HOW INDUSTRIAL EMPLOYEE CAPITALIZE ON DIGITAL SERVITZIATION: TOTAL QUALITY MANAGEMENT PERSPECTIVE

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Abstract

Industry 4.0's rapid expansion can revolutionize industrial employees' operational functions by integrating servitization-based digital solutions (advanced ecosystem services). Industrial employees can benefit from servitization if they improve internal processes. Organizational comprehensive quality management strategies are vital in employee activities throughout servitzation journey. Traditional TQM approaches are unsuitable for Servitization offerings. This study analyses servitization's possibilities and drawbacks and proposes the digitalization of total quality management approaches for industrial employees. We choose multiple case studies including industrial personnel of one cornerstone firm and three symbiotic partners. We use the Gioia methodology to describe traditional TQM's drawbacks and possibilities for new TQM approaches to capture servitization's potential.

Keywords: Digitalization, Digital Servitization, Total Quality management, industrial employee, B2B, Italy

1. Introduction

Digital servitization has revolutionized firms' focus on industrial ecosystem value chains (Leminen et al., 2022). The digital servitization phenomena are making manufacturing firms "antifragile" by using Industry 4.0 technologies. Nevertheless, a broad understanding of servitization in this evolving period goes beyond the scope of Industry 4.0 technologies. Servitization relies on these technologies to improve quality and firm

financial performance (Shen et al., 2023). While there is often a focus on the perspective of industrial customers (those who buy industrial products in a business-to-customer context), discussing the shift towards servitization through product service systems (PSSs), subscription-based services, and power-by-hour services, while it is equally important to consider the role of industrial employees who will be adopting this new paradigm in their practices.

Industrial employees are crucial to continual improvement and quality standards through operational processes. Industrial employees can enhance and automate their operational procedures, such as production and planning, to enhance procurement, recognize customer requirements, minimize errors (risk management), and enhance continuous improvement (Lepistö et al., 2021). To benefit from servitization, such as platform, performance, and quality-based services, industrial employees must acquire the operational capacity to integrate advanced ecosystem services (AES) into decision-making and operational processes. AES is defined as the collaborative services to fulfill the interest of mutual customers – The services which can't be achieved solely and required ecosystem perspective. Therefore, due to traditional total quality management (TQM) processes, large-scale industrial employees are slow to integrate AES, and current situations often fail to maximize servitization (Syed & Rialti, 2024).

The drawbacks and possibilities of TQM practices for providing AES need additional study. It's becoming clear that employees' TQM practices shape their ecosystem interactions. This enables value creation and capture using AES. TQM practices to manage AES are difficult since they must change drastically. AES may require different TQM practices to design and implement digital services (Hornung et al., 2010). Indeed, industrial customers in the ecosystem boost employee productivity by encouraging them to use digitally enabled services like platform, performance, and quality software (Matsunaga, 2024). Such Industry 4.0-based systems monitor TQM procedures and offer ways to boost industrial employee productivity using big data analytics (Anderton et al., 2023). Digital servitization (shift in industrial employee TQM practices that enables AES offerings and digital solutions to their product by integrating software and technologies that enable value capture, delivery, and creation) is triggered by industrial customers and improves industrial employees' TQM practices. Thus, the creation and integration of AES require digitalized TQM approaches.

We argue that traditional TQM processes limit servitization success (Shusong & Jun, 2013). The alternative is to propose new TQM 4.0 practices for servitization and implement them to strengthen their ecosystem relational orientation to build new value-added services to jointly capitalize on servitization. Ponsignon et al., (2019) examined the digitalization of TQM models and the competencies and capacities associated with people, processes, and technology in a qualitative study. Ališ (2018) suggests that digital solutions might enhance internal operations by expanding customer data collection methods. Despite this, most research lacks evidence of TQM digitalization approaches for servitization (Ponsignon et al., 2019). They recommend more digitalization drawbacks for servitization. Following emerging industrial conversations, TQM techniques play a critical role in integrating AES by creating new value for industrial ecosystems (Haque et al., 2021). This research aims to respond to the gap by investigating the research question:

Research Question: How may industrial employees profit from servitization by digitalizing their TQM practices?

TQM's drawbacks in digital servitization must be understood first. Indeed, AES demands industrial employees to switch from capital-oriented to operational-oriented

TQM. The old-fashioned capital-oriented model emphasizes one-time product and service investments. Capitally-oriented models emphasize competitive advantage and financial performance (Casey & Asamoah, 2016). However, an operationally orientated approach tracks daily activities to provide real-time product and service performance updates to customers. It allows flexibility and TQM-inspired practical actions (Chang & Dowlatabadi, 2019). Switching from a capitally-oriented model to an operationally-oriented model needed a new relationship and collaborative strategy with industrial customers, and the traditional TQM practices (Lepistö et al., 2021) are unsuitable for such models. Many organizations may struggle with TQM practices such as employee involvement and leadership in evaluating AES (Raja, 2010). However, TQM 4.0 implementation drawbacks are unknown. Industrial employees may struggle with ecosystem service decision-making and process management to achieve particular results. However, we need further information on these TQM 4.0 drawbacks. The objective of this paper is to identify the main TQM 4.0-related problems during digital servitization.

Second, industrial employees must know how to strategically structure their TQM processes to maximize digital servitization's benefits. The notion of TQM 4.0 in servitization is still unexplored (Bouranta et al., 2019) and has not been fully examined in the literature. There are no defined rules for industrial employees to digitalize their TQM procedures to create digital servitization value. Industry and practitioners lack awareness of the key steps needed to digitalize TQM for AES. Most research has focused on industrial customers in B2C settings, but information on how industrial employees digitalize TQM processes for AES in B2B settings is limited (Hollebeek et al., 2022). Thus, enterprises must examine ways to digitalize traditional TQM procedures and orchestrate industrial employee TQM practices inside ecosystems to produce and create value.

This article examines how industrial personnel might digitalize their TQM procedures to handle digital servitization's **possibilities and drawbacks**. We use in-depth multiple case study data from 20 industrial employees from four industrial manufacturing organizations to investigate their servitization journey.

2. **Theoretical basis**

We reviewed the literature on TQM practices, digitalization, and its increasingly strategic role in industrial ecosystem servitization, leveraging and complementing each other to offer enhanced AES. We emphasize trends that show the need to frame traditional TQM procedures for digital servitization, as AES demands value co-creation logic between industrial employees and industrial customers. Thus, we describe the research gaps that encouraged this work and novelty.

2.1 Digital Servitization

Vandermerwe & Rada (1988) coined the term "servitization". Servitization and its complexity have changed with time and new technologies. After 2010, digital servitization has gained attention from practitioners and managers due to industry 4.0 technologies because it connects customers with businesses, providing vital data that helps organizations make resilient decisions (Syed & Rialti, 2024).

Thus, digital servitization, which arose from digitalization and servitization, aims to build autonomous and dynamic processes that enable mass manufacturing of personalized products and integrate outcomes, solutions, and services. Providing extended services is the hallmark of servitization (Finne et al., 2013).

Digital servitization has five main characteristics (Sony et al., 2021). These characteristics can create industrial ecosystem value (Rantala et al., 2023):

- Digitalization
- Optimization & Customized production
- Human Machine interaction
- Automation and adaptation
- Value added Services

Digital servitization has been linked to quality management difficulties (Erkul et al., 2021). TQM is integral to industrial development and growth, but there is little literature on digital servitization, TQM, and culture in adapting and digitalizing TQM practices for the modern industrial landscape (Ramezani & Jassbi, 2020). This research fills a gap in the literature and is novel by employing a whole new method.

Since 1988, scholars and policymakers have recognized that TQM techniques' synergistic role in organizations has shifted from capital to operational focus (Erkul et al., 2021). Due to competitiveness and digitalization, industrial enterprises have prioritized automation, adaption, and ongoing development. Delegating essential responsibilities and procedures lets employees in the industry benefit from vital skills, technology, and innovation. This changed logic became clearer when enterprises used their ecosystem-specialized expertise. Each department needs an information-sharing culture, authority, and resources to improve efficiency and industrial ecosystem innovation (Tang et al., 2022). Industrial employees' rising strategic involvement in ecosystems (Choi et al., 2002) has shown the significance of TQM procedures in driving ecosystem-driven innovation (Spiegelaere & Gyes, 2012). An organization and its ecosystem actors increasingly rely on TQM methods to reduce costs, boost competitiveness, and increase profitability. Well-organized TQM methods ensure production quality. This helps the company grow and flourish (Borkowski & Stasiak-Betlejewska, 2015). TQM methods can influence inventory and warehouse management, stimulate capital investment to operational commitment, leverage operations function automation, and reduce overall price level through relational and cooperation approaches.

TQM practices for AES and TQM practices for only products were consistently distinguished by researchers. The digital servitization trend shows that more industrial customers are switching from selling items to selling digital services or integrating products, services, and technology. Scholars agree that few know how organizations might digitalize their TQM methods to efficiently offer AES. Industrial employee must strategically and creatively use TQM to take advantage of digital servitization (Kamalaldin et al., 2020). Essentially, the goal is to reinstate TQM procedures that maximize value such as optimizing industrial employees' knowledge and competencies in ecosystems to maximize innovation, value, and strategy (Bienhaus & Haddud, 2018), and automating digital operations, and strategic actions (Wu et al., 2007).

Given the lack of research on TQM 4.0, it is crucial to understand its practices and potential future developments. Over the past five years, literature has used different terms to conceptualize TQM and Industry 4.0. To fully define TQM 4.0, we identified various terms:

Nguyen et al., (2023) characterized TQM 4.0 as a proactive strategy that emphasizes organization, people, and technological elements and makes processes and outcomes more transparent. Souza et al., (2021) explored TQM 4.0 as a way to adapt quality management practices within the industry 4.0 framework and help industries navigate

this evolving phase, which includes significant changes in quality management and human resource management. Salimbeni & Redchuk (2023) defined Quality 4.0 as switching to data-driven quality management. Quality management necessitates not just understanding and addressing the demands of consumers, but also those of employees (Khan et al., 2022). Quality 4.0 uses algorithms and intelligent solutions from advanced technology to improve quality (Ramezani & Jassbi, 2020). Digital tools are used to increase the company's ability to supply reliable, high-quality products to all customers (Sony et al., 2020).

2.2 Digitalization of TQM practices

We argue that employees in the industry should adopt TQM 4.0 techniques to maximize on digital servitization. Industry 4.0 technologies bring a fundamental transformation in quality management and digitalize industrial ecosystem collaboration and relationship to offer AES and how they manufacture, deliver, and create value. According to Buenechea-Elberdin et al., (2023), radical shift requires investing in employees, with ingenuity and aptitude, which is a starting point to servitization. Employee abilities, competencies, inventions, creativity, attitudes, and values affect AES through industrial customers' learning capacities, TQM procedures, and the firm itself. AES frequently adds complex platforms, manufacturing, and quality services and software. Cyber-physical production software (CPPS) and enterprise quality management software (EQMS) integrate physical products with data and services (Prashar, 2023). Thus, TQM techniques must be substantially modified to integrate these complex services.

Therefore, organization needs to fully understand the four fundamental phases of TQM: Quality planning, control, assurance, and continuous improvement. The research recognizes that operationalization levels changes step by step and thus AES requires a more dynamic TQM strategy. Revised TQM techniques should suggest organizational management for integrating AES, coordinating servitization, and ecosystem collaboration. Revised TQM procedures stressed the importance of people, technologies, and organization in Servitization success, accomplished through employee harmony (Souza et al., 2021).

All of these approaches aim to combine human expertise with technical capabilities. Servitization requires technology. However, the integration of multiple technologies in the industrial context alters the digitalization of TQM and requires new capabilities from industrial employees to manage these changes. TQM 4.0 aims to synchronize industrial employees' skills with digital servitization and TQM 4.0 methods.

We believe AES must adapt TQM logic and there are several reasons for this:

- First, relational and cooperation perspectives drive AES output (Perona et al., 2017). Industrial customers must be more involved because the AES cannot be prescriptively stated due to their specific characteristics. To co-create AES, TQM must be more collaborative and agile. Thus, adopting AES requires ecosystem openness and trust, which is essential for long-term success (Kohtamäki et al., 2019). Industrial customers may generate more value by improving their interaction with industrial employees, getting closer to their activities, and providing solutions to their unique servitization concerns.
    - Industrial customers can increase quality by analyzing employee digital ecosystem data. This analysis helps them uncover ways to improve industrial employees' operational tasks and provide improvement instructions. Industrial customer interactions are also changing, adding complication. For instance, new industrial customers asking for sensitive information about old customers can

create transparency and governance issues (Viswanadham, 2018). Thus, governance and common data infrastructures are essential to TQM. Traceability, flexibility, and openness in handling the expanding data needed to build AES are required (Martins et al., 2020). He adds that TQM practices are important in formal and informal governance and affect relationships. He emphasized formal governance to reduce the complexity.

- Second, in the age of digital servitization, TQM, which links technology and people, must play a more active role in fostering innovative ecosystem relationships that promote long-term thinking and the co-creation of cutting-edge AES (Brauman et al., 2007). Industrial employees sometimes lack the skills and knowledge to analyze AES, which requires new approaches to big data analysis and service software development (Opresnik & Taisch, 2015). Due to the ambiguity of these AES, it is crucial to seek feedback from a wide range of industrial customers, including development and operations, to establish accurate requirements, interpret shared value, and plan execution. However industrial reluctance and inertia impede many organizations from digitizing their traditional TQM techniques, and many have difficult AES acquisition processes (Springer et al., 2012).
- Finally, many organizations struggle to digitalize their TQM processes because they fail to align rewards and incentives, which reshape industrial employees' mindsets and behaviors to adapt to operationally orientated models. This change theoretically aligns rewards, incentives, and benefit logic with a shared goal, but it also introduces uncertainty and risk for industrial employees, who must now manage these factors as they become dependent on industrial customers. However, typical TQM cannot handle such unexpected events. However, Brah et al., (2000) believe that TQM is vital to business model transition.

3. **Methodology**

We employed multiple case studies to explore modern-day and novel phenomena (Syed et al., 2023). This methodology looks perfect for the research's explanatory phase because it yields lots of comprehensive information. Additionally, it helps when the study's components have not yet been operationalized using quantitative variables (Marrucci et al., 2022).

We selected "The Alpha α" as our primary company. This company was selected for its emphasis on digitization and servitization efforts. Through a collaboration with consultancy firm "The CSF ©", they provided workshops and training sessions to employees, resulting in improved efficiency, reduced costs, adaptation to market demands, and a transformation of their digital mindset.

Additionally, the ecosystem comprises four industrial enterprises. The selection of these firms was based on their mimicking of cornerstone organizations' (Syed et al., 2024) exemplary leadership, decision-making, and organizational practices. They monitor the rate at which the industrial employees of cornerstone firms change TQM. The inclusion of these organizations provides abundant data and profound insights to address this gap.

- The Alpha α – Based in Florence, Italy
- The Beta β – Based in Florence, Italy
- The Gamma γ – Based in Arezzo, Italy
- The Delta δ – Based in Arezzo, Italy

The analysis focused on servitization and TQM practices. Data were inductively and retrospectively obtained. In a retrospective case study (Berg & Madsen, 2020), we compare the TQM practices of symbiotic enterprises and traditional TQM practices with

servitization approaches.

Snowball sampling is used to select each firm's respondents, who are recommended by managers based on their expertise and knowledge in production, planning, procurement, quality control, and benchmarking to better understand current practices. Our different respondents' experiences and rich data allowed us to establish a holistic knowledge and evolving notions of TQM techniques for Servitization.

4. **Expected Results and findings**

The adoption of digital servitization strategies will significantly improve the quality of relationships and collaboration. This will be achieved through enhanced access to customers and data, leading to higher levels of relational intimacy and informational openness, which in turn will drive data-driven efficiency and effectiveness, thereby improving relationship quality and enabling relational innovation.

Furthermore, the presence of comprehensive TQM practices will be the crucial antecedent for the successful implementation of servitization strategies. These practices will ensure that the firm can effectively plan, assess, control, and improve its servitization efforts, thereby enhancing its competitive advantage.

Integration of digital technology will enhance the relationship between TQM and servitization outcomes. This suggests that TQM techniques will improve servitization outcomes more when digital technologies are used. Digital tools will boost servitization plans by enabling continual improvement and quality control. The following TQM practices can be implemented to capitalize on servitization:

- The planning dimension will involve the development of strategic plans to integrate servitization into the firm's business model. This will include identifying financial, strategic, and marketing drivers for servitization and designing appropriate business models such as add-on, sharing, usage-based, and solution-oriented models.
- Servitization Assessment: The assessment dimension will focus on evaluating the effectiveness of servitization strategies. This will involve measuring key performance indicators (KPIs) related to servitization, such as customer satisfaction, revenue growth, and operational efficiency.
- Servitization Control: The control dimension will emphasize the importance of maintaining quality standards and ensuring that servitization processes are aligned with the firm's overall strategy. This will involve implementing TQM principles and lean manufacturing techniques to optimize servitization processes.
- Servitization Improvement: The improvement dimension will highlight the need for continuous improvement in servitization practices. This will involve identifying and addressing gaps in servitization processes, leveraging digital technologies to enhance efficiency, and integrating feedback from customers and suppliers to refine servitization strategies.

The study will reveal that digital servitization is characterized by complex network dynamics. New players will become part of the value chain, influencing the effects of digitalization and servitization. This complexity will require a holistic approach to understanding the impact of digital servitization on the firm's operations and relationships.

5. **Managerial Implication**

The research will provide valuable insights for managers on how to successfully implement digital servitization strategies. This will include recommendations on how to

address the barriers to investment in digital strategies, how to develop a multilevel perspective on digital servitization, and how to adapt traditional TQM practices that are the barrier to digital servitization.

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