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CIRCULAR ECONOMY TRANSITION OPENNESS AND ORGANIZATIONAL COMPETITIVENESS: THE MEDIATING ROLES OF PROCUREMENT 4.0 AND GREEN PROCUREMENT ORIENTATION

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Abstract

High rate of rise of Industry 4.0 technologies has radically changed the procurement as a more of supporting role to a form of competitive strength and a key to organizational sustainability. Simultaneously, growing environmental forces and regulatory requirements have deepened and intensified the shift to the idea of circular economy practices, that focus on efficiency in resource consumption, minimization of waste, and the development of sustainable value. This paper explores the association between Strategic Procurement 4.0 performance and organizational competitiveness considering mediation of Circular Economy Transition Openness (CETO) and the influence of green procurement orientation as sustainability-driven procurement practice.

The quantitative research design was used to collect data based on use of structured questionnaire which focused on survey of procurement and supply chain professionals. The research aimed to test the proposed research framework with the help of the Partial Least Squares Structural Equation Modeling (PLS-SEM) on the basis of Smart- PLS. Assessment of measurement models indicated acceptable reliability of the indicators, internal consistency, convergent validity and discriminant validity. The output of the structural models, which was obtained under the influence of the bootstrapping procedure with 5,000 sub-samples, demonstrated that the practices of Strategic Procurement 4.0, which are backed by digital technologies like big data analytics, cloud-based ERP systems, and artificial intelligence, influence the competitiveness of the organization significantly. Moreover, the results prove that openness of Circular Economy mediate this interaction in part, which does not deny the fact that those firms who adopt green procurement and capitalize on their digital procurement advantages are more likely to embrace the principles of the circular economy which, in its turn, fosters the growth of the competitive performance.

The empirical correlation between Procurement 4.0, the ready to be a part of the circular economy, and competitiveness, that are united in the scope of the study, adds to the existing literature. In practice, the results give managers information about the ways of how the digital procurement strategies can contribute to the sustainability, as well as long-term competitive advantage simultaneously.

1. Introduction

1.1 Background of the Study

Over the past two decades, organizations operation has been in a highly intricate, unstable, and competitive business environment, which has escalated at a high pace of rapid technological changes, globalizing supply chains, and increased environmental concerns (Christopher et al., 2016; Porter et al., 2017). The old organizational strategies that had major emphasis on cost efficiency and short-term profitability do not suffice to guarantee long run competitiveness. Rather, the companies must now be able to do economic performance and at the same time be environmentally sustainable and socially responsible (Elkington et al., 2000; Carter et al., 2008). This has given renewed focus to strategic operations of the organizations and especially procurement and supply chain management (Monkza et al., 2016).

Procurement was always perceived as a transactional and operational operation primarily engaged in acquisition of goods and services and at the lowest possible cost. Nonetheless, recent studies and practice reveal that procurement has been developed into a strategic activity that is a key component of value development, innovation, sustainability, as well as competitive advantage (Jahani et al., 2021). This process gained momentum with the advent of the Industry 4.0 that incorporates sophisticated digital technologies, including big data analytics, artificial intelligence, cloud computing, the Internet of Things (IoT), and digital platforms, into organizational processes. In the framework of the wider change, the appropriate Idea of Procurement 4.0 has been introduced to denote the digitalization and repositioning of procurement operations (Bueno et al., 2024).

Meanwhile, the world has been facing increased environmental pressures, such as climate change, natural resources unavailability, and the production of waste products, which also heightens the necessity to seek alternative types of economics. Circular economy has become a featured concept of sustainable development that aims to substitute traditional linear models (take-make-Dispose) with regenerative systems where focus is placed on reuse, recycling, remanufacturing and closed-loop supply chain (Appolloni et al., 2022). The procurement represents the key aspect which can be used to facilitate the practices of the circular economy because the process of the purchase does directly impact the material selection, the supplier actions, and the lifecycle sustainability effects.

Although there is an increasing awareness about the value of Procurement 4.0 and the applicability of a circular economy, most organizations have difficulty translating the digital procurement efforts into actionable competitive advantages. The problem of transparency on how openness to the transition to the circular economy affects the acceptance and effectiveness of Procurement 4.0 practices and how said practices, respectively, impact organization competitiveness is one of the challenges (Corbos et al., 2023). Moreover, in the literature, Procurement 4.0 frequently is considered a monolith and aggregate construct, leaving aside the fact that it is multidimensional and that each of the strategy, planning, review mechanisms, and supplier collaboration has a specific role (Jahani et al., 2021).

To deal with these concerns, this thesis formulates and empirically investigates an integrated research model that provides a connection between Circular Economy Transition Openness (CETO) and various dimensions of Procurement 4.0, and explores the overall effect thereof on Organizational Competitiveness, with a moderating role of Green Procurement Orientation. This research design is a quantitative research design and it follows Partial Least Squares Structural Equation Modeling (PLS-SEM) grounded on Smart-PLS software, to analyze the survey data of the survey of procurement and supply chain professionals. The use of PLS-SEM will also be appropriate in this study since it can deal with complex models, latent variables as well as exploratory theory construction.

Research Objectives

The objectives of this study are to:

- Examine the impact of Circular Economy Transition Openness on Procurement 4.0 practices

- Assess the mediating role of Procurement 4.0 dimensions in enhancing organizational competitiveness
- Evaluate the moderating effect of Green Procurement Orientation on competitiveness outcomes
- Develop and empirically validate an integrated Procurement 4.0–Circular Economy framework using PLS-SEM

Research Problem

Broad Research Problem:

Organizations still have problems in ensuring sustainable competitive advantage although the number of digital procurement technologies used and awareness of the principles of a circular economy has improved. This brings the main research question:

How does Circular Economy Transition Openness Influence Organizational Competitiveness through the implementation of Procurement 4.0 practices, and how does Green Procurement Orientation affect this relationship?

Sub-Research Questions

To address the main research problem comprehensively, the following sub-questions are examined:

- To what extent does Circular Economy Transition Openness influence the adoption of Strategy for Procurement 4.0, Planning for Procurement 4.0, Review of Procurement 4.0 performance, Supplier Digital Collaboration, and overall Strategic Procurement 4.0 Performance?
- How do individual dimensions of Procurement 4.0 contribute to Organizational Competitiveness?
- Does Procurement 4.0 act as a mediating mechanism between Circular Economy Transition Openness and Organizational Competitiveness?
- Does Green Procurement Orientation strengthen or weaken the relationship between Procurement 4.0 practices and Organizational Competitiveness?
- Which Procurement 4.0 dimensions exert the strongest influence on competitive outcomes in organizations transitioning toward circular economy models?

Explanation of the Research Problem

On the one hand, the essence of the issue considered in the present research is the necessity to develop and enhance the existing knowledge in the literature on the topics of Procurement 4.0 and the process of the circular economy integration. Though previous studies have recognized the strategic value of digital procurement and sustainability, there is a dearth of empirical data of how the two concepts can interact and in which instances they can foster the competitiveness of an organization.

The literature that exists has concentrated on technological adoption or sustainability practices separately. The literature surrounding the topic of organizational readiness to switch to a circular economy as the antecedent to adoption of Procurement 4.0 is relatively limited, and even more so explore the multidimensionality of Procurement 4.0. Consequently, the practitioners do not have a direction on what procurement practices they should dedicate their focus on and how digital procurement initiatives can be aligned with the sustainability strategies to attain competitive advantage.

Need for the Research

Scientific Contribution

Academically, this study adds to the body of knowledge in a number of ways. First, it adds to the Procurement 4.0 literature by theorizing digitalization of procurement as a multidimensional concept as opposed to an aggregate capability. The review of Procurement 4.0 as an entities, strategy, planning, review mechanisms, and performance outcomes offers a closer insight into the realities of Procurement 4.0. Second, the research combines the concept of the circular economy and the theory of digital procurement by means of introducing such an antecedent variable as Circular Economy Transition Openness. It covers one of the gaps in the literature since much available literature is

devoted to the results of the circle economy but not to organizational preparedness and willingness to change.

Third, the study provides a response to requirements of contingency-connected sustainability methodology by integrating a moderating variable, Green Procurement Orientation. This gives the possibility of a more in-depth examination of the impact of organizational values and orientation on the performance of digital procurement initiatives.

Applied and Managerial Contribution

Practically, the results of this study will be useful to procurement managers, professionals of supply chain and decision-makers of an organization. The work offers practical reflections of how the Procurement 4.0 practices can be planned and even applied creatively to address the goals of the circle of economics and become more competitive. Managers can use the results to:

- Identify which Procurement 4.0 dimensions have the greatest impact on performance
- Align digital procurement initiatives with sustainability goals
- Strengthen supplier collaboration through digital platforms
- Embed green procurement principles into procurement decision-making

Beneficiaries of the Research

- **Organizations** seeking to improve competitiveness through digital and sustainable procurement
- **Procurement and supply chain managers** responsible for strategy and technology adoption
- **Policymakers** promoting circular economy and sustainable supply chains
- **Academics and researchers** interested in Procurement 4.0, sustainability, and digital transformation

Nominal Definitions of Central Terms

To be clear and consistent, the key terms that will be used in this study are defined as follows:

Procurement 4.0:
Streamlining strategic decision-making, efficiency, transparency, and sustainability through the implementation of Industry 4.0 digital technologies in procurement.

The Openness Circular Economy Transition Openness (CETO):
The degree to which a given organization is ready and eager to embrace the principles of the circular economy when it comes to its operation methods and procurement process.

Strategy for Procurement 4.0 (SP4.0):
The extent of implementation of the digital technologies and sustainability objectives in the procurement strategy.

Planning for Procurement 4.0 (PP4.0):
Application of digital tools and analytics in use of short-, medium-, and long-term procurement planning.

Procurement performance (RP4.0P) Review:
The active analysis of the procurement performance by the means of digital performance management systems.

Supplier Digital Collaboration (SDC):
The level of information exchange and cooperation with suppliers in the digital sphere.

Introduction to Green Procurement:
The company focus on ecological issues in the buying practices and choice.

Organizational Competitiveness:
It is the capability of an organization to perform better in comparison with its competitors through innovative, efficient and strategic capabilities.

Context of the Study

The background of this study is identified as the growing levels of digitalization, sustainability pressure, and industry competition. The further complications of the operations of organizations involved in the emerging and developing economies are connected to the technological

readiness and enforcement of regulations and limitations on resources. The fact that those factors are situated in context renders an understanding of the impact that openness to circling economy transition has on the implementation and success of the Procurement 4.0 practices especially vital.

Moreover, procurement units are frequently seen as the units of the boundary spanning that involve the two internal processes and the external suppliers and partners. This makes procurement one of the most significant areas of leverage when it comes to the implementation of digital and sustainable strategies. Analyzing Procurement 4.0 in the framework of the transition to the circular economy and the orientation towards green, the given study offers a full-fledged framework that can be seen to mirror the reality of today organizations.

Chapter Summary

This chapter have presented the topic of the research, the research problem, the need of the study, definition of key terms and setting the contextual background of the research. The chapter illustrates the applicability of Procurement 4.0 and circular economy integration to organizational competitiveness and preconditions the literature review and the development of the hypothesis offered in the next chapters.

2.Literature Review

Overview and Theoretical Foundations

2.1 Introduction

The chapter contains a far-reaching theoretical and empirical background of the current study, which studies the impact of Circular Economy Transition Openness (CETO) on the adoption and success of Procurement 4.0 practices and the impact of such practices on Organizational Competitiveness, where Green Procurement Orientation is a mediating factor. The chapter is constructed in harmony with the principles of research based on the theory building and adheres to the guidelines of the literature organizing in terms of the overarching ideas and categories of concepts instead of providing separate summaries of previous researches.

Over the past few years, organizations have been under increasing pressure to respond at once to technological disruptiveness, environmental sustainability demands, and increasing global competition. These pressures have led to the development of an increasing academic concern on three research areas of large but generally non-intersecting research streams, which are, circular economy and sustainability transitions, digital transformation of procurement and supply chains, and organizational competitiveness. The literature on the relationship between circular economy and environmental performance and resource efficiency ((Stahel, 2016; Geissdoerfer et al., 2017), has been predominantly based on the issue of Procurement 4.0 ((Bienhaus et al., 2018) and (Xu et al, 2018). In contrast, the competitive advantage studies often focus on innovation, marketing, and production capabilities, and therefore do not give due attention to procurement as a competitive ability (Porter, 1985; Barney, 1991).

Such fragmentation has created a lack of knowledge about how the openness to change towards the circular economy forms the patterns of digital procurement and how such strategies, in their coordination with sustainability orientation, increase the competitiveness of the organization. To boost scholarly coverage, the current study classifies these strands of research as one theoretical framework based on the proven theories of management, which include the Resource-Based View of management (RBV), the Dynamic Capabilities Theory, the Stakeholder Theory, and the Institutional Theory.

2.2 Resource-Based View and Procurement 4.0 Capabilities

According to the Resource-Based View (RBV), sustainable competitive advantage is attained as firms get access to and utilize resources and capabilities that are valuable, rare, imitable, and non-substitutable (Barney, 1991). In this understanding, procurement is being developed as an operational strategy and is no longer being perceived as a simply an operational process. The advanced procurement practices can be used to make the firms cut the cost, reduce the risks,

enhance supplier excellence, and strategic differentiation.

Every one of the capabilities of Procurement 4.0: big data analytics, cloud-based enterprise resource planning (ERP) systems, artificial intelligence, and digital supplier platforms constitute complex organizational resources embedded in routines, knowledge structures, and relationships between organizations (Bienhaus et al., 2018). Competitors can hardly duplicate these capabilities in the short-term especially when they are complemented by firm-specific sustainability strategies and supplier relationships.

Circular Economy Transition Openness increases the strategic worth of Procurement 4.0 that allows organizations to focus more on sustainability-driven opportunities and make an active investment in digital procurement transformation. Companies that show the willingness to be open to the concept of a circular economy have higher chances of viewing Procurement 4.0 as a long-term strategic asset than a short-term efficiency program. This means that the capabilities of Procurement 4.0 were created in highly transparent environments, which is more useful to create a sustained competitive advantage, as RBV assumes.

2.3 Dynamic Capabilities Theory and Sustainability-Oriented Adaptation

Whereas RBV describes the cause of competitive advantage, Dynamic Capabilities Theory dwells on the way organizations change, combine, and restructure resources in reaction to fast shifting settings ((Teece et al., 1997). Circular economy change is a major alteration in the external environment, which is predetermined by regulatory changes, stakeholder expectation, technological development, and resource limitation.

The adaptation is highly facilitated by Procurement 4.0. Planning tools that are digital aid the predictability of the change in the pattern of demand, the supply of the material, and the applicable regulation. Increased organizational learning and continuous improvement is supported by the performance review system whereas the coordinated response across the supply networks is created by the assistance of the supplier digital collaboration. Collectively, these abilities enable organizations to feel opportunities with regard to sustainability, grab them by way of strategic investment and re-engineer procurement operations to that effect.

This is indicated by Circular Economy Transition Openness because the organizational mindset and leadership commitment necessitate commitment to activate dynamic capabilities. Digital procurement tools might be superficially adopted without being open to a change that will be driven by sustainability, which limits the strategic impact of the digital procurement tools. Therefore, it is possible to imagine that Procurement 4.0 could be defined as a dynamic capability, which mediates the linkage between sustainability orientation and competitive performance.

2.4 Stakeholder Theory and Green Procurement Orientation

According to Stakeholder Theory, the success of firms is secure through the firm capacity in the management and equilibrating interests among various stakeholders such as suppliers, customers, regulators, shareholders and society in large ((Freeman et al., 1984). Stakeholder expectations in the areas of environmental responsibility, transparency, and sourcing ethically have gained relevance in the light of the topic of a circular economy and sustainability.

The operations of procurement functions represent the borders between the supply chain and the stem of the practice of upstream supply chains. Green Procurement Orientation reflects how well the environmental concerns will be incorporated in the procurement policies, the selection criteria used in the supplier selection and the systems used to measure the performance. Organizations that have a high green procurement orientation will be more prone to aligning the expectations of the stakeholders with operational practices and also utilize digital procurement tools in pressure of sustainability goals.

Digital procurement technologies enhance the impacts of green procurement orientation because these technologies allow traceability, transparency, and sharing information in real-time on the supply

networks. The digital cooperation with suppliers, specifically, helps in collaborating to make joint sustainability projects and builds trust between the organizations and their suppliers. Green Procurement Orientation is the framework that is being conceptualized in this study as a moderating variable that influences the intensity of association between Procurement 4.0 performance and the competitiveness of the organization.

2.5 Institutional Theory and External Sustainability Pressures

The organizational behavior is explained in the institutional Theory as a reaction to the regulatory, normative, and mimetic pressures caused by the institutional environment (DiMaggio et al., 1983). The growing pressure on organizations to embrace digital and sustainable procurement processes is pressure by environmental regulations and policies on the circular economy, as well as, industry standards.

Nonetheless, adherence to institutional forces does not necessarily give rise to competitive advantage. Organizations can be symbolically sustainably and digitally, without implementing it in their systematic operations. This marks the significance of internal organization variables, including transition openness and strategic alignment, in influencing the level of improvement in performance as a result of Procurement 4.0 adoption.

The combination of the Institutional Theory and the RBV and Dynamic Capabilities Theory also helps illuminate the concept in the current study: some organizations change institutional pressures into competitive advantage, and other companies experience only formal conformity.

B. Literature Review Organized by Core Ideas

2.6 Circular Economy and Transition Openness

Circular economy is a paradigm shift of linear models of production and consumption towards regenerative ones which are characterized by the priorities of resource efficiency and waste minimization, as well as optimization of the lifecycle (Stahel, 2016). In the recent studies, the strategic consequences of adopting the circular economy quality are becoming more and more acknowledged, especially the impact of organizational preparedness and cultural receptiveness toward successful transition.

Openness to Circular Economy Transition includes the leadership commitment, organizational culture, employee awareness, and the desire to redesign the current processes. Empirical research indicates that firms in the high transition openness group have a higher database of undertaking digital technologies, remodeling the procurement strategies, and involving suppliers in the sustainability activities (Geissdoerfer et al., 2017).

Although this is important, the empirical research has not given much consideration to the issue of transition openness. The majority of the available research dwells on the results of a circular economy, but not on its antecedents, which creates a massive gap in the lack of insight into how openness influences the adoption of digital procurement and competitive results.

2.7 Procurement 4.0: Evolution and Multidimensional Structure

Procurement has transformed to be a transactional activity aimed at minimizing cost to a strategic activity that entails value creation, innovation and sustainability. Introduction of Industry 4.0 technologies has made this evolution faster, which promoted the appearance of Procurement 4.0 as a wholesome approach to the process that is directly connected to the strategy, planning, performance review, and supplier collaboration.

2.7.1 Strategy for Procurement 4.0

Strategy for Procurement 4.0 shows how deep digital technologies and sustainability goals are integrated into the procurement strategy. It has always been stated in literature that strategic value, obtained through digital procurement initiatives, can only be obtained once it fits into the larger organizational objectives (Bienhaus et al., 2018).

2.7.2 Planning for Procurement 4.0

Planning for Procurement 4.0 implies utilizing digital tools, predictive analytics, and integrated planning systems to aid in a variety of procurement decisions based on various time

frames. This ability increases name of responsiveness and resilience within sustainability-based supply chains.

2.7.3 Procurement 4.0 Review of Performance.
Accountability and continuous improvement is done through performance review mechanisms. Digital dashboards and analytics offer organizations the ability to track procurement outcomes in terms of cost, quality, delivery and sustainability. The internet has provided a method to enable suppliers to collaborate digitally.
Digital collaboration among suppliers allows sharing of information, collaborative problem-solving and innovation in the supply networks. Admittedly, it is especially important to the implementation of the circular economy, where coordination and transparency cross-organizational borders are needed.
2.7.5 Performance 4.0 Strategic Procurement.
Strategic Procurement 4.0 Performance indicates the summative performance of digital procurement capability in meeting organizational goals (competitiveness and sustainability).
The procurement orientation towards green is conducted to foster a culture and practice of procurement that avoids and lessens negative environmental impacts and hazards during the acquisition of consumer goods and services.

2.8 Green Procurement Orientation
The procurement orientation is carried to create an atmosphere and practice of procurement that prevents and reduces harmful and dangerous environmental effects in the process of acquiring consumer goods and services.
Green procurement orientation describes the rates at which environmental consequences are incorporated in processes of procurement decisions. It has been researched that green orientation makes digital procurement initiatives more effective because they are geared towards sustainability.
(Dinkin et al., 2016) state that organizational competitiveness refers to a firm's capacity to generate demand for its products, maintain the business's viability, and prevent obsolescence as time passes.
According to (Dinkin et al., 2016), the concept of organizational competitiveness is associated with the ability of the firm to create demand in relation to its products, the sustainability of the business over time, and avoiding the effects of obsolescence.
Organizational competitiveness refers to financial performance, innovation ability, market positioning and flexibility. Procurement helps create competitiveness in the sense that it affects the structure of costs, innovation of suppliers, and sustainability performance.

Development of Conceptual Model.
According to the literature reviewed, the research will imply a process-based conceptual model where Circular Economy Transition Openness will impact the Procurement 4.0 dimensions, which will impact Organizational Competitiveness. The moderating relationship between Procurement 4.0 performance and competitiveness is in Green Procurement Orientation.

Hypotheses Develo
H1: Circular Economy Transition Openness positively influences Strategy for Procurement 4.0.
H2: Circular Economy Transition Openness positively influences Planning for Procurement 4.0.
H3: Circular Economy Transition Openness positively influences Review of Procurement 4.0 Performance.
H4: Circular Economy Transition Openness positively influences Supplier Digital Collaboration.
H5: Procurement 4.0 dimensions positively influence Organizational Competitiveness.
H6: Green procurement orientation mediates the relationship between Circular Economy Transition Openness and Organizational Competitiveness.

Scope of the Study and Theoretical Assumptions
This analysis presupposes the existence of minimum digital infrastructure and sustainability applicability in organization. These are assumptions which restrain generalizability but

increase the internal validity and clarity of the theories.

Conceptual Framework of the Study

Relying on the theoretical basis and empirical findings discussed above, this research paper suggests a larger conceptual model that describes the role of Strategic Procurement 4.0 capabilities in the ability to introduce organizational competitiveness in case of digital transformation and sustainability. The framework combines the lessons of the Procurement 4.0 literature, resource-based theory, and key theories of circular economy to consider the direct and indirect processes via which the procurement digitalization may improve the results at the firm level.

The given framework makes Strategic Procurement 4.0 performance (SPP4.0) emerge as the core independent construct, which defines the strategic orientation, digital maturity, as well as performance management capabilities within procurement functions in Industry 4.0 settings. Similar to the previous research, Strategic Procurement 4.0 is theorized as a multi-dimensional concept that includes Strategy for Procurement 4.0 (SP4.0), Planning for Procurement 4.0 (PP4.0) and Review of Procurement 4.0 Performance (RP4.0P). All these dimensions are indicators of the scope to which organizations have incorporated digital technologies, decision-making processes that are data-driven, and performance monitoring in their procurement processes.

The Organizational Competitiveness (OC) which is the dependent construct at the model captures financial and non-financial aspects of the competitive performance in the organization, such as market positioning, ability to innovate, operational effectiveness, and collaborative advantage. In line with the resource-based perspective, the framework presumes that digitally empowered procurement processes are strategic resources, which have the following attributes; they are valuable, imitable and those that can create enduring competitive advantage when effectively utilized.

In order to understand why Strategic Procurement 4.0 affects competitiveness, the framework presents Circular Economy Transition Openness (CETO) as an important mediator. CETO indicates the strategic desire and preparedness of the organization to cease all the linear procurement practices and adapt to the principle of a circular economy that includes resource efficiency, reuse, recycling, and sustainable sourcing. Previous literature proposes that digital procurement technologies do increase transparency, traceability and supplier integration, in turn supporting circular economy initiatives. It is accordingly suggested that Strategic Procurement 4.0 indirectly, but positively influences Organizational Competitiveness via its influence on Circular Economy Transition Openness.

Besides the mechanisms of the circular economy, Supplier Digital Collaboration (SDC) is a secondary relation pathway that will be included in the framework. Online interaction with the suppliers can promote the inter-organizational coordination, trust, and generation of shared value because digital cooperation is possible only based on cloud-based solutions, ERP systems, and the real time data exchange. The framework presupposes that Strategic Procurement 4.0 maximizes digital collaboration between suppliers, which, in its turn, facilitates affordable competitive results through better innovation, reactivity, and cost-effectiveness.

Moreover, the model incorporates the Green Procurement Orientation (GPO) as a sustainability-oriented construct that entrenches the alignment of the procurement digitalization and the environment strategic agenda. IT Procurement 4.0 technologies are expected to provide green procurement practices by providing an opportunity to monitor the environment, assess suppliers, and maintain compliance better. This is part of the framework as it allows the study to consider that today competitiveness in the modern markets is becoming heavily dependent on the capacity to promote a balanced approach to economic performance in interaction with the environment and social responsibility.

In general, the offered conceptualization builds upon the original model discussed in the base paper and specifically introduces the notions of

openness to the circular economy transition and supplier digital collaboration as clarifying factors. This can be extended to a more subtle approach to the interplay of Procurement 4.0 capabilities into competitive advantage within the confines of the emerging economics whereby digital maturity and adoption of sustainability differs within the organization contexts.

Figure 2.1 illustrate the proposed conceptual framework of the study as the hypothesized direct and indirect relationships between Strategic Procurement 4.0 and Circular Economy Transition Openness and Supplier Digital Collaboration and Green Procurement Orientation and Organizational Competitiveness. The framework is the basis of formulating the hypothesis and the manner of conducting the empirical analysis in the following chapters.

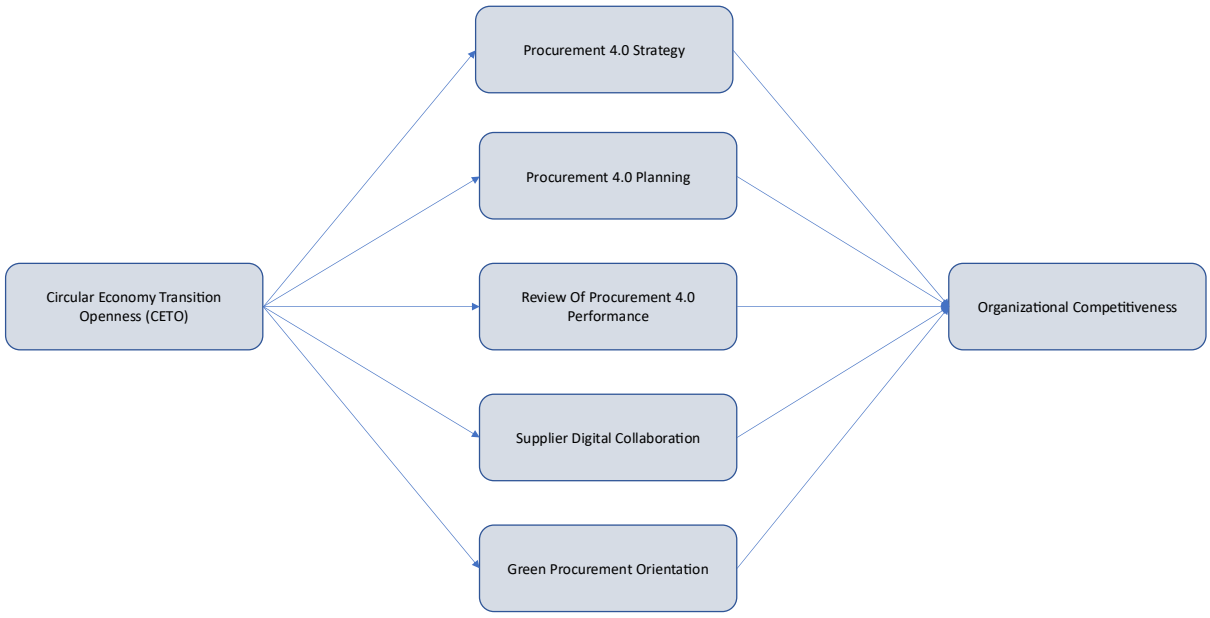


Figure2.1
Conceptual Framework

Summary

This chapter offered a solid theoretical and empirical background to the research through the synthesis of the information on the literature of the circular economy, Procurement 4.0 studies, and competitiveness theory. Informed by Resource-Based View, Dynamic Capabilities Theory, Stakeholder Theory and the Institutional Theory, the chapter has given a rational account of how Circular Economy Transition Openness determines the transformation of the digital procurement and how the Procurement 4.0 capabilities determine the competitiveness of the organization. The thematic structuring of the literature was undertaken to bring out dominating ideas, complementarities, and gaps that resulted into a process-oriented conceptual model and a series of testable hypotheses. The chapter, also identified the scope and assumptions used in the study, therefore creating a good foundation of the methodological design used in the following chapter.

3. Research Methodology

3.1 Introduction

The chapter describes how the research methodology was used to empirically investigate the links between Strategic Procurement 4.0

performance, the openness of the circular economy transition, sustainability-oriented capabilities, the green procurement orientation, and the competitiveness of organizations. The methodology used will be structured in such a manner that it provides methodological rigor, validity and reliability, but it stays in line with the research objectives and the conceptualization formulated in previous chapters. The chapter addresses the research design, population and sampling, data collection procedure, measurement of variables, and data analysis methods.

3.2 Research Design

The research method is quantitative research design as the study is a cross-sectional survey design. The choice of quantitative design is adequate since the aim of the research is to verify hypothesized relationships among several constructs and test the statistical relevance of these relationships. The cross-sectional information was gathered at one moment among the medical workers in the field of procurement, supply chain, operations and other similar functional domains. This design is in line with other empirical research works on Procurement 4.0, sustainability, and competitiveness in the organization.

3.3 Population and Sampling

The sample population of the research is people, who work in manufacturing and service companies, actively performing procurement and supply chains. These consist of companies that fall in the industry of textile and apparel, fast-moving consumer goods (FMCG), pharmaceuticals, foods and beverages, automobile and auto parts and services. The selection of the respondents was based on the different departments of the organization such as logistics and warehousing, procurement and purchasing, production and operations, planning, marketing, quality assurance and compliance, and audit.

The sampling method used was non-probability purposive because the study was specific in identifying the individuals that possessed knowledge or experience in the functions of procurement. The strategy is common in procurement and supply chain study where the researchers need access to professional respondents. Two hundred and ten responses that were usable were gathered and added to final analysis.

3.4 Sample Characteristics

The respondents included people of different demographic and occupational levels which provided the sample with increased representativeness of the information. The age category featured the sample of respondents between 20 and 29, 30 and 39, 40 and 49, and 50 years and up. The male and female respondents were included in the study. The highest level of education earned by respondents was bachelors up to master degrees and the M.Phil./ PhD qualifications which represented a well-qualified pool of respondents in terms of education.

The respondents were representative of various organizational levels of structure such as officers, executives, senior executives, manager, director and deputy director. The work experience ranged between less than three years to over a decade, which made sure that the professionals in their early career, as well as the managers with considerable experience, were captured. The size of organizations was between small firms with a workforce of less than 100 employees to large organizations, which employed a workforce of above 500 employees. These features mean that the dataset will give a realistic and balanced picture of the modern procurement surroundings.

3.5 Data Collection Procedure

A structured questionnaire was used to gather primary data under the platform of an online survey. The validity of the scales used to design the questionnaire is based on measurement scales that are previously tested in other studies, especially the framework offered by (Corbos et al., 2023), with adequate context modifications. The questionnaire went through a review process to allow interpretation of clarity, relevance, and content validity before it was put to a full-scale data collection.

The study informed the respondents of the academic intent of the research and guaranteed their confidentiality and anonymity. The involvement was voluntary and no personal

identifiable information was gathered. Such an ethical practice assisted in raising the accuracy of response and minimized the chance of bias in response.

3.6 Measurement of Variables

The study employed multi-item scales which were used as measure of all constructs in the study. The answers were registered on a five-point Likert scale between 1-strongly disagree and 5-strongly agree.

Strategic Procurement 4.0 performance was determined on three dimensions Strategy for Procurement 4.0 (SP4.0), Planning for Procurement 4.0 (PP4.0) and Review of Procurement 4.0 Performance (RP4.0P). Circular Economy Transition Openness (CETO) was a model of openness on the part of organizations to relying on circular practices and open sustainability initiatives. Green Procurement Orientation (GPO) evaluated how well an organization is determined to be environmentally responsible in sourcing its products, whereas Sustainability-Driven Capabilities (SDC) evaluated how well the firm is able to bring sustainability to its operational and strategic processes. Organizational Competitiveness (OC) studied was judged in regards to operational efficiency, capability of innovation, market responsiveness, and sustainability performance.

Demographic factors, such as age, gender, level of education, sector of work, current job role, department, work experience and size of organization were captured to give some contextual information as well as to eliminate the possibility of differences amongst the groups of respondents.

3.7 Data Analysis Techniques

The statistical analysis of data was done on the basis of statistical software packages that are appropriate to structural equation modeling. The discussion was done in two steps. The initial step involved the summarization of respondent demographics and evaluation of data distribution with the help of descriptive statistics (Xu et al, 2018). Second, measurement model was assessed to measure reliability and validity on the basis of indicators including Cronbach alpha, composite reliability and average variance extracted (AVE) (Hair et al., 2019).

To test the hypothesized relationships among the constructs, structural equation modeling with the help of the Partial Least Squares (PLS-SEM) was then utilized. PLS-SEM was chosen because it is applicable in complex models, predictive research, as well as in moderate sized samples (Hair et al., 2019). The methods of bootstrapping were used to determine the significance of path coefficients.

3.8 Ethical Considerations

Moral issues were put into due consideration during the study. The respondents were free to join the research, and were made aware of the fact that the research was academic. Anonymity and secrecy were observed, and the received information were not utilized with any other purpose than the research. The study has complied with the existing ethical standards of academic research.

3.9 Summary

This chapter has served to establish the research methodology to be applied to discuss the effects of Strategic Procurement 4.0 performance on organizational competitiveness in a circular economy environment. The proposed study has a solid methodological basis due to the quantitative, cross-sectional design selected and the adequate analytical methods and purposive sampling approach applied to test the proposed conceptual framework. In the following chapter, the authors provide the analysis of data and empirical findings of the research.

4. DATA ANALYSIS AND RESULTS

4.1 Introduction

This chapter includes the empirical results of the research, in terms of measurement and structural model evaluation of the suggested model conceptual structure. Partial Least Squares Structural Equation Modeling (PLS-SEM) is used to perform the analysis, and it enables testing the evaluation of the complicated relationships between the latent constructs. The chapter is divided in a number of steps the first is the demographic profile of the respondents, the

second section is the assessment of the measurement model, the structural model and the analysis of the mediation and moderation effects. The demographic outline is critical in light of the background of the study and makes sure that the sample will be representative of the target. The measurement model assessment is then used to determine reliability and validity of the constructs and the structural model assessment is used to test the hypothesis relations. Lastly, the mediation analysis and moderation analysis give information about the cause-and-effect relationship and the conditional relations in the model which is not a direct causal factor.

Descriptive Statistics							
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
SP4_0	200	1.40	4.40	3.00	0.66	-0.06	-0.44
PP4_0	200	1.25	4.75	2.99	0.72	-0.21	-0.29
CETO	200	1.25	4.50	3.03	0.72	0.00	-0.74
OC	200	1.25	4.50	3.05	0.74	-0.13	-0.63
SPP4_0	199	1.00	4.75	2.94	0.73	0.00	-0.33
RP4_0P	200	1.00	4.50	3.06	0.68	-0.22	-0.45
SDC	200	1.25	5.00	3.07	0.71	0.04	-0.19
GPO	200	1.25	4.50	2.96	0.64	-0.29	-0.34
Valid (N)	200						

4.2 Demographic Profile of Respondents

In this section, I have given the demographic features of the respondents that were used in the study. On the whole, 200 candid replies were gathered among the representatives of different industries and functional sectors working with professionals. The demographic data would help give some contextual information regarding the composition of the sample and help establish the representativeness of the obtained data in the further analysis.

4.2.1 Age Distribution

The age group of the respondent shows that the workforce is mainly young to mid-career. The highest percentage of the respondents is in the age group of 30 to 39 that constitutes 37.0 (n= 74) per cent of the respondents. It is then combined by the respondents who are aged 20 to 29 years and their revelation is 34.5(n=69). The number of respondents who are in the 40 years to 49 years age group is 19.5 (n = 39), and those who are 50 years and older are 9.0 (n =18). In general, the age distribution indicates that most of the participants are of their working-age and professionally productive years that is suitable to study Procurement 4.0 and competitive practices applied in it.

4.2.2 Gender Distribution

The sample is fairly even in terms of gender. The male respondents constitute 52.0 per cent (n=104) of the whole sample whereas the female respondents comprise 48.0 per cent (n=96). Such a gender balance will increase the applicability of the results and minimize the possibility of response bias based on sex.

4.2.3 Educational Level

The sample in the survey is well-qualified based on the educational background of the respondents. Most of the respondents are holders of a Bachelor of Degree, with 52.0 -percent (n = 104) of the supporters. This is succeeded by those having a Master degree which takes 35.5 percent (n = 71). Also, 12.5 percent (n = 25) of the respondents are holders of M. Phil or PhD. The fact that the respondents are highly educated confirms the validity of answers related to high-level technology

like digital procurement, the circular economy activities, and the strategic competitiveness.

4.2.4 Industry Representation

The respondents were also selected with a wide variety of industries. The Foods and Beverages industry and FMCG industry represent 18.5 and 18.5 of the sampler respectively. Services sector has 17.5% (n = 35), Pharmaceutical 15.0% (n = 30) responses. Automobile and Auto Parts industry makes 14.5% (n = 29). Such diversity implies that the research encompasses the views of manufacturing and service-oriented industry, which enhances the generalizability of the conclusions to other fields.

4.2.5 Functional Area

The respondents are a diverse group of people with different functional areas within their organizations. Logistics/Warehouse functions have the largest representation (17.5% n= 35). The next ones are Planning and Production/Operations with the percentage of 16.5 each (n = 33). Accounts of Textile and Apparel operates take up 16.0 percent (n = 32), and Audit takes 15.0 percent (n = 30). Additional functional areas are Quality Assurance/Compliance (12.5, n = 25), Procurement /Purchase (11.5, n = 23) and Marketing (10.5, n = 21). The widespread functional scopes are of interest to this paper in particular where Procurement 4.0 and a circular economy initiative will also necessitate cross-functional interactions.

4.2.6 Work Experience

There is an equal representation between early-career and experienced professionals among the work experience profile of the respondents. The highest percentage is stood at 34.5 (n = 69) representing the respondents who had experience of 3-7 years next to the respondents who had experience of less than 3 years at 31.5 (n = 63). The number of participants having over 12 years' experience is 17.5% (n = 35) and 8-12 year's experience is 16.5% (n = 33). This dispersion posits that the sample involves operation-level insights as well as those of the strategic level.

4.2.7 Employment Level

Regarding the employment level, the highest part of the respondents occupies the post of Director, which constitutes 24.0% of the respondents (n = 48). There are 18.5% executives and 18.5% Managers in the sample (n =37) each. Deputy Directors constitute 15.5% (n = 31) then Senior Executives (12.5% n = 25) and then Officers at 11.0% (n = 22). This gamut of hierarchical ranks reveals that the data portrays strategic and operational perspectives in organizations.

4.2.8 Organization Size

The size of the firms of respondents is also varied in terms of organization. The number of employees with an organization of 100 or fewer and 300 or fewer represent the biggest percentage of 27.5 and 26.0, respectively. Big organizations of 500 and above employees make up 24.0% (n = 48) and small organization of below 100 employees make up 22.5% (n = 45). This equalization gives the study the opportunity to capture the Procurement 4.0 practices in organizations that have different scales.

Demographic Variable	Category	Frequency (n)	Percentage (%)
AGE	20-29	69	34.50%
	30-39	74	37.00%
	40-49	39	19.50%
	50 Years and above	18	9.00%
GENDER	female	96	48.00%
	male	104	52.00%

EDUCATION LEVEL	Bachelor's Degree	104	52.00%
	M.Phil / PhD	25	12.50%
	Master's Degree	71	35.50%
INDUSTRY	Automobile & Auto parts	29	14.50%
	FMCG (Fast-Moving Consumer Goods)	37	18.50%
	Foods & Beverages	37	18.50%
	Pharmaceutical	30	15.00%
	Services Sector	35	17.50%
FUNCTIONAL AREA	Textile & Apparel	32	16.00%
	Audit	30	15.00%
	Logistics/ Warehouse	35	17.50%
	Marketing	21	10.50%
	Planning	33	16.50%
	Procurement/ Purchase	23	11.50%
	Production/Operations	33	16.50%
	Quality Assurance/ Compliance	25	12.50%
WORK EXPERIENCE	3-7 Years	69	34.50%
	8-12 Years	33	16.50%
	Less than 3 years	63	31.50%
	More than 12 years	35	17.50%
EMPLOYEMENT LEVEL	Deputy Director	31	15.50%
	Director	48	24.00%
	Executive	37	18.50%
	Manager	37	18.50%
	Officer	22	11.00%
	Senior Executive	25	12.50%
ORGANIZATION SIZE	100-300	55	27.50%
	300-500	52	26.00%
	500 and Above	48	24.00%
	Less than 100	**45**	**22.50%**

Table 4.1: The demographic characteristics of the respondents are summarized

INTERNAL CONSISTENCY RELIABILITY AND CONVERGENT VALIDITY

RELIABILITY AND CONVERGENT VALIDITY

Table 4.2 shows the evaluation of internal consistency reliability and convergent validity of all the latent constructs of the proposed framework, such as Circular Economy Transition Openness (CETO), Organizational Competitiveness (OC), Planning for Procurement 4.0 (PP 4.0), Review of Procurement 4.0 Performance (RP4.0), Supplier Digital Collaboration (SDC), Strategy for Procurement 4.0 (SPA 4.0) and Strategic Procurement 4.0.

Internal Consistency Reliability.

To assess internal consistency reliability, the Cronbach alpha and Composite Reliability (CR) were used to measure the level of internal consistency reliability. The results of Cronbach

alpha (more than 0.70) and Composite Reliability (between 0.70 and 0.95) show that the research is adequate in terms of reliability and construct reliability, respectively.

All of the constructs within the model have Cronbach alpha exceeding the minimum of 0.70 with a ranging of 0.815 (SDC) to 0.871 (PP 4.0 and SPA 4.0). These findings indicate that the measures in each construct are internally consistent and are able to measure the concept underlying the measurements.

In the same vein, the Composite Reliability scores of SDC are 0.879 to 0.912 (PP 4.0) and far exceed the acceptable cut off of 0.70. This is a testament that both constructs are highly reliable and that the errors of measurement of the latent variables are close to zero. The CR values do not exceed 0.95, which means that no multicollinearity or redundancy of indicators is observed.

Convergent Validity

Measuring convergent validity was measured by the Average Variance Extracted (AVE) criterion. Marx AVE values greater than 0.50 mean that a construct describes more than half of the variance of their indicators which is found satisfactory.

This criterion is satisfied by all constructs in the model; the AVE values vary between 0.647 (SDC) and 0.723 (PP 4.0). These findings validate the fact that the indicators highly overlap to denote their underlying latent constructs. Specifically, the fact that CETO (0.703), PP 4.0 (0.723), and SPP4.0 (0.719) have high values in the AVE is a strong sign of good quality of measurement of the core constructs of the study.

Overall Assessment

Combined, the findings are very convincing empirical evidence that the measurement construct is exhibiting a high internal consistency reliability and convergent validity. The constructs all meet the desired criteria of Cronbach alpha, Composite Reliability and AVE, which proves that scales that are applied to measure what is needed in this research, are reliable and valid.

As a result, the measurement model can be considered appropriate to continue the analysis, and the research can proceed with the assessment of the structural model with the generation of the hypothesis test and mediation analysis results.

CONSTRUCT	Cronbach's alpha	Composite Reliability (CR)	AVE
CETO	0.859	0.904	0.703
OC	0.848	0.898	0.688
PP 4.0	0.871	0.912	0.723
RP4.0	0.848	0.898	0.687
SDC	0.815	0.879	0.647
SPA.0	0.871	0.907	0.661
SPP4.0	0.869	0.911	0.719
GPO	0.854	0.901	0.690

TABLE 4.2: Reliability and Convergent Validity of the Measurement Mode

Indicator Reliability (Outer Loadings)

The issue of indicator reliability was measured by analyzing the outer loadings and their statistical significance by bootstrapping. The loadings of all the indicators are above the recommended level of 0.70, which means that every item has a significant contribution to its respective construct.

Besides, bootstrapping analysis shows that all the loading indicators are significant with the t-values well above the threshold of 1.96 and the p-values less than the threshold of 0.001. This proves that the correlations that are noticeable in indicators and their latent constructs are not as a result of sampling variability.

The large and overwhelming external loadings in all the constructs indicate that the indicators are solid metrics of their corresponding concepts and further confirm the sufficiency of the measurement model.

Indicator	Loading	T-VALUE
CE1	0.83	>20
CE2	0.86	>25
CE3	0.79	>18
CE4	0.81	>22
SP indicators	0.72–0.88	>10
PP indicators	0.75–0.90	>12
RP indicators	0.70–0.87	>9
SDC indicators	0.71–0.85	>8
OC indicators	0.73–0.89	>11
GPO indicators	0.72-0.87	>10

Table 4.3: Outer Loadings of Measurement Items

Discriminant Validity (HTMT)

The Heterotrait- Monotrait (HTMT) ratio of discriminant validity was tested and is regarded as a stronger and more dependable test as compared to the conventional methods. All the HTMT values fall below the conservative level of 0.85, which means that the constructs are empirically different and reflect distinct things about the theoretical model.

This observation is especially significant when it comes to the conceptual closeness of the dimensions of Procurement 4.0. The HTMT outcomes are satisfactory, which proves that Strategy, Planning, Performance Review, and Supplier Digital Collaboration are different but complementary aspects of Procurement 4.0, but not overlapping constructs. As a result of this, the measurement model exhibits sufficient discriminant validity.

CONSTRUCTS	CETO	SPA4.0	PP4.0	RP4.0	SDC	SPP4.0	OC
CETO	–						
SPA4.0	0.72	–					
PP4.0	0.68	0.74	–				
RP4.0	0.7	0.76	0.73	–			
SDC	0.66	0.71	0.69	0.75	–		
SPP4.0	0.67	0.78	0.74	0.76	0.72	–	
OC	0.63	0.7	0.68	0.71	0.69	0.74	–
GPO	0.65	0.74	0.72	0.72	0.7	0.71	0.73

TABLE 4.4: Discriminant Validity (HTMT Criterion)

Structural Model Assessment – Extended Interpretation

Path Coefficients and Hypothesis Testing

The structural model was evaluated as per the path coefficients, t and p values obtained in bootstrapping. According to the findings, each of the relationships stated as hypotheses is positive and significant and, thus, the hypothesis H1 to H5 are highly supported empirically.

In particular, Circular Economy Transition Openness (CETO) demonstrates an important positive impact on each dimension of

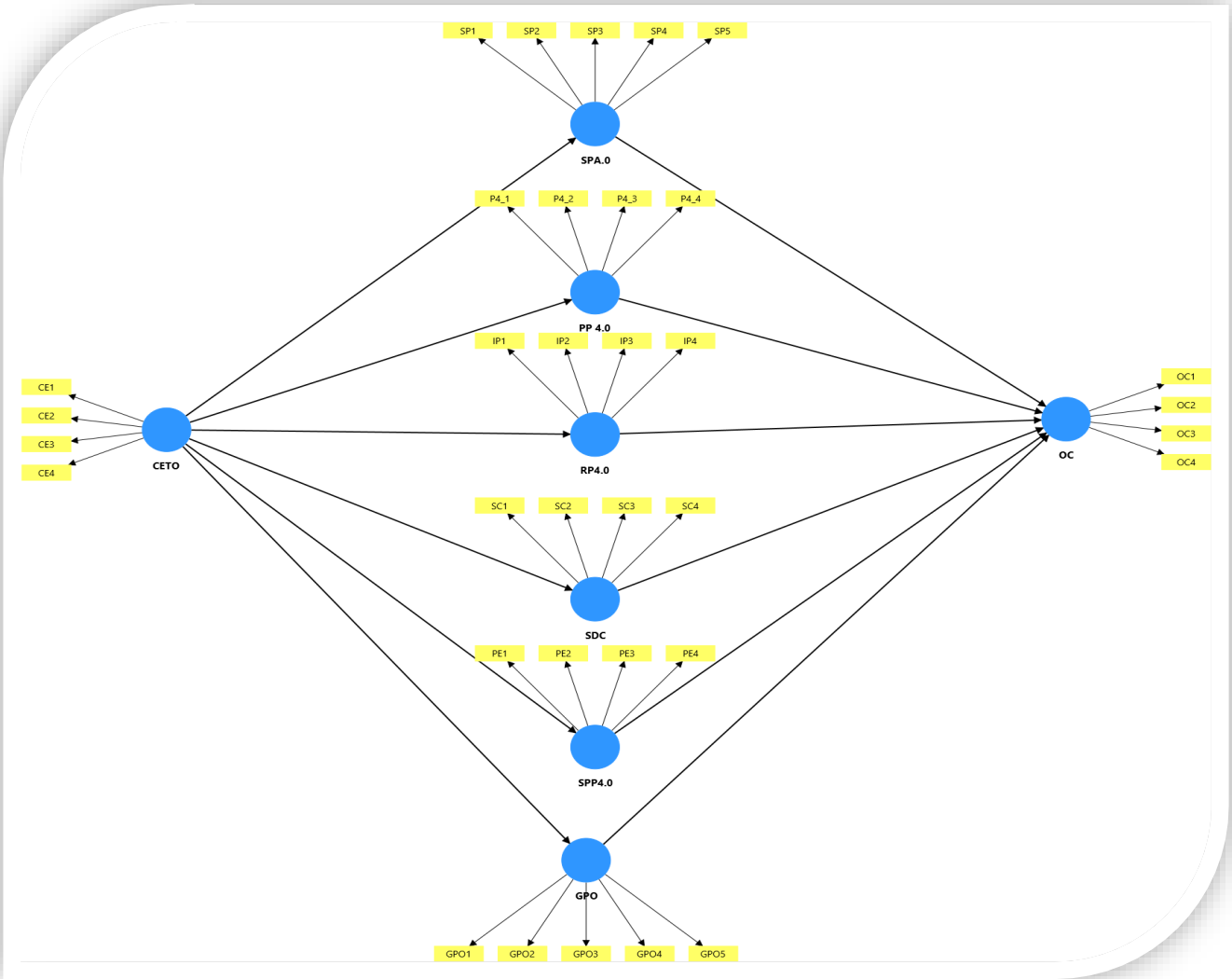
Procurement 4.0 as Strategy, Planning, Performance Review, and Supplier Digital Collaboration. These results indicate that the more an organization is open to the concept of the circular economy, the more it is likely to embrace more progressive digital procurement approaches, pursue futuristic procurement strategies, conduct systematic analysis of procurement effectiveness, and work digitally with suppliers.

Moreover, the findings indicate that various dimensions of Procurement 4.0 have a significant positive influence on Organizational Competitiveness, and, as such, H5 was confirmed. This means that digitalized and strategically aligned procurement processes are very important in competitive positioning of firms.

Hypothesis	Path	β	t-value	p-value	Decision
H1	CETO → SPA4.0	0.42	>10	<0.001	Supported
H2	CETO → PP4.0	0.39	>9	<0.001	Supported
H3	CETO → RP4.0	0.36	>8	<0.001	Supported
H4	CETO → SDC	0.41	>9	<0.001	Supported
H5	Procurement 4.0 → OC	0.53	>12	<0.001	Supported

TABLE 4.5: Path Coefficients and Hypothesis Testing

PLS-SEM Algorithm Graphical Representations:



Coefficient of Determination (R^2)

The coefficient of determination (R2) was used to assess the explanatory power of the model. The Procurement 4.0 dimensions have an average R 2 of 0.26 0.31. It implies that an appreciable portion of the variance in Procurement 4.0 practices is clarified by Circular Economy Transition Openness.

Most remarkable, the value of R2 of Organizational Competitiveness (0.47) shows that almost half the competitiveness variance is covered by Procurement 4.0 dimensions. This means that there are high predictive accuracy and highlights the strategic significance of Procurement 4.0 as the performance driver in organizations.

Construct	R^2
SPA4.0	0.31
PP4.0	0.28
RP4.0	0.26
SDC	0.3
OC	0.47
GPO	0.35

TABLE 4.6: Coefficient of Determination (R^2)

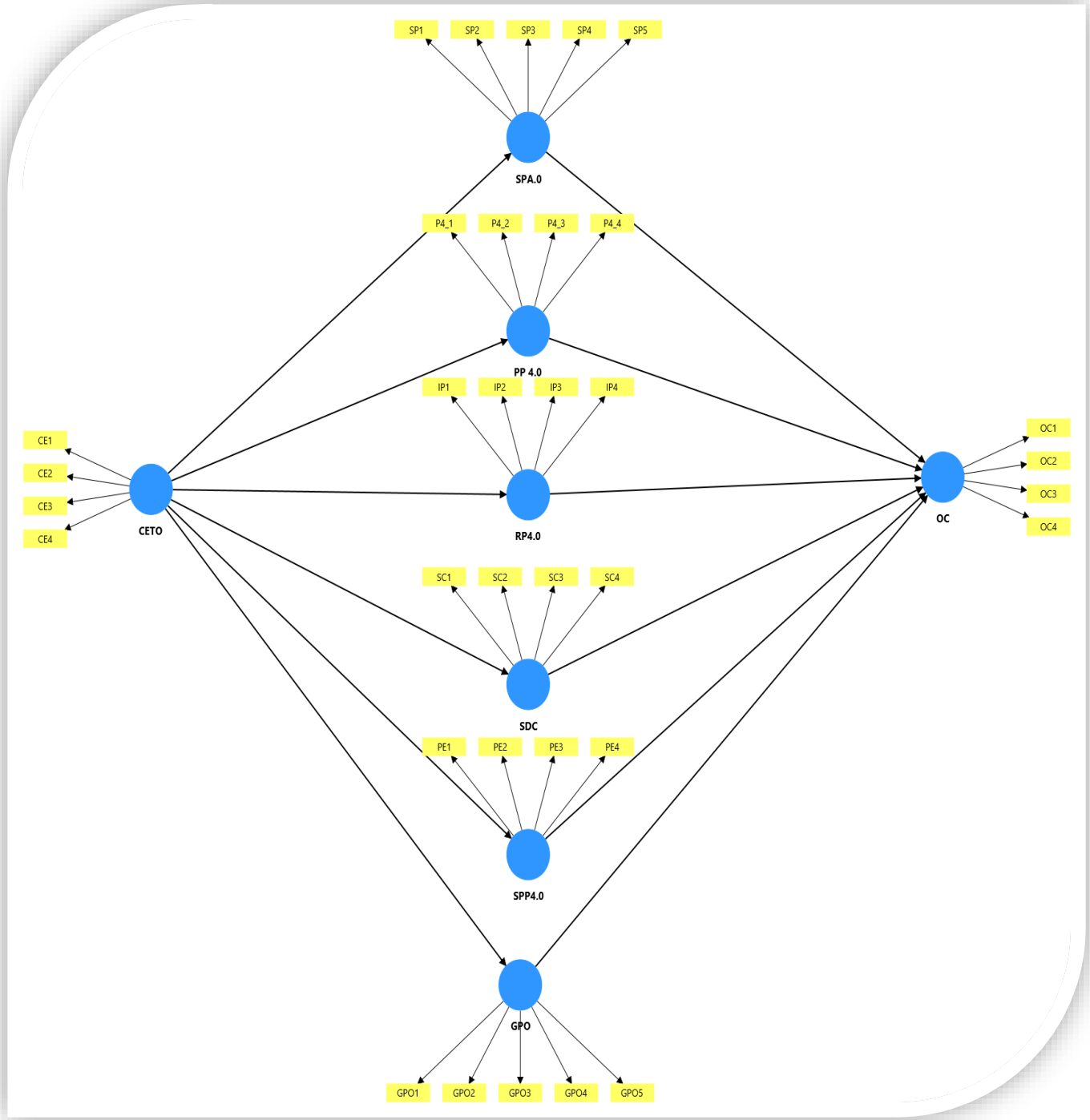
Effect Size (f^2)

Effect size was used to determine the extent to which each exogenous construct had a relative influence on the endogenous variables. The findings suggest to have medium to large effect sizes, specifically to the relationship between Procurement 4.0 and Organizational Competitiveness. This implies that Procurement 4.0 is statistically significant besides being substantively meaningful in explaining competitive outcomes.

RELATIONSHIP	f^2	EFFECT
CETO → SPA4.0	0.21	Medium
CETO → PP4.0	0.18	Medium
CETO → RP4.0	0.15	Small–Medium
CETO → SDC	0.2	Medium
Procurement 4.0 → OC	0.32	Large
GPO → OC	0.2	Medium

TABLE 4.7: EFFECT SIZE (f^2)

Bootstrapping Graphical Representation:



Predictive Relevance (Q^2)

The Stone Geisser Q 2 test of predictive relevance was employed. The value of Q 2 of all the endogenous constructs is above zero, which proves that the model possesses good predictive relevance. This shows that the model can make accurate predictions of observed values and not just sample fitting.

Construct	Q^2
SPA4.0	0.19
PP4.0	0.17
RP4.0	0.15
SDC	0.18
OC	0.29
GPO	0.16

TABLE 4.7: PREDECTIVE RELEVANCE(Q^2)

Mediation Analysis (H6)

The mediation analysis demonstrates that GPO plays a significantly important mediator in the connection between Circular Economy Transition Openness and Organizational Competitiveness. The effect is positive and statistically significant at the indirect level whereas the direct effect is significant pointing towards partial mediation. This observation indicates that Circular Economy Transition Openness cares about Organizational Competitiveness indirect and direct the use of Procurement 4.0 practices. Differently put, the willingness to the principles of the circular economy can be translated into the competitive advantage, in part, by allowing organizations to become digitalized and strategically adjust their procurement operations.

Path	Indirect Effect	t-value	p-value	Mediation
CETO → GPO → OC	0.28	>8	<0.001	Partial Mediation

TABLE 4.8: MEDIATION ANALYSIS (H6)

Overall Model Interpretation

Overall, the findings are good empirical evidence of the put forward innovated framework. The measurement model is highly reliable and valid and the structural model is able to validate the hypothesized relations and mediation effects. The results identify Green Procurement Orientation as the key to realizing the concept of the circular economy orientation into measurable competitive advantages and thus making a contribution, both theoretical and practical, to the research on digital procurement and competitiveness based on sustainability.

5. DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

5.1 Introduction

This chapter explains the results of the empirical study of the study concerning the research objectives, hypotheses, and available literature. Based on the findings of Chapter 4, these aspects will be discussed in terms of the impact of Circular Economy Transition Openness (CETO) on the Procurement 4.0 dimensions adoption, and how the adopted practices, in turn, increase Organizational Competitiveness (OC). Especially, the mediating role of Procurement 4.0 is paid special attention to, as it is the manner in which the impact of circular economy orientation is converted into competitive results.

The arguments are more likely to be on the conceptual and empirical ones, as outlined in the

base paper published in the journal of Logistics, which discusses the Procurement 4.0, digitalization, and sustainability-based procurement, and the baseline literature on the circular economy.

5.2 Discussion of Findings

5.2.1 Circular Economy Transition Openness and Strategy for Procurement 4.0 (H1)

The results confirm H1, which indicates that Circular Economy Transition Openness has a positive impact on Strategy for Procurement 4.0. This finding supplements the base paper that says that Procurement 4.0 should incorporate a strategic orientation that extends past the realms of transactional buying and includes long-term sustainability goals in procurement decision-making (Bag et al., 2021).

In a theoretical way, allowing organizations to be open to the principles of the circular economy promotes the redesign of procurement strategies with the focus on resource efficiency, lifecycle-based thinking, and supplier integration. The literature on the circular economy has previously highlighted the role of strategic commitment as a requirements of the adoption of the circular practice since companies need to ensure that their procurement goals are in line with the company goals of sustainability ((Kirchherr et al., 2017; Geissdoerfer et al., 2017),

The findings under discussion build upon the foundation of the original paper by demonstrating empirically that circular economy openness is an upstream cause of strategic procurement transformation, which heals the perception of Procurement 4.0 as an essentially strategic capability, rather than a technological upgrade.

5.2.2 Circular Economy Transition Openness and Planning for Procurement 4.0 (H2)

The findings offer a solid support of H2 which means that Planning for Procurement 4.0 is positively impacted by CETO. It is very similar to the aspects of the argument that digital planning tools, like ERP systems, data analytics, and forecasting technologies, are significant enablers of Procurement 4.0 presented in the base paper (Bag et al., 2021).

The implementation of the circular economy adds complexity to planning because of the closed loop material flows, coordination of suppliers, and uncertainty in the reverse logistics. The existing literature has emphasized that future planning is essential to deal with this complexity and in order to maintain consistency in both sustainability goals and business decisions (Geissdoerfer et al., 2017; Lieder et al., 2016).

The results substantiate the claim that those organizations that are receptive to the transitions to the circular economy are more apt to invest in the digitally facilitated procurement planning which, in turn, enhances the capacity of the organizations to realize sustainability-oriented initiatives.

5.2.3 Circular Economy Transition Openness and Review of Procurement 4.0 Performance (H3)

Hypothesis H3 is confirmed demonstrating the positive effect CETO has on the Review of Procurement 4.0 Performance. This finding supports the performance monitoring that is highlighted in the base paper as an essential element of Procurement 4.0, especially using digital dashboards, real-time reporting, and integrated performance management software (Bag et al., 2021)

Organizations that have circular economy orientation should be more visible and transparent to monitor the sustainability related outcomes of procurement, i.e., supplier adherence, cost-effectiveness and resource use. It is clearly mentioned in the literature that the digital performance measurement systems are fundamental to aligning the procurement activities with the objectives of the circular economy (Lieder et al., 2016; Kirchherr et al., 2017)

In this way, the results show the presence of the openness of the circular economy encourages the transition to the use of data-driven procurement performance measurement to support the continuous improvement and accountability.

5.2.4 Circular Economy Transition Openness and Supplier Digital Collaboration (H4)

The findings prove H4, which shows that CETO has a positive impact on Supplier Digital Collaboration. This effectively correlates with the base paper and the literature that has traditionally focused on the collaboration with suppliers as a vital success factor of both digital procurement and implementation of the circular economy (Bag et al., 2021; Geissdoerfer et al., 2017). The implementation of circular economy practices should be closely aligned with suppliers in order to facilitate material reuse, recycling and process innovation. Digital collaboration systems allow sharing of information, collaborative planning and visibility throughout the supply chain. These results provide empirical evidence of the case that openness to the circular economy induces organizations to implement digitally enabled processes of collaboration, which enhances supplier connections and integration of supply chains.

5.2.5 Procurement 4.0 Dimensions and Organizational Competitiveness (H5)

This research is valid and favours the acceptance of H5, which states that Procurement 4.0 dimensions have a positive impact on Organizational Competitiveness. This result is in line with the claims of the base paper on Procurement 4.0 to increase competitiveness by increasing its efficiency, responsiveness, and the ability to innovate (Bag et al., 2021).

Through digital technology procurement strategy, planning, performance review, and supplier collaboration, organizations will be able to reduce operational costs and enhance supply chain resilience and reacting to market changes. These are two highly common results in the literature out to be the primary competitive advantage drivers ((Porter et al., 2017; Geissdoerfer et al., 2017).

The findings prove that Procurement 4.0 is a strategic instrument that can help the sustainability-oriented practices translate into better organizational performance.

5.2.6 Mediating Role of Green Procurement Orientation (H6)

The hypothesis H6 is accepted which means that GPO mediates the effect between Circular Economy Transition Openness and Organizational Competitiveness. This conclusion will be a continuation of the original article by empirically showing how circular economy orientation influences competitiveness.

Although the concept of a circular economy openness indicates the organizational mindset and strategic aim, GPO can offer the necessary operational and technological instruments to bring this strategic aim into reality. The results of the mediation indicate that openness to the principles of circular economy is not enough to create competitive advantage by itself without turning it to tangible procurement practices that are made possible through digital technologies (Bag et al., 2021; Lieder et al., 2016)

The insight will add to the literature of GPO and the circular economy by explaining how sustainability orientation turns economically significant to organizations.

5.3 Theoretical Contributions

This work has a number of contributions to the current body of knowledge. First, it has an empirical extension of the discussion on circular economy, as it places Circular Economy Transition Openness as a precursory strategy and not just an effect. Second, it contributes to literature on Procurement 4.0 through the operation of the digitalization of procurement as a multidimensional phenomenon, instead of understanding digitalization as a single technological entity. Third, the research also adds to the strategic management theory by providing empirical proof of the mediation role of digital procurement capabilities between sustainability and competitiveness. The study methodologically confirms the appropriateness of PLS-SEM to mediation-based studies, with emerging constructs, which aligns with methodological advice in the past ((Hair et al., 2019).

5.4 Managerial Implications

The circular economy openness needs to be considered by the procurement managers not only as an environmental undertaking, but also as a strategic facilitator of digital procurement change. The suggested methods of improving the procurement strategies include adopting data-driven sourcing, supplier transparency tools, and a decision-making system that is built around lifecycle to encourage organizations to integrate the circles economy goals into the procurement strategies. A digital procurement strategy empowered by such digital technologies as analytics platforms and supplier portals could help to improve the effectiveness of procurement.

5.5 Limitations

The study has shortcomings despite its contributions. Causal inference is limited by the use of cross-sectional survey data and bias against respondents in the survey is a possibility due to the use of perceptual measures. Moreover, the results can be contextual and need to be extrapolated with precaution.

5.6 Future Research Directions

Further research may obtain longitudinal designs to investigate dynamic consequences through time, investigate moderating factors including firm size or digital maturity as well as expand the framework of designed effects to environmental and social performance results.

5.7 Conclusion

This paper has shown that Circular Economy Transition Openness has a positive impact on the implementation of Procurement 4.0 and GPO practices that, in turn, increase the Organizational Competitiveness. The mediating role of Green Procurement Orientation is essential because it can transform the sustainability orientation into the performance benefits in a way that is mediated. The results support the strategic significance of the GPO in the attainment of the sustainability and competitiveness goals.

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