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Synergizing the Digitalization, Servitization, and Green Practices for Circular Economy: A Configurational Approach

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Abstract

The transition to a circular economy is increasingly recognized as being vital for the sustainable development of industries. Indeed, the emergence of new green and digital technologies, such as Internet of Things, artificial intelligence, precision agriculture and renewable energy solutions, drives businesses to undergo multiple transformations. With the adaptation of their business models and the enhancement of customer orientation, these technologies facilitate the creation of new business solutions and services that promote business circularity. Several factors have been identified in the emerging literature on the circular economy that could potentially impact the operationalization of the circular economy. It is, however, still unclear how these factors interact to result in the implementation of circularity. Hence, the purpose of this study is to explore the various configurations of enabling conditions that lead to successful circular economy operationalization. By using a fuzzy set qualitative comparative analysis (fsQCA), we examine the impact of different configurations of “digitalization”, “servitization”, “business model innovation”, “green practices”, and “customer participation” conditions on achieving circular economy. Based on survey data obtained from Dutch AgriTech companies, multiple paths to successful circular economy adoption are observed. The findings underscore the complexity of achieving circular economy, demonstrating that no single strategy is sufficient. Instead, a

combination of several factors must synergize in order to ensure sustained circularity. Therefore, this study contributes to both the literature on digital servitization and circular economy, while providing insight to practitioners and policy makers seeking to promote circularity.

Keywords: Circular economy, servitization, digitalization, green practices.

Introduction

In recent years, the importance of transitioning different industries toward sustainable business practices has gained attention in response to environmental challenges, resource depletion, and climate change (Bocken, Boons & Baldassarre, 2019; Kolagar, 2024). Additionally, industrial firms are facing unprecedented challenges from change and disruption, in the face of the rapid development of enabling technologies, that can put their future viability at risk. This has led the very logic of businesses to transform towards a regenerative economic system aiming at protecting the environment by closing the material loop, reusing resources, and ensuring resource efficiency (Blackburn, Ritala & Keränen, 2023).

Indeed, the circular economy has emerged as a vital paradigm, aiming to decouple economic growth from resource consumption (Bocken & Ritala, 2022) through the different so-called R-principles (e.g. recover, recycle, repurpose, remanufacture, refurbish, repair, reuse, reduce, rethink, and refuse). This has been especially true in the agricultural technology (AgriTech) sector, as there are a number of innovations and advancements that are supporting and transforming traditional agricultural practices. In a harmonious blend of innovation and tradition, technologies such as artificial intelligence (AI), machine learning (ML) algorithms, the industrial internet of things (IIoT), and renewable energy solutions are converging with agriculture. The use of green and digital

technologies is enabling businesses to undergo a number of transformational processes (Opazo-Basáez, Vendrell-Herrero & Bustinza, 2018). Indeed, digitalization facilitates real-time monitoring and optimization of agricultural operations, while artificial intelligence greatly enhances decision-making and predictive capabilities (Kolagar, 2024; Sjödin, Parida & Kohtamäki, 2023). Through precision agriculture, crop yields and resource usage can be improved, and renewable energy solutions can be used to reduce the carbon footprint of operations. Together, these technologies facilitate servitization, which in turn promotes circularity by transforming processes, capabilities, and offerings within industrial firms and their ecosystems (Kolagar, Parida & Sjödin, 2022) to create, deliver, and capture increased service value (Sjödin, Parida & Kohtamäki, 2020). By offering continuous maintenance, monitoring, and optimization, companies can extend the lifecycle of products, reduce waste, and enhance customer engagement. Servitization, in fact, is closely aligned with circular economy as it promotes efficient resource utilization and continual improvement of performance.

Despite this potential, the operationalization of circular economy is a complex and multifaceted challenge. While several conditions—such as digitalization, servitization, business model innovation, green practices, and customer participation—have been identified as critical enablers, there is still much uncertainty around the interaction between these factors and it remains poorly understood how these conditions synergize to create effective pathways to operationalize circular economy. This study aims to address this gap by exploring the different configurations of enabling conditions that lead to successful circular economy implementation. By analyzing survey data from the Dutch AgriTech companies, we seek to uncover multiple strategies that companies adopt towards reaching circularity and provide a nuanced understanding of how

digitalization, servitization, and green practices can be effectively integrated. The findings of this study will contribute to the literature on digital servitization and circular economy, offering valuable insights for practitioners and policymakers. By highlighting the necessity of a holistic and integrated approach, we aim to provide actionable recommendations that can facilitate the transition towards circularity.

Methodology

To explore the distinct configurations that enable circular economy operationalization in the AgriTech sector, we employed a fuzzy set qualitative comparative analysis (fsQCA) approach (Sjödín, Parida & Kohtamäki, 2019). As a result of this method, complex causality can be examined and several pathways to a desired outcome can be identified. Data was collected from a diverse sample of Dutch AgriTech companies of varying sizes. The survey included items measuring digitalization, servitization, business model innovation, green practices, customer participation, as well as the circular economy operationalization.

Preliminary Findings

As a result of our preliminary analysis, we have identified multiple distinct strategies for achieving operationalization of the circular economy. Key configurations indicate that high levels of digitalization and servitization, when combined with robust green practices, significantly enhance circular economy operationalization. Furthermore, business model innovation and active customer participation emerged as critical complementary factors in several successful configurations. These findings highlight the complexity and interdependence of various strategic transitions, underscoring that no single factor is sufficient on its own. Instead, a holistic

approach that synergizes digital, servitization, and green initiatives is essential for fostering circularity. It is through this nuanced understanding that practitioners and policymakers will be able to gain actionable insights that will promote circular economies.

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