, Paiola, Saccani & Rapaccini, 2021). However, despite this evidence, the literature lacks an empirical model that separates Servitization and Digital Transformation as independent phenomena that can converge towards Operational Performance through different pathways. This study aims to fill this gap.

Existing empirical studies that examine the relationship between Digital Transformation, Servitization, and business performance are predominantly unidirectional. For instance, Kohtamäki, Parida, Patel and Gebauer (2020) discuss the relationship between Digital Transformation and performance, considering Servitization as a moderating factor. This perspective assumes that companies embark on Digital Transformation and then realize that their digitalized offerings can be better tailored to customer needs through services. However, we propose an alternative view. Companies could also begin by implementing Servitization and subsequently integrate digital capabilities to standardize and scale their services.

These two seemingly contrasting views of digital servitization align with a central concept in international marketing literature: standardization versus adaptation to foreign markets. On one hand, subscription-based business models like Spotify exemplify the adaptation pathway, where companies transform a product (e.g., CDs) into a digital token (e.g., downloads) and subsequently offer it as a service (e.g., streaming) to better meet consumer needs (Parry, Bustinza & Vendrell-Herrero, 2012). Similarly, autonomous vehicle solutions follow the adaptation pathway, starting with digitalization of resources (e.g., vehicles) and then adding customized solutions (e.g., services) (Leminen, Rajahonka, Wendelin, Westerlund & Nyström, 2022). On the other hand, shared economy business models such as Uber represent the standardization pathway, where a service (e.g., ride-hailing) becomes more efficient with the integration of digital technologies (Reuschl, Tiberius, Filser & Qiu, 2021). Another example of standardization is advanced service models like Rolls Royce's Power-by-the-hour, where manufacturing companies monitor and enhance their services through digital technologies by leveraging data obtained from sensors for more efficient service delivery (Bigdeli, Baines & Kapoor, 2022).

Data and results

In this study, we propose two mediation models to explore the relationship between digital transformation, servitization, and operational performance. The dependent variable in both models is operational performance (P), but the roles of servitization (S) and digital transformation (D) are reversed as independent and mediating variables in each model. This approach allows us to associate the models with the adaptation and standardization pathways discussed earlier. When servitization serves as the mediating variable (DSP), it represents the adaptation pathway, whereas when digital transformation serves as the mediating variable (SDP), it represents the standardization pathway. Importantly, our goal is not to compare the two models to determine which one best explains operational performance but rather to examine how digital transformation and servitization integrate more effectively in a digital servitization model.

Through the analysis of a purpose-built survey conducted with 127 Spanish companies using Partial Least Squares Structural Equations Modeling (PLS-SEM), we find compelling evidence suggesting that the standardization pathway is more effective in deploying integrated digital servitization business models. To further strengthen our analysis, we also consider a model where both digital transformation and servitization act as mediators, with the independent variable being human capital, which is argued to be an antecedent of both factors. The results of this robustness test align with our previous findings.

Expected contributions

This article contributes to the literature in several ways. Firstly, it addresses the need for quantitative studies examining the intertwined nature of Servitization and Digital Transformation (Gebauer et al., 2021; Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019). Secondly, it is the first article to leverage widely used frameworks in international marketing (i.e., standardization vs adaptation) to theoretically analyze the pathways towards digital Servitization. Finally, the article presents a straightforward methodology that can be applied to other industrial and geographical contexts. Moving forward, this method has the potential to develop into a meta-analysis that could finally answer the question of which comes first: the chicken or the egg? (Nohe, Meier, Sonntag & Michel, 2015).

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The impact of creating a Servitization identity in managing Paradoxical Tensions for Manufacturing Firms

Juan Carlos Monroy-Osorio

University of Deusto

EAFIT University

Abstract

The following research introduces a groundbreaking model designed to strategically mitigate paradoxical tensions prevalent in manufacturing firms. This model, anchored on knowledge transfer, customer orientation, and market orientation, identifies these elements as critical resolution strategies. It employs servitization—a shift from product-focused operations towards integrated product-service solutions—as a moderating variable. This transformational strategy empowers firms with advanced servitization to proficiently manage inherent paradoxes, creating mutual value for both the organization and its customers. Employing Generalized Structural Equation Modeling (GSEM) for validation, the research underscores a correlation between the advanced degree of servitization implementation and its subsequent impact on paradoxes management within firms. The study offers a fresh perspective on organizational paradoxes by endorsing an approach that accommodates multiple demands concurrently, rather than favoring a singular force, thereby averting additional conflicts. In essence, this research makes a considerable contribution to servitization studies, arming manufacturing firms with a strategic avenue to enhance their operational efficiency and strategic effectiveness.

Keywords: Servitization, paradoxes, advance servitization, resolution strategies.

Resume

The following research introduces a model to address the paradoxical tensions within manufacturing firms, providing an approach to manage industry-specific tensions. These paradoxes, manifesting as a complex interplay of opposing yet interrelated forces, pose significant operational challenges that necessitate strategic management solutions (Dieste, Sauer & Orzes, 2022; Tóth, Sklyar, Kowalkowski, Sörhammar, Tronvoll & Wirths, 2022). The proposed model seeks to untangle these intricacies by emphasizing knowledge transfer, customer orientation, and market orientation as pivotal resolution strategies. This process involves a strategic shift from product-centric operations to the delivery of integrated product-service solutions (Kohtamäki, Rabetino & Einola, 2018). It paves the way for value creation, not just for the organization, but also for its customers. The model suggests that these resolution strategies can effectively mediate the various paradoxes that surface within operational contexts, contingent on the degree of servitization implementation. From basic to advanced servitization, it posits that managing paradoxical tensions effectively aligns with the degree of servitization ingrained in a firm's managerial operations.

Embracing a servitization mindset provides a strategic roadmap for manufacturing firms, enabling them to negotiate their industry's intricacies, enhance operational efficiency, and strengthen strategic effectiveness (Huikkola, Rabetino, Kohtamäki & Gebauer, 2020). The validation of the proposed model leverages the application of Generalized Structural Equation Modeling (GSEM), a robust method for assessing complex relational patterns (Vendrell-Herrero, Bustinza & Opazo-Basáez, 2021). The study's results illuminate a direct correlation between different degrees of servitization and the consequent influence of a servitization mindset on manufacturing firms. These findings underscore servitization's pivotal role in

managing paradoxical tensions effectively, revealing new exploratory and adoptive pathways for manufacturing firms. The research incorporates firms ranging from 10 to 250 employees in size. A total of 1,504 firms meeting the criteria —operating in manufacturing industries coded 31, 32, and 33 under NAICS— were identified within Spain's territory. Figure 1 depicts the conceptual model utilized in the study, derived from a sample of 354 validated responses from manufacturing firms. The participating firms were deemed representative in terms of their sectoral and size compositions.

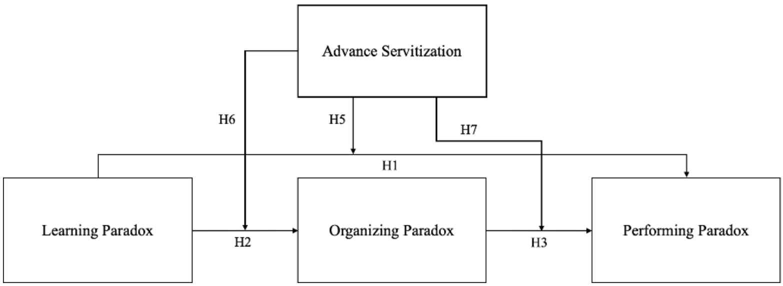

Figure 1. Conceptual model.

The research contributes significantly to the current knowledge pool, offering a theoretical enhancement to the servitization research community. The exploration of organizational paradoxes and subsequent resolution strategies create a complex backdrop to the challenges faced by servitized manufacturing firms. As defined by Lewis (2000), a paradox is a persisting conflict between interrelated opposing forces necessitating harmonious management (Smith & Lewis, 2011). This interpretation presents a clear distinction from an "instrumental approach" that favors one force over another, leading to a paradoxical outcome of escalating conflict given the inherent interconnectedness of these forces (Andriopoulos & Lewis, 2009).

Paradox theory posits that long-term sustainability necessitates an ongoing commitment to reconcile multiple, often divergent demands (Kohtamäki et al., 2018; Schuh, Kim, Wang & Liu, 2023). This perspective discourages defensive behaviors, urging organizations and their leaders to manage these tensions by concurrently addressing these seemingly conflicting forces. The present research delves into this dynamic, exploring learning, organizing, and performing paradoxes within manufacturing firms, with a specific emphasis on those that have adopted an advanced servitization approach. Unlike conventional methods that merely identify these tensions, paradox theory presents resolution strategies designed to transform paradoxical tensions into manageable scenarios or even resolve them entirely (Dieste et al., 2022). The role of servitization as a moderator in this context is pivotal; it creates a discernible difference in how paradoxes are handled between servitized and non-servitized firms. In essence, advanced servitization can provide a nuanced lens through which these firms perceive and manage inherent organizational paradoxes, potentially altering their resolution strategies and outcomes.

Through transforming and potentially resolving these paradoxical tensions, firms can better navigate the intricate dynamics of exploitation and exploration, stability and change, and efficiency and innovation (Tóth et al., 2022). In conclusion, the integration of a servitization mindset and the effective management of paradoxical tensions can greatly assist manufacturing firms in enhancing their operational efficiency and strategic effectiveness within an increasingly complex and competitive industry landscape.

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Financial control and management of advanced service contracts

Prof. Dr. Shaun West

Lucerne University of Applied Sciences and Arts, Lucerne

Dr. Kyle Alves

University of the West of England, Bristol

Prof. Andrea Tenucci

Sant'Anna School of Advanced Studies, Pisa

Lorenzo Montaruli & Prof. Paolo Gaiardelli

University of Bergamo, Dalmine

Abstract

This study investigates the financial and controlling challenges associated with the transition to Product-as-a-Service (PaaS) business models, particularly in the context of advanced services. The research employs a mixed-method approach, including a Delphi survey and a workshop with industry experts. Preliminary findings indicate that firms need help managing cash flows, understanding costs, and complying with financial regulations in the PaaS model. Key issues identified include the need for a total cost of ownership model, accurate margin expectations, and robust financial controlling processes. The study concludes with a call for further research to define best practices for financial controlling in service contracts. Future research must consider the role of costing, balance sheet impacts, cash flow management, sales recognition of service contracts, and the development of tools to support the design and delivery of advanced services.

Keywords: Product as a service, advanced services, finance and control, business models.

Introduction

The motivation for this work comes from a prior study into the contractual issues associated with advanced services (Alves, Stoll & West, 2022). In the prior study, based on a mixed-method approach to understanding the challenges around matching advanced service contacts with associated value propositions, it became evident that the finance and control of advanced services deserved additional research focus. The findings of the previous study confirmed that many of the approaches firms used to contract a service originate in product-based contracts and require improvement in many respects when supporting services.

The shift to PaaS challenges many firms' existing business models, requiring innovative financing around asset ownership (Toxopeus, Achterberg & Polzin, 2018). The transition requires moving from simply selling the products they manufacture to selling the product with an attached bundle of services covering the lifecycle of the product. In PaaS, there is no transfer of ownership of the physical machine/product, but instead the results of its operation are sold. This model is not new. Among others, Xerox is well-documented for making this switch in the past. Nevertheless, due to the shift to PaaS business models, firms report 'bloated' balance sheets and challenges with managing cashflows (Raddats & Baines, 2023). This is unsurprising in many respects. Historically, many manufacturers sold products with low margins, expecting the sale of associated services to recover their position. This is also often called the 'razor/razor-blade' pricing model. Due to the relatively low margins, many firms wishing to move to the PaaS business model find insufficient cash flows to commercialize their new offers. Other firms, such as Rolls-Royce, attempted to overcome this challenge by using financial intermediaries to own the equipment and provide leasing options for their customers

(Toxopeus et al., 2018). This model is also prominent in the auto industry.

Even without the complexity of additional intermediaries, OEMs face significant challenges in adopting new revenue models where cashflows are translated to 'per-use' fees. Such challenges include creating a financial model integrating new cash flows (both costs and revenues) to allow the firm to understand its future cash position. Next comes the difficulty of estimating risk on gain/pain sharing outcome models (Selviaridis & Wynstra, 2015). This task requires integrating past data within actuarial calculations into the process, which is difficult for traditional manufacturers. Often, the finance function is not ready to support PaaS-based solutions (in terms of costing, pricing, estimations, etc.) because a change of approach is required with advanced services. The problem is even more significant when considering the difficulty of forecasting and discounting cash flows in multi-year contracts (Tenucci & Cinquini, 2018).

The final challenge is that of putting a financial controlling process in place to ensure that sales recognition aligns with IFRS 2016, a financial regulation with which many OEMs must comply. The application of 'percent of completion' (POC) is key to project control and critical within advanced service agreements for sales recognition. Sales totals in such contracts do not equal the invoice value, but rather are related to the anticipated costs and margins of the contract.

Based on the observed lack of evidence of empirical investigation in this area identified by a panel of practitioners and academics, our research question asks, "what does good practice in finance and control look like for the design and delivery of advanced services?"

Methodology

This study utilizes a mixed methods approach, specifically an explanatory sequential design. The Delphi survey provides an overview of the importance of different contract issues, while the workshop allows for a more nuanced exploration of those areas of concern. This methodology ensures focus is placed on contemporary issues as identified by practitioners and academics actively involved in this research area. It also supports the development of recommendations to address the identified knowledge gap which are relevant to managers of these services. The methodology consists of three phases.

The first phase involves a quantitative Delphi survey (Paliwoda, 1983) conducted with a panel of experts. These experts, selected based on their expertise in the field, are asked to rank contract issues related to the translation of value positions into advanced service agreements. The survey data is analyzed using statistical techniques to generate a comprehensive list of topics of concern.

The second phase employs a qualitative approach through a workshop with the same group of experts. The workshop provides a platform for in-depth discussions and qualitative insights. These experts are encouraged to share their perspectives and experiences regarding the contract issues. The workshop discussions are recorded, transcribed, and analyzed using thematic analysis to identify emergent themes.

In the final phase, the analysis of the workshop discussion informs the research agenda. The emergent themes identified through qualitative analysis guide suggestions for further investigations and provide a deeper understanding of the knowledge gap associated with value positions and advanced service agreements.

Findings

The preliminary results confirmed the assumption that firms must be better equipped to successfully deliver advanced services. Managers require new skills and tools to create the necessary cash flows for the development phase. In many cases, they need to be better equipped to understand fully the costs and how to ensure optimal performance when faced with dynamic input costs. Firms can only reliably create a PaaS or pay-per-use revenue model with the total cost of ownership model. This means that margins must be determined during the delivery phase. This impacts sales recognition and overall profitability. There may also be aspects relevant to manufacturing-as-a-service that needs further investigation. Three of our findings that merit further investigation within the aspects of best practice for financial controlling in service contacts are:

i. how to include the cost of the equipment, financing/leasing, and impact on the balance sheet;

ii. ongoing management of the contract margins is needed for the review and assessment of sales;

iii. the development of formal tools to support the initial offer development, contracting process, execution phases, and overall governance aspects.

This research provides support for further research on these three foundational areas, identified by practitioners and academics as necessary for the transition to best practices, or even basic compliance with financial reporting regulations, to occur.

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Key capabilities for the servitization and digital servitization journey

Valentina Forrer

Free University of Bozen-Bolzano

Erica Santini

University of Trento

Filippo Visintin

University of Florence

Abstract

Servitization is not an homogenous phenomena, and digital technologies are enlarging the organizational solutions allowing companies to navigate in this journey. The paper assesses differences in the organizational capabilities allowing customer contacts in the servitization and digital servitization journey of well-established manufacturers. The study is exploratory and based on two case studies. The first case refers to a servitization journey at the time of transition from unconnected products to digital and connected ones and it has been retrieved in the servitization literature. The second refers to a manufacturer that recently entered a digital platform based servitization journey. Findings shows that the deployment of front-office staff in the delivery of advanced services is crucial in the servitization journey. In the digital platform based servitization journey, a well-developed R&D department is the core of service capability development and it leads the company through the journey. The resulting differences coming to light from the comparison of these two journeys offer a more comprehensive understanding about the capabilities allowing an efficient and effective customer contact.

Keywords: Servitization, digital servitization, digital platforms, commodification of services, service capabilities.

Introduction

The current digital transformation has dramatically enlarged the scope and the nature of manufacturing strategies in the global competition, opening to what is now called as digital servitization (Paiola & Gebauer, 2020; Eloranta, Ardolino & Saccani, 2021). Digital technologies foster a different way to deliver services where indirect interactions between customer and service providers allow service and therefore servitized manufacturers to reduce the need for having strong person-to-person customer interactions (Sampson & Chase, 2020).

Traditionally, the servitization journey has been explored by looking at the deployment of well-developed front-office capabilities allowing effective and efficient customer and manufacturer interactions (Martinez, Bastl, Kingston & Evans, 2010; Jovanovic, Raja, Visnjic & Wiengarten, 2019). However, digital technologies allowing automated systems might decries the importance of interpersonal interactions (Sampson & Chase, 2020). Despite the recent literature is stressing the importance to explore digital servitization journeys, our knowledge about the differences with the servitization ones is still limited. This paper aims to understand how servitization and digital servitization journeys differ in the service capability development and how the commodification of service components thought the development of digital platforms allows a traditional manufacturer to navigate the digital servitization journey.

Literature review

Paiola and Gebauer (2020) underline that product related knowledge and specific manufacturers' resources and capabilities are a starting point for service business development in the digital era. Service capability development bases on the industrialization of the back-office that allow the exploitation of the potential of new technologies and the development of platforms flexible enough to fit individual customer needs (Reinartz & Ulaga, 2008). Digital systems shaped how the interactions between customers and service providers take place, and allowed remote interactions and self-service (Chase, 2010). The commodification of service components fosters a variety of organizational solutions for the distribution of the operational responsibilities between total solution providers and customers, reducing or automating customer interaction (Sampson & Chase, 2022).

These arguments open the debate about the similarities between service capabilities development in place during these two types of servitization journeys, since "offerings that involve customer interaction are fundamentally different from those that do not involve interaction, and should be managed differently, even if in the same industry" (Sampson & Chase, 2020, pp 1064).

Case Studies

The data sampling consists of two manufacturer firms which result particularly suitable for illuminating the phenomenon of servitization and digital journey (Eisenhardt & Graebner, 2007). The first case bases on the servitization journey of Océ, a leading multinational company operating in the professional printing sector (Visintin, 2012). The second case, Alpha, is the business unit of an important global player specialized in the design and production of machine tools for industry.

Results and Discussion

The comparison between the two journeys describes several differences and findings reveal a quite complex picture. In the digital servitization journey where digital platforms define the customer solutions, front- office competencies seem to lose their central role, and customer contact passes through automated systems able to deliver advanced services and self-service options. The expertise of the back-office is at the core of the implantation of effective customer solutions; and the digital servitization strategy bases on the outsourcing of low value added services and the development in-house of advanced services.

In the servitization journey, an effective strategy seems to lead the manufacturer to become a systems integrator. Conversely, the digital servitization journey opens to the delivery of total customer solutions where interactions aiming at satisfy individual needs are mainly supported by digital platform ecosystems. These digital platform ecosystems enable remote interactions with providers, and self-service activities.

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Session 7

Ethics and Sustainability in Servitization

Co-Chairs: Oscar Bustinza & Emanuel Gomes

(venue: TBS Executive room 702 -7th floor)

Commercialization of Advanced Digital Servitization: A Contingency Framework for matching challenges and positioning strategies

Rocky Mahmud, Thomas Brekke

University of South-Eastern Norway, Norway

Vinit Parida

Luleå University of Technology, Sweden

Abstract

The development of digital technologies has led to the emergence of advanced digital servitization-centric firms. Autonomous driving and shipping are great examples of advanced-level digital servitization initiatives. Although there is a need for technology development, the company must focus on developing appropriate business models for successful commercialization. One of the significant steps of business model development is defining the firm ´s strategic positioning, which is hardly discussed in the existing servitization literature. Despite the presence of several academic studies, there is a need for understanding the varying challenges associated with digital servitization. To address these gaps in the literature, we investigate seven autonomous driving and shipping technology providers to present a case study. A total of 28 in-depth semi-structured interviews were conducted and analyzed following the thematic analysis guideline of Braun and Clarke (2006). The findings suggest that advanced digital servitization firms have to meet challenges associated with organizational readiness and market readiness. The study further discovers three key positioning strategies the sample cases are implementing. We contribute to the literature by developing a contingency framework to explain how

advanced digital servitization firms can manage challenges through positioning strategies. This study has several practical implications for managers and business owners.

Keywords: Digital servitization, autonomous solutions, positioning strategy, smart solutions.

Background

Transforming from a product-oriented business model to a service-oriented business model is becoming a common business practice for firms, and service centricity is regarded as servitization (Raddats, Kowalkowski, Benedettini, Burton & Gebauer, 2019). The boom of digital technologies such as the internet of things (IoT), artificial intelligence (AI), neural networks, big data, and machine learning have created opportunities for businesses to advance their servitization strategies (Falkenreck & Wagner, 2017; Paiola & Gebauer, 2020). Using digital technologies for value creation, value capture, and delivery is broadly regarded as digital servitization in academic literature (Parida, Sjödin & Reim, 2019; Coreynen, Matthyssens & Van Bockhaven, 2017). With the development of digitalization technology, smart and connected products, and services have been emerging, which are impacting the competition and dynamics of many industries (Porter & Heppelmann, 2014). Autonomous transportation and logistics solutions are an example of an advanced level of digital servitization (Thomson, Kamalaldin, Sjödin & Parida, 2022) and have the potential to change the industry dynamics.

Successful commercialization of advanced digital servitization-centric offerings; for instance, autonomous driving and shipping solutions would not only require solving technological challenges but also the development of business models aligned to a firm strategy (Kohtamäki, Parida, Oghazi, Gabauer & Baines, 2019;

Leminen, Rajahonka, Westerlund & Wendelin, 2018). Developing a business model to commercialize autonomous solution is a critical task (Thomson, et al., 2022), because of several internal and external challenges that firms need to address during the transformation process (Gebauer, Paiola, Saccani & Rapaccini, 2021; Paiola & Gebauer, 2020). Given the significance of alignment with ecosystem partners (Parida, Sjödin, Lenka & Wincent, 2015; Reim, Sjödin & Parida, 2019), positioning a firm in the ecosystem is a significant strategy (Baines, Lightfoot, Peppard, Johnson, Tiwari, Shehab & Swink, 2009). Defining the strategic position should be the most significant primary activity for developing a successful business model for servitized firms (Bustinza, Bigdeli, Baines & Elliot, 2015) because it helps the firms to gain a competitive edge (Porter & Heppelmann, 2014).

The presence of internal and external challenges pushes firms to decide their trade-offs to determine their strategic position in the ecosystem (Rymaszewska, Helo & Gunasekaran, 2017). The existing literature highlights several challenges associated with autonomous solutions and other advanced-level digital servitization (See, e.g., Coreynen et al. 2017; Tronvoll, Sklyar, Sörhammar & Kowalkowski, 2020; Zhang & Banerji, 2017) yet further understanding of the servitization challenges is needed (Reim et al., 2019). The current digital servitization literature investigates potential solutions to the challenges, and most of these studies approach the challenges from dynamic capability perspectives (Pisano, 2017; Teece, 2018; Sjödin, Parida, Kohtamäki & Wincent, 2020). Arguably, strategic positioning could be a great tool to manage associated challenges with digital servitization. It would be more effective in the case of autonomous solutions as it is at the infancy level. Despite the significance, no literature examines how digital servitization-centric firms meet their challenges through strategic positioning.

This study addresses this gap in the servitization literature by answering how an advanced-level digitally servitized firm approaches strategic positioning under varying internal and external conditions. In light of the above discussion, we develop and present a case study of multiple advance level digital products-service-solution providers operating in the transportation and logistics industry. The case study gathers empirical evidence from seven autonomous driving and shipping technology providers operating in Europe.

Method and Findings

For the study, we have done 24 semi-structured in-depth interviews with the top managers (CEOs, CBOs, CTOs) of the selected seven cases. Further, we have conducted four expert interviews who have been in the industry for a long time. The transcriptions of these interviews are the main data source for this study. We have used websites, podcasts, and different published information as secondary data sources. Following the guideline of Braun and Clarke (2006), we analyzed the qualitative data to present the findings of this study.

The study identifies that autonomous solutions providers have to manage various internal and external challenges. The internal challenges include intelligence-based capabilities, commercialization capabilities, and organizational flexibility. And the external challenges are ecosystem integration, customer readiness, and access to financial resources. We then identify three key positioning strategies that the autonomous driving and shipping technology providers are implementing. Finally, we develop and present a contingency framework that shows how these positioning strategies are helping the selected cases to manage the identified challenges.

Building based on the structural contingency theory (Donaldson, 2001, 2006), this study contributes to the literature on servitization and digital servitization by developing a contingency framework for choosing the most appropriate positioning strategy under varying settings. This study presents the significance of having an ecosystem aligned positioning staretgy, especially in the context of advance level digital servitization firms. The article concludes with the limitations of the study and offers suggestions for future studies on advanced digital servitization.

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Digital Servitization for Sustainable Value Creation: A Sustainability-based Commercializing Driven by Digital Technologies

Taylan Kilinc, David Sjödin, Vinit Parida

Luleå University of Technology

Abstract

This study explores the transformative processes of digital servitization (DS) within industrial firms and their associated ecosystems by focusing on the role of customer collaboration and the application of socio-technical systems (STS) theory. While DS offers opportunities for businesses to enhance operations, optimize processes, and improve efficiency, its potential for environmental sustainability and customer involvement remains underexplored. This study addresses these gaps by investigating three business-to-business (B2B) cases, aiming to understand the iterative processes and interdependencies between providers and customers in the development of eco-sensitive services. Drawing on the STS theory, which analyzes the impact of changes in one part of the system on the entire system, the article proposes a holistic approach to work system design for DS transformation. The findings highlight stepwise iterative processes and provide a framework for B2B firms to progressively transform their operations into environmentally friendly digital service offerings. This research contributes to the DS research stream by integrating a pertinent theory and sheds light on the sustainability potential of DS while emphasizing the importance of customer collaboration in value creation (VC).

Keywords: Digital servitization, socio-technical systems theory, customer collaboration, sustainability.

Introduction / Purpose

This study aims to investigate the processes and interdependencies involved in transforming industrial firms towards sustainable DS in the B2B context. With the rapid advancements in digital technologies, businesses increasingly have the opportunity to optimize processes, improve efficiency, and understand customers better through innovative digital services (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019; Sjödin, Parida, Palmié & Wincent, 2021). However, the potential for environmental sustainability and the role of customer collaboration in DS require further exploration (Paiola, Schiavone, Grandinetti & Chen, 2021; Schiavone, Leone, Caporuscio & Lan, 2022).

This study targets to fill these gaps by examining the iterative processes of DS and the collaborative efforts between industrial firms and their customers. By leveraging STS theory (Appelbaum, 1997), the study seeks to understand how changes in one part of the system can impact the entire work system design for DS transformation.

Through an analysis of three B2B cases, the study uncovers the stepwise iterative processes involved in developing eco-sensitive services that provide sustainable value to both providers and customers. The findings propose a framework and vision for B2B firms to progressively transform their operations and offerings into environmentally friendly digital services, highlighting the significance of customer involvement in VC.

By shedding light on the importance of customer collaboration and STS in DS, this study aims to contribute to academic research and managerial practices. Specifically, the findings offer practical insights and recommendations for B2B firms on how to enhance customer involvement and develop sustainable digital service offerings. The study also aims to identify limitations and propose future research opportunities to encourage further exploration of the sustainability aspects of DS and the collaborative dynamics between providers and customers.

Theoretical Background

DS refers to the integration of digital technologies into products to create value through additional services (Parida, Sjödin, Lenka & Wincent, 2015). However, the B2B context of DS is still in its early stages and requires further research (Gebauer, Paiola, Saccani & Rapaccini, 2021), especially considering the eco-sensitive service development. The definition used in this paper describes DS as a transformation in processes, capabilities, and offerings within industrial firms, enabled by digital technologies such as IoT, big data, AI, and cloud computing (Sjödin, Parida, Kohtamäki & Wincent, 2020). The infrastructure of DS relies on smart connected products with sensors, networks, and software, enabling remote control, monitoring, and optimization capabilities (Porter & Heppelmann, 2014).

The study also addresses the need for customer involvement in DS. Involving customers in the design and development of DS processes is crucial for VC and alignment with customer needs (Kamalaldin, Linde, Sjödin & Parida, 2020; Paiola & Gebauer, 2020). Services require a higher level of customer involvement compared to product-based businesses (Tronvoll, Sklyar, Sörhammar & Kowalkowski, 2020). Customer collaboration is not only important for economic value but also for achieving environmentally sustainable processes (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2018).

Furthermore, the study adopts the STS theory (Trist, 1981) to examine the DS processes in the B2B context. STS theory emphasizes the interrelatedness of social and technological subsystems within an organization and their holistic relation to the external environment (Pasmore, Francis, Haldeman & Shani, 1982). It recognizes that organizations consist of people utilizing technology to produce products or services, and the effectiveness of this mutuality is valued by customers. The STS theory provides a holistic approach to understanding emerging issues with social and technical dimensions, making it highly suitable for analyzing DS (Münch, Marx, Benz, Hartman & Matzner, 2022).

Consequently, the investigation of the study consults transformative processes of DS in the B2B context, with a focus on customer collaboration and the utilization of the STS theory. By examining the interplay between social and technological aspects, the study aims to provide insights for B2B firms on how to enhance customer involvement, develop sustainable digital service offerings, and attribute environmental sustainability to the transformational processes and outcomes of DS.

Methods

The study utilizes an exploratory multiple-case study approach (Yin, 2009), conducting 20 semi-structured interviews with employees involved in sustainability-based digital services. The cases involve Swedish incumbent firms and their B2B clients. Data collection includes interviews, company presentations, follow-up interviews, and project reports (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2009). Thematic analysis is employed to identify connections and patterns in the data, resulting in the development of second-order themes and an overall data structure (Gioia, Corley & Hamilton, 2013).

Findings

The findings emphasize the importance of customer involvement and relationship-building in the digital service development process (Figure 1). Technical aspects such as interoperability of machines and data integration are crucial for optimizing productivity, cost reduction, and energy consumption. Social sub-system reconfiguration includes identifying roles and responsibilities for managing customer success and becoming more customer-facing. Joint optimization involves continuous interaction with key stakeholders and the use of advanced analytics and AI for efficiency and environmental sustainability. Training programs for operational processes and customers are explored to improve effectiveness.

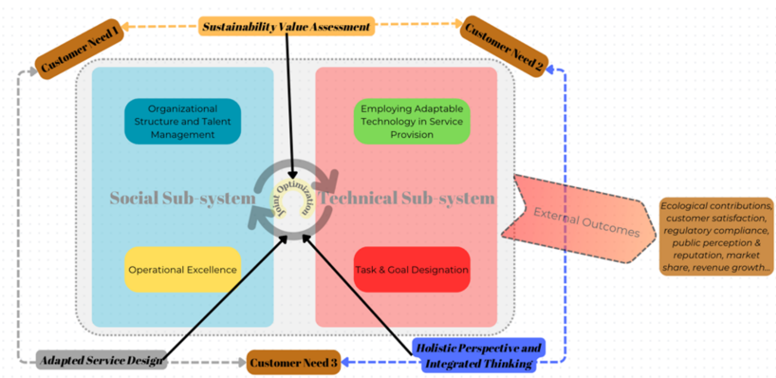

Figure 1. Work system innovation framework based on STS for DS processes.

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Race and gender bias in AI-enabled search engine services

Thomas Brekke, Caroline Aasgaard Cahro, Christine Maria Ødegård

University of South-Eastern Norway

Abstract

The present study investigates gender bias in Artificial Intelligent (AI) enabled digital service solutions, specifically, the evolution of AI for voice-assistant and search engine services. Voice-assistant and search engine services are increasing in scope, and they expect to solve every day and even critical tasks. Despite significant improvements with the use of AI, we see several examples of the technology working better for men than for women, and that technological solutions continue and reinforce race and gender stereotypes. For this purpose, we focus on an exploratory study of seven software consultancy companies developing voice-assistant and search engine services. Our contribution is two-fold: We 1) depicts how gender bias in technology development is related to lack of routines and practices that include women to take part of software development in practice, 2) for managers we offer a way forward to bridge the gap between gender inclusive strategies and practices. For research, the study provides a new research agenda which is not very well understood in the existing digital servitization literature.

Keywords: Artificial intelligence, digital servitization, search engine services, gender bias.

Introduction

Use of digital services for optimalization of voice assistant and search engine services is increasing in scope and they expect to solve more advanced every day and even critical tasks as artificial intelligence (AI) and machine learning enable new digital service solutions such as functionality of self-driving cars, traffic updates and weather forecasts (Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022) Search engines services and voice assistant is regarded to be race and gender neutral. However, they are not. As an example. Voice assistant such as Siri and Alexa understand men better than women (Bajorek, 2019; Smith, 2019; Tatman, 2017). Another example is face-recognition such as FaceID on iPhone, which recognize white men better than woman or other colored peoples (Buolamwini & Gebru, 2018; Lohr, 2018). However, as these AI-based digital service technologies becomes more ingrained in our daily lives, these biases have several consequences for people's lives and companies' business (Thomson, Kamalaldin, Sjödin & Parida, 2021). Novel service technologies are driving new service development, therefore enabling new types of smart search solution offerings through voice-assistant services require processes and competencies to create value from technology (Kohtamäki, Rabetino, Eonola, Parida & Patel, 2021).

The literature on gender bias has mostly focused on how women are underrepresented in the industry, lack of recruitment of women to tech industry, the fact that they are difficult to retain, and finally their impact on the organizational culture (Hanappi-Egger, 2013). Despite extensive research related to the importance of women in technology industry, the research has to a lesser extent been able to explain why technological solutions, such as voice assistant and search engine services, contain race and gender bias. This paper investigates why technology work better for (white) men than for women and secondly what companies can do to develop gender-neutral digital services that are better adapted to the user's needs.

Method

For answering these research questions, an in-depth explorative research study is conducted for 7 technology software consultancy companies. A qualitative analysis was built on interviews with top-mangers, human-resource managers, and designers/developers. In addition to the interviews an extensive systematic literature review (SLR) was conducted. Secondary data was retrieved from company documents, news bulletins on search engine and ChatGTP, and public reports. A thematic analysis (Braun & Clarke, 2022) was used to create the coding structure. The analysis consists of six recursive phases, starting with familiarization, initial coding, searching for themes, reviewing, looking for aggregate themes, refining, and reporting. Thematical analysis provides well developed framework for identifying patterns across large data sets, whilst preserving empirical grounding in the data (Braun & Clarke, 2006).

Findings

The thematic analysis revealed that software technology consultancy companies do have strategies, and objectives for diversity and race and gender balance. Furthermore, the findings also shows that the studied companies do not see a connection between their own strategy and the practices they carry out to balance gender bias in technology development. However, findings also shows that these strategies and objectives is not very clear to the technology developers on how to follow up gender equality in practice when new AI solutions is to be developed. Most of the companies apply usability testing and service design methods to verify new solutions against specific user preferences and to identify user needs. Findings show that it is difficult for these technology companies to follow-up usability testing considering gender equality in practice. The companies tend to focus more on short-term consideration, such as resource planning and cost efficiency, rather than plan to avoid race and gender bias in technology development. Some of the case companies are not even aware that gender bias is taking place, and it is therefore difficult for them to understand what strategies and routines one must change to achieve race and gender equality. Lack of understanding and attention from the company's management as well as lack of routines will continue to exacerbate gender bias in the development of voice-controlled and search services.

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AI for Servitization in the Production Industry: A Critical Analysis of Individual and Organizational Impacts

Basak Canboy, Wafa Khlif

TBS Education

Abstract

Artificial Intelligence (AI) technologies can be seen as a "pharmakon" (Steigler, 1998), possessing both remedial and poisonous qualities. They are constantly advancing in capability and becoming integrated across diverse sectors, including production. Consequently, it is crucial to undertake a thorough analysis of the boundaries and impacts associated with relying on AI for servitization. The objective of this study is to critically investigate the interplay between humans and AI, examining trust, collaboration, and skill enhancement within both internal and external boundaries considering the context of AI-driven servitization in the production industry.

Servitization refers to the transition from product-oriented to service-oriented business models, where companies focus on providing services as the primary growth engine (Wise & Baumgartner, 1999; Jacob & Ulaga, 2008). This shift recognizes the evolving nature of service ecosystems and the need for systematic changes and complexities (Rabentino, Kohtamäki & Gebauer, 2017). Digital servitization together with AI go one step further, and view servitization through the lens of digital transformations (e.g. Kohtamaki, Parida, Oghazi, Gebauer & Baines, 2019; Davenport & Ronanki, 2018). They involve the utilization of digital tools and technologies, specifically customer and firm-level data, to optimize key business processes and resources or increase personalization for value creation strategies and tactics (Vendrell-Herrero, Bustinza,

Parry & Georgantzis, 2017). While AI in general can enhance societal good (Wamba, Bawack, Guthrie, Queiroz & Carillo, 2021), in the context of digital servitization, manufacturers can use AI for remote monitoring, control, optimization, and automation to deliver solutions more efficiently and directly (Porter & Heppelman, 2014; Vendrell-Herrero, Bustinza & Vaillant, 2021).

Therefore, AI can assume a pivotal position in the configuration and operation of service-oriented solutions. Aligned with the principles of the network society (Castells, 2001), it possesses the potential to transcend the confines of commerce and exert influence over all facets of societal, economic, political, and cultural domains. The realm of corporations is undergoing a process of decentralization and restructuring, manifesting as self-programmed and self-directed entities that engage in horizontal coordination within a network characterized by remarkable adaptability in response to an increasingly fragmented and unpredictable market. This sheds light on the essence of power distribution and the intricacies concerning surveillance, personal privacy, and public life in a broader context. More specifically, AI is often criticized for its lack of transparency, potential bias and discrimination, as well as its impact on job displacement and accelerating economic inequalities (e.g. Müller, 2020; Cachat-Rosset & Klarsfeld, 2023). The complexity of AI algorithms makes it difficult to understand decision-making processes, and biases present in training data can be perpetuated which raise deep trust concerns (Green, 2018).

Moreover, AI algorithms analyse vast amounts of data and create personalized virtual environments, blurring the boundaries between the real and virtual. This raises questions about how AI-driven servitization shapes individuals' understandings of what is real, authentic, and meaningful. Furthermore, the personalized nature of AI services can lead to the isolation of individuals within algorithmically curated bubbles, potentially impacting social cohesion, empathy, and attitudes towards human connection (Banafa, 2023). The integration of AI into servitization introduces control mechanisms that shape consumer behaviours and desires, aligning with Gilles Deleuze's notion of the "société de contrôle" (control society) (Deleuze, 1995). The controlling society tends to be exploitative in the name of freedom (Han, 2015). It operates with what may appear to be openness and freedom but is, in reality, a subtle means of control through instantaneous and constant communication and, thus, exposure. AI-driven servitization empowers companies to exercise control through personalized recommendations, targeted advertisements, and data-driven decision-making. This control is enacted by AI systems, impacting individuals' choices and preferences in subtle ways. Deleuze points to minds or psyches which are controlled through unconscious social conditioning.

The advancement of AI technology also raises concerns among employees about potential unemployment and knowledge deprivation. At the organizational level, AI can have implications for work processes, job roles, and organizational structures. With AI's ability to perform several tasks more efficiently and accurately than humans, there is a reduced demand for human labour, particularly in routine and repetitive tasks that are easily automated (Müller, 2020). Industries such as manufacturing, customer service, and transportation are particularly susceptible to AI-related job displacement. However, it is important to recognize that in servitization, there are situations where human involvement remains essential to maintain and advance knowledge. Human judgment and the ability to understand contextual nuances are crucial in subjective assessments, creativity, collaboration, and complex reasoning—areas where human input and expertise are irreplaceable. While AI can automate certain tasks, we argue that there will always be a need for human skills, particularly in areas requiring empathy, intuition, and critical thinking as well as crisis management. Consequently, one of the roles of organizations will rely on skill development of their employees to counterfeit possible negative effects of AI internally.

In conclusion, this article underscores the significance of contemplating the paradoxical transition associated with AI. The latter amplifies human potentialities in various aspects, whilst concurrently diminishing human competencies and capacities. AI possesses the ability to evoke both the finest and most undesirable traits in human conduct, as it assumes a role in the decision-making process by permeating our minds. Within the framework of consumer capitalism, AI has the potential to function as an ideal facilitator of our insatiable desire for instant gratification.

Simultaneously, the utilization of AI can also engender practices aimed at cultivating a collective intelligence for contributory economies.

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The emergent role of Digital Twin in Green Services: a systematic review and outlook

Carlos Galera Zarco

University College London

Abstract

The ongoing shift towards a sustainable and decarbonised economy brings considerable challenges to many organisations aiming for zero carbon emissions. In this context, the focus on service orientation is evolving as a facilitator in fostering more eco-friendly business models. However, the notion of green service and how designing and implementing these services remains as an open issue within the service literature. In parallel to this, we are witnessing the advent of new technologies acting as catalysts in this transformation towards a greener economy. Within these emergent technologies, Digital Twin is demonstrating its capability in enhancing operational efficiency and process optimisation. Despite an upsurge in the studies considering Digital Twin, there is no comprehensive understanding on how this technology can enable services and facilitate sustainable practices. This ongoing research study intends to depict the current state of art and current best practices across industries in order to better understand the role of Digital Twins as enablers of green services. Methodologically, the study firstly perform a systematic literature review and benchmarking analysis. Building upon the insights from this first stage, the researcher will engage with a focus group from industry and academia to explore the current uses and future landscape of Digital Twin application within service development. The ultimate goal is to construct a comprehensive framework identifying the pivotal socio-technical considerations for Digital Twin-enabled green services to flourish. The envisioned framework could guide both professionals and

academics in the design and effective deployment of green services leveraging Digital Twin technology.

Keywords: Green Services, Digital Twin, Industry 4.0, Sensor Enabled Services.

Introduction

Ambitious goals to decarbonise economy by 2050 has been set by leading economies (e.g., EU Green Deal, 2022). These sustainable objectives steers all industrial sectors towards new growth strategies that reduce resource consumption (Climate Change Act, 2008). Likewise, recent assessments of the fulfilment of these goals underscore the imminent need for increasingly rigorous measures and legal commitments to achieve these enthusiastic Net Zero emissions target (Committee on Climate Change, 2020). Amid this scenario, organisations face the complex task of quantifying their CO_2 emissions across their processes and supply chains, while aiming to reorient their business strategies to align with these environmental objectives. Some of these transformative shifts, particularly visible among manufacturers, are the servitization phenomenon and the development of Product Service Systems (PSS) (Baines, Lightfoot, Evans, Neely, Greenough, Peppard et al., 2005; Mont, 2002). Nonetheless, even though services represent around 65-85% of GDP in advanced economies, research into their role in the green transition is surprisingly scant. Therefore, there is a growing demand for more research into defining the notion of green service and providing a better understanding for the design and development of such services, which ultimately, can significantly contribute to the development a greener economic model (Ström, 2020).

To reach the aforementioned green objectives, significant investment and innovation in emergent and data-driven technologies are necessary. New digital technologies (AI, Digital Twin, IoT, Blockchain, etc.) have the potential to revolutionise our economy and spearhead the transition towards green economy (von Kutzschenbach & Daub, 2021). Among these innovations, Digital Twin (DT) technology is being applied and showing its potential in areas such as production planning, control, and maintenance management (Kritzinger, Karner, Traar, Henjes & Sihn, 2018), predictive maintenance (Melesse, Di Pasquale & Riemma, 2020), and diverse lifecycle-based applications (Liu, Pingyu & Wenlei, 2020; Holler, Falk & Walter, 2016). Additionally, DTs are beginning to be understood as service facilitators (Meierhofer, West, Rapaccini & Barbieri, 2020), particularly relevant in the development of PSS (Bertoni & Bertoni, 2022). Nevertheless, there is a significant knowledge gap in understanding the role of DT in service design and the offering of value propositions beyond mere operational efficiency (Aheleroff, Xu, Zhong & Lu, 2021). More specifically, there is a distinct lack of research exploring the function of DT as a catalyst for green service development.

Taking into account the aforementioned, there two main areas where this study aims to contribute; one is the need of an enhanced comprehension of the green service concept and its role in the green transition, and the other is the role of DT as enabler to green service offerings. Consequently, the current research endeavours to accomplish a three-fold objective. First, it aims to contextualise green services within this tech-driven landscape and identify characteristics of green services in existing DT-enabled services. Second, it seeks to gain insights into current cross-industry best practices concerning the design and deployment of green services enabled by DT. Lastly, it intends to find out essential socio-technical elements to propose a framework able to collaborate in a better design and offering of DT-based green services.

Methodology

A three-stage methodology is identified as the most appropriate approach to accomplish the proposed objectives. This methodology, which is being implemented in the ongoing research, is outlined in depth hereafter. The initial stage entails conducting a systematic literature review (SLR) to gain a comprehensive understanding of the state of the art in DT-enabled service provision and to identify which of these DT-based service offerings can be deemed 'green'. The review unfolds in three stages: planning of the review, executing the review, and review reporting (Tranfield, Denyer & Smart, 2003). A preliminary set of keywords pertaining to green services is established by examining the definition of green services, alongside the categorisation for resource integration processes in green services proposed by Guyader, Ottosson, Frankelius and Witell (2020): reducing, recirculating, recycling, redistributing, reframing, renewing. This initial list of keywords is later amalgamated with a second set of keywords characterising DT technology and a third group of keywords to include the notion of technology-enabled services. SCOPUS database has been chosen as the primary source for searching academic literature. Building on these initial results and relevant publications from grey literature (which includes white papers, industry reports, use cases, governmental documents, etc.), a benchmarking analysis is performed to comprehend and compare the existing cross-sector practices.

The second phase of this research methodology builds upon the initial insights derived from the SLR and benchmarking analysis. These insights guide the creation of a series of open-ended questions for use in a focus group. These experts integrating the focus group hail from both academic and industry backgrounds, providing diverse viewpoints to refine preliminary findings and assess how sense-making occurs in the design and develop DT-enabled green services. One major focus of the focus group will be to identify socio-technical factors (including aspects related to people, processes, and data) that may be highly influential in the successful development of green services driven by DT.

The third and final step in the research method involves a comprehensive analysis of all the collected content with the ultimate objective to construct a framework that can illuminate the potential of DT to enable the deployment of green services.

Preliminary Findings

As we navigate through the designated methodology, we anticipate achieving a more profound understanding of technology-driven green services. Specifically, we are exploring the resource integration processes that are instrumental in designing and developing DT-enabled green services. This ongoing investigation is expected to augment our understanding of how DT can be employ to deliver green services. The study also tries to offer insight into best practices and variances across industries. In addition, the potential identification and structuring of crucial socio-technical factors associated with organisations (like culture, roles, capabilities, and skills), processes (including value co-creation, standard practices, and operational business models), and data (encompassing data management and governance, data sharing, and data privacy and security) are envisaged to provide innovative guidance in the development of green services utilizing DT.

Preliminary findings form SLR highlight the most prominent integration processes in DT-enabled green services: 1) Reducing: This process emerges as a main resource integration strategy present in the offering of DT-enabled green services. DT facilitates the re-design of operational procedures to conserve resources, and it plays a vital role in eco-operation training services. 2) Redistributing: DT enhances knowledge sharing, which in turn boosts collaborative consumption. This redistribution process aggregates supply and demand for peer-to-peer services. 3) Recirculating or "reusing": DT enables a better understanding of spare parts or machinery that could potentially be repurposed or reused, thus extending their lifecycle and reducing waste. 4) Recycling: DT can simulate circular supply chains, promoting services that match waste volumes with raw materials needed by different organizations or industries.

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Session 8

AI, digitalization and services

Co-Chairs: Esteban Lafuente & Jean Pierre Seclen-Luna

(venue: TBS Conference room 703 -7th floor)

Digital-enabled service innovation in a construction environment

Gabriel Tiefenthaler

Lucerne University of Applied Sciences and Arts & Hilti Group

Prof. Dr. Shaun West

Lucerne University of Applied Sciences and Arts

Dr. Christopher Ganz

ETH Zurich

Ana Gea, Dr. Nils Krönert

Hilti Group

Abstract

This paper examines the integration of digitalization and customer-centric innovation within the traditionally conservative construction sector. Using a single-case study approach, the research scrutinizes the development of a digitally-enabled service system predicated on conventional product business within the construction sector. The study follows a Lean Startup approach over twelve months and business model design frameworks, particularly emphasizing customer experience and service design. The research findings confirm that an iterative and customer-centric approach can offer a promising approach despite the inherent challenges associated with service innovation in traditional manufacturing enterprises. This research underscores that despite service innovation challenges in traditional manufacturing firms, Lean Startup, with its action-learning approach coupled with other tools, can effectively support the innovation of data-enabled service systems within a product-based business.

Keywords: Digitally-enabled service systems, service innovation, Lean Startup, customer-centric approach.

Introduction

The construction industry, traditionally slow to adopt new technologies, is experiencing a paradigm shift due to digitalization and industrialization (Papadonikolaki, Krystalis & Morgan, 2022). Digital solutions such as Building Information Modeling (BIM) transform traditional working practices and provide a foundation for new services to improve products in the building industry. Concurrently, industrialization, marked by prefabrication and modular construction, boosts productivity, reduces waste, and improves quality control (Zhuang, Zhang, Wang, Jin, Zhou & Shi, 2021). Simultaneously, customer-centric innovation and digitally-enabled services are gaining traction (Nambisan, 2017) and support new sectors. Digitally-enabled service systems allow us to integrate digital platforms and service ecosystems, fostering collaboration, value co-creation, and system-wide learning (West, Gaiardelli & Rapaccini, 2018; Nambisan, 2017).

The Lean Startup approach, first coined by Ries (2011), is a customer-centric, agile methodology for innovation. Lean Startup has often been used for product development yet may also have value within service innovation (Ostrom, Parasuraman, Bowen, Patrício & Voss, 2015) and business model innovation (Gassmann, Frankenberger & Csik, 2014). Business model innovation demands an action-learning approach to innovation through planned exploration. According to Spieth, Schneckenberg and Ricart (2014), adapting these frameworks to individual firms can be challenging as many firms remain tied to innovation processes designed for incremental product development. The application of service design that focuses on customer experience has gained recognition for developing innovative and data-enabled services (Stickdorn, Hormess, Lawrence & Schneider, 2018). However, moving to a customer-centric approach can be challenging due to a complex reluctance to embrace more open forms of innovation (Chesbrough, 2010).

Through a case study over twelve months, this research explores how service innovation within a Lean Startup approach was used to develop a new digitally-enabled service system based upon traditional product business within the construction environment. The research question followed in this study is: "How can a traditional product firm innovate services better?".

Methodology

This research uses a single-case study to validate the significance of material sequencing in construction and to generate theories for enhancing validation methods based on reflections from an action research framework (Voss, Tsikriktsis & Frohlich, 2002). The methodology followed a four-phase iterative process over a period of twelve months. The understanding phase involved a thorough analysis of the organizational situation, laying the groundwork for the study. Reflection insights from the entire project considered the dual objective of the research. Primary data were obtained through observations, interviews, workshops, and prototype testing, while secondary data were drawn from internal organizational sources.

Findings

The problem or challenge for the initial service innovation was based on the problems identified from several Gemba walks that allowed for the collection of new insights on the problems that lead to loss of productivity on construction sights. This helped to underpin the iterative, customer-centric approach to creating the solutions. The practical application of this approach was in developing digitally-enabled services based on existing product sales and integrating new research and capabilities to enable delivery.

The Lean Startup was core in the innovation process applied, which was relatively new for the firm. Its core principle of iterative testing and refining with minimal resource expenditure guided the development of the business model. The initial Gemba walks provided the basis for the problem definitions and allowed them to be reframed from the perspective of the potential beneficiaries (the actual beneficiary was initially unclear). Low-fidelity prototypes facilitated early customer engagement (i.e., Gemba walks) and supported action learning. This was completed by defining and redefining the problem statement, the actors, and the value propositions. The business model framework was used to support the definition of the Minimal Viable Offer (MVO) (Figure 1). It provided a framework to support ideation, communication, and further refining the concept(s). Reaching the target actors, including the beneficiaries in the field, supported speed and flexibility in the innovation process.

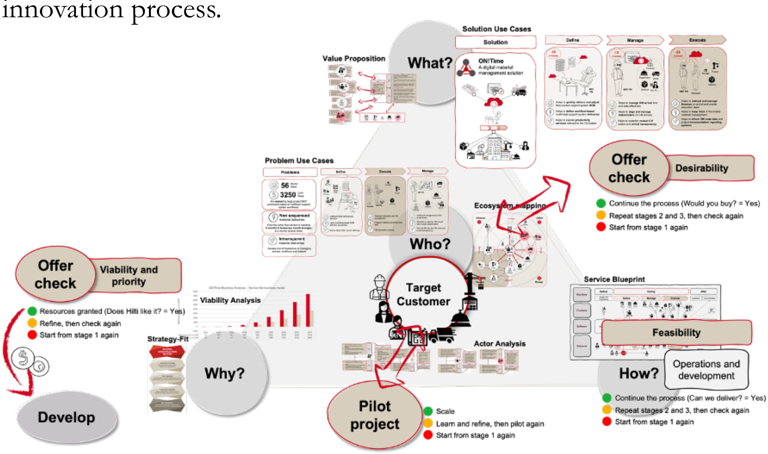

Figure 1. The development of a digitally-enabled business model.

The study reinforces the prior insights of Trimi and Berbegal-Mirabent (2012) that simple prototypes enable early customer engagement and a cost-effective approach to validated learning. The simple concepts developed were also used internally with the 'experts' to facilitate the necessary discussions, as internally, the 'experts' exhibited some resistance to the concept.

The proposed development process incorporates a number of different tools, including a business model framework (Gassmann et al., 2014) and elements of West, Stoll and Müller-Csernetzky (2022) process for developing innovation based on data. This blended approach provides a robust process, from initial management initiation to final field testing, ensuring alignment with organizational strategy and capabilities. The development process mirrors the Lean Startup principles for prototype testing of Ries (2011) and Stickdorn et al. (2018), confirming the importance of early customer engagement and assumption validation (Trimi & Berbegal-Mirabent, 2012). Furthermore, the procedure integrates considerations of the firm's internal environment and governance concerns of innovation within agile environments (Dikert, Paasivaara & Lassenius, 2016). The approach taken is described as a journey in Figure 2, considering the five stages of the process:

i. initiation;
ii. understanding value creation;
iii. designing value delivery;
iv. creating value capture mechanisms;
v. develop and pilot-test the MVO.

In conclusion, this research reveals that while the journey of service innovation in traditional manufacturing companies is laden with challenges and iterations, it can be undertaken. Nevertheless, it has significant differences from traditional product development processes. It confirms that the Lean Startup approach can be used

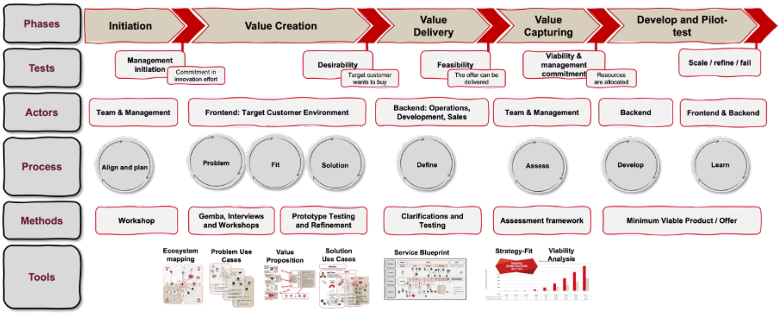

Figure 2. The overview of the service innovation process.

to innovate via an action-learning approach to innovating new digitally-enabled service systems within a traditional product-based business.

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Value of digital in Field Service

Sven Träger

Petra Müller-Csernetzky

Shaun West

Lucerne University of Applied Sciences and Arts

Aim

This study delves into the application of digital technologies in field services, a critical customer touchpoint in many business relationships. Field services, often overlooked, play a pivotal role in establishing trust and ensuring long-term customer satisfaction. The research investigates the key factors driving the adoption of digital technologies in the field service industry using a mixed-methods approach. The findings underscore the importance of a customer-centric approach and the potential of innovative methodologies in driving innovation. The study identifies nine key factors for adopting new field service technologies: operational efficiency, increasing customer expectations, and responsiveness topping the list. The research concludes with recommendations for adopting technology that supports cooperation within the field service journey, employing a humanist approach, exploring various technologies within specific use cases, and fostering collaboration among researchers. This paper serves as the initial phase of a broader research effort exploring the application of technology in the field service environment.

Keywords: Field Services; Digital Technologies; Human-centric Approach; Innovation Methodologies; Technology Adoption.

Introduction

This paper investigates the utilization of digital technologies in field services, which are crucial touchpoints in many customer-supplier relationships. Field services have often been neglected despite their significance in establishing trust and ensuring long-term customer satisfaction.

In the contemporary business landscape, field service often constitutes the main, or often sole, point of interaction between a customer and a firm (Wirtz, 2019), in both B2B and B2C environments. Whether a firm procures machinery or avails services from a third party, tangible contact is typically established when a customer encounters a problem. This falls within the purview of field service, which, within the context of this study, pertains to all operations executed outside a company, typically at the customer's site. A service is an action performed for another party and is not always linked to a physical good. It can also be an activity that creates value, induces a desired change of state, and is related to the 'customer' experience (Wirtz & Lovelock, 2021). When existing definitions are distilled to their core, the remaining characteristics include immateriality, direct contact between the provider and the customer, the 'uno-actu' principle, flexibility, and no transfer of ownership. This encompasses physical objects, services, persons, places, organizations, and ideas aimed at value co-creation within a context (Kotler, Armstrong & Opresnik, 2021).

The significance of this research is underscored by the substantial changes in the field and customer service working environments in recent years. Companies were compelled to reassess and modify their services in response to the challenges posed by the pandemic, including travel restrictions, supply shortages, and limitations on staff. Consequently, enhancing material and time efficiency emerged as a key objective. Digitalization has also revolutionized our capacity to communicate with back-office personnel and engage with customers (Adike, 2022). In an era where customers demand rapid and personalized digital service options and more transactions are conducted remotely and online, a company's technicians may be the primary representatives interacting with customers. Therefore, field services must keep pace with these developments, investing in digital technologies as a cornerstone of success.

Based on the motivation for the study, the research questions identified were, *"What are the key factors driving/slowing the adoption of digital technologies in the field service industry?*".

Methodology

A mixed methods approach was applied in this study as this was considered the most appropriate to answer the research question as the combination allows quantitative and qualitative data integration (Harris & Brown, 2010). Interviewees and survey candidates were selected based on the keywords of "field service*" from LinkedIn and the Field Service News database.

The qualitative data collection was carried out through interviews, which were transcribed using an AI-supported tool called Descript. 13 interviews were carried out during Q2/2023. The transcription process resulted in 190 pages of data, which were analyzed using an open-coding approach in three iterations. The data analysis involved listening to recordings, highlighting transcripts, and extracting keywords to that way condense the gathered knowledge down to 22 pages into tables that were then further distilled to nine key factors. The quantitative data collection was done using Qualtrics in Q2/2023; 20 people from the field services were asked to rank the key factors identified from the interviews in order of importance.

Findings

The research provides valuable insights into adopting digital technologies in the field service sector, highlighting the importance of a customer-centric approach and the potential of innovative methodologies in driving innovation. From the coding of the interviews, the five main problem areas for field service providers were found to be: i., in the business model of field service, due to the change in expectations and emerging new technologies; ii., the customer's changing expectations of field services; iii., the aging profile of the workforce; iv. the change in the range of technologies supported by field services; and, v., the availability (or otherwise) of spare parts necessary for planned and unplanned inspections.

In general, challenges for the operation emerged from the limited customer segmentation within the field service firms, the challenges that sales faced with selling field services, and the tendency to use informal forms of communication. On the customer side, there were comments about the perceived deskilling of the customer's staff and the lack of customer feedback. Considering the transformational aspects, COVID-19 was viewed as an accelerator for adopting new technologies. However, the more human aspects of change management were considered more important, particularly the aging workforce and change in employee expectation and work-life balance; this was particularly challenging with younger technicians. Technology was important with some of the more promising technologies associated with mobile or AI in the back office; informal and formal experimentation was ongoing, with some reported adoption failures. Acceptance was considered highest when the technology addressed the field service technician's or customer's human experience aspects, and they were involved to some degree in its development.

The gathered information from the interviews can be attributed to the central theme of cooperation and collaboration. Considering the complexity of the field service environment, this is not surprising. Also, collaboration allows companies and customers to create real value on both sides. Other key findings are:

- the involvement of multiple actors in the field service journey makes it difficult to ensure a seamless value co-creation process;
- that value co-destruction can also quickly occur (often accidentally) in this complex environment;
- adoption of new technologies and processes depends on many factors.

The nine key factors identified from the interviews are ranked in order of importance in Table 1 with associated details.

Key factor	Detail
Operational efficiency	To streamline processes, reduce costs, and enhance overall efficiency
Increasing customer expectations	To meet the growing demand for improved service quality
Responsiveness	To adapt to the changing business environment
Remote work (and contact limitations)	To facilitate remote service delivery
Competitive advantage	To improve field service delivery and value co-creation
Workforce management and skill development	To better allocate resources and provide training and development
Generational change in the workforce	To capture and communicate knowledge from one generation to the next
Increasingly complex processes	To improve actor interaction
Sustainability improvements	To reduce overall carbon footprint and to improve resource utilization

Table 1. Nine key factors for the adoption of new field service technologies in order of importance.

This research provides valuable insights into adopting digital technologies in the field service sector, highlighting the importance of a human-centric approach and the potential of innovative methodologies in driving innovation and technology uptake in this segment. In conclusion, this paper represents the initial phase of a broader research effort that explores the application of technology in the field service environment. In the future, the researchers aim to identify barriers to technology adoption within field services and actively seek collaborations with other scholars.

The paper recommends adopting technology that supports cooperation within the field service journey to ensure value co-creation and avoid value co-destruction. Additionally, a human-centric approach should be employed in presenting value co-creation processes and their technological enablement, with storyboards as an effective communication tool. Firms are encouraged to explore various technologies within their specific use cases to identify the most suitable options for their field service operations. Finaly, collaboration is essential in identifying barriers to technology uptake within field services.

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Managing the emergence of AI-enabled Product-Service Innovations in Autonomous solutions

Marko Kohtamäki

University of Vaasa / Luleå University of Technology

Thomas Brekke

USN Business School

Rimsha Naeem

University of Vaasa

David Sjödin

Luleå University of Technology / University of Vaasa

Vinit Parida

Luleå University of Technology / USN Business School / University of Vaasa

Abstract

The study explores the effect of AI enabled services on manufacturers' product-service systems, focusing on the shift to AI-enabled autonomous solutions. For this purpose, we focus on a single case study of a leading solution provider developing AI-enabled autonomous integrated solutions. The study presents two main contributions: 1) integrating AI into product-service innovations and 2) identifying key managerial practices during this transition. A case study is used to illustrate these contributions and provide insights for managers planning AI-enabled product-service systems. The study also outlines a research agenda for future AI-enabled service innovation studies.

Keywords: Digital servitization and product-service systems (PSS), artificial intelligence (AI) and augmented reality, business model innovation and value creation logic, digital transformation and digital business transformation.

Introduction

Manufacturing companies of integrated solutions are rapidly transitioning towards smart autonomous solutions particularly in product industries manufacturing moving vehicles. The on-going digital transformation of product manufacturing companies and solution providers have received many labels with similar or slightly different meanings, all relevant: digital transformation, digital business transformation, digital servitization, digital business models. What is common is the belief that industries are moving towards digital business models (e.g. Burström, Parida, Lahti & Wincent, 2021), and this transition requires new technological solutions, offerings and business models, and ecosystem management capabilities (Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022). In autonomous integrated solutions, AI-enabled services and product-service systems how particular potential regarding co-created customer value, as well as higher monetary value for the manufacturer (Kohtamäki, Parida, Patel & Gebauer, 2020). However, developing AI-enabled digital product-service systems is quite far from easy and simple and many manufacturing companies still struggle with monetizing digital offerings (Linde, Sjödin, Parida & Gebauer, 2021). The present study will tap into this transition towards AI-enabled product-service systems, in the context of autonomous solutions, the role and interplay between AI-enabled service technologies, business models and ecosystems. It is our argument that an exploration of AI-enabled product-service systems in a leading solution provider transitioning towards autonomous integrated solutions can provide important insights to understand how this transition at the level of offerings takes place (Sjödin, Parida, Kohtamäki & Wincent, 2020), and how the transition can be facilitated within the transformation (Kohtamäki, Rabetino, Einola, Parida & Patel, 2021).

Theoretical positioning

Research on servitized product manufacturing companies have emerged during the past two decades (Rabetino, Kohtamäki, Brax & Sihvonen, 2021). The research has covered well the business models and value creation strategies, transformation processes, service technologies, and their performance effects, with emphasis on case studies and qualitative research, but also strong reflective emphasis on reviews and conceptual theory development. Yet, during the last years, scholars started using the concept of digital servitization to highlight the increasing role of digitalization of manufacturing firms, and the need to emphasize digitalization of services, product-service systems, business models and value system architectures. Since then, the emphasis on digitalization has increased in servitization research, alongside some other important issues, such as sustainability. However, artificial intelligence is a series of novel technologies that has been developing over decades, and has rapidly started growing in the past years in various industries, finally reaching also manufacturing companies and their product-service systems. In servitization and product-service systems the role of AI has started to emerge, first tens of studies conducted on AI-enabled product-service systems. Currently, the servitization and product-service systems studies are clearly still lacking a structured research agenda as well as structured streams of empirical research. The issue of artificial intelligence, with smart product-service systems, and autonomous solutions of various kinds, is of importance, and requires theorization, conceptual development, and case studies from those companies that are at the forefront of the development.

Against these backdrops, the present study intends to tap into the following research question: *What are the primary practices to facilitate the emergence of AI-enabled Product-Service Innovations in autonomous solutions?*

Contributions

The study contributes to servitization and product service systems literatures that are interested on the role of artificial intelligence in servitized product manufacturing companies. We use a novel single case study of one of the leading solution providers producing moving autonomous product-service systems for global logistic operators. Our contribution is two-fold: We 1) depict the novel transition towards AI-enabled product-service innovations in interplay with service technologies and business ecosystems, to 2) understand the needed managerial practices in the transition journey.

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Digital Servitization: Unleashing the Power of AI Platforms for Enhanced Solution Delivery

Anand R Moorthy
University of Pisa
Mario Rapaccini
University of Florence

Introduction

Servitization has emerged as a transformative strategy for manufacturers, enabling a shift from product-centric to service-centric business models (Kowalkowski, Gebauer, Kamp & Parry, 2017, Gebauer, Paiola, Saccani & Rapaccini, 2021). Digital technologies, particularly Artificial Intelligence (AI) hold the potential to significantly advance service models, driving improvements in customer experience, operational efficiency, and other critical business goals (Das, Phalin, Patidar, Gomes & Thomas, 2023, Opresnik & Taisch, 2015, Häckel, Karnebogen & Ritter, 2022). Therefore, in this era of digital transformation, successful servitization necessitates a comprehensive understanding of the role of AI platforms in driving effective solution delivery (Sjödin, Parida, Palmié & Wincent, 2021, Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). This research explores the concept of digital servitization and examines how AI platforms, along with other digital technologies, can facilitate the transition towards service-centric business models. It further investigates the potential of digital servitization in enhancing customer-centricity, operational efficiency, and sustainability within the context of AI platforms.

Background and Objectives

The objective of this study is to delve into the digital transformation required for successful servitization and solution delivery, with a specific focus on AI platforms. The research aims to explore the role of AI platforms in enabling manufacturers to deliver integrated solutions that effectively address customer needs. By investigating the integration of AI platforms into servitization strategies, this study aims to uncover the benefits, potential challenges, and best practices associated with digital servitization. Furthermore, the research examines how the utilization of AI platforms is anticipated to enhance customer-centricity, improve operational efficiency (Soori, Arezoo & Dastres, 2023), and contribute to sustainability goals.

Methodology

This study adopts a case study-based approach to explore the implementation of AI platforms for digital servitization and solution delivery. Firstly, a literature review will be conducted to establish a solid understanding of the theoretical foundations and empirical evidence related to digital servitization and the utilization of AI platforms. This review will serve as the basis for developing a conceptual framework that integrates AI platforms and servitization strategies. Secondly, qualitative case studies will be conducted with manufacturing companies that have successfully implemented AI platforms for their digital servitization initiatives. These case studies will provide insights and practical experiences on how AI platforms have transformed their solution delivery processes. Finally, surveys will be administered to a wider sample of manufacturers to collect data on the expected impact, foreseen challenges, and perceived benefits of utilizing AI platforms in the context of servitization.

Implications and Contributions

This research aims to contribute to the existing literature by emphasizing the importance of AI platforms in digital servitization and solution delivery. The expected findings will shed light on the benefits and challenges associated with the implementation of AI platforms for successful servitization. The research will highlight the role of AI platforms in enhancing customer-centricity, improving operational efficiency, and driving sustainability within the context of servitization. The study will provide valuable insights to manufacturers on how to effectively leverage AI platforms to propel their servitization strategies. Moreover, the research aims to contribute to the academic discourse on the intersection of AI platforms and digital servitization, opening avenues for further research in this dynamic field.

Conclusion

In conclusion, digital servitization represents a significant transformation in how manufacturers deliver solutions to customers. The integration of AI platforms, along with other digital technologies, empowers manufacturers to enhance customer-centricity, improve operational efficiency, and contribute to sustainability goals. This research explores the concept of digital servitization and presents expected results for manufacturers seeking to embrace the digital transformation required for successful servitization, specifically by utilizing AI platforms.

Keywords: Digital servitization, AI platforms, solution delivery, customer-centricity, operational efficiency, sustainability.

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The challenge of digital servitization of emerging technologies: The role of contracting and control in sourcing an autonomous driving platform

Christian Dremel, Patrick Mikalef

Norwegian University of Science and Technology

Vinit Parida

Luleå University of Technology

Matthias Söllner

University of Kassel

Abstract

The accelerating pace at which physical objects are augmented through digital technologies has created a wave of opportunities and challenges for organizations to innovate in a shift referred to as digital servitization (Barrett, Davidson, Prabhu & Varago, 2015; Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022; Maglio, 2015; Shleha, Vaillant & Vendrell-Herrero, 2023). This requirement is particularly prevalent in industries with high-complexity products, such as in the automotive, aviation and industrial manufacturing domains (Porter & Heppelmann, 2015). Nevertheless, the growing embeddedness of digital technologies in products and services is forcing organizations in a range of industries to outsource such competences to overcome focal technical limitations. As digital servitization in such industries quickly becomes the new norm, so do sourcing and contracting agreements revolve progressively more around these digital technologies while challenging organizations as they strive to effectively engage in inter-organizational ecosystems (Bughin, LaBerge & Mellbye, 2017; Kohtamäki, Parida, Oghazi,

Gebauer & Baines, 2019; Kohtamäki et al., 2022; Trang, Mandrella, Marrone & Kolbe, 2022). Consequently, there is a need to understand how organizations address the ambiguity of sourcing digital technology capabilities during dynamic and constantly changing conditions in order to realize digital servitization (Demirbas, Gewald & Moos, 2018; Gewald & Schäfer 2017).
Against this backdrop, this study builds on the literature of sourcing and contracting of digital technologies, to explore how organizations effectively deal with the ambiguity of sourcing emerging technologies such as that of artificial intelligence. Sourcing such technologies is an important, and under-studied aspect of the ability of organizations to converge servitization and digitalization (Kohtamäki et al., 2019; Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Extant research on sourcing and contracting of digital services has delved into several important aspects relating to the modes and mechanisms of inter-firm arrangements. Within this body of research, studies have looked at mechanisms of reducing contractual risk (Arbogast, Larman & Vodde, 2012), the process of implementing large scale IS projects in relatively stable contexts (Gewald & Schäfer, 2017), and patterns of technology delivery and governance (Dibbern, Goles, Hirschheim & Jayatilaka, 2004), among others. Yet, there is a lack of understanding of how organizations source capabilities to leverage digital technologies for shifting from a product-centric to a service-centric business model. This poses a significant gap as the capabilities required to develop such digital servitization are an inextricable part of the whole. This study is motivated by the lack of knowledge on how to source capabilities for digital servitization in the context of emerging technologies, such as AI, and more specifically in the case context of autonomous driving. The aim of this research is to generate insights into how novel emerging digital technologies that are to be embedded in digital servitization may require a change in control structures in sourcing for strategic innovation beyond of an incumbents' core competence (Srivastava, 2005). Consequently, the research question we seek to answer in our paper is:
How can organizations address the ambiguity during sourcing of emerging technologies for digital servitization with strategic importance?

To answer our research question, we build on rich empirical insights of a single case study in the automotive industry. We target the automotive industry as it is highly affected by digital servitization and technological innovations such as autonomous driving, connectivity, electromobility, and shared mobility (ACES) (Dremel, Wulf, Herterich, Waizmann & Brenner, 2017; Heineke & Kampshoff, 2019). Our case study with CarCo (Anonymized), a German premium car manufacturer, is characterized by technological novelty (i.e., autonomous driving and machine learning) and technical hurdles (i.e., providing storage and computing capacities to analyse data volumes of up to 200 Petabyte) with frequently changing functional requirements or unclear regulatory requirements in target markets in combination with an ambitious timeline (i.e., begin of series production intended for 2021). With our exploratory research we aim at illuminating the far-reaching implications of sourcing capabilities for emerging technologies in the move towards digital servitization.

Keywords: Digitalization, Advanced Services, Datafication, Tailored Services.

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Session 9

Servitization and Circular Economy

Co-Chairs: Joan Freixanet & Josep Rialp

(venue: TBS Executive room 702 -7th floor)

Transitioning from a Linear Economy to a Circular Economy from the Boundary Perspective

Tuomas Huikkola, Marko Kohtamäki, Rodrigo Rabetino
University of Vaasa, Finland

Abstract

This study investigates how a traditional energy ecosystem can transform its linear business logic into circular logic by changing ecosystem-level boundaries. Based on analysis from five different regional energy/waste management ecosystems in Finland, this study contributes to the discussion of the circular economy ecosystems by analyzing ecosystem changes through a boundary lens. We show how a strategic transition toward a circular economy requires several parallel adjustments and alignments of distinct ecosystem boundaries, such as changing 1) the collective ecosystem identity to turn it into a circular ecosystem, 2) ecosystem capabilities to develop capabilities that support broader circular economy activities, 3) the ecosystem power distribution to build a new position based on distinctive governance mechanisms, and 4) efficiency logic to improve the effectiveness through effective relational mechanisms within and between ecosystems. This study encourages managers to consider multiple boundary perspectives and their modification and alignment when driving ecosystem-level systemic transitions.

Keywords: Boundaries, circular economy, ecosystem, sustainability, waste management.

Introduction

Sustainability has become a popular stream in the business management literature, as climate change poses an unprecedented threat to humankind (Howard-Grenville, Buckle, Hoskins & George, 2014). Organizations have increasingly contributed to creating more sustainable businesses while providing large-scale opportunities (Curtis & Mont, 2020). Manufacturers such as Caterpillar have started to pursue servitization strategies (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019) to serve their customers throughout their lifecycle by selling outcome-based solutions instead of selling pure equipment (Keränen, Terho & Saurama, 2021). Additionally, consumer companies have started to reuse, rent, and sell second-hand products to their customers. Traditional energy companies such as Neste have begun to sell fossil-free electricity for their clients (Kiyar & Wittneben, 2015). Furthermore, energy and waste management companies have adopted circular business models to utilize idle resources more effectively and contribute to economic, social, and environmental issues (Velter, Bitzer, Bocken & Kemp, 2020).

Shifting a linear business model to a circular one, however, is a difficult initiative for an established company (Frishammar & Parida, 2019). As energy companies' old linear business models are well-known and profitable and their capabilities have been built to serve this purpose, there are many organizational rigidities related to the adoption of new business models that require a different mindset, capabilities, and business logic from both companies and their boundaries (Bocken & Konietzko, 2022). Frishammar & Parida (2019: 6-7) stated, *"Because business models transcend organizational boundaries, contributions made by partners in the ecosystem must be better understood. Consequently, when outcomes are systemic and require a full ecosystem of partners to be mobilized, it is misleading to think of products as being made and sold by individual firms alone."* Business model changes affect the scope of a firm's offerings and the activities it decides to engage in along the value network, whether internally or externally (Santos & Eisenhardt, 2005). Hence, the boundary perspective can explain how strategic and systemic change can be successfully managed in ecosystems (Kohtamäki et al., 2019).

The present study addresses the following research question: *"How does a business model transition toward a circular business model shape an energy ecosystem's boundary changes?"* We conducted a multiple case study investigating five regional energy/waste management ecosystems' transitions from linear to circular logic. The present study makes two main contributions to the CE literature: 1) It analyzes how an ecosystem's transition from linear to circular is shaped by different boundary decisions, 2) it shows how boundary decisions need to be adjusted and aligned not only within an ecosystem but also between (un)related ecosystems.

Theoretical background

This paper contains two main literature streams: Firm boundaries and circular economy. This paper contributes to the intersection of these distinct literature streams, thus increasing our understanding of boundary changes required to transform from linear to circular logic.

Firm Boundaries & circular economy

Organizational boundaries perspective involves using synergetic, complementary, and interdependent theoretical lenses to study (re)positioning in an ecosystem (Santos & Eisenhardt, 2009). Changing boundaries involves reconsidering which activities should be performed hierarchically in-house, which activities should be purchased outside, and which activities to do in collaboration (Williamson, 2008). Repositioning in an ecosystem requires a simultaneous change in identity (who are we as a firm?), position (where and how do we compete?), capability (what do we know?), and efficiency logic (what activities should we do?) (Bäck & Kohtamäki, 2015).

The circular economy (CE) has become a significant business trend (Bocken, Ritala & Huotari, 2017), as sustainability has become agenda for executive boards (Ritala, Huotari, Bocken, Albareda & Puumalainen, 2018), governments globally have agreed to mitigate climate change, and consumers have started to favor sustainable firms (Klein, Smith & John, 2004). Furthermore, governments and supranational unions (e.g., EU) have started to fund initiatives related to the extension of a product or raw-material lifecycle. The key objective of this is to minimize waste and create additional value by repeatedly reusing materials. CE involves sharing, reusing, repairing, refurbishing, and recycling existing materials and products as many times as possible (European Parliament, 2022). CE manifests in the rise of versatile businesses such as equipment rentals (Ulaga & Reinartz, 2011), services/solutions (Keränen et al., 2021; Tukker & Tischner, 2006), and (digital) platforms (Eloranta & Turunen, 2015).

Circular business models (CBMs) refer to firms implementing circular activities to create, deliver, and capture value sustainably in all economic, social, and environmental dimensions (Geissdoerfer, Pieroni, Pigosso & Soufani, 2020). As value propositions are central to any business model, CBMs emphasize the client's perception of value differently than linear models do (Frishammar & Parida, 2019). Rolls-Royce provides its TotalCare solution to its aviation clients, enabling its customers to maximize their flying potential while improving resource efficiency and reducing waste. When clients expect to buy outcomes instead of products, a firm's mechanisms and activities designed to create, deliver, and capture value change (Keränen et al., 2021). Often, this requires alterations in a company's business logic & mindset (Kowalkowski & Ulaga, 2017), processes (Huikkola, Kohtamäki & Ylimäki, 2022), capabilities (Ulaga & Reinartz, 2011), boundaries (Frishammar & Parida, 2019), and execution (Reim, Parida & Sjödin, 2021). As strategic change entails risks and rigidities, managers must consider a holistic perspective of firm change (Makkonen, Nordberg-Davies, Saami & Huikkola, 2022). Firm boundary theories provide a holistic viewpoint to analyze systemic changes.

Transition towards circular economy from the boundary lenses

The present study intends to shed light on how a CE shapes an ecosystem's boundaries via identity, capabilities, power, and efficiency lenses. This study thus extends the literature on the CE (Bocken et al., 2017;) and business models (Bocken & Konietzko, 2022; Curtis & Mont, 2020; Frishammar & Parida, 2019) by providing a complementary and holistic perspective on how systemic changes can be managed and executed at the ecosystem level. Boundary lenses have previously been used to study focal companies (see Bäck & Kohtamäki, 2015; Santos & Eisenhardt, 2009), but this study shows that boundary theories can also be applied in ecosystem contexts. In particular, organizations' managers and executives need to go beyond their own companies and start to think about and evaluate ecosystem-level boundary decisions. Ecosystems should thus create a unified narrative of their identities - who are we as an ecosystem, and what type of an ecosystem do we want to be(come)? Ecosystems have an opportunity to create a network effect through this improved and clarified identity among key stakeholders that helps attract and acquire new talent, investments, and publicity. Second, ecosystems must focus on developing and creating mutual capabilities (e.g., digitalization or innovation-related capabilities) and unlearning old behaviors (even breaking path dependencies). In addition to traditional technical and technological know-how, business-related capabilities, collaboration capabilities, and even the capability to lobby and affect influential people are relevant to thriving in the CE. Third, ecosystems are positioned within societies, and energy ecosystems can specialize despite regulatory restrictions. This specialization can create repositioning opportunities for different organizations operating within and between ecosystems. Fourth, efficiency logic causes a shift from hierarchies and ownership toward markets and alliances because of the rise of a CE. In particular, alliances with KIBS organizations and research institutions are established to address the new challenges and opportunities created by this systemic change.

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Digital Servitization for a Circular Manufacturing Industry

Bjørn Ronny Vien, Bård Tronvoll, Rolf Findsrud

Inland Norway University of Applied Science, Elverum, Norway

Abstract

Digital servitization help manufacturing small and medium-sized enterprises (SMEs) with resource utilization and decrease waste generation through digital tools for remote monitoring, control, optimization, and automation in processes and solutions. This study aims to examine which circular benefits manufacturing SMEs can obtain from digital servitization and further make a framework showing how firms can obtain these benefits and which benefits require a higher degree of evolvement from service ecosystem actors – working towards circularity. Preliminary findings from on a qualitative study of 18 manufacturing SMEs show that manufacturing SMEs often focus on the R-framework's 'reduce' through optimization and efficiency in resource utilization and remanufacture, where firms use parts of the resources again. Some manufacturing SMEs also focus on R's such as recycling, refusing, and rethinking. However, these require more engagement from service ecosystem actors. Consequently, higher levels of digital servitization and circularity require higher levels of service ecosystem engagement.

Keywords: Digital servitization, Circular economy, Service ecosystem, Manufacturing.

Introduction

The circular economy aims to keep the value of resources in the economy as long as possible to minimize resource consumption and waste generation. As the focus on circularity in the manufacturing industry is increasing by governments (e.g., European Commission, 2020), the circular economy is a hot topic. Through digitalization for remote monitoring, control, optimization, and automation of processes and solutions (Porter & Heppelmann, 2014), digital servitization can be a vital enabler to enhance circularity in manufacturing small and medium-sized enterprises' (SMEs) service ecosystems and how value is cocreated (e.g., Paiola, Schiavone, Grandinetti & Chen, 2021; Paschou, Rapaccini, Adrodegari & Saccani, 2020). Digital servitization can also increase circularity through alternative solutions such as renting, sharing, leasing (e.g., Ciasullo, Polese, Montera & Carrubbo, 2021), or pay-per-use business models. However, transitions to a circular economy often require a socio-institutional change (Potting, Hekkert, Worrell & Hanemaaijer, 2017) among service ecosystem actors. For example, using the R-framework, to rethink resource usage or providing solutions through pay-per-use requires a socio-institutional change among actors where the logic switch from owning to renting. Thus, some elements can be easier for manufacturing SMEs to focus on to be more circular. For instance, higher level circularity elements (e.g., refuse, rethink and reduce) often require innovation in technology and product design, while other elements also require more fundamental changes in business models and institutions inside the service ecosystems (Potting et al., 2017). Correspondingly, digital servitization often requires an alignment with other ecosystem actors' business models to succeed (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019). As circularity in the manufacturing industry is increasingly important (e.g., European Commission, 2020), we need further research on which digital servitization mechanisms lead to distinct circularity benefits (Paschou et al., 2020).

Method

This exploratory study uses in-depth interviews with managers in 18 manufacturing SMEs in Norway. We follow a Gioia-inspired methodology (Gioia, Corley & Hamilton, 2012) for the coding structure and analysis, giving an excellent empirical structure for conceptualization and providing a conceptual framework.

Findings and conclusions

Preliminary findings show that manufacturing SMEs that digital servitize often become more circular by reducing the usage of natural resources and waste generation through optimization of resource utilization. This is often through use of AI software and machines, such as robots, laser cutters, cameras, scanners, and sensors, to remote monitor, control, optimize and automize processes to become more efficient. Some manufacturing SMEs also focus on rethinking resource usage, how to provide service and solutions (e.g., through pay-per-use), and recycling products through service. However, these require a higher degree of engagement from service ecosystem actors. Thus, to reach a high degree of circularity, manufacturing SMEs must collaborate with service ecosystem actors, often leading to socio-institutional inertia and difficulties in digital servitization. Our findings show some manufacturing SMEs can have an easier time focusing on certain circularity elements (e.g., rethink, reduce, refuse, or recycle) due to the type of solutions they provide and the type of actors they are engaging with. Based on the findings, this study provides a conceptual framework showing which digital servitization mechanisms lead to which circularity benefits in manufacturing SMEs and the service ecosystem and which circularity focus will require more engagement from service ecosystem actors. This framework can be crucial in aiding managers and practitioners in manufacturing SMEs to navigate towards circularity in the service ecosystem.

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The specialization of generalization: is servitization inherently transdisciplinary?

Glenn Parry, Hannah Gooding

Surrey Business School, University of Surrey

Abstract

A variety of skill sets need to be developed during the transition from engineering product to customer service. Service may be defined as the application of competencies for the benefit of another. To facilitate the realisation of value (benefit), those working in servitizing firms must maintain the specialist competence of manufacturing, whilst developing new generalist competencies that involve understanding customer value, management, integrative abilities and openness. Transdisciplinary Engineering (TE) is the ability to transcend a single discipline to deliver value by drawing upon multiple competencies from across the disciplines. This study argues servitization is an intrinsically transdisciplinary process. Despite the need for broader service competencies, a lack of knowledge surrounding competencies needed for transdisciplinary servitization persists. Difficulties arise due to TE being a developing knowledge area. TE processes will already exist in servitization, but because the concept is poorly understood, formalisation has not yet taken place. The study seeks to open a new line of research into TE competencies required for servitization and their development. To frame the TE field in the servitization context, generalist lessons from TE working are used.

Paving the way towards a circular economy: Lifecycle services to make the transition towards circular business models

Daniel Wörner, Dr. Lukas Budde, Prof. Dr. Thomas Friedli
University of St.Gallen

Abstract

Evolving market needs for increased environmental sustainability in the manufacturing industry causes industrial companies to reevaluate their manufacturing processes (Young, Byrne & Cotterell, 1997). Many manufacturing companies aim to gradually transition to sustainable business models (SBMs) (Bocken, Rana & Short, 2015). The need for a transition from traditional towards circular business models (CBMs), a subset of SBMs, has to be mediated in order to enhance companies' competitive advantage (Geissdoerfer, Vladimirova & Evans, 2018). Adopting SBMs is not only linked to reducing waste or energy consumption in-house but also creates opportunities to develop novel sustainable services increasing competitiveness in a market environment characterized by increasing competition (Prause, 2015). But despite great ambitions, companies are only slowly making progress with their endeavors (Geissdoerfer, Vladimirova et al., 2018). The challenge of developing a CBM and transforming decade-old business models while staying economically competitive is highly complex. Above all, it requires decision-makers to be able to evaluate and manage the entire asset life cycle, from design to disposal (Sonnemann, Gemechu, Remmen, Frydendal & Jensen, 2015). Currently, many companies lack the knowledge necessary for such a transition leading to deficiencies to capture and deliver created value (Bocken, Schuit & Kraaijenhagen, 2018). This calls for new solutions and innovative approaches to enable fast and effective progress towards CBMs using lifecycle management (Geissdoerfer, Morioka, de

Carvalho & Evans, 2018). The operationalization of the 4R-principles (reuse, refurbish, remanufacture, recycle) supports the transition towards CBMs and calls for further investigation. As such, achieving an optimal balance of their environmental and economic performance. The research is conducted with Swiss based manufacturers.

Keywords: Business Model, Circular Economy, Circular Strategies, Lifecycle Services.

Lifecycle services enabling circular strategies transforming business models

There is increasing pressure on companies to integrate the concepts of sustainable development along their value chain, as well as to report sustainability performance as a measure of accountability (Bjørnbet, Skaar, Fet & Schzlte, 2021). Since services tend to be relatively easily imitable, protective actions are recommended to protect a manufacturer's competitive advantage. Interestingly, for product manufacturers moving towards more advanced integrated solutions, lifecycle services (LCS) provide means to differentiate vis-à-vis competitors by integrating services along the product lifecycle. The primary objective is to design a lifecycle portfolio, including all types of services required by different customers. As such, LCS can be considered as strategic enablers allowing companies to transition towards a circular economy (CE). (Rabetino, Kohtamäki, Lehtonen & Kostama, 2015; Seles, Mascarenhas, de Sousa Jabbour & Trevisan, 2022).

LCS can lead to an extended asset lifecycle during the utilization phase (Figure 1). Key aspects of a company, e.g., (1) management and organization, (2) methods and processes, (3) product and design, and (4) materials must be coherently addressed and coordinated to make a transition towards a CE (Fluchs, Neligan, Schleicher & Smith, 2022). The development of advanced

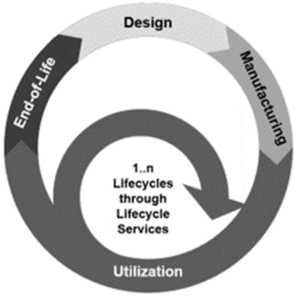

Figure 1. Extended asset lifecycle due to lifecycle services during utilization phase based on Fluchs et al., 2022.

manufacturing capabilities utilizing 10R-based circular strategies, i.e., refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover options (Figure 2) can provide opportunities in a CE context while helping firms to achieve a competitive edge over their competitors (Kirchherr, Reike & Hekkert, 2017). In CE-based models, the resources stay in the system, however, 10R strategies impose from various challenges (Bag, Gupta & Kumar, 2021) and are associated with topics like resources and (dynamic) capabilities (Seles et al., 2022). LCM is addressed through exploring the interactions between industrial assets and its LC utilizing R-principles, e.g., reuse, refurbish, remanufacture, and recycling. These principles primarily concern Middle and End of Life while these cycles are by far the longest periods. As such illustrating the highest lever impacting the ecological footprint while still having high revenue potential.

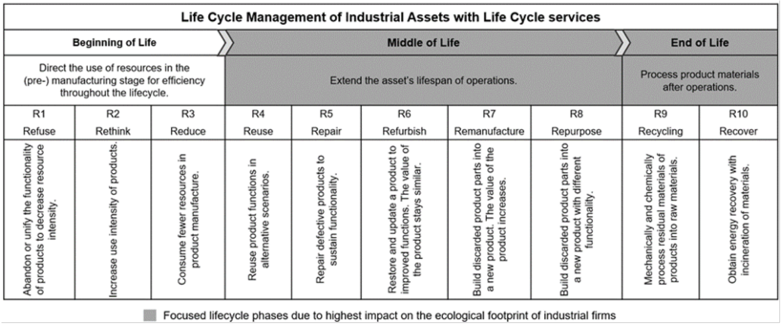

Figure 2. Holistic overview of 10R-principles according to the lifecycle of industrial assets based on Kirchherr et al. 2017.

Developing a research question

Pressing research gaps exist regarding the complexity of implementing LCS (Manda, Bosch & Worrell, 2015). Focusing on the factors influencing circular strategies along with the lifecycle, the research questions are:

- *RQ1: How does lifecycle management facilitated by lifecycle services foster the transition towards circular business models?*
- *RQ2: Which factors are most relevant to implement lifecycle services within the contextual business environment?*

Preliminary Findings

LCM is acknowledged as a useful approach that supports the decision-making of companies using the entire life of an asset (Saling, 2015). Through the entire LC, LCM aims to reduce the environmental and improving profitability related to an asset (Khan, West & Wuest, 2020). To leverage the full potential, companies must be willing to expand the scope of its collaboration and communication to (all) value chain players, hence go beyond their organizational boundaries (Khan et al., 2020). LCM can be gradually implemented in any company and industries (Saling, 2015).

The inherently sustainable orientation of R-principles can positively impact sustainable value and revenue potential. Analyzing at the meso- and macro-level, the former level refers to the investigation of ecosystems created by executing circular strategies by an array of actors linked to the manufacturing industry (Wrålsen, Prieto-Sandoval, Mejia-Villa, O'Born, Hellström & Faessler, 2021). A specific set of actors, connecting dyadic, triadic, and multilateral relationships to deliver circular strategies (Trevisan, Castro, Gomes & Mascarenhas, 2022).

Manufacturing companies face different challenges transitioning towards a CE. Overcoming such barriers can great prosperous opportunities for companies (Figure 3). From an internal manufacture viewpoint, attention is directed towards understanding how to adapt processes and product design to efficiently execute such LCS, i.e., analyzing strategies for sustainable design in production. Externally, the focus is on evaluating and defining options for a LCS design, i.e., selecting appropriate services to extend the machinery lifetime through monitoring and tracking the health. Interestingly, analyzing and understanding the specific customer needs across the installed base is still highly immature emphasizing sustainable value and revenue potential. The predominantly traditional business models of manufacturing companies primarily promote the optimization of a linear economy, i.e., linear business models. As such, more circular-oriented business models instead of traditional business models are necessary. However, several challenges arise when implementing R-principles to make the transition toward CBMs. The key barriers, i.e., realizing economies of scale, economic optimization, technologies for new products, and individual roadmaps for products, hinder the transition. Interestingly, a successful application of the aforementioned R-principles can lead to various opportunities fostering the transition, such as LCM of products, ecological and economic optimization potential, and possibilities to synchronize circularity roadmaps. LCM plays a key role to foster CBMs within the manufacturing industry (Figure 3).

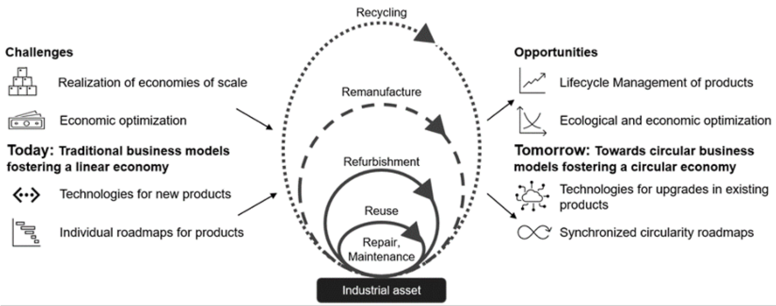

Figure 3. Challenges and risks of industrial firms implementing circular business models.

The transformation towards CBMs bears risks but simultaneously creates revenue potential and sustainable value creation potential. The revenue potential is achieved by capitalizing on the ecological and economical reward, i.e., extending the product LC while reducing resource consumption, and by the high potential to increase the margin on cycled industrial assets over lifetime extending cycles given that the initial bill of material is rather similar. Sustainable value creation potential can be realized by managing industrial assets in lifetime extending cycles and reducing the ecological impact, and by prioritizing product performance.

In sum, exploring LCM facilitated by LCSs brings advantages but imposes strategic challenges transitioning towards CBMs. CBMs are not only creating sustainable value, employing pro-active multi-stakeholder management, and have a long-term perspective, but also close, slow, intensify, dematerialize, and narrow resource loops (Geissdoerfer, Morioka et al., 2018). Adopting CBMs often requires companies to shift their current operating logic from a firm-specific focus to one of active interaction with relevant actors, i.e., strategic partners, suppliers, and customers, enabling a company to also create environmental value beyond pure economic value creation while realizing competitive advantage.

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The Ethical and Social Ramifications of AI-based Servitization and Solution Delivery in Circular Economy

Surajit Bag, Shivam Gupta, Josip Maric, Muhammad Sabbir Rahman

Introduction

The process of converting conventional goods and services into digital ones is known as "digital servitization", and it is done in an effort to increase productivity and open up new business prospects (Paschou, Rapaccini, Adrodegari & Saccani, 2020). Whereas, delivering a product or service to a customer in a way that satisfies their needs and expectations is referred to as solution delivery (Turner & Simister, 2001; Kumar, Steward & Morgan, 2018). Many tasks, including product creation, manufacturing, marketing, and customer service, may be involved in this digital servitization and solution delivery (Gebauer, Paiola, Saccani & Rapaccini, 2021). In order to deliver cutting-edge goods and services to clients in a way that is effective, efficient, and satisfies their demands, digital servitization and solution delivery work together.

A variety of AI platforms are available for the delivery of digital services and solutions. Examples include: Google Cloud AI Platform, Azure Machine Learning, Amazon SageMaker, IBM Watson Studio and H2O.ai[1]. Selecting a platform that satisfies the

[1] https://www.altexsoft.com/blog/datascience/comparing-machine-learning-as-a-service-amazon-microsoft-azure-google-cloud-ai-ibm-watson/

particular requirements of clients' projects is crucial because each platform has a different set of features and capabilities.

Bastianello (2020) pointed out that in order for firms to adopt circular concepts, an effective way might be to use service-oriented business models. A circular economy (CE) can make use of a variety of AI platforms and solution delivery strategies (Wilson, Paschen & Pitt, 2022). For instance, product as a service where in a CE, where items are offered as services rather than being sold outright, AI can be utilised to develop service-based business models. By allowing things to be used for extended lengths of time, can contribute to the extension of their useful lives and the reduction of waste. However, in product-service systems, in a CE, where goods and services are combined in a way that maximises resource efficiency and reduces waste, AI can also be utilised to develop product-service systems.

While choosing AI platforms and solution delivery strategies, it is crucial for businesses to thoroughly analyse their unique goals and demands in order to ensure that they are able to accomplish their desired results.

When adopting digital servitization projects, firms may run into a number of real-world difficulties. Integrating new technology into their current systems and procedures can be difficult for enterprises. When new technologies are complicated or fundamental system modifications are needed, this can be very difficult. Also, managing the data produced by projects for digital servitization is another difficulty. Among them are concerns about data storage, data security, and data privacy. Furthermore, the successful implementation of digital servitization projects depends on the ability of various technologies and systems to interact with one another in an efficient manner. This might be difficult since it calls for meticulous planning and coordination on the part of the organisation to integrate various technologies and systems. Additionaly, it can be disruptive for businesses and their employees when significant changes to current processes and systems are made as a result of digital servitization. It might be difficult to manage this shift and make sure that staff members can adopt new procedures and technologies. Lastly, organizations must carefully control their costs to guarantee that they can realise a favourable return on their investment while implementing digital servitization efforts because they can be costly (Peillon & Dubruc, 2019). It will be crucial to think about the ethical and social ramifications of AI as it becomes more common in servitization activities and to make sure that it is used sustainably and responsibly.

Consideration should be given to a number of ethical and societal consequences of AI-based servitization and solution delivery. Issues may revolve around privacy since the gathering and analysis of significant volumes of data may be required as a result of the use of AI in servitization and solution delivery activities, which may give rise to privacy concerns. Personal data must be safeguarded against unauthorised access and misuse and must be collected, kept, and utilised in accordance with all applicable laws and regulations. Secondly, bias in AI algorithms and systems can occasionally result in the unfair treatment of particular people or groups. The danger of bias must be reduced when designing and implementing AI-based service and solution delivery systems, and any biases that are present must be acknowledged and corrected. Third, transparency issues may arise from the usage of AI in servitization and the provision of solutions. In order for customers and other stakeholders to understand how these initiatives work and the elements they take into account, it is crucial to make sure that the algorithms and systems used are visible and understandable. Third, employment may be impacted by the usage of AI in servitization and the delivery of solutions. In some circumstances, it might result in the automation of particular duties or employment, which might have detrimental effects on workers. It's crucial to take into account how AI will affect employment and make sure that the advantages of these technologies are dispersed properly.

Last but not least, businesses that carry out AI-based servitization and solution delivery projects have a social duty to make sure that their operations are sustainable and have a beneficial influence on society. This involves taking into account how these efforts will affect the environment and making sure they are created and carried out in a way that benefits all stakeholders.

Therefore, the ethical and social ramifications of AI-based servitization and solution delivery must be carefully considered by businesses, and they must take action to allay any potential worries that may surface. **Drawing on stakeholder theory the objective of this study is to examine if it is beneficial for organizations to take stakeholders' interests into account while developing AI-based servitization and solution delivery (AI-SS) in a CE.**

Methods and Analysis (Qualitative investigation)

The development of the key constructs of 'ethical and social ramifications of AI-based servitization and solution delivery in CE' and their respective items, which included independent and dependent variable related instruments, followed by a mixed-methods study. The present study adopted two phases of research design to identify the constructs, refine the items of each construct, validate the items and test the conceptual model (Martin-Delgado, Mula, Guilabert, Solis, Gomez, Ramirez Amat et al., 2022). Thus, our study was designed with two distinct phases. During phase one, we conducted qualitative semi-structured in-depth interviews through an online platform. The goal of these interviews was to gain insight into the antecedents that influence collaborative ecosystems and social sustainability. Additionally, we aimed to gather information on how to establish an ethical and social system that supports the creation of an artificial intelligence-driven servitization and solution delivery-based collaborative ecosystem in a CE. Moving to phase two, we used multivariate analysis of survey data to test and validate the scale and examine the proposed research framework and hypotheses. We focused on investigating the relationships between ethical and social elements, stakeholder collaboration, and social sustainability. We used a mixed-methods approach, building on the qualitative findings from the interview data. This approach was necessary because there was no established theory to guide our investigation of the complex relationships among our study constructs. Our research design was therefore well-suited to exploring this phenomenon in depth (Creswell, Plano Clark, Gutmann & Hanson, 2003).

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Session 10

Data, Analytics, and Servitization

Co-Chairs: Laid Zejnilovic & Josip Marić

(venue: TBS Conference room 703 -7th floor)

Towards a treble innovation strategy: Open innovation and emergent differentiation strategy

Gonçalo Cordeiro de Sousa, Emanuel Gomes

Nova School of Business & Economics

Ferran Vendrell-Herrero

University of Edinburgh

Abstract

Service innovation is gaining traction and combined with more traditional product and process innovation is forming a triad of technological innovations, treble innovation. We argue that both open innovation and differentiation focus will increase the likelihood of becoming treble innovation in a subsequent period, but the effect of open innovation will be stronger for dual innovation firms, whereas the effect of differentiation focus will be stronger for non-innovators. We test our conceptual model using data from repeated Community Innovation Surveys administered to 1,081 Portuguese manufacturing SMEs in 2016 and 2018. We constraint our analysis to firms that were not treble innovators in 2016, so we could infer causal relationships between independent variables measured in 2016 and the probability to adopt treble innovation in 2018. The results contribute to our understanding on how technological innovation develops in manufacturing industry, as well as the relative importance of open innovation and differentiation strategies to complete a treble innovation portfolio in the future depending on their current innovation portfolio.

Keywords: Open innovation, Treble innovation, Technological innovation, Differentiation, emergent strategies, complementary perspective.

Introduction

Technological innovation in manufacturing has undergone significant progress with the growing interest in service-based business models (Visnjic, Wiengarten & Neely, 2016; Visnjic, Ringov & Arts, 2019). Underlying manufacturing-based service business model is the rise of a treble innovation strategy, which implies the simultaneous deployment of three technological innovations: product, process and service (Vendrell-Herrero, Bustinza, Opazo-Basáez & Gomes, 2023). Despite the possible paradoxes associated with implementing simultaneous innovations (e.g., Visnjic, Jovanovic & Raisch, 2022), empirical results seems to suggest that treble innovation firms have higher performance than companies with other innovative profiles (e.g., Opazo-Basaez, Vendrell-Herrero, Bustinza, 2022; Vendrell-Herrero et al., 2023), mainly because the complementary nature of their innovation outcomes (Cassiman & Veugelers, 2006; Damanpour & Gopalakrishnan, 2001; Ennen & Richter, 2010). Treble innovation approach is commonly adopted by large industrial organizations. In the road transport industry, the French tire manufacturer Michelin has been the first to develop the cross-climate tire that can be used efficiently in summer and winter (Product), it has implemented production systems based on human-machine cooperation (Process) and offers services from fleet management to road transport operators (Service). In the energy sector, the Italian renewal energy supplier Enel commercializes state-of-the-art renewal energy plants and technological solutions (Product), but also have developed e-mobility platforms to ensure energy provision to electric cars (Process) and exploit smart technologies to enable households and businesses to optimize their energy usage (Service). In the automotive industry, the US firm Tesla Motors, designed a totally new concept of electric cars (Product) that are produced on highly robotized factories (Process) and offer free update autopilot software to their clients (Service).

Whilst all these examples show that treble innovation approach is associated to highly competitive firms, it is still unclear what the antecedents of treble innovation are. The aim of this study is to fill this gap. Drawing on Mintzberg (1987) different concepts of strategy, we argue that there are two routes to becoming a treble innovation firm. First, we draw on the "strategy as a pattern" definition to establish a focused open innovation strategy that seeks to fill firm's weakest points in reaching a treble innovation portfolio (weakness-based innovation). Firm's access missing knowledge/ skills externally through open innovation practices. This route would be characterized by dual innovation firms, which acquire their missing technological innovation pillar through the market. Michelin and Enel followed this route. Secondly, we draw on the "strategy as a position" approach to strategy resulting in an emergent differentiation strategy (strength-based innovation). The stereotype of this route would be non-innovative firm or a newly formed start-up that identifies an opportunity to follow a differentiation strategy that brings together a varied combination of technological innovations, and thus evolving from non-innovator to treble innovator rapidly. Tesla Motors followed this route. Altogether, a salient element of our argument is that the starting point is paramount to understand the route that firms navigate to become treble innovation firms. Firms with initial innovative strength may become treble innovation firms through a pattern of actions, whilst firms that do not have this initial innovative strength may become treble innovation firms through a "new" positioning. A new stream of research has identified treble innovation and some of its potential antecedents. Vendrell-Herrero et al. (2023) have suggested that product leaderships increase firm's likelihood of becoming treble innovator. The authors also highlighted that more open firms would tend to be more predisposed to develop all three innovations simultaneously. In a different approach, Vendrell-Herrero, Bustinza, Parry and Georgantzis (2017) research showed that to implement a business service strategy successfully, firms must have full control over the resources that enables them to have a competitive edge. In line with this reasoning, Baines, Bigdeli, Bustinza, Shi, Baldwin and Ridgway (2017) emphasized certain potential predecessors to became treble innovator. However, existing evidence is mainly based on cross-section approaches; hence innovation dynamics have not been considered. In this article, however, we seek to fill this methodological gap by using two waves of the Portuguese community innovation surveys (CIS). We restrict our analysis to manufacturing SMEs that have been observed both periods and are not treble innovators in the first period. Therefore, the study examines the causal effects of factors such as open innovation, differentiation strategy and innovation profile in first wave influence the adoption of specific innovation strategies in the second wave. Our contribution can be summarized in three points. First, we underscore an innovation profile, treble innovation, that expands complementary perspective (e.g., Cassiman & Veugelers, 2006; Ennen & Richter, 2010) in innovation management, by presenting treble innovation as a more sophisticated mechanism to leverage complementarities between technological innovations. Second, drawing on emergent strategy theories we build a framework that explain two possible routes to become treble innovation firms, depending on firm's current innovation profile. Firms with an initial innovation strength tend to become treble innovators through a "strategy as a pattern" approach, while firms that lack this initial strength may become treble innovators firms through a "strategy as a position" approach. Third, it expands previous work assessing the antecedents of treble innovation approach (Vendrell-Herrero et al., 2023) by implementing a longitudinal method that ensures the causal identification, where the independent variables precede the dependent variable in one CIS wave, aiming to understand firms' trajectory until becoming treble innovator.

Results

Logistic regression results can be seen in tables 1 and 2. Models 1 and 2 in Table 1 test equations 1 and 2 and is used to assess H1 and H2. Our H1 advocates that a higher open innovation breadth (t-1) will lead to a higher likelihood of an organization to become treble innovator in the succeeding period (t). As it can be noted in Model 1, reported in Table 1 (McFadden Pseudo R2 = .102), open innovation (t-1) demonstrates a positive impact on treble innovation development, meaning, firms that demonstrate a higher open innovation breadth (t-1) will tend to demonstrate a higher probability to become treble innovators in the following period (t).

	Model 1		Model 2	
	Coefficient	Marginal effect	Coefficient	Marginal effect
Open Innovation (t-1)	0.093***	0.010***		
	(0.035)	(0.004)		
Differentiation (t-1)			0.180***	0.019***
			(0.063)	(0.007)
Access to public funding (t-1)	0.669***	0.081***	0.758***	0.092***
	(0.224)	(0.030)	(0.217)	(0.030)
Revenue (t-1)	-0.000**	-0.000**	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
ROA (t-1)	1.226	0.132	1.195	0.127
	(0.915)	(0.098)	(0.909)	(0.096)
Production (t-1)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.331***		-2.797***	
	(0.210)		(0.597)	
Observations	1,081	1,081	1,081	1,081
McFadden Pseudo R2	0.102	0.102	0.102	0.102
Log likelihood	-408.40309		-408.44603	
Industry FE	YES	YES	YES	YES
Innovation Profile FE	YES	YES	YES	YES
Correctly predicted				
Cut off	0.149		0.149	
Sensitivity	65.22%		65.84%	
Specificity	69.89%		69.46%	
Overall	69.20%		68.92%	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1. Baseline Logistic regression.

	Model 3		Model 4	
	Coefficient	Marginal effect	Coefficient	Marginal effect
Open Innovation (t-1) * No Innovator	0.229	0.025		
	(0.224)	(0.024)		
Open Innovation (t-1) * Single Innovator	0.052	0.006		
	(0.083)	(0.009)		
Open Innovation (t-1) * Dual Innovator	0.097**	0.010**		
	(0.038)	(0.004)		
Differentiation (t-1) * No Innovator			0.157*	0.017*
			(0.084)	(0.009)
Differentiation (t-1) * Single Innovator			0.227*	0.024*
			(0.134)	(0.014)
Differentiation (t-1) * Dual Innovator			0.178	0.019
			(0.122)	(0.013)
Access to public funding (t-1)	0.654***	0.079***	0.760***	0.092***
	(0.221)	(0.030)	(0.217)	(0.030)
Revenue (t-1)	-0.000**	-0.000**	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
ROA (t-1)	1.224	0.132	1.193	0.127
	(0.918)	(0.099)	(0.910)	(0.097)
Production (t-1)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.339***		-2.776**	
	(0.212)		(1.097)	
Observations	1,081	1,081	1,081	1,081
McFadden Pseudo R2	0.103	0.103	0.102	0.102
Log likelihood	-408.13371		-408.3794	
Industry FE	YES	YES	YES	YES
Innovation Profile FE	YES	YES	YES	YES
Correctly predicted				
Cut off	0.149		0.149	
Sensitivity	64.60%		65.84%	
Specificity	69.89%		69.57%	
Overall	69.10%		69.01%	

Robust standard errors in parentheses
*** p<0.01, *

Table 2. Logistic regression with interaction effects with innovation profile.

H2 suggests that firms demonstrating higher levels of differentiation focus (t-1) will tend to exhibit a higher likelihood of becoming treble innovation firms in the subsequent period (t). In H3 and H4 we argue that firm' current innovation profile will have an impact moderating these relationships, positive moderation for open innovation breadth (H3) and negative moderation for differentiation focus (H4). As evident in Model 2, exhibited in Table 1 (McFadden Pseudo R2 = .102), a differentiation focus (t-1) is positively associated to the firm's probability to achieve treble innovation in the subsequent period (t). In Model 3, table 2, the results suggests that all the effect of open innovation breadth on subsequent achievement of treble innovation status is constrained to dual innovation firms. Hence, H3 is supported. Results in Model 4 (McFadden Pseudo R2 = .102) show that whilst no-innovators (t-1) and single innovators exhibit a positive and significant impact on the likelihood of a firm to become treble innovator in the subsequent period (t), the effect is non-significant for dual innovators. Thus, H4 is supported.

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Strategic actions building ecosystem legitimacy for digital servitization: a case study of a manufacturer's launch of a new smart service

Marius T. Kristiansen (mariustk@uia.no), Tor Helge Aas

University of Agder, Norway

Abstract

Many manufacturing firms now recognize the importance of digital servitization efforts and seek to engage with these processes. To successfully conduct a digital servitization effort within their current ecosystem and establish themselves as a legitimate actor with a new digital service or business model, manufacturers must ensure that their innovation surpasses the legitimacy threshold set by other ecosystem actors. They will also need legitimacy internally to secure the resources needed for digital servitization. Our research unpacks the strategic actions taken by a world-leading OEM manufacturer to gain legitimacy as they introduce a new digital service into their existing ecosystem. The findings suggest that strategic actions aimed at securing external resources for development were crucial in obtaining internal legitimacy, while strategic actions focused on ecosystem orchestration, visualisation and value co-creation played a vital role in gaining external legitimacy. The manufacturer relied on cognitive legitimacy during the front end of the innovation process, moral/normative and pragmatic legitimacy during the new service development phase and a combination of all three types of legitimacy during the delivery phase.

Keywords: Digital servitization, legitimacy, strategic actions, ecosystem, manufacturing.

Introduction

Digital servitization can be defined as: *"the transformation in processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies"* (Sjödin, Parida, Kohtamäki & Wincent, 2020, p. 479). Scholars have increasingly focused on digital servitization, and research has shown how the utilization of digital technologies like the Internet of Things (IoT) and Artificial Intelligence (AI) can enhance service innovation in this domain (Paschou, Rapaccini, Adrodegari & Saccani, 2020).

While digital servitization holds immense potential for the actors involved, the literature also recognizes its inherent challenges. Among these challenges is the need for the manufacturer within the ecosystem to establish themselves as a legitimate service provider (Sjödin et al., 2020). This can prove to be arduous, especially for manufacturers that are at the early stages of offering digitally enabled services (Kannan-Narasimhan, 2014). While the literature offers general insight into how legitimacy for innovations can be build (Bunduchi, 2017), there remain research gaps in how legitimacy in the context of digital servitization is built (Shen, Sun & Parida, 2023). This paper focuses on this gap by posing the following research question: *What are the strategic actions taken in different phases to secure legitimacy for a new smart service in an established ecosystem?*

Theoretical foundation

Legitimacy is often defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions." (Suchman, 1995, p. 574). Gaining legitimacy for innovation is a challenging endeavor (Bunduchi, 2017), and the standards of legitimacy can shift as different criteria are applied in varying situations (Autio & Thomas, 2018; Thomas & Ritala, 2022). Furthermore, when the innovation also requires integration and utilization of the resources of ecosystem actors to deliver the value proposition, the battle for legitimacy becomes even more crucial.

An ecosystem can be defined as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 40). Scholars have suggested various actions that ecosystem orchestrators can undertake to secure legitimacy. For instance, Thomas and Ritala (2022) differentiate between discursive and performative legitimation activities and ecosystem identity construction.

While our focus is on the manufacturer's servitization journey rather than the ecosystem or orchestrator role itself, we argue that the frameworks developed in the ecosystem literature offer valuable perspectives to examine the strategic actions taken by a manufacturer pursuing a digital servitization journey. In our study, we employ the framework developed by Thomas and Ritala (2022) as a theoretical lens.

Method

We conducted an exploratory single case study involving a world-leading OEM manufacturer that recently engaged in and successfully launched a digital servitization initiative. The data for our study was gathered through full access to the internal project database of the digital servitization initiative. This database comprised 2180 documents, including contracts, progress reports, development documents, minutes of meetings, and presentations spanning the period from 2013 to 2021. Additionally, we conducted seven in-depth interviews with eight senior managers representing various ecosystem actors.

For the data analysis, we employed thematic analysis to develop an empirically grounded framework. This framework was guided by insights from previous research in the field of servitization.

Findings

Strategic actions taken in the first phase included personal meetings, workshops and drafting of project proposals. This ended with a contract between the manufacturer and an ecosystem actor which funded the start of the project. In the development phase, strategic actions included field research, applying design thinking and agile development, creation of simulations, workshops, training of users, and regular status meetings. This phase progressed to the launch phase when a pilot was launched and later the project was declared commercialized. Strategic actions in the launch phase were based on storytelling, pilot project results, first commercial sales and continuous development of the smart service.

Contribution

By utilizing the theoretical lens of Thomas & Ritala (2022), we were able to elucidate the strategic actions that foster legitimacy for manufacturing firms within the realm of digital servitization. These findings not only contribute to filling a gap in the servitization literature, but also hold significant practical implications for managers. Further research could explore the strategic actions undertaken by other ecosystem actors.

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How to make the data ready for digital service innovations

Jasmin Singh

Doctorate Candidate, Fraunhofer IMW

Heiko Gebauer

Professor, Fraunhofer IMW, Linköping University and University of St.Gallen

Abstract

Digital service innovations intrinsically inherit advancements in data analytics, a topic recently being discussed in machine learning and artificial intelligence literature. What literature neglects is the importance of the necessary fundament of analytics, clean data and a clean and integrated data landscape across systems. To enable new functionalities required for new ways of working, the systems and data need to first be aligned with new requirements. Our research aims to gain a better understanding of the process aligning these requirements to make the data and systems fit for advanced analytics and consequently machine learning and artificial intelligence. The research was conducted with a single case study together with a globally acting Medical Technology Company aspiring to enable new analytics technologies in their ways of working consulting employees and company presentations.

Keywords: IT landscape, data analytics, business intelligence, advanced analytics.

To achieve competitive advantages, the innovation of digital services is becoming increasingly important for product companies. Digital services require an increasing amount of consistent, high quality and timely data and data landscape within the company for the rapid advancements of data analytics. The latter has been recently discussed in the growing body of literature about the emergence of machine learning and artificial intelligence. But this literature neglects the actual IT and data landscape as the foundation for taking advantage of machine learning and artificial intelligence in digital service innovations.

Similarly, practitioners envision more and more automized insights from data. The technical development teams as well as the data consuming departments such as business intelligence teams are asked to enable better decisions. IT Systems, setting the possibilities and boundaries for what can happen with the data they house, should also inherit the ability of decision making based on AI algorithms.

New functionalities should enable new ways of working with in-depth insights. At the same time, practitioners overlook that the necessary requirements to the IT and data infrastructure of a company get more and more sophisticated.

Consequently, our research aims to gain a better understanding about the process for getting the internal IT and data infrastructure ready for AI-driven digital service innovations. Our research was conducted together with a firm, a globally acting Medical Technology Company that has the same aspirations. As a self-proclaimed sales organization that chose a customer centric approach and is therefore highly affected by how effective the sales representative is, the idea is to have analytics and AI functionalities incorporated in business processes to increase efficiency and effectiveness of the salesforce. Basic analytics functionalities such as a customer service system queuing customers in the phone queue according to their status within the customer segmentation, enabling quick response for most valued customers, skipping the queue ahead of less valued customers. Or advanced analytics such as buying pattern analyses for the customer base flagging customers with changes in buying patterns to act early on potential negative impact but also capitalize on positive changes. Both are very desirable scenarios to become a company with digital service innovations.

Literature describes many possibilities and potential use cases for analytics and AI, but what it neglects is the basis needed for all those cases and the fact that companies have to first create that base. This negligence can result in managements misunderstanding what the own company's data can and can't do with its status quo.

If the customer segmentation with which the customer service system is queuing the customers is not properly set up, the system cannot queue the customers correctly. For example, a big customer is calling in and has a complaint. The system should recognize the customer based on phone numbers stored in the customers master data record, the record however is not properly labelled, the system therefore queues the customer with less priority despite being a high value customer with a complaint. The system is in-effective, even worse, it can harm the business by deprioritizing the wrongly labelled customer. Systems need to be aligned, master data needs to be clean, and a governance process needs to be in place for keeping it clean to enable the possibility of digital service innovation.

This paper aims to describe this necessary IT and data landscape for digital service innovations based on the single case study of the firm, describing which issues triggered the change, collecting key challenges within IT and data infrastructure during the digital transformation towards digital service innovations. How the problems can be addressed, contributing a generic process on how to overcome the challenges, and proposing possible solution approaches by deriving concrete action points.

And how the problems are relevant for digital service innovation and which topics should be researched further, closing a gap in current research. The study was conducted with directly involved employees as primary source and company presentations on the topic as secondary literature.

Big data anlytics and internet of things for sustainable supply chain: Focal Lense of Dynamic Capability Theory

Mahak Sharma

Assistant Professor, University of Twente

Abstract

This research aims to investigate hypothesized relationships between the Internet of things (IoT) and big data analytics (BDA) with supply chain visibility (SCV) to achieve resilient, agile and sustainable supply chain in the UK manufacturing sector. The authors have conducted mixed method approach where in the first phase a conceptual model was proposed using a systematic literature review and expert interviews. In second phase structural equation modelling (SEM) using SPSS 26 PROCESS macro. The results of the study indicate that there is a significant relationship between the IoT and BDA on SCV. The relationship was also positively significant between SCV with supply chain resilience (SCR) and SCR with SCS (Supply Chain Sustainability). This work provides novel contributions both theoretically as well as practically. This paper uses focal lens from dynamic capability theory to investigate the dynamism of IoT and BDA in enhancing resilience, agility and sustainability thereby making a robust SC that can work effectively even in extreme situations with vacillations and capitulating situations.

Keywords: Supply chain visibility, Supply chain resilience, Supply chain agility, Supply chain sustainability, Internet of things (IoT), big data analytics (BDA), Industry 4.0 (I4.0).

Introduction

The modern global economy has resulted in interconnected and compound supply chains (SC). With dynamic needs SCs try to use lean practices in order to offer higher quality, lower costs, and boost business agility however, they cannot ensure that they have lowered the risks and wastage of resources (Spieske & Birkel, 2021). It is believed that Industry 4.0 (I4.0) is the foundation for 21st century manufacturing firms (Sharma, Raut, Sehrawat & Ishizaka, 2023). I4.0 technologies can revolutionize the landscape of production. Quality improvements with I4.0 help in reducing scrap leading to waste reduction, thereby making judicious use of materials and energy to re-produce the same product (Di Maio & Rem, 2015). Supply chains resilience (SCR) discusses how operative, tactical and strategic perspectives need to be applied in cases of severe disruptions such as pandemics (Ozdemir, Sharma, Dhir & Daim, 2022). At the same time, resilience issues in supply chains go far beyond risk management only (Kumar, Raut, Sharma, Choubey & Paul, 2022). Organizations across globe integrate sustainability metrics into their supply chain (SC) management practices (Ivanov, 2018) to improve resilience across SC.

Supply chain visibility (SCV) is the ability to track and monitor every aspect of the supply chain, from procurement to delivery. It helps companies identify potential disruptions and take corrective action before they occur. SCR is a vital aspect of any business, especially during tumultuous times such as natural disasters, pandemics, or economic downturns (Sahu, Sharma, Raut, Sahu, Sahu, Antony & Tortorella, 2022). It refers to a company's ability to withstand and recover from disruptions to its supply chain quickly. Studies on SCR commonly argue that the adoption of SCV is mandatory to have resilient SC which leads to Supply Chain Sustainability (SCS) thereby reducing long-term business risks (Jabbarzadeh, Fahimnia & Sabouhi, 2018). Further, it is expected that with the help of advanced technology, companies can track inventory levels, monitor transportation routes, and receive real-time updates on supplier performance. Implementing novel technologies such as big data analytics and the internet of things (IoT) for SCV has become increasingly important in today's business world (Sahu, Molla & Deng, 2022). With the ability to track and monitor goods from the point of origin to the final destination, businesses can improve their supply chain efficiency, reduce costs, and enhance customer satisfaction. Further, IoT devices can be used to collect data on shipments, including location, temperature, and humidity. This information can be transmitted in real-time to a central system, allowing for easy tracking and monitoring of the entire supply chain (Kumar, Raut, Agrawal, Cheikhrouhou, Sharma & Daim, 2022). Hence, it is expected that by utilizing IoT technology, businesses can identify potential issues in the supply chain before they become major problems. In scenarios where shipment is getting delayed due to weather conditions, the IoT devices can alert the business and allow them to make adjustments to their operations to minimize disruptions (Ozdemir et al., 2022). Overall, the internet of things provides a powerful tool for businesses to improve their supply chain visibility and enhance their operations. With the ability to track and monitor goods in real-time, businesses can reduce costs, improve efficiency, and provide better customer service (Kumar, Raut, Agrawal et al., 2022).

On the other hand, lack of SCV can make it challenging to identify disruptions, leading to delays and lost revenue. Many a times firms cannot track problems precisely such as inventory levels tracking & tracing or company may run out of stock leading to lost sales and customer dissatisfaction.

In that line to make a SC resilient and agile, companies need to quickly respond to disruptions and keep their supply chain running smoothly. They can identify alternative suppliers, optimize transportation routes, and adjust inventory levels to meet demand. This not only helps them maintain customer satisfaction but also reduces costs and increases efficiency. By investing in advanced technology and monitoring their supply chain closely, companies can ensure that they are prepared for any disruption and can quickly recover from it (Kumar, Raut, Agrawal et al., 2022). In conclusion, technology helps firms to improve their SCV thereby enhancing SCR and supply chain agility (SCA) for a SCS.

Conceptual Framework

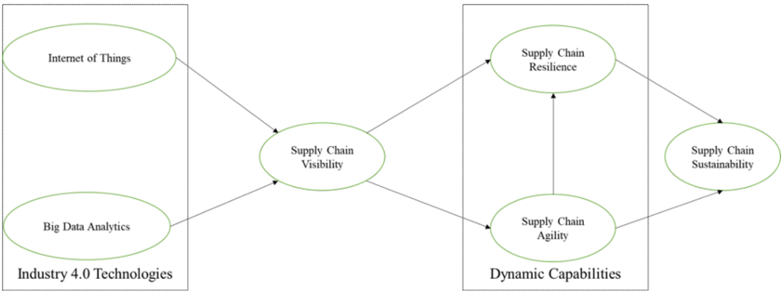

Figure 1. Conceptual Framework.

Results and Analysis

Based on the analysis conducted in accordance with Landau and Everitt (2003), simple linear regression models were utilized to showcase the main effects of independent variables on dependent variables. It is worth noting that all variables were mean-centred and transformed into standardized z-scores before conducting the analyses. The outcomes of main effects are presented in Table 1. It was discovered that, H1 was accepted as the direct effect of big data analytics (BDA) was found to be significantly positive on SCV.

Similarly all hypothesis were checked and found significant except H4 where we checked impact of SCV on SCA.

Hypothesis	Predictor Variables	Outcome Variables	Standardised Beta(β)	SE	CR	P	Results
H1	BDA	SCV	.359	.043	8.306	***	Significant
H2	IoT	SCV	.220	.044	8.116	***	Significant
H3	SCV	SCR	.459	.046	10.260	***	Significant
H4	SCV	SCA	.047	.046	1.021	.307	Insignificant
H5	SCA	SCR	.452	.045	10.048	***	Significant
H6	SCR	SCS	.263	.047	5.572	***	Significant
H7	SCA	SCS	.285	.047	6.083	***	Significant

Note: *p < 0.05. **p < 0.01, *** p < 0.001
SE= standard error; CR: Construct reliability; H: Hypothesis; BDA: Big Data Analytics; IoT: Internet of Things; SCV: Supply Chain Visibility; SCR: Supply Chain Resilience; SCA: Supply Chain Agility; SCS: Supply Chain Sustainability

Table 1. Results of Main Effects.

Conclusion

The empirical investigation presents evidence stating that the utilization of technology is of utmost importance when it comes to enhancing supply chain visibility. By implementing advanced technological solutions namely IoT and BDA, firms can make themselves future looking thereby effectively boosting their supply chain resilience and agility, ultimately leading to a more successful supply chain management. This is particularly relevant in today's fast-paced and constantly-evolving business landscape, where supply chain disruptions can occur unexpectedly and have severe consequences. Therefore, it is imperative for companies to prioritize the integration of technology to optimize their supply chain processes and stay ahead of the competition. Further, incorporating I4.0 technologies i.e., IoT and BDA in the SC can lead to a more sustainable and efficient system. By using sensors and connected devices, companies can track and monitor their products from production to delivery, reducing waste and improving transparency. The data collected from these devices can also be used to optimize operations and identify areas for improvement. With the help of IoT and BDA, companies can create a more sustainable supply chain that benefits both the environment and society as a whole.

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Session 11

Service Delivery and Platform Technologies

Co-Chairs: Carlos Galera-Zarco & Bart Kamp

(venue: TBS Executive room 702 -7th floor)

Value Ecosystem Capture through AI-driven Industry 4.0 Technologies and Servitization Convergence

Oscar F. Bustinza, Luis M. Molina, Manuel Rios de Haro,

Department of Management I, University of Granada

Marco Opazo-Basaez

Deusto Business School, University of Deusto

Abstract

This article analyzes the AI-driven Industry 4.0 technologies-servitization pathway to capture value within ecosystems. We examine the key AI-driven dimensions that shape the Industry 4.0 framework, namely the base, smart supply chain management, smart manufacturing, and smart working technologies. Additionally, we explore the primary dimensions of servitization, including service offerings, resource base, and activity system, as well as the overall convergence that explains the value appropriation within the ecosystem. Through the application of a PLS-SEM approach to a purposefully selected sample of servitized manufacturing firms in Germany and the UK, we discover evidence supporting the partial mediation role of servitization in the relationship between Industry 4.0 and value ecosystem capture. Overall, our study contributes to revealing the advanced autonomous analytical capabilities, deep learning, and similar AI-based technologies that underlie the implementation of Industry 4.0. These technologies facilitate the development of customized service-augmented innovations. Consequently, the convergence of digital technologies incorporating AI algorithms leads to the delivery of new solution-based value propositions, which are the mechanisms of value capture described in this study.

Keywords: Artificial intelligence, Industry 4.0, servitization, value ecosystem capture.

Industry 4.0 technologies can be categorized into at least two main layers (Frank, Dalenogare & Ayala, 2019): the supporting Base technologies layer, which comprises new IoT, cloud services, big data, and analytics (Bustinza, Opazo-Basaez & Tarba, 2022); and the Front-end technologies that facilitate the transformation of manufacturing activities −Smart Manufacturing (Opazo-Basáez, Vendrell-Herrero, Bustinza, Vaillant & Marić, 2023; Vendrell-Herrero, Bustinza & Vaillant, 2021), the development of distinctive offerings (Smart Products), the management of materials (Smart Supply Chain), and the adoption of new forms of work (Smart Working). Among these front-end technologies, several are supported by artificial intelligence (AI), enabling data collection for machinery failure monitoring or automated detection of inefficiencies in production processes (Tao, Cheng, Qi, Zhang, Zhang & Sui, 2018).

On the other hand, servitization offerings can be understood through three dimensions: the resource base, the service offering, and the activity system (Ayala, Gerstlberger & Frank, 2018). The resource base encompasses the internal knowledge and human resources within an organization that are dedicated to service provision. The service offering represents the intangible resources of a manufacturing firm and how they align with the firm's strategic vision as a service provider. Lastly, the activity system encompasses the internal organizational processes used for the development and delivery of manufacturing-based services. Finally, value ecosystem capture is achieved through a set of mechanisms: efficiency, accountability, shared customer value, and novelty.

To illustrate value capture process, the pathway from AI-driven Industry 4.0 technologies-servitization leading to ecosystem value capture is depicted in Figure 1, along with the corresponding hypotheses.

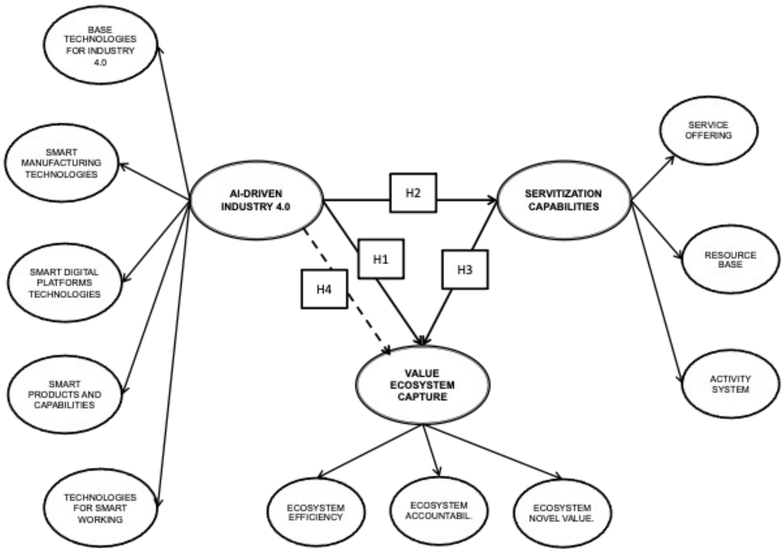

Figure 1. Pathway AI-driven Industry 4,0 technologies-servitization-value ecosystem capture.

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Importance of artificial intelligence (AI) and AI platforms in servitized-based solution delivery

Yancy Vaillant

Department of Strategy, Entrepreneurship and Innovation, TBS Education, France

Email: y.vaillant@tbs-education.fr

Esteban Lafuente

Department of Management, Polytechnic University of Catalonia (UPC Barcelona Tech), Spain

E-mail: esteban.lafuente@upc.edu

Abstract

The research presented in the paper focuses on the use and importance of artificial intelligence (AI) and AI platforms in servitized-based solution delivery. Manufacturers of capital goods are shifting from selling products to providing customized solutions in response to specific customer problems. Digitalization has played a key role in enabling the delivery of service-based solutions by facilitating customer-oriented needs-finding and personalized problem-solving capabilities. AI is a crucial digital technology in this changing landscape. AI platforms can facilitate digital servitization and potentially enhance the solution delivery capacity of companies. But are the products making use of AI and AI platforms getting equally effective outputs when it come to solution delivery? A logistic model using self-devised survey data covering 291 product lines is conducted to answer this key research question. The results demonstrate that AI and AI platforms are essential tools for servitization-based solution delivery. General AI tools contribute to needs-finding and customized problem-solving capabilities, while AI platforms are specifically linked to the products' servitized-based solution delivery capacity.

Keywords: Artificial intelligence, AI platforms, Servitization, Solution Delivery, Problem-solving.

Extended Abstract

Manufacturing firms are moving from selling products to providing solutions (Wise & Baumgartner, 1999; Jacob & Ulaga, 2008). They depart from the traditional concept of designing, manufacturing, and selling products to offering higher-value customized solutions in response to specific customer problems (Gebauer, Paiola & Saccani, 2013, Kohtamäki, Einola & Rabetino, 2020). Consequently, the ability to transition from product to solution delivery is increasingly important for the competitiveness of manufacturers (Vendrell-Herrero, Vaillant, Bustinza & Lafuente, 2022). Digitalization has facilitated the delivery of service-based solutions by enabling customer oriented needs-finding abilities as well as personalized problem-solving productive capabilities (Kohtamaki, Parida, Oghazi, Gebauer & Baines, 2019). In this way, servitization represents an accessible means of customization for manufacturers that allows them to more easily transition from a product to a solution business model (Davies, Brady & Hobday, 2007; Storbacka, Windahl, Nenonen & Salonen, 2013).

Among the digital technologies that are increasingly changing production and the competitive landscape, artificial intellegence (AI) is becoming the new operational foundation of business, altering how firms interact with technology (Iansiti & Lakhani, 2020; Wamba, Bawack, Guthrie, Queiroz & Carrillo, 2021). Broadly speaking, AI can support three essential servitization needs for customized and scalable solution delivery: automating business processes, providing cognitive insight through data analysis, and stimulating cognitive engagement through AI recommendation and collaboration systems that increase personalization (Davenport & Ronanki, 2018). As such, AI algorithms provide internal (to the company) and external (to the customer) benefits in a servitization path (Barbieri, Rapaccini, Adrodegari, Saccani & Baccarin, 2021).

AI platforms can be a fundamental factor for manufacturers in this process since they facilitate the implementation of AI-enabled functions by simplifying AI adoption (Mucha & Seppälä, 2020). As such, AI platforms can facilitate, to a large extent, the digital servitization and consequent solution delivery capacity of manufacturing firms (Cenamor, Sjödin & Parida, 2017). They can do so since AI platforms can be used to automate the typical tasks requested in digital servitization (Barbieri et al., 2021). These platforms can significantly help increase the diffusion of AI applications and the development of data-driven models and advanced services in the digital servitization domain, allowing manufacturers to open up new solution delivery capabilities and attain better economic and competitive outputs (Wamba, Queiroz, Guthrie & Braganza, 2021).

But are products making use of AI and AI platforms getting equally effective outputs when it come to solution delivery? What is the importance of AI and AI platforms in enabling products to adapt to the specific problem resolution needs of their users? To what extent are AI and AI platforms influencing the ability of products to integrate the complementary services enhancing their solution delivery capability? These questions guide the research presented in this paper. To answer these questions, the study makes use of a self-devised survey from 2023 covering 291 distinct products lines from 213 different Spanish companies.

Results show how AI and AI platforms are essential tools for servitization-based solution delivery. But whereas general AI tools are significantly associated with the greater needs-finding and customised problem solving capabilities of products, AI platforms are found to be linked to the products' servitized-based solution delivery capacity. On the one hand, the data processing capacity of AI tends to significantly contribute to the products' problem-identification and adaptation abilities. And on the other, AI platforms such as SAS, Watson (IBM), Azure (Microsoft), TensorFlow, Google AI Platform, o similar, tend to have a significant impact over the products' ability to integrate complementary services enhancing solution delivery capabilities.

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A cloud-based Artificial Intelligence platform for the delivery of mobility services

Dieudonné Tchuente

TBS Business School, Information, Operations and Management Sciences Department, France

Email: d.tchuente@tbs-education.fr

Extended abstract

Servitization represents a strategic approach for companies to adapt to changing market demands and create a sustainable competitive advantage by delivering value-added services alongside their core products (Baines, Bidgeli, Bustinza, Guang Shi, Baldwin & Ridgway, 2017). Servitization is particularly of greater importance in manufacturing industries, which traditionally create value from the production of goods and are sometimes considered as opposed to service activities, offering a customer the benefit from a valuable activity (Mahut, Daaboul, Bricogne & Eynard, 2017). By the end of the 1990s, manufacturers realized that services were more lucrative than products, which was the beginning of the servitization era (Wise & Baumgartner, 2000). Beforehand, the company's focus was the product's sale, and there were only very few links between the company and the customer after the sale. With servitization, the actual customers' value creation is centered on intangible services such as specialized skills, knowledge, and processes (Coreynen, Matthyssens & von Bockhaven, 2017). Servitization also led to a new concept of PSS (Product Service System), which relates to the transition of gathering products and services into a single offer (Goedkoop, Cees, Van Halen, Te Riele & Rommens, 1999; Vaillant, Lafuente & Vendrell-Herrero., 2023). PSS are usually classified into three groups (Tukker, 2004): (i) product-oriented services (e.g., maintenance); (ii) use-oriented services (e.g., a heavy machinery manufacturer offering rental and leasing services to its customers);

(iii) result-oriented services (e.g., car sharing or car rental services which allow individuals to access vehicles for specific periods without the need for ownership). Nowadays, transversely to this classification, the use of digital technologies (e.g., the Internet of Things, cloud computing, big data analytics, artificial intelligence "AI") in servitization ("digital servitization") is increasingly viewed as an enabler and driver of the business model, value creation, and value capture (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019). Prior studies showed that one of the main applicative areas of digital servitization is the automotive field (Paschou, Rapaccini, Adrodegari & Saccani, 2020). This can be easily explained by the fact that in automotive, the financial value flow (direct and indirect spending) is more important during the use phase than the initial value of the product. The use phase can be relatively long (e.g., eight years on an average for a European car). Thus, emphasizing the relationship with the customer during the use phase in such a context is essential (Oliva & Kallenberg, 2003). The current literature on servitization in automotive mainly focuses on methodologies for the adoption of servitization (Mahut et al., 2017), a conceptual framework for implementations (Ferreira Junior, Scur, Nunes, 2022), the global related challenges and opportunities (Genzlinger, Zejnilovic & Bustinza, 2020; Kurpiela & Teuteberg 2022), the relationship between suppliers and manufacturers (Jankovic-Zugic, Medic, Pavlovic, Todorovic & Rakic, 2023), and specific environmental and sustainability issues (Han, Heshmati & Rashidghalam, 2020; Opazo-Basáez, Vendrell-Herrero & Bustinza, 2018; Smania, Yukio Arakaki, Freitas Oliveira Cauchick-Miguel & De Sousa Mendes, 2023). However, the role of only a few digital technologies has been explored in this context (Paschou et al., 2020). More specifically, despite the major advances on AI this last decade (Wamba, Bawack, Guthrie, Queiroz & Carrillo, 2021), its role in automotive servitization is hardly explored (Ferreira Junior et al., 2022; Genzlinger et al., 2020). This research gap is addressed here.
Our research question can be precisely formulated as following: how AI can be used to provide advanced services to car drivers?
The answer to this question can rely on the collection and the processing of data in the vehicle (internal components) and his environment (e.g., road surface, road signs, other users) through its

sensors (e.g., positions, cameras, lidars, speeds, suspensions). In a nominal case, a vehicle can only perceive its internal state and its immediate environment (a few meters or a hundred meters). However, if vehicles can communicate, any vehicle can also be informed of changes beyond its immediate environment (several hundred meters or kilometres). Through this simple assumption, a large palette of advanced mobility services can be provided to drivers, including automatic in-vehicle digital map updates (e.g., map layers with up-to-date traffic signs, road quality features, road surface conditions, free parking, recommended speed, or road hazards), the monitoring of the driver behavior, or the state of vehicle components for predictive maintenance. These services can bring strong added value to the driver in terms of security and comfort.

By following the previous assumption, a world-leading automotive supplier and tire manufacturer has integrated digital servitization in his business model through a new cloud-based and AI-platform. The methodology consist of collecting, storing, and processing cars' sensors data to provide new mobility services to many other actors of the mobility ecosystem (e.g., car manufacturers, map providers, road operators, smart cities). With the consent of drivers, anonymized sensors' raw data (e.g., GPS positions, accelerometers, speed, wheel speeds, cameras/lidars detections, suspensions) can be collected inside the car and transferred in the cloud using standardized formats such as SENSORIS (Sensor Interface Specification)[2]. A partnership can also be defined with car manufacturers to transfer data from their cloud to the dedicated cloud. Depending on the service, some raw data can be selected regularly into specific data pipelines (e.g., data cleaning and preparation steps for the application of machine learning algorithms) to produce consolidated knowledge to be shared with third parties. For instance, the cars' GPS positions and road signs cameras' detections can be processed and consolidated in the cloud (using clustering algorithms and Bayesian probabilities) to build and provide automatic, regular, and up-to-date road signs maps to cars manufacturers or map providers (Tchuente, Senninger, Pietsch &

[2] https://sensoris.org/

Gasdzik, 2021). Globally, the proposed digital platform can be highly scalable and exhibits data network effects, as the more data its collects, the more valuable the platform becomes to drivers (Gregory, Henfridsson, Kaganer & Kyriakou, 2021).
For the theoretical contribution, a new approach for vehicles communication through a cloud interface is proposed. Beyond technical constraints (e.g., cloud/big data management, data quality assessment, building and monitoring of machine learning models), the construction and the deployment of such a platform also need to consider many other constraints related to the organization, privacy, the safety, or the security. For the practical contribution, a wide range of new advanced mobility services can be built and proposed to many actors of the mobility ecosystem.

Keywords: Digital servitization, Artificial Intelligence, AI platform, automotive, mobility services.

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AI platform for digital servitization

Clara Filosa

Department of Management and Engineering, University of Padova

Marin Jovanovic

Department of Operations Management, Copenhagen Business School

Lara Agostini, Anna Nosella

Department of Management and Engineering, University of Padova

Abstract

Incumbent manufacturers are increasingly developing digital servitization (DS) projects to strengthen their position in the market and meet the growing demands of personalized solutions. This emergent paradigm requires a profound, yet little understood, reconfiguration of business models (BMs) to adapt corporate activities and their structure -in particular value-capture mechanisms- to the new value proposition. The literature provides limited insights into manufacturers' BM adjustment process, hardly revealing the stages of their DS journey. This in-depth case study explores a global manufacturer in the energy sector and the development of a business-to-business (B2B) artificial intelligence (AI) platform to support the effective provision of digital solutions. The aim is to show the dynamics behind the transformation process and how the BM dimensions change, in particular the profit generation strategies, as well as B2B AI-platform functionalities that support a successful DS transformation.

Keywords: Digital servitization, B2B AI platform, energy sector, sustainability.

Introduction and Relevance of the Research

In the present age, manufacturers are put under pressure to adapt their business models (BMs) to the rising globalization and competition (Cenamor, Sjödin & Parida, 2017). Recently, a phenomenon has sparked interest among academics and businesses, modifying organizations' competitiveness: digital servitization (DS).

DS is the transformation in processes, capabilities, and offerings to progressively create, deliver, and capture value through services based on enabling digital technologies (Shen, Sun & Parida, 2023), leveraged to monitor and optimize product usage, driving value for both providers and customers.

According to the definition, DS must be accompanied by a reconfiguration of firms' BMs: it entails new ways of creating, delivering and capturing value (Sjödin, Parida, Jovanovic & Visnjic, 2020), calling, in turn, for new competencies, resources, strategies, and increased integration (Kohtamäki, Parida, Oghazi, Gebauer & Baines, 2019).

Rarely this BM redesign unfolds at once; rather it follows a processual evolution over time, which is far from easy (Kohtamäki et al., 2019; Sjödin et al., 2020).

However, understanding on how manufacturers shift to DS paradigm is still limited and rarely uses a processual approach that unveils how activities evolve during the transition (Kohtamäki, Rabetino, Parida, Sjödin & Henneberg, 2022; Tian, Coreynen, Matthyssens & Shen, 2022). Furthermore, there is a gap regarding the adjustments in BM components and, specifically, the alignment of new value-capture mechanisms to advanced digital solutions provision (Sjödin et al., 2020)

Recent literature depicts AI platform as an effective tool to enact the DS transformation: they are used to connect goods and gather, analyse and exchange field data, generating insights and enabling advanced services provision (Cenamor et al., 2017; Delenogare, Le Dain, Ayala, Pezzotta & Frank, 2023).

However, knowledge on how manufacturers adopt and leverage AI platforms to generate value is relatively limited (Cenamor et al., 2017; Barbieri, Rapaccini, Adrodegari, Saccani & Baccacin, 2022).

By adopting an in-depth qualitative approach based on semi-structured interviews, this study examines a global B2B manufacturer in the energy sector and how it exploits a B2B AI platform for supplementing its core product (wind turbines) with digital services, leveraging data analytics and action recommendations to remotely monitor blade conditions across different sites and turbines, regardless of brand.

Our aim is, hence, to tackle the outlined gaps by answering the following research questions: how do manufacturers exploit B2B AI platform to provide effective digital solutions? What path do companies follow to successfully implement DS projects? What changes occur in BM components and, specifically, how are value capture mechanisms adapted to the new value proposition?

This study contributes to the literature, integrating knowledge about DS transformation, from a B2B AI-platform leverage lens, and the consequent BM components innovation: it elucidates the strategic and operational advantages of platform's implementation, including the ability to monitor and maintain wind turbines more efficiently, creating lower downtime and greater energy output, and it clarifies B2B platforms' functions in the energy industry and their potential to drive DS transformation.

From a practical perspective, the article emphasizes potential effects of B2B AI platform in DS, offering a knowledge base that may assist managers in successfully addressing the challenges that this transformation raises.

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Session 12

Unveiling Digital Service Innovation: Strategies, Tools, and Collaborations

Co-Chairs: Federico Adrodegari & Glauco da Sousa

(venue: TBS Conference room 703 -7th floor)

Exploring organizational tensions in digital service innovation through the paradox theory lens

Lorea Narvaiza, José Antonio Campos

University of Deusto

María Luz Martín Peña, Eloísa Díaz Garrido

Rey Juan Carlos University

Abstract

Digital service innovation (DSI) involves developing new services using digital technologies, exploiting connectivity and enhancing supplier-customer relationships. However, gaps exist in understanding the challenges and tensions arising from DSI at various organizational levels and the impact of the external context. Paradox theory can provide insights into the complexities of DSI. This study aims to address the impact of customer readiness for digital services and relationships among actors in the ecosystem on DSI, as well as identify organizational factors that align with DSI. The study adopts a qualitative approach, specifically a case study method, to explore the tensions and organizational factors related to DSI. The aim is to contribute to the literature by analyzing intra- and inter-organizational tensions and identifying the organizational factors that support DSI. Analyzing these factors through the lens of paradox theory enables organizations to understand and manage the tensions inherent in DSI. The study emphasizes the need for a dynamic and contextual approach, embracing tensions as opportunities for growth and innovation. By applying paradox theory, organizations can develop strategies to effectively navigate tensions and leverage them as sources of competitive advantage and innovation in the realm of DSI.

Keywords: Digital service innovation, actors, ecosystem, Organizational factors, Paradox theory.

Literature review

DSI refers to the development of new services using digital technologies (Setzke, Riasanow, Bohm & Krcmar, 2021) that exploit product connectivity to create value through digitally enhanced supplier-customer relationships (Tronvoll, Sklyar, Sörhammar & Kowalkowski, 2020). Despite the growing interest in services, there are still gaps recently identified related to DSI (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2022). For instance, some studies have studied the challenges arised at different organizational levels when adding digital services (Tronvoll et al., 2020). Others have focused on the tensions at the intra- and inter-organizational levels in digital service processes and how can they manage (Galvani & Bocconcelli, 2022). So, DSI can generate paradoxical tensions within the organization and with other actors (Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Paradox theory recognizes that organizations often face contradictory demands and tensions that arise from competing goals and expectations (Cunha & Putman, 2019). Paradox theory can help to study the complexity involved in DSI strategies (Kohtamäki, Einola & Rabetino, 2020).

Building on the previous literature there is a gap on how the external context, such as external actors (Vendrell-Herrero et al. 2017; Galvani & Bocconcelli, 2022) could impact DSI. More precisely we will research on customer's readiness for digital services (Galvani & Bocconcelli, 2022) and the relationships of actors in the ecosystem (Huikkola, Rabetino, Kohtamäki & Gebauer, 2020; Kamp, Ochoa & Diaz, 2017; Sjödin, Parida, Jovanovic & Visnjic, 2020).

Against this background, the aim of this paper is to answer these research questions:

RQ1: How can customer's readiness for digital services impact DSI?

RQ2: How can relationships among actors of the ecosystem impact DSI?

RQ3: What organizational factors would provide the best fit with DSI?

The answers to these questions will allow us to know whether DSI creates tensions inside organizations (paradox of DSI). In the realm of DSI, organizations must navigate a variety of paradoxes to effectively leverage technology and create value for customers. Transitioning to DSI may entail not only positive outcomes but also problems for organizations such as structural inertia (Exploration vs. Exploitation), third-party or technological dependency (Openness vs. Protection), or the incapacity to access the necessary talent to reap the promised benefits of DSI (Flexibility vs. Stability).

Method

Considering the exploratory nature and the complex social context with several actors involved in the ecosystem, we follow a qualitative approach and, particularly, we use the case study method. Case studies are particularly appropriate when complex social phenomena are considered in their real context (Yin, 2003). They are also suitable for theory building or testing when theory is based on context (Gioia, Corley & Hamilton, 2012). This study is based on a single exploratory case study, which is suitable when the assessed action has no clear, single set of outcomes (Yin, 2018).

Expected results and potential contributions

The aim of this study is to contribute to the literature on DSI using the paradox theory lens. We want to offer some insights about intra- and inter-organizational tensions that could impact on DSI, analyzing which organisational factors would be the best fit with

DSI (leadership and strategy, organization culture, organizational structure and coordination mechanisms, talent management practices, centralized-descentralized decision-making, partnereships and ecosystem collaboration). These organizational factors interact and influence one another, shaping how tensions are perceived, managed, and resolved within the context of DSI. Analyzing these factors through the lens of paradox theory can provide insights into how organizations can navigate tensions and leverage them as sources of competitive advantage and innovation.

By applying paradox theory, organizations can gain a deeper understanding of these tensions and develop strategies to manage them effectively. This perspective encourages a dynamic and contextual approach, recognizing that tensions are inherent in the process of DSI and should be embraced as opportunities for growth and innovation.

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Digital micro-services on an AI-based construction site simulation platform: Exploring service types and key challenges

Koteshwar Chirumalla, Ignat Kulkov, Anas Fattouh

Digital and Circular Industrial Services (DigiCircle) Research group, Mälardalen University

Abstract

A construction site typically encompasses various heavy-duty industrial electric and autonomous vehicles. As the construction industry embraces advanced digital and Industry 4.0 capabilities, it has begun exploring ways to enhance customer support for continuous site operations through diverse digital micro-services. These micro-services offer opportunities to improve operational efficiency, promote sustainability, and deliver tailored solutions. However, their specific types and implementation challenges remain insufficiently understood across different levels of construction site operations. To bridge this knowledge gap, this study aims to investigate the potential of digital micro-services on an Artificial Intelligence (AI)-based construction site simulation platform within the heavy-duty vehicle industry. By conducting a case study in a manufacturing company operating in the heavy-duty vehicle industry, this research identifies the key types of digital micro-services that the company can offer. It considers four levels of construction site operations: site-level, fleet-level, machine-level, and component-level. Furthermore, the study elucidates the primary challenges encountered during the development and delivery of digital micro-services on an AI-based site platform. Drawing upon the Technology-Organization-Environment (TOE) theory, the research systematically categorizes these challenges. Overall, this study contributes to the existing literature on digital servitization, data-driven services, and digital platforms by shedding light on the

significance of digital micro-services in the construction industry. Through the exploration of their types and challenges, it provides valuable insights for practitioners and researchers.

Keywords: Digital servitization, Data-driven services, Digital platforms, Industry 4.0.

Introduction

The construction industry is confronted with intricate challenges as it strives to embrace digitalization and achieve net-zero emission targets in site operations. To tackle these challenges, manufacturing companies, particularly Original Equipment Manufacturers (OEMs) in the construction sector, are actively developing advanced digital AI-based construction site simulation platforms. AI offers numerous benefits to the modeling and simulation of construction sites (Baduge, Thilakarathna, Perera, Arashpour, Sharafi, Teodosio et al., 2022). These platforms are intended to enhance operational efficiency, promote environmental sustainability, and provide tailored solutions through the provision of digital micro-services (Li, Xue, Li, Hong & Shen, 2018; Shumei, Xiaofei, Dewen, Qianfan & Liwei, 2011).

Despite the promising benefits associated with these platforms, there exists a significant gap in understanding the diversity of these services, the obstacles encountered during their development and delivery, and their effectiveness in meeting industry demands.

This study endeavors to navigate the intricate landscape of digital micro-services, aiming to unravel their inherent nature, the challenges they entail, and their untapped potential within the realm of AI-based construction site simulation platforms. By addressing this existing research gap, the study offers valuable insights and guidance for industry professionals, policymakers, and academics who seek to harness the potential of these services for a wide range of purposes (Wan, Kumaraswamy & Liu, 2013).

Methodology

The research employed a case study approach (Yin, 2009) and utilized semi-structured interviews as the primary method of data collection. The study included a total of 12 participants who held various roles within an OEM and construction companies. These participants consisted of four individuals from management, four from information technology (IT), and four representing the construction site, including both managers and engineers involved in site operations. The interview questionnaires were thoughtfully designed and tailored to each participant, aiming to elicit rich and detailed data regarding their experiences with digital micro-services on an AI-based construction site simulation platform. The collected data was analyzed using a three-order thematic analysis approach (Braun & Clarke, 2006) to identify relevant themes and findings. Specifically, the key challenges were examined through the lens of the Technology-Organization-Environment (TOE) theory, which elucidates how a firm's technological, organizational, and environmental context influences the adoption and implementation of technological innovations (Tornatzky & Fleischer, 1990). This theory proves relevant and applicable to the study context.

Results

The study yielded comprehensive insights into the different service levels within construction sites, including site, fleet, machine, and component levels. These insights shed light on the key challenges encountered during the development and delivery of digital micro-services, as depicted in Figure 1.

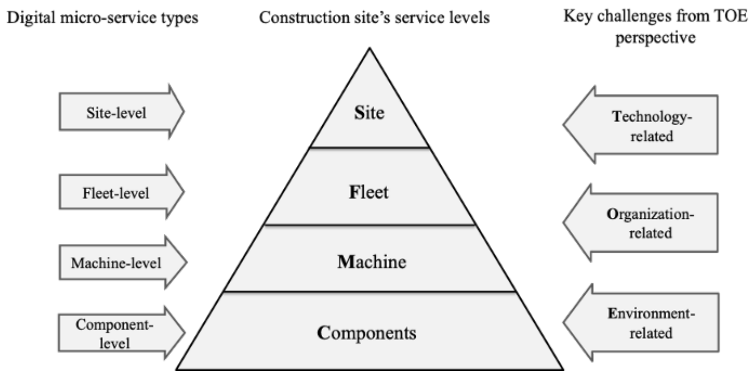

Figure 1. Mapping key types of digital micro-service and key challenges across the four levels construction site.

At the site level, the customer-centric approach emphasized by Interviewee1 calls for digital services to provide actionable, outcome-based information. This includes the integration of financial data into user interfaces and dashboards to provide a clearer understanding of operational implications. The importance of embracing innovation, digitalization, and connectivity to stay competitive is underscored, with a need for visionary leadership to drive change and adoption of service business models.

Moving to the fleet level, Interviewee2 highlighted the importance of differentiating between site data and machine data and determining data ownership. This differentiation is vital for managing construction equipment effectively. His emphasis on predictive maintenance and component monitoring as crucial aspects of equipment management resonates at the machine level, demonstrating the role of data-driven solutions in improving efficiency and sustainability.

At the component level, Interviewee3's insight reveals the role of microservices and new technologies in meeting the rising sustainability expectations of customers. Manufacturers should be prepared to engage in deeper, strategic conversations with customers about sustainability, as it becomes an integral aspect of their decision-making process.

However, implementing micro-services comes with challenges that are technology-related, organization-related, and environment-related. Technology-related challenges are illuminated by Interviewee2's focus on streamlining operations through microservices and enabling continuous feedback loops between stakeholders. In contrast, organization-related challenges arise from SL's emphasis on the need to adjust KPIs, reporting, and compensation structures to encourage the adoption of service business models. Interviewee4 underscored environment-related challenges, including the necessity for understanding customers' needs, developing clear strategic visions, and fostering effective collaboration within teams.

To conclude, the suggested mapping will improve the understanding of key types of digital micro-services on AI-based platform and involve challenges in the site operations in the construction industry. The study has an important contribution to the theory of digital servitization, data-driven services, and digital platforms with a specific focus on digital micro-services in the construction industry.

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Driving manufacturers' competitiveness through digital service innovation: The foundational roles of strategic and learning orientation

Benjamin Biesinger, Karsten Hadwich

University of Hohenheim, Stuttgart, Germany

Abstract

This research focuses on identifying causal relationships between manufacturers' strategic orientations, learning culture, and digital service innovation, contributing to an enhanced understanding of how these factors influence digital servitization outcomes. Drawing on the resource-based view and dynamic capabilities of organizations, we seek to understand how strategic orientations interact with an organization's cultural propensity to learn and innovate. Our research introduces a novel theoretical framework that reconciles insights from the digital servitization, digital service innovation, and organizational learning literatures. Furthermore, we discuss a methodology designed for empirical testing and suggest future research avenues, paving the way for manufacturers to develop and leverage their strategic and cultural assets for successful digital service innovation.

Keywords: Digital servitization, digital service innovation, competitive advantage, strategic orientations, organizational learning culture, organizational learning.

Introduction

Manufacturers striving for competitive advantage by moving to advanced services are increasingly exploring how digital technologies can make their services "smart", notably related to the Internet of Things, big data, and artificial intelligence (Gebauer, Arzt, Kohtamäki, Lamprecht, Parida, Witell et al., 2020). However, the impact of strategic orientations and learning culture on digital service innovation and their translation into expected performance outcomes remains poorly understood in the existing literature. Therefore, this study aims to provide a novel perspective on strategic and learning orientation in digital service innovation by integrating recent advances in organizational learning into a conceptual framework and suggesting concrete pathways for empirically testing the proposed construct relationships.

Theoretical background

Competitive advantage requires manufacturers to innovate fast and effectively (Lengnick-Hall, 1992). Against the backdrop of the growing implementation of service-driven strategies in manufacturing (Baines, Ziaee Bidgeli, Sousa & Schroeder, 2020), referred to as servitization, this involves significant digital service innovation at the intersection of product manufacturing, industrial services, and software development (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2022). Drawing on the resource-based (Barney, 1991; Peteraf, 1993) and capabilities views (Day, 1994; Teece, Pisano & Shuen, 1997), innovation outcomes are conceived as a function of intangible resources that shape decision making. Specifically, strategic orientations translate strategies into organizational values that guide resource allocation and thus the degree of certain innovation outcomes (Simpson, Siguaw & Enz, 2006; Spanjol, Mühlmeier & Tomczak, 2012). Learning orientation, although not a strategic orientation per se, embodies the values that drive organizational learning processes and thus provides the capacity for innovation efforts (Baker, Mukherjee & Gattermann Perin, 2022). It moderates the influence of strategic orientations that provide the direction for innovation. In this way, the interaction between learning orientation and strategic orientations sets the digital service innovation process in motion, from organizational learning to capability development, innovation outcomes, and performance outcomes.

Methodological approach

This conceptual study follows a two-step approach to provide a theoretical and methodological foundation for explaining digital service innovation and subsequent performance outcomes. First, we integrate insights from the digital servitization, digital service innovation, strategic orientation, and organizational learning literatures within the resource-based view and dynamic capabilities framework. The resulting conceptual model sets the stage for future empirical testing, particularly in manufacturing and engineering industries pursuing digital servitization goals (Coreynen, Matthyssens & von Bockhaven, 2017; Favoretto, Mendes, Oliveira, Cauchick-Miguel & Coreynen, 2022). Second, we propose a multi-method research design that combines probabilistic and configurational perspectives to provide a comprehensive view of significant factors and necessary conditions for digital service innovation (Sukhov, Friman & Olsson, 2023), with the aim of guiding the subsequent empirical validation of the hypothesized relationships within the specified industrial context.

Preliminary findings

The conceptual model proposes that digital service innovation is driven by established strategic orientations in manufacturing, such as service and innovation orientation (Clauss & Spieth, 2016; Lin, Luo, Ieromonachou, Rong & Huang, 2019) as well as novel digital orientations for innovation in the digital era (Khin & Ho, 2018;

Kindermann, Beutel, Garcia de Lomana, Strese, Bendig & Brettel, 2021). In contrast to previous studies on the servitization of manufacturing (e.g., Lin et al., 2019), we explicate the role of learning orientation as a moderator when it comes to translating strategic orientations into innovation outcomes (Baker et al., 2022). This suggests that culturally driven organizational learning capabilities and processes can significantly moderate the relationship between strategic orientations and digital service innovation. Furthermore, we provide a conceptual link between digital service innovation and financial and non-financial servitization outcomes, indicating that effective digital service innovation could lead to competitive advantages for manufacturers.

Theoretical and practical contributions

The main contribution of this study is a novel causal model of strategic orientations and learning orientation for digital service innovation that advances our understanding of cultural change processes in manufacturers seeking competitive advantage by transforming into smart industrial service providers. To this end, the study first introduces new strategic orientations for digital service innovation. Second, it reconceptualizes the central role of learning orientation in enabling digital service innovation. Third, it provides a clear path for multi-method testing of the developed causal model. The study lays the foundation for future empirical work that is expected to provide practical guidance for the change management of manufacturers seeking to effectively innovate their services in the digital era.

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Toolkits for safe mass AI-assisted innovation by citizens

Leid Zejnilovic, Pedro Oliveira, Ricardo Coelho da Silva

Nova School of Business and Economics, Universidade Nova de Lisboa

Abstract

Lack of specialized knowledge has been one of the major obstacles to innovation by citizens. As artificial intelligence (AI) systems become more advanced and widely available, they will exponentially increase access to knowledge for citizens around the world. With broader access to humanity's collective knowledge via AI, ordinary citizens will gain the capacity to make extraordinary contributions. In this article, we first build upon the literature of user and free innovation to demonstrate that because of AI we are entering the era of mass AI-assisted innovation by citizens. Then, using the theory of ecosystems, we speculate possible paths of the ecosystem development in response to the new technological affordances, and the emergent change in the power of the innovation landscape. We argue that the innovation process is inevitably becoming modularized, parametrized, and support to mass innovation is becoming increasingly servitized. Finally, we argue that for the mass AI-assisted innovation by citizens to be safe, a specific toolkit will need to be developed. For this piece of the innovation puzzle, it is not obvious that financial incentives exist for the market to develop it but is an essential one for the mass AI-assisted innovation to thrive. We propose platform-based toolkits that are sponsored by policymakers, but developed as open-source collaborative systems, that may remedy the traditionally slow policy response in the world that cannot afford the lack of safety in innovation by citizens.

Keywords: Mass AI-assisted innovation, innovation servitization, ecosystem, safety.

Introduction

User innovation refers to the innovation activity undertaken by individuals to solve observed issues, typically without a monetary reward in mind (von Hippel, 2017). Regular citizens, facing a pressing need for solutions that the industry hasn't provided, often take the initiative to create these solutions themselves, with frequent success (Gambardella, Raasch & von Hippel, 2017). While specialized knowledge is often a requirement for these innovations (Lüthje, Herstatt & von Hippel, 2005), nation-wide studies have demonstrated that this behavior happens often, with significant portions of the population actively innovating (Chen, Su, de Jong & von Hippel, 2020; de Jong, von Hippel, Gault, Kuusisto & Rassch, 2015; von Hippel, de Jong & Flowers, 2012).

The availability of what is currently perceived as cutting-edge artificial technology like large language models (LLMs) facilitate ordinary citizens' access to knowledge (Bouschery, Blazevic & Piller, 2023), leading to mass AI-assisted innovation. This can be further augmented by integrating LLMs into toolkits. Toolkits are provided by firms to allow users to modify commercial products (von Hippel, 2001), thereby addressing the needs of heterogenous user bases (Franke & von Hippel, 2003).

However, LLMs also have risks associated to their use, from the generation of false results in the form of "hallucinations" (Varshney, Yao, Zhang, Chen & Yu, 2023), to factual suggestions that are nonetheless dangerous for humans. Furthermore, development of LLMs is dispersed, with different stakeholders concurrently developing models and systems, resulting in diverse user experiences, and the increased modularization of the innovation process. Given the known risks and model variety, the safety dimension becomes key. But current safety guidelines have not yet caught up to these developments, and adaptations of regulation to technological innovations are often slow and haphazard (Levin & Downes, 2023), leading to serious gaps in these systems. In this increasingly modularized and parametrized innovation process, with support to mass innovation becoming increasingly servitized, an ecosystem orchestrator becomes necessary as a curator and moderator of the developing technology and its uses.

In this paper, we use the theories of user and free innovation (von Hippel, 2017), ecosystems (Jacobides, Cennamo & Gawer, 2018), and servitization (Visnjic Kastalli & Van Looy, 2013), to discuss how platforms can be used to ensure the safety of future innovation activity by citizens.

AI in Platforms Safety

The literature on platforms provides examples of how AI is used in relation to users' safety. AI systems have been implemented to automate content moderation systems in social media platforms (Gillespie, 2020), dealing with issues related to hate speech and misinformation (Gorwa et al., 2020). The capabilities of these systems enable the platform managers to do content moderation at scale and meet expectations of platform responsibility, safety, and security (Gorwa, Binns & Katzenbach, 2020).

Methods

To better understand security issues with the use of AI for user innovation and provide the basis for a discussion, we use a case study based on the Patient Innovation platform. Patient Innovation is an online repository of thousands of solutions developed by ordinary citizens who are patients and caregivers, and which has already been identified in the ecosystem management literature as an ecosystem orchestrator (Cennamo, Oliveira & Zejnilovic, 2022) The fact that Patient Innovation represents a relevant ecosystem in this space also makes it a viable setting to study the increased modularization and servitization in user innovation with mass AI-assisted innovation.

While the platform has orchestrated different stakeholders and the modules of the healthcare innovation ecosystem, the part of safety has been the least developed one. We use archival data describing the platform's development to describe how the platform has grown. Additionally, we study how policymakers have adapted policy in healthcare innovation, to identify the potential configuration that can viably be scalable to address the safety challenges posed by the use of AI.

Results

From the experience of the Patient Innovation platform, we find that a specific platform-based toolkit must be developed to address the challenges of modularization of the innovation process. Given the lack of obvious financial incentives for the market to develop this platform, and the heterogeneity of the stakeholders and innovation modules service providers, we propose an open-source collaborative AI platform, that serves as ecosystem safety orchestrator for mass AI-assisted innovation done by citizens. We elaborate on the governance types that allow freedom to further modularize and servitize elements of the innovation process, and provide the agility to the platform to adapt to fast technological changes and validate the different modules in the new innovation toolkit.

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Session 13

International and Economic Perspectives on Servitization

Co-Chairs: Erica Santini & Harry Smirnia

(venue: TBS Executive room 702 -7th floor)

A contingency perspective on the operating models of global servitization

Mario Rapaccini

University of Florence

Khadijeh Momeni, Miia Martinsuo

Tampere University

Timon Urs Knapp, Jens Poeppelbuss

Ruhr-Universität Bochum

Abstract

When industrial manufacturers pursue growth in their service business, they set up operations in different locations, often in different countries globally. Each service business unit will need to align its operating model with the local circumstances and requirements, which may be extremely challenging. While earlier research covers some aspects of internationalizing service business, understanding the contingencies that influence the definition of location-specific operating models requires further research. This paper explores the changes to the operating models of an internationally-operating manufacturer that is on its move to an extended global service business. We conducted an in-depth case study to gather evidence on the impact of various actors and contingencies on the manufacturer's operating models. We found that both internal (e.g., subsidiaries) and external (e.g., dealers, distributors and service partners) actors greatly affect the development of global service sales, depending on the business consistency and heterogeneity of the target markets. Adopting a contingency theory perspective, we provide empirical insights about the tensions that affect the operating models of global service provision in manufacturing.

Keywords: Globalization, servitization, case study, operating models.

Introduction and Background

When going for a global service business, manufacturers have to change their operating model (Kreye, 2022). This is particularly complex, as globally operating manufacturers become intertwined with constellations of internal (e.g., headquarters, production facilities, subsidiaries) and external (e.g., suppliers, dealers, service partners) actors (Gupta & Govindarajan, 2000) that collaborate to deliver goods, services and integrated solutions (Kreye, 2021). It is said that downstream actors particularly affect the possibility of creating value with services (Andersen & Bering, 2023; Gebauer, Paiola & Saccani, 2013; Saccani, Visintin & Rapaccini, 2014; Shah, Jajja, Chatha & Farooq, 2020). Critical decisions concern defining the right extent of integration and autonomy between these actors (Peillon, 2021). Service offerings are in fact conceived globally, but downstream channels tend to have some freedom for customization to better match the needs of local markets (Hakanen, Helander & Valkokari, 2017). Previous literature also shows that operating models are based on a mix of globally and locally acting capabilities, such as exploring customer insights (on a local level), as well as integrating knowledge and building digital infrastructures (on a global level) (Parida, Sjödin, Lenka & Wincent, 2015). It is claimed that there is a need for exploring how manufacturers align, integrate, and coordinate these operating models with their downstream networks (Raja & Frandsen, 2021; Kowalkowski, Kindström & Bremer, 2011) and what "becoming glocal" implies on a managerial level especially when the global and local aspects of service business have to be brought into balance (Hakanen et al., 2017). Against this background we address the following research question: *What are the* *contingencies that influence the operating models of manufacturers that implement a global service business?*

Our study is inspired by a contingency theory perspective on the servitization of internationally operating manufacturers. Contingency theory suggests that the effectiveness of organizational change is dependent on the fit with the particular situation (Sousa & Voss, 2008). Hence, there will be no single best way of organizing for global service provision. Understanding relevant contingencies better and how they interact with the operating models of global service provision is the key research objective of this case study.

Research Method

We conducted an in-depth case study of a manufacturer of professional equipment for hospitality, healthcare, and food industries. The firm was facing problems arising from its large and fragmented network when developing its service business. Primary data were collected through semi-structured interviews with 18 managers from both the headquarter and subsidiaries of five markets.

Findings and Discussion

To develop and sell global service offerings, manufacturers need to cope with market heterogeneity (Kreye, 2022). This study confirms that to grow with services, manufacturers need to find ways to adapt their global offerings to local situations while maintaining a consistent brand image (Hakanen et al., 2017). In line with findings from Kreye (2022) and Hakanen et al. (2017), our study specifies this paradox by unwrapping the operating models in a global setting and highlighting the need for the fit between the service concept, the customer segments, the service infrastructure and processes, and the resources and capabilities of the manufacturer as the focal actor with varying needs and preferences of further downstream actors. These include country subsidiaries, dealers, service partners, distributors, and obviously the end-customers. This fit has to be found considering how a modular service offering can be globally enabled, and then decomposed and rearranged to satisfy requirements that vary to a great deal, due to cultural and country-specific aspects, financing opportunities, market position, reputation, leadership and pressures from rivalry. Other factors to be considered are the service offerings promoted by partners such as dealers and distributors. Further complexity originates from deciding to which kind of customers the manufacturer should directly sell, and conversely which should be left to the indirect dealers network. This decision is also affected by additional product and market contingencies. For example, our findings suggest that larger customers in hospitality and healthcare are more attracted by the offering of lifelong customer support and services, while food operators have amore short-term orientation that demands for other service packages. Moreover, manufacturers have to balance the need for a global operating infrastructure (e.g., applications, workflows, IT services) and various local systems that the subsidiaries have developed. Subsidiaries may in fact override some of the global procedures, to tailor their operations and integrate better with downstream actors. Last, some subsidiaries have limited resources and capabilities in comparison to others, so they need more support to deploy the global service offer. Therefore, in order to successfully roll out a service-based offering globally and act in a “glocal” manner, companies require managerial ambidexterity on multiple levels.

In conclusion, manufacturers have to carefully consider the unique constellation of existing needs of various actors when going for a global service business. These originate from the usually well established and product-dominated downstream network, including both internal and external organizations. In particular, we found that servitizing manufacturers often struggle with addressing the heterogeneity of their subsidiaries and partners, e.g., in terms of size, experience and readiness to sell and deliver advanced services on a global scale.

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Effect of Innovations and Digital Strategies on Company's Environmental Impact and Market Share

Jean Pierre Seclen-Luna

Pontifical Catholic University of Peru

Pablo Moya-Fernández

University of Granada

Abstract

Empirical evidence acknowledges that innovations enhance resource utilization efficiency and have a positive impact on the environment. Thus, the necessity of sustainable development presents a vital challenge for manufacturing companies that could require a perspective on adopting digital strategies. This study delves into this approach by investigating the effect of different innovation – process innovation, product-service innovation, organizational innovation, and marketing innovation – on environmental impact and market share. Using a dataset from the National Innovation Survey in the Peruvian Manufacturing Industry in 2018, the OPROBIT method was applied to 791 companies. The results show that companies that implement innovations have positive associations with environmental impact and market share. However, when companies implement digital strategies, PSI is not associated positively with these results. Thus, this research adds nuances to those relationships.

Theoretical Framework

These days, scholars and managers have agreed that companies should implement innovations to compete in a complex environment and achieve performance (Porter & Kramer, 2011). These authors even stated that sustainability orientation is no longer a question of compliance or ethics, but an increasingly critical factor to achieve competitive advantage and long-term viability. More recently, experts also stated that companies should adopt digital strategies since today's digital era revolves around using new technologies that create value for companies (Parida, Sjödin & Reim, 2019). In that context, organizations operate in a world increasingly permeated with digital technology; it is embedded in the core of many organizations' products, services, and operations (Yoo, Boland, Lyytinen & Majchrzak, 2012).

Manufacturing companies are increasingly attaching considerable importance to services in the value creation process (Kohtamäki, Baines, Rabetino, Bigdeli, Kowalkowski, Oliva & Parida, 2021). Moreover, service innovation drives organizations to obtain much better market performance (Grawe, Chen & Daugherty, 2009). In that sense, manufacturing industries are offering a hybrid offer that contains both products and services (Vendrell-Herrero, Bustinza, Campos Granados & Opazo-Basáez, 2021). Product and process innovation, and even product-service innovation (PSI), may support companies in obtaining environmental objectives (De Madeiros, Duarte-Ribeiro & Cortimiglia, 2014; Seclen-Luna, Moya-Fernánde & Pereira, 2021), and make progress in resource efficiency (Yin, Ming & Zhang, 2020). However, companies may struggle to innovate independently to address the complex challenges associated with the development of sustainability advantages. Thus, this study focuses on the influence of innovations and digital strategies on a company's environmental impact and market share (Figure 1).

In our study we used the OPROBIT method with data from the National Innovation Survey in the Peruvian Manufacturing Industry (2018). The analysis is based on a sample of 791 Peruvian

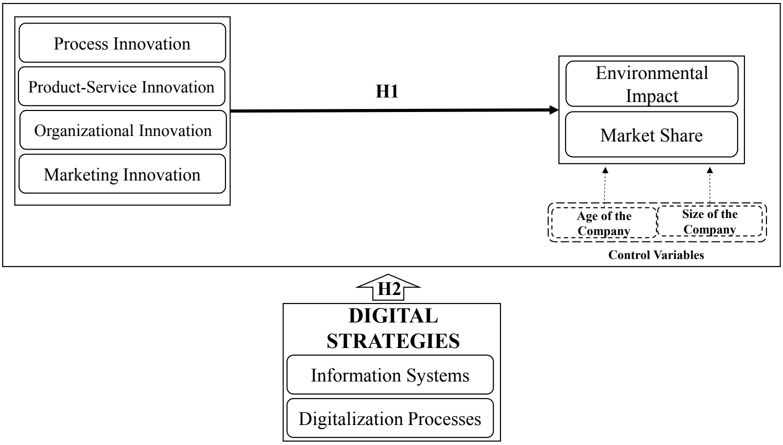

Figure 1. Theoretical Model.

companies engaged in product, service, process, organizational and marketing innovation and have reported their effects on environmental impact and market share.

Dependent variables are ordinals and independent ones are dichotomous. This study considers digital strategies as a moderating variable on the relationship between innovation and environmental impact (and market share). To control the sample, the research includes industry and company's size variables, measured by logarithms. RStudio software is used to perform descriptive and regression analyses. We applied a multivariate technique to test the hypotheses.

Preliminary Results

Our findings show on the one hand that PSI, process, and organizational innovation, have positive effects on environmental impact when the total sample is analyzed. However, if the analyses consider the moderation when companies implement digital strategies, there are some differences. For example, PSI is not associated positively with environmental impact, and the other types of innovations have positive effects on environmental impact.

On the other hand, PSI, process, and marketing innovation are positively associated with increase of market share. Nevertheless, if the analyses consider the moderation by digital strategies, we found relevant differences. For instance, PSI are not associated positively with increased market share, conversely, process and marketing innovation have positive effects on market share; especially, for companies that implemented digitalization of their processes. Lastly, size of the company is positively associated with the relationships between innovations and environmental impact, however, for market share, it does not.

Concluding Remarks

The present research provides a nuanced understanding of the impact of different kinds of innovations; process innovation, product-service innovation (PSI), organizational innovation and marketing innovation on a company's environmental impact and market share. However, when companies implement digital strategies, PSI is not associated positively with environmental impact and market share. Thus, despite the role of services in manufacturing industries has become increasingly relevant as industrialized nations have progressively transitioned towards service-based economies (Hofmeister, Kanback & Hogreve, 2023), in the emerging contexts, it seems to be no clear or companies show low degrees of complexity of digital strategies and relationships to PSI in an integrated way (Seclen-Luna & Alvarez-Salazar, 2023).

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Exploring Profitability in International Distribution Channels of Servitized Companies: An Empirical Investigation

Waleed Shleha
Polytechnic University of Catalonia
Yancy Vaillant
TBS Education
Jonathan Calleja-Blanco
University of Barcelona

Extended abstract

The transformation of business models from product-centric to service-oriented, known as servitization (Vandermerwe & Rada, 1988), has diversified the revenue streams and profitability of servitized companies by offering value-added services alongside their core products (Gomes, Lehman, Vendrell-Herrero & Bustinza, 2021; Bustinza, Lafuente, Rabetino, Vaillant & Vendrell-Herrero, 2019). By understanding the profitability of these service-based revenue streams, companies can assess the effectiveness of their revenue diversification strategies and evaluate the sustainability and growth potential of these offerings (Neely, Benedettini & Visnjic, 2011; Neely, 2008). Understanding the profitability dynamics of these service-based revenue streams becomes even more critical as companies navigate the complexities of international expansion and allocate resources strategically (Aminoff & Hakanen, 2018).

Within the context of business model diversification, the internationalization of servitized companies plays a crucial role in

helping diversify revenue streams beyond product sales on a global scale (Shleha, Vaillant & Calleja-Blanco, 2023; Hakanen & Aminoff, 2016). By offering value-added services in international markets, companies can establish recurring revenue sources, enhance customer loyalty, and minimize the risks associated with relying solely on product-centric business models (Shleha, Vaillant & Vendrell-Herrero, 2023). Having a clear understanding of the profitability potential of service offerings in different international markets allows companies to assess the return on investment for these expansion initiatives (Vendrell-Herrero, Vaillant, Bustinza & Lafuente, 2022). This knowledge enables them to prioritize resources effectively and make well-informed decisions about the most lucrative markets and distribution models for their servitized offerings (Vendrell-Herrero, Parry, Bustinza & O'Regan, 2014).

Furthermore, the profitability assessment of service-based revenue streams in international markets facilitates strategic adaptation of business models to maximize profitability (Buckley, Strange, Timmer & de Vries, 2020). By comprehending the profitability landscape in specific international markets, companies can identify the most profitable hybrid product-service offerings (Aminoff & Hakanen, 2018). This knowledge empowers them to align their business models accordingly, tailoring their strategies to meet the specific demands and preferences of international customers (Shleha, Vaillant & Calleja-Blanco, 2023; Shleha, Vaillant & Vendrell-Herrero, 2023). By focusing on the most profitable service offerings, companies can optimize their revenue streams and enhance overall profitability (Guedes, Fernandes Crespo & Patel, 2023).

Following the literature on servitization, scholars have explored the relationship between servitization and profitability (Kharlamov & Parry, 2021), but findings have been mixed, with some studies supporting a positive impact while others suggesting a U-shaped or inconclusive relationship (Lee, Yoo & Kim, 2016, Crozet & Milet, 2017). Moreover, existing research on servitization has predominantly focused on domestic markets, leaving a substantial gap in understanding the profitability dynamics of servitied companies in an international context (Shleha, Vaillant & Vendrell-Herrero, 2023, Aminoff & Hakanen, 2018, Hakanen & Aminoff, 2016).

To bridge this gap, this study aims to investigate the profitability of international distribution models in servitized companies. The primary objective is to examine the impact of servitization and determine the optimal level of servitization on profitability. The research questions revolve around understanding the relationship between servitization and profitability, identifying the obstacles encountered by servitized companies during international expansion, and determining the most profitable distribution model and level of servitization for international operations.

By drawing upon the existing theoretical framework on servitization and internationalization, this study aims to contribute to the literature by providing empirical evidence and insights into the profitability mechanisms of international distribution channels.

To achieve the objectives outlined above, the research will be structured as follows: First, an extensive review of the literature on servitization, profitability, and international distribution models will be conducted to establish a solid theoretical foundation. This literature review will encompass studies exploring the impact of servitization on profitability and the factors influencing the profitability of international distribution models. Additionally, the review will examine the challenges encountered by servitized companies during international expansion in terms of profitability.

Next, the research methodology for data collection and analysis will be presented. The research will leverage primary data from an optic and visual servitized company, and enhance it by incorporating fixed costs for each product and service, as well as variable costs associated with each country. This comprehensive dataset will enable a thorough examination of the profitability implications of different distribution models and levels of servitization in an international context. The application of quantitative analysis techniques and econometric modelling to establish robust empirical evidence on the relationship between servitization, distribution models, and profitability, will be employed to test the formulated hypotheses and establish robust empirical evidence.

The research findings will be presented and discussed, focusing on the relationship between servitization, distribution models, and profitability.

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Unfolding Service-Centric Business Model Innovation Across Geographic Markets

Leon M. Adler

University of Leipzig

Heiko Gebauer

Fraunhofer IMW, Linkoping University, and University of St.Gallen

Abstract

This paper investigates how a service-centric Business Model Innovation (BMI) of a selected health care equipment manufacturer unfolds across main geographic. An in-depth qualitative research study together with a single health care equipment manufacturer was conducted. This paper provides a process framework, which describes how service-centric BMI unfold across geographic markets. While previous literature assume that service-centric BMIs unfold globally and neglects role of geographic markets, our process framework demonstrates how (digital and physical) services and software applications emerge within and across different markets.

Keywords: Business Model Innovation, Healthcare Sector, Value Creation.

Introduction

A service-centric business model represents a crucial innovation for any product manufacturer. Service-centric business models are a specific form of Business Model Innovation (BMI) that arises as products become increasingly augmented with service offerings. Such service portfolios consist of digital and physical services and basically emerge through a design and implementation phase.

In the first design phase, product manufacturers have to design their service portfolios and individual services to match customer needs. They have to ensure that the value proposed through its services matches customer needs and preferences. Services can be either rather standardized for all customers or customized to the individual customer needs. If services can be rather standardized across the global customer base, it is less relevant to include market organizations in the design process. If services need to be rather customized, it is important to include market organizations into the design processes due to their proximity to their customers and their in-depth understanding of individual customer needs.

In the second implementation phase, product manufacturers have to think through the way how the services in the service portfolio are provided to the customers. Since service portfolios consist basically of digital and physical services, the value creation emphasizes Place Logics (PL) and Space Logics (SL). Physical services require most likely a PL. In this PL, market organizations with their organizational structures, people, and culture and competences are a key factor in the value creation. Digital services follow a SL, whereby value can be created relatively independently from market organizations.

Despite the demonstrated importance of market organizations in the various geographic markets in the process for letting service-centric BMIs unfold, literature has largely neglected the topic. This paper investigates how a service-centric BMI unfolds across main geographic markets.

Theoretical background

Service-centric business models first originated from the concept of servitization, which describes the shift in a product firm from providing products to providing advanced PSSS. It concerns moving away from providing value-in-exchange to creating value-in-use. Instead of buying products, customers want to receive the value inherently offered by product use, thus consuming it as a service.

Digital servitization suggests that service-centric BMIs increasingly includes digital services. While there has been an increasing number of contributions on service-centric business models, there is still little knowledge about the process for letting service-centric BMIs unfolds especially across geographic markets.

Research Method

Our study took place together with a major health care equipment manufacturer. Data were collected in 2022. The company had already invested significant efforts into building its technological infrastructure for its service-centric business model, but had not yet realized expected customer value or monetary gains. In response, the firm launched a cross-business unit project aimed at innovating its service-centric business model to create value. The project used a discovery-oriented, theories-in-use approach from the outset and developed a process framework for successful service-centric BMI implementation. Altogether, we conducted 100 in-depth semi-structured interviews with top management, product management, service, R&D, application specialist, and marketing employed at a healthcare equipment manufacturer and suppliers across different markets.

Findings

We have adopted a global market perspective that encompasses the European, American and Asian markets, in order to gain a more comprehensive understanding of service-centric BMI.

"Preparation" stage of the BMI process requires careful consideration of the appropriate starting point for success. Our approach involved conducting a thorough analysis of each market's specific characteristics and business objectives to select our starting points in different markets. Initially, we chose to initiate our operations in the European market, starting with the GER market where our company's headquarters were located, which we expected to yield quick results. As the process model progressed, we shifted our focus to the company's largest market the US in American market, given its vast and homogeneous nature compared to the country-specific markets in European market. To ensure the robustness of our analysis, we also selected other countries in European market, such as the UK and CZ, for cross-validation. The UK was notable for its advanced results in service-centric BMI for the company, while CZ had to work efficiently towards the same service-centric business model with few resources and costs. To the American market, we added CAN due to its progress, similar to the UK but extending to far greater distances. For the Asian market, we considered our focus on CHN as the second largest market for the company and IND as a fast-growing market. We also included the SEA market due to the unique characteristics of its sub-markets, including wildly varying resources, partly no infrastructure, high to no security concerns.

In the "Ideation and Internal Research" stage of the BMI process, gathering extensive knowledge about the firm and the market in a timely and comprehensive manner is crucial. The incorporation of the GER market facilitated prompt insights due to its convenient market access, and the education standard prevalent in this market enabled effective communication, enabling a seamless exchange of information. Similarly, the UK served as a valuable partner in advancing the service-centric BMI by sharing advanced insights. The CZ, being a relatively niche market in Europe, provided a lucid perspective on the most pressing issues, contributing substantially to the overall process model. Constant digital communication facilitated the American market access. Notably, a significant portion of the US business was transacted through dealers who served as intermediaries. CAN provided an opportunity to re-consider the UK European market perspective to validate or reject proposals related to American market. The primary focus has been on the US, where the digital servicing industry has made significant progress. Nonetheless, the complexity of the US market has necessitated a gradual increase in the company's involvement during the next phase. The involvement of the Asian market, including CHN, SEA, and IND, was scheduled last due to its complexity and challenges. Although CHN presents a vast market, its political situation presents significant hurdles, including the possibility of a lockdown and stringent regulatory requirements. As a result, service-centric BMI in China has progressed slowly. Conversely, India demonstrated a very open attitude and high market accessibility, which favored the process. Although the SEA market is an open market, infrastructure and resources vary greatly between sub-markets, leading to its classification as less critical for the first phase of the process.

During the "Triangulation of service-centric business model" stage, the company aims to gain insights into the markets by conducting interviews with both suppliers and customers. The US market has become the most critical, and a specific emphasis has been placed on it, necessitating a closer collaboration with dealers. This, in turn, has led to constant communication about the process, resulting in a slowdown. Nonetheless, as the primary point of contact in the market, dealers serve as the mouthpiece to customers, making their feedback particularly valuable. It is noteworthy that the American healthcare market is under significant pressure to remain profitable, making access to customers and suppliers more challenging. The results were triangulated with Asian market and European market to ensure consistency globally. US-specific issues in the ecosystem have been addressed differently, and cross-checks with Asian market and European market have helped consolidate core knowledge globally. Individual features have been adjusted accordingly.

During the “Creation of a service-centric business model” stage, we conduct on-site observations and in-depth interviews with customers and suppliers in the American market. However, direct access to customers on-site poses a challenge due to market institutionalization and reliance on suppliers. Therefore, we contact suppliers directly for customer contacts that meet our requirements and credential ourselves for the appropriate institutional facilities. In contrast, in European market, we can contact customers directly without credentialling. In the Asian market, due to resource limitations, we do not carry out any on-site verifications, which is certainly a weak point in the process model carried out. We complete this stage after digital cross-checks with Asian market, refine initial artifacts (e.g., vision, value proposition, and customer journey), and develop a service-centric business model for the firm.

Discussion and conclusion

The study emphasizes the need for health care product manufacturers to embark on service-centric BMIs. We provide a clear process framework based on an in-depth case study with the American and European markets of how service-centric BMI unfolds. The process framework elucidates the key stages, activities, and roles that are involved in the BMI process, with a focus on application-oriented considerations. Thereby, it is important to recognize the impact of geographic markets on the process of service-centric BMI, and to take into account the enablers and barriers that pertain to service-centric business models in the healthcare sector.

Appraising service potential of customized and standardized goods: A transaction cost economics approach

Bart Kamp

Deusto University / Orkestra-IVC

Abstract

One of the questions that many servitization scholars look into, is: What factors determine whether an industrial company makes progress in providing services and generating income through them? The literature offers numerous factors that can contribute to answering this question, and it can be approached from multiple perspectives or frameworks. One conceptual framework that has not been used so much in this regard, is transaction cost economics (TCE).

This framework is mainly used to make "make or buy" decisions, choosing between: (a) internally conceiving a product or service, (b) outsourcing its development through a contract with a third party, or (c) acquiring the asset or service through a purchase transaction from an external supplier. However, it can also be used for servitization questions (Kamp, 2021).

The proposed paper pledges to look into whether the (asset) specificity of products, levels of B2B interaction and degrees of uncertainty avoidance on behalf of buyers and suppliers, can influence a manufacturer's ability to develop a successful service business.

To assess the former, a survey was conducted among several machine tool companies and component suppliers to the automotive industry. All respondents came from Gipuzkoa (Basque Country, Northern Spain). Afterwards, on-site visits and interviews were held with several respondent companies.

Preliminary findings show that as assets become more personalized and exclusive (asset specificity increases), manufacturers have fewer service offerings and lower service-related revenues. High uncertainty avoidance behaviour on either side of the B2B relationship also influences service business potential negatively, while the level of interaction has a rather neutral impact on the scope of services provided and income obtained from them.
On the basis the empirical results, several hypotheses can be formulated as regards why the respective survey participants have either a thriving or stagnating service business, and how to improve or sustain their situation.

Keywords: Service business, transaction cost economics.

References

Kamp, B. (2021). Reviewing Service Types from a Transaction Cost Economics Perspective. In M. Kohtamaki (Ed.). *The Palgrave handbook of servitization* (pp. 197-213). Springerlink. https://doi.org/10.1007/978-3-030-75771-7_13

Session 14

Keynote Speaker #2 and Closure

It’s all about servitization
(Emanuel Gomes, Nova SBE)

Chair: Ferran Vendrell-Herrero

(venue: Aula Magna 7th floor)

Closure: Recap, awards and announcements
Yancy Vaillant & Ferran Vendrell-Herrero

This book of abstracts encapsulates the proceedings of the **10th International Conference on Business Servitization (ICBS)**, hosted at the TBS Education Barcelona campus on November 9-10, 2023. This year's conference prominently highlights the theme: 'Platforms for Digital Servitization and Solution Delivery.'

Featuring 55 contributions and 2 keynote speakers, this edition of the ICBS plays a pivotal role in shaping the future of the field. Emphasizing the significance of artificial intelligence, discussions revolved around its role in catering to three essential servitization needs: (i) automating business processes, (ii) providing cognitive insights through data analysis, and (iii) fostering cognitive engagement via AI recommendations and collaborative systems for enhanced personalization. The integration of AI algorithms not only brings internal benefits to companies but also extends external advantages to customers within the servitization trajectory.

ICBS conventionally caters to a diverse audience comprising business professionals, policymakers, and researchers. This 10th edition of the conference delved into current research within the burgeoning field of servitization, straddling theoretical advancements and practical applications of methodologies and techniques. Its overarching goal remains to offer a platform for both academia and industry practitioners to convene, exchange ideas, and showcase the latest developments in the dynamic domain of servitization.

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