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Review Article

Sustainable Procurement Practices in Humanitarian Organizations: Adaptive Capability and Co-Evolution as Antecedents in a Developing Economy

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ABSTRACT

This study examines the interplay among co-evolution, adaptive capability, and sustainable procurement practices in Humanitarian Organisations (HOs). In addition, it examines the mediating role of adaptive capability in the relationship between co-evolution and sustainable procurement practices. Following a positivistic stance, data collected from 79 HOs at a particular point in time were evaluated using partial least squares structural equation modelling (PLS-SEM) with SmartPLS version 4.0.9.0. The results reveal significant positive relationships between co-evolution, adaptive capability, and sustainable procurement practices. Further, adaptive capability mediates the relationship between co-evolution and sustainable procurement practices. In order to achieve sustainable procurement practices in HOs, the study concludes and recommends that co-evolution with agents in the procurement environment needs to be considered and adaptive capability strengthened and streamlined. The findings should, however, be interpreted within the limitations of the research design, since the results do not capture the different levels at which HOs practice procurement sustainability; hence, future research is encouraged to employ longitudinal and qualitative analysis. This study is novel in demonstrating how co-evolution relates to adaptive capability and sustainable procurement practices. It also explains the role that adaptive capability plays in the relationship between co-evolution and sustainable procurement practices.

KEYWORDS

Sustainable procurement practices; co-evolution; adaptive capability; humanitarian organizations; complex adaptive systems.

1. Introduction

Sustainable procurement and its effects on relief operations, society, and the environment have attracted considerable attention from researchers and humanitarian practitioners in recent years. To ensure sustainable humanitarian operations, it is essential to integrate sustainable procurement practices (SPP) throughout humanitarian activities. Following the adoption of the Sustainable Development Goals (SDGs) by United Nations Member States in 2015, efforts have been made to promote sustainable procurement practices, particularly in accordance with SDG 12 and Target 12.7. SPP entails integrating environmental, social, and economic considerations into the procurement of goods, works, and services (Brammer & Walker, 2011). In humanitarian operations, sustainable procurement involves incorporating these considerations into the acquisition of relief items, works, and services required to respond to humanitarian needs (Zarei, Carrasco-Gallego, & Ronchi, 2019).

The procurement of works in humanitarian operations may include the opening of access roads, construction of temporary shelters and permanent settlements, and extension of water and other essential infrastructure. Services may include education, medical care, sanitation, water, protection, and hygiene, while relief items include food and non-food items (Tay, Loh, & Chen, 2025).

Procurement expenditure accounts for approximately 65% of the costs of humanitarian relief operations (Moshtari, Altay, Heikkilä, & Gonçalves, 2021). Given such substantial expenditure, sustainable procurement has the potential to make a significant contribution to sustainable humanitarian operations by considering the economic, environmental, and social implications of procurement decisions. Sustainability is also increasingly recognized as important to disaster response, recovery, and resilience (Djordjević & Gačić, 2024).

Despite the role of SPP in achieving sustainable development and supporting sustainable operations, its implementation remains challenging. Studies show that sustainable procurement is influenced by organizational, institutional, managerial, and contextual conditions (Brammer & Walker, 2011; Raj, Agrahari, & Srivastava, 2020; Zaidi, Mirza, Hou, & Ashraf, 2019). These challenges may be particularly significant in developing-country contexts, where institutional and organizational constraints can hinder sustainable procurement implementation (Zaidi et al., 2019).

The complex environment within which humanitarian organizations operate, characterized by uncertainty, changing conditions, multiple actors, resource constraints, and the need to meet varied beneficiary needs rapidly, may further hinder the attainment of sustainable procurement (Wankmüller & Reiner, 2021). Humanitarian organizations must respond quickly to beneficiary requirements while simultaneously interacting with suppliers, donors, government institutions, communities, and other humanitarian actors (Moshtari et al., 2021; Zarei et al., 2019). Evidence from Uganda shows that the structure of humanitarian organizational networks and coordination among actors are important in disaster response (Masaba, Aryatwijuka, Ntayi, & Bagire, 2025).

Extant literature on sustainable procurement focuses largely on organizational pressures (Raj et al., 2020), organizational culture, innovation capability and stakeholders (Al Nuaimi, Khan, & Ajmal, 2020), management and institutional drivers (Kannan, 2021), and awareness of sustainable procurement practices (Testa, Iraldo, Frey, & Daddi, 2012). However, much of this research has been conducted in public-sector and conventional supply-chain settings (Brammer & Walker, 2011; Kannan, 2021; Zaidi et al., 2019). Studies in the humanitarian sector have concentrated mainly on non-sustainable procurement concepts, for example, inter-organizational coordination and adaptability (Mutebi, Ntayi, Muhwezi, & Munene, 2020), supply-chain agility (Mutebi, Muhwezi, & Munene, 2021), supply-chain performance (Aryatwijuka, Kamukama, Frederick, & Rukundo, 2021), organizational learning and role clarity (Mutebi, Muhwezi, Ntayi, Mayanja, & Munene, 2022), and stakeholder expectations, inter-organizational coordination and procurement practices (Mutebi et al., 2025).

To a large extent, these scholarly works have not considered sustainable procurement practices in humanitarian organizations. Yet humanitarian operations are conducted in complex environments in which organizations must interact, coordinate, learn, and adapt to changing circumstances. Humanitarian logistics has consequently been examined through a Complex Adaptive Systems (CAS)

perspective because of the complexity and interaction that characterize humanitarian operations (Schiffing, Hannibal, Tickle, & Fan, 2022).

The current study contends that the level of sustainable procurement practice adoption in relief operations may vary according to organizations' interactions with suppliers and other actors within their operating environment (co-evolution), as well as their capacity to adjust to changes in the operating environment (adaptive capability). Evidence from humanitarian organizations in Uganda indicates that stakeholder expectations and inter-organizational coordination are associated with procurement practices (Mutebi et al., 2025). However, there is scant literature focusing specifically on how co-evolution and adaptive capability contribute to the adoption of SPP in humanitarian operations.

Existing literature therefore provides a constrained understanding of the contribution of Complex Adaptive Systems mechanisms to sustainable procurement practices in humanitarian supply-chain activities. Consequently, to address this gap, this study seeks to demonstrate how such mechanisms may explain sustainable procurement practices in humanitarian operations. The study develops and empirically examines a model through the lens of Complex Adaptive Systems theory (Schiffing et al., 2022).

According to Complex Adaptive Systems theory, organizations operating in complex environments interact with and adapt to other agents within their operating environments (Holland, 1992, 1995). Such interactions and adjustments may influence organizational practices and responses. Organizations with the capacity to adjust their internal structures, functions, and processes may be better positioned to respond to changing procurement requirements and stakeholder expectations. Similarly, interaction and coordination among organizations may influence procurement practices in humanitarian operations (Masaba et al., 2025; Mutebi et al., 2025). This study therefore fills the observed gap by developing a conceptual model anchored in Complex Adaptive Systems theory to clarify how co-evolution and adaptive capability are associated with sustainable procurement practices in humanitarian operations.

2. Theoretical Review and Development of Hypotheses

2.1. Complex Adaptive System

Holland (1995) described a complex adaptive system (CAS) as an integrated system that develops over time based on its learning and adaptation characteristics. According to CAS theory, systems may experience abrupt and unforeseen transformations as they interact with and respond to changes in their environments. Besides understanding and fulfilling their roles, organizations need to respond to the needs of their clients if they are to survive. In fulfilling their roles, agents develop distinct relationships with other operating organizations that influence their actions and outcomes (Stacey, 2007). Due to changes in the environment, organizations need to learn from the operating environment and from information and prior experience in order to organize and adjust accordingly (Holland, 1995). The sustainability of procurement practices may therefore depend on the co-evolution and adaptive capability of humanitarian organizations.

A system with adaptability is responsive, flexible, reactive, and proactive in responding to changes in its environment and the actions of other agents (Tukamuhabwa, Stevenson, Busby, & Zorzini, 2015). In this regard, resilience represents an important dimension of adaptive capability, enabling systems to withstand disruptions, learn from changing conditions, and adjust their responses. Cvetković (2026a, 2026b) and Cvetković, Milenković, Lukić, and Renner (2026) conceptualize resilience as a multidimensional and context-dependent construct that extends beyond recovery from disruptions to encompass adaptive learning, institutional capacities, and social interactions. In humanitarian operations, adaptability, organizational networks, and inter-organizational coordination are important in responding to complex operating environments (Mutebi et al., 2020). Similarly, evidence from humanitarian organizations in Uganda demonstrates the importance of organizational

networks and coordination in disaster response (Masaba et al., 2025). CAS characteristics such as co-evolution and adaptive capability may therefore help explain the economic, social, and environmental sustainability of procurement activities. Sustaining procurement practices in humanitarian settings is complex; hence, understanding them calls for a Complex Adaptive Systems lens. Therefore, CAS variables can be used to explain sustainable procurement practices within the complex environments surrounding humanitarian operations.

2.2. Sustainable Procurement in Humanitarian Organizations

As organizations increasingly engage in sustainability agendas, sustainable procurement practices have become an issue of growing concern. Various studies define sustainable procurement practices as activities implemented by organizations to purchase operational requirements in a manner that generates maximum economic and social benefits while minimizing environmental degradation and adverse effects on human health (Bugri, Michael, & Arthur, 2019). In this study, sustainable procurement practices refer to procurement practices that contribute to long-term organizational success by maintaining an appropriate balance among environmental, social, and economic considerations. Sustainable procurement practices are measured in accordance with Chen et al. (2020). Examples include developing sustainability-focused procurement policies, dealing with suppliers with high sustainability ratings, and implementing written procurement policies that demonstrate commitment to environmentally friendly products and services. Sustainable procurement policies can address climate-change and social concerns, making their adoption increasingly important. Sustainability measures can therefore contribute to reducing environmental degradation while creating a more equitable, safer, and healthier society (Alibašić, 2018). The integration of sustainability into disaster management and recovery is also increasingly recognized as important for strengthening long-term resilience (Djordjević & Gačić, 2024).

Despite their importance, sustainable procurement practices among humanitarian organizations remain limited (Balcik & Ak, 2014; Ertem & Buyurgan, 2013). Failure to embrace sustainable procurement may undermine stakeholder confidence and the ability of humanitarian organizations to meet growing expectations for responsible use of resources (Walker & Brammer, 2009). This is particularly important because humanitarian organizations operate within networks involving donors, suppliers, governments, implementing partners, and beneficiaries, making coordination among these actors important for effective humanitarian response (Masaba et al., 2025). Humanitarian organizations also struggle to implement sustainable procurement practices because of limited flexibility, difficulties in adjusting to constantly evolving requirements and conditions, inadequate involvement of suppliers and other partners, regulatory compliance challenges, procurement fraud, and limited budgets (Moshtari et al., 2021). These constraints suggest that sustainable procurement in humanitarian settings requires organizations that can adapt their procurement practices and effectively interact with actors within their operating environment. Given the limited understanding of how humanitarian organizations achieve sustainable procurement under such dynamic conditions, this study examines sustainable procurement practices in humanitarian organizations.

2.3. Co-evolution

Co-evolution describes the feedback arising from interactions between organizations and their ecosystems. According to Norgaard (1981, 1994), co-evolution is a multilayered and interlinked process. The Norgaard school argues that humans change their environments both materially and cognitively. Organizations today operate in environments that are highly dynamic and uncertain (Stacey, 2007). Notwithstanding the calls for a co-evolutionary narrative, few studies have examined how co-evolution leads to sustainable activities in scientific domains as well as business management (Abatecola, 2013; Murmann, 2013). Sustainable practices are progressively viewed not as static organizational activities but as adaptive and open processes shaped by co-evolutionary dynamics

(Djordjević & Gačić, 2024). The implication is that evolutionary perspectives are seen as an engine for navigating interlinked ecological, social, and socio-ecological systems, which are potentially consequential with increased awareness of interdependent aspects such as adaptive capability and the implementation of sustainable procurement practices (Milenković & Cvetković, 2025).

In the same way, humanitarian organizations operate in uncertain environments that require dynamic, evolving systems with nested hierarchies and multidimensional interactions to successfully implement sustainable procurement practices (Allen, 2001; Giampietro, 2004; Stacey, 2007). Humanitarian organizations also operate within interconnected networks in which interactions and coordination among actors are important for effective disaster response (Masaba et al., 2025). Given the urgency synonymous with emergency logistics activities, sustainable procurement practices in humanitarian organizations tend to adopt more responsive and adaptive procurement processes, only to experience fraud, receive quality-deficient goods, and encounter opacity amidst fiscal pressures (GHA, 2019; UNHCR, 2018; UNICEF, 2019). Yet, adaptation, non-linearity, emergence, and cross-scale interactions can provide them with the necessary resources to influence sustainable procurement practices and future outcomes from a co-evolutionary perspective (Levin et al., 2013; Milenković & Cvetković, 2025).

Humanitarian organizations need to recognize and reshape their acquisition practices through co-evolution to create different pathways that ensure adaptive capacities and, ultimately, the selection and maintenance of procurement procedures that provide relief supplies capable of satisfying the diverse demands of beneficiaries. Opportunities for sustainable procurement can be enhanced by implementing an evolutionary approach to humanitarian procurement practices, while resilience can also be strengthened (Djordjević & Gačić, 2024; Masaba et al., 2025).

2.4. Adaptive Capability

Changing operating environments require organizations to adapt. Miles, Snow, Meyer, and Coleman (1978) developed a framework in which organizations are divided into four patterns according to how they respond to disruptions and challenges: defenders, prospectors, analysers, and reactors. A broader version of this model was developed by DeSarbo, Di Benedetto, Song, and Sinha (2005). In addition to the original four types of behaviour, they incorporated organizational capabilities, performance, and environmental factors. Conversely, Hrebiniak and Joyce (1985) proposed a model of adaptability based on the interaction between environmental determinism and strategic choice or organizational reactions. A typology of organizational adaptability can therefore be developed when these aspects are considered together. As a result of these interactions, four types of adaptation are identified: natural selection, differentiation, strategic choice, and undifferentiated choice (Kaehler, Busatto, Becker, Hansen, & Santos, 2014).

According to the models developed, an organization's adaptive capability is strongly associated with its ability to change its competences, capabilities, and resources to meet the demands of a dynamic environment. Adaptive capacity is similarly associated with the ability of systems to adjust to adverse and changing conditions and reduce their vulnerability (Rahman et al., 2025). Especially in humanitarian work, where change is constant, achieving organizational objectives requires continuous adaptation as well as strategic flexibility. Humanitarian organizations operate within complex networks in which effective coordination and interaction among actors are important for responding to changing disaster conditions (AbuRamadan & El-Mougher, 2022; Masaba et al., 2025). Without room for emerging strategies, deliberate strategies could confine an organization to its past and limit its success in the future (Winter, 2003).

Organizations are considered adaptive when they are able to modify, reconfigure, or connect their resources, capabilities, and competences in order to remain relevant. Adaptive capability is therefore particularly important in disaster environments characterized by changing vulnerabilities, uncertainty, and resource constraints (Rahman et al., 2025). For this reason, organizations seek to increase

the flexibility of their strategic responses in order to keep pace with rapidly changing environments and strengthen their capacity to respond effectively.

2.5. Co-evolution and Sustainable Procurement Practices in Humanitarian Organizations

In a constantly changing business environment, it is inevitable that organizations learn to evolve and do so quickly (Winter, 2003). One of the key ingredients in implementing sustainable procurement practices, particularly in humanitarian work, is the capacity to adjust to the demands of a specific task. Humanitarian work is rarely homogeneous; that is, there are no perfectly identical tasks for which an organization can use the same methodology or approach to achieve the same goal (Kovács & Spens, 2007). In such an operating environment, humanitarian organizations are required to constantly redesign and reform their methodologies, strategies, structures, or approaches to delivering aid (Van Wassenhove, 2006). For example, the European Union has developed a Humanitarian Logistics Policy aimed at providing a flexible and co-evolutionary process for logistics and procurement (Andrecka, 2017).

Kolk and Tsang (2017) investigated co-evolution in China with regard to small cars and sustainability, particularly the interactions between businesses and government departments. The study's findings indicated that China's central government implemented measures to promote the manufacture, acquisition, and use of compact automobiles, which were expected to advance social, economic, and ecological goals. The findings revealed that co-evolution leads to sustainable sourcing portfolios that promote green procurement. Similarly, Lema, Rabellotti, and Gehl Sampath (2018) studied how innovation systems and global value chains co-evolve in developing nations. Their findings revealed that co-evolution, in the form of novelty and efficiency, improved home-grown innovation capabilities, with potentially positive outcomes for overall competitiveness and ethical purchasing. The authors concluded that integrating businesses from resource-constrained environments into international value-chain ecosystems of innovation shapes the development of technological and innovative capabilities at the firm level and across different geographical scales, thereby supporting sustainable economic development.

According to Naveed, Watanabe, and Neittaanmäki (2017), the co-evolving interaction between streaming infrastructure and live-music value chains paved the way for the US music industry to thrive sustainably. Similarly, the integration of sustainable purchasing regulations and consumer intelligence tools can create a flexible structure for the economic performance of products throughout their lifespan, thereby enhancing supply in response to demand for products that promote circularity through accurate information on product specifications (Sarkis, 2012). Consumer information tools currently provide product-specific criteria, including durability standards, the use of recycled materials, and recycling alternatives. More recently, Khine, Tay, and Loh (2026) found that sustainable humanitarian procurement requires context-specific supplier evaluation that integrates economic, resilience, social, and environmental considerations, with procurement priorities changing between emergency and non-emergency situations. These findings suggest that continuous interactions between organizations and their changing environments can reshape procurement practices and support sustainability. In humanitarian organizations, where procurement decisions occur within dynamic and interconnected environments, co-evolution is therefore expected to enhance the implementation of sustainable procurement practices. Hence, the following hypothesis is proposed: H1. Co-evolution is positively associated with sustainable procurement practices.

2.6. Co-evolution and adaptive capability

Humanitarian operations involve multiple interacting agents of varying sizes, mandates, and motivations that continuously co-evolve within complex environments (Mitchell, 2009). These interactions enable actors to leverage complementary capabilities, thereby enhancing the effectiveness of procurement activities in humanitarian settings (Rice, 2005). Through this co-evolutionary process,

humanitarian organizations (HOs) develop adaptive capabilities that enable them to modify procurement practices based on accumulated learning and experience (Teece, 2007). This is consistent with the dynamic capabilities perspective, which focuses on how organizations build and reconfigure their competencies in response to evolving operational conditions.

Conceptualizing humanitarian procurement systems as complex adaptive systems (CAS) provides a useful theoretical lens for understanding their nonlinear, emergent, and self-organizing nature (Mitchell, 2009). Within such systems, traditional linear and rigid procurement approaches become less effective, necessitating flexible and adaptive procurement structures capable of responding to volatile and uncertain conditions (Schiffling et al., 2022). Recent disaster-management research similarly emphasizes adaptive governance, interconnectedness, learning, and flexible responses as important mechanisms for addressing complex and systemic risks (Gavrić & Trivan, 2026).

The co-evolution of actors within these systems produces nonlinear interactions over time, leading to emergent capabilities such as environmental scanning, adaptive decision-making, and resilience (Brynjolfsson & McAfee, 2014; Eisenhardt & Martin, 2000). These capabilities are critical in enabling HOs to mobilize and allocate resources efficiently across time and space, ensuring timely procurement and delivery of humanitarian goods (Kovács & Spens, 2007; Van Wassenhove, 2006). Furthermore, adaptive capabilities enable humanitarian organizations to continuously redesign procurement practices in response to both internal dynamics and external environmental pressures (Teece, 2007; Winter, 2003). These adaptations are shaped not only by organizational learning but also by ongoing interactions between agents and their operating environments, reinforcing the evolutionary nature of humanitarian supply systems (Holland, 1992). Evidence from disaster contexts also suggests that accumulated operational experience can strengthen organizational learning, adaptive capacity, and long-term resilience (Islam et al., 2026).

Importantly, no single agent possesses the capacity to manage the full complexity of humanitarian procurement systems. Instead, system-wide coordination and collective action are required to achieve effective outcomes (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007; Senge, 1990). This underscores the significance of systems thinking and inter-organizational collaboration in strengthening adaptive capability and procurement performance in humanitarian contexts. Consequently, continuous interaction, learning, and co-evolution among humanitarian actors are expected to strengthen their ability to reconfigure resources and respond to changing operating conditions. Therefore, the following hypothesis is proposed: H2: Co-evolution is positively associated with adaptive capability.

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2.7. Adaptive Capability and Sustainable Procurement Practices

Organizational adaptability plays a critical role in enabling humanitarian actors to re-establish operational order, coordinate effectively, and align their roles with their respective mandates in order to achieve intended relief outcomes (Mutebi et al., 2020). In highly volatile and uncertain environments, adaptability enhances an organization's capacity to respond promptly to evolving conditions, thereby increasing operational flexibility and improving responsiveness to beneficiaries' needs. This, in turn, strengthens the ability of implementing partners to deliver timely and context-appropriate interventions (Dubey et al., 2020).

Moreover, adaptability facilitates the continuous realignment of organizational processes and resources, enabling humanitarian actors to respond proactively to environmental disruptions and emerging demands. Such adaptability reinforces overall operational effectiveness by allowing organizations to adjust their existing capabilities and resources in accordance with changes in the operating environment (Teece, 2007). In this regard, adaptive capability is important for sustaining procurement practices in humanitarian organizations operating under changing and uncertain conditions. We therefore hypothesize that: H3: Adaptive capability is positively associated with sustainable procurement practices.

2.8. Mediating Role of Adaptive Capability between Co-evolution and Sustainable Procurement Practices

Extant literature suggests that co-evolution can influence sustainable procurement practices both directly and indirectly through adaptive capability. Humanitarian organizations operate within complex systems involving continuous interactions with suppliers, donors, governments, communities, and other humanitarian actors (Mitchell, 2009). Through these interactions, organizations acquire knowledge, learn from experience, and adjust their structures and practices to changing conditions. Such co-evolutionary processes strengthen the ability of humanitarian organizations to adapt their procurement activities to uncertain and dynamic operating environments (Mutebi et al., 2020; Teece, 2007).

Adaptive capability therefore provides an important mechanism through which the benefits of co-evolution are translated into sustainable procurement practices. Although interaction and knowledge exchange may expose humanitarian organizations to new sustainability requirements and practices, their implementation requires the ability to reconfigure organizational resources, processes, and procurement routines. This is particularly important in humanitarian contexts characterized by uncertainty, changing beneficiary needs, resource constraints, and supply disruptions (Kovács & Spens, 2007; Van Wassenhove, 2006). Adaptive capability enables organizations to respond to these changes by modifying sourcing strategies, supplier relationships, specifications, and procurement procedures while incorporating economic, environmental, and social considerations.

From a complex adaptive systems perspective, organizational outcomes emerge through continuous interaction, learning, feedback, and adaptation among interconnected actors (Holland, 1992). Accordingly, co-evolution generates knowledge and learning, while adaptive capability enables humanitarian organizations to translate such learning into appropriate organizational responses. Evidence from humanitarian organizations in Uganda further demonstrates that relationships among actors alone may not be sufficient to produce desired outcomes; intervening organizational mechanisms such as coordination help translate network interactions into improved disaster response (Masaba et al., 2025). In a similar manner, adaptive capability can provide the mechanism through which co-evolutionary interactions are transformed into sustainable procurement practices.

Therefore, co-evolution is expected to enhance adaptive capability through continuous interaction, learning, and mutual adjustment, while adaptive capability subsequently enables humanitarian organizations to integrate sustainability considerations into procurement decisions. Adaptive capability thus explains, at least partly, how and why co-evolution contributes to sustainable procurement practices. Based on this reasoning, the study hypothesizes that: H4: Adaptive capability mediates the positive relationship between co-evolution and sustainable procurement practices in humanitarian organizations (Figure 1).

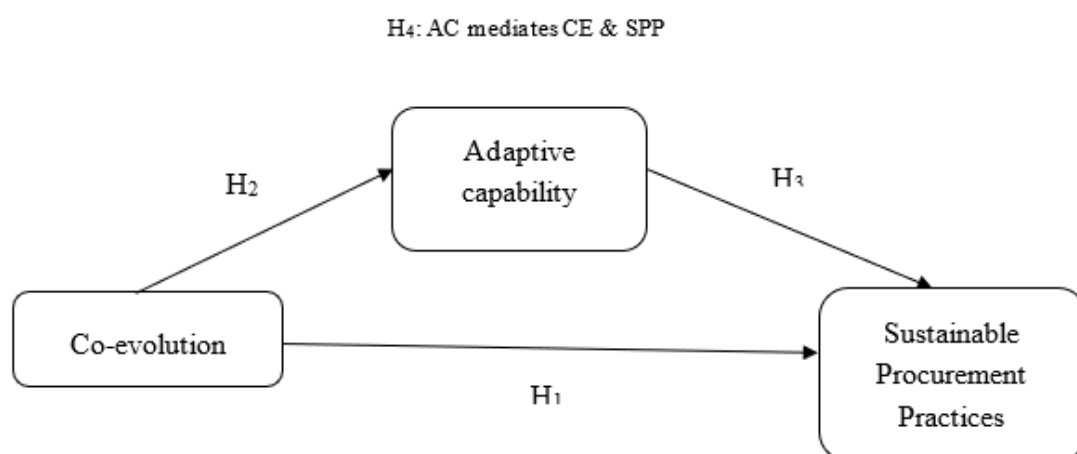


Figure 1. Conceptual framework

3. Methods

3.1. Research Design, Study Population and Sample Size

This study employed a quantitative, descriptive cross-sectional survey design. The quantitative cross-sectional approach was appropriate as it facilitates the collection of large volumes of objectively measurable data based on respondents' perceptions of the study variables, enabling the testing of pre-specified postulations at a single point in time (Setia, 2016).

To ensure representativeness, a sample of 79 organisations was drawn from a study population of 105 humanitarian organisations, as determined using the Yamane (1967) formula. Because data were obtained from multiple informants within the same humanitarian organisation, individual responses were aggregated to the organisational level. A total of 113 responses were received from respondents representing the 79 humanitarian organisations and were subsequently aggregated at the organisational level.

Prior to aggregation, the appropriateness of combining informant responses was evaluated by examining interrater reliability and within-organisation agreement using the intraclass correlation coefficients ICC(1) and ICC(2), together with the within-group agreement index (rwg), following Bliese (2000). The results provided strong support for aggregation, with ICC(1) = 0.68, ICC(2) = 0.94, and rwg = 0.91, indicating substantial agreement and reliability among informants from the same organisation. Accordingly, responses from informants belonging to each organisation were averaged to derive organisation-level composite scores. This aggregation procedure yielded a final analytical sample of 79 humanitarian organisations, which constituted the organisational-level units of analysis used in the subsequent statistical analyses.

Descriptive findings presented in Table 1 indicate that most of the participating organisations operate within the Health and Nutrition sector, followed by those engaged in core humanitarian services, Water, Sanitation and Hygiene (WASH), and food assistance.

In terms of operational experience, most organisations have been active in the settlements for over 20 years, with a substantial proportion having operated for between 5 and 10 years. This suggests a high level of institutional experience and enhances the credibility of the responses provided regarding sustainable procurement practices.

Furthermore, the majority of organisations reported employing more than 200 staff, followed by those with 151–200 employees, indicating substantial organisational capacity to manage procurement processes and effectively deliver humanitarian assistance across diverse geographical locations. (Table 1).

Table 1. Organizational characteristics

Org. Tenure in years	F	%	NGO Sector	F	%
Up to 5	10	13.2	Food	8	10.5
5 - 10	26	32.5	Wash	9	11.4
11 - 15	8	10.5	Education	6	7.9
16 - 20	7	8.8	Health & Nutrition	24	29.8
Over 20	28	35.1	Shelter & infrastructure	3	4.4
Total	79	100	Core relief	17	21.1
No. of Employees	F	%	Logistics	3	4.4
Below 50	2	2.6	Protection	7	8.8
50 -100	8	9.6	Energy & environment	2	1.8

Org. Tenure in years	F	%	NGO Sector	F	%
101 - 150	13	16.7	Total	79	100
151 - 200	21	27.2			
Above 200	35	43.9			
Total	79	100			

With respect to the unit of analysis, the findings presented in Table 2 indicate that the majority of participants were male, suggesting a higher representation of men within humanitarian organisations, particularly in roles that demand operational flexibility and the capacity to manage the intensive nature of humanitarian work.

Regarding age distribution, most respondents were within the 35–40-year age bracket, followed by those aged 30–35 years. In addition, a substantial proportion had been employed within their respective organisations for more than six years, reflecting considerable institutional experience. The respondents also reported educational attainment of at least a bachelor's degree, with many possessing advanced degrees and professional certifications, indicating a strong foundation of knowledge and expertise relevant to sustainable procurement practices.

Regarding professional roles, most participants held positions as Procurement Officers, followed by Logistics Managers. This distribution suggests that the data were obtained from individuals directly involved in procurement and logistics functions, thereby enhancing the reliability of the insights provided. Overall, the findings demonstrate that the respondents possessed substantial practical experience and technical competence, enabling them to provide informed perspectives on organisational procurement operations. (Table 2).

Table 2. Respondent characteristics

Gender	F	%	Educ Level	F	%
Male	66	58.4	Diploma	3	2.6
Female	48	41.6	Bachelor's	61	53.9
Total	113	100	PG Diploma	25	22.1
Age Bracket in years	F	%	Master's	24	21.4
Below 25 years	7	6.1	Total	113	100
25 - 30	23	20.5	Professional Certification	F	%
30 - 35	32	28.3	CPA	15	13.2
35 - 40	35	30.9	ACCA	21	18.5
40 - 50	15	13.3	CIM	17	15.0
Above 50 years	1	0.9	CIPS	28	24.7
Total	113	100	None	32	28.3
Employee Tenure in years	F	%	Total	113	100
< 5	40	35.4	Position Held	F	%
6 - 10	42	37.2	Logistics manager	33	29.2
11 - 15	25	22.2	Project Manager	26	23
16 - 20	4	3.5	Operations officer	20	17.8
> 20	2	1.7	Procurement Officer	34	30
Total	113	100	Total	113	100

3.2. Sampling Techniques, Data Collection and Ethical Considerations

Humanitarian organizations operating within refugee settlements were selected using a simple random probability-based sampling technique to enhance representativeness and minimize potential selection bias. This approach provides each organization within the sampling frame with an equal and independent chance of being selected, irrespective of its sectoral specialization or organizational size, thereby enhancing the representativeness and generalizability of the findings (Saunders, Lewis, & Thornhill, 2019).

A comprehensive sampling frame was constructed using an official registry of humanitarian organizations operating in Uganda. Each organization was assigned a unique identification number, after which a lottery-based random selection procedure was implemented. The identifiers were drawn without replacement until the target sample size of 79 organizations was achieved. The use of random selection without replacement ensured that each organization had an equal opportunity of being selected and that no organization was selected more than once.

To further enhance the quality of the data, a multi-informant approach was adopted within each selected organization. Key personnel directly involved in procurement and logistics functions—including procurement officers, supply chain officers, logistics coordinators, project managers, and operations managers—were purposively targeted as respondents because of their domain-specific knowledge and familiarity with organizational procurement and logistics activities. This approach helped to reduce reliance on a single key informant and improved the reliability of the data by capturing informed organizational perspectives from personnel directly involved in the activities under investigation.

Access to respondents was facilitated through the Human Resource (HR) departments of the participating organizations following formal approval. Structured questionnaires were distributed internally and were accompanied by a cover letter explaining the objectives of the study, assuring respondents of confidentiality and anonymity, and emphasizing that participation in the study was voluntary. Participants were given between one and two weeks to complete the questionnaire. This period was considered sufficient to allow respondents adequate time to understand the questions, reflect on the issues under investigation, and provide responses based on their knowledge and experience.

Completed questionnaires were returned in sealed envelopes through the HR departments and were subsequently collected by the researcher. This procedure was intended to maintain the confidentiality and integrity of the data while minimizing possible external influence during the response process. The use of sealed envelopes further ensured that individual responses were not accessible to organizational representatives involved in facilitating the data collection process.

To address potential non-response bias, follow-up reminders were issued through HR focal persons, while response rates were continuously monitored to ensure adequate representation across the participating organizational categories. Respondents were given sufficient time to complete and return the questionnaires, and follow-ups were undertaken without compelling individuals to participate. In addition, the use of a standardized questionnaire and uniform administration procedures across the participating organizations helped to reduce measurement error and enhance consistency in the data collection process.

To address potential common method bias (CMB), both procedural and statistical remedies were employed (Fuller, Simmering, Atinc, Atinc, & Babin, 2016; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Procedurally, validated measurement scales were used, questionnaire items were refined to improve clarity, and respondents were assured of confidentiality and anonymity. These measures were intended to reduce respondents' evaluation apprehension and the possibility of providing socially desirable responses. Statistically, Harman's single-factor test was conducted, and the results showed that the first factor explained only 28% of the total variance, which was below the commonly applied 50% threshold. Given the limitations associated with relying solely on Harman's single-factor test, an additional assessment of common method effects was undertaken. The results indicated

that common method effects were not substantial. Collectively, the procedural and statistical assessments suggest that common method bias was unlikely to materially influence the study findings.

Ethical considerations were observed throughout the data collection process. Formal permission to undertake the study was obtained from the relevant authorities and participating organizations before questionnaires were distributed. Respondents were informed about the purpose of the study and were assured that their participation was entirely voluntary. Confidentiality and anonymity were maintained throughout the research process, and the information obtained from respondents was used solely for academic purposes. Respondents were also free to decline participation or withdraw from the study without any adverse consequences. These procedures were intended to protect participants' rights and ensure that the study was conducted in accordance with accepted ethical principles in social science research.

Overall, the combination of probability sampling at the organizational level and purposive selection of knowledgeable respondents within the participating organizations strengthened the methodological rigor of the study. Simple random sampling minimized systematic selection bias at the organizational level, while purposive selection ensured that data were obtained from respondents with appropriate knowledge and experience of procurement and logistics activities. The multi-informant approach, standardized data collection procedures, measures to minimize non-response, and procedural and statistical controls for common method bias collectively strengthened the reliability and validity of the study findings.

3.3. Measurement and Operationalization of Study Variables

To confirm the validity and reliability of the study, all study variables were adopted and adapted from established measurement scales in prior scholarly literature, as detailed in Table 3. (Table 3).

Table 3. Operationalization and measurement of constructs
(REFERENCE DETAILS COULD NOT BE VERIFIED – PLEASE CHECK) [Ali et al., 2017; Chen et al., 2020].

Study variable	Constructs	Items	Source (Author/s)
Co-evolution	Boundary spanning Complementarity	The construct was operationalized using 10 items reflecting the dimensions of boundary spanning and complementarity. All items were operationalised and anchored on a 5-point Likert scale with options ranging from strongly agree (1) and strongly disagree (5).	Mayanja, Ntayi, Omeke, Kibirango, and Mutebi (2022); Richter, Schlaegel, Midgley, and Tressin (2019)
Adaptive capability	Horizontal scanning Change management Resilience	The construct was measured using 14 items encompassing the dimensions of time horizon, change management, and resilience. All items were operationalised and anchored on a 5-point Likert scale with options ranging from strongly agree (1) and strongly disagree (5).	Arndt and Gould (2010)Ali et al. (2017)
Sustainable procurement practices		Assessed using 14 items, All items were operationalised and anchored on a 5-point Likert scale with options ranging from strongly agree (1) and strongly disagree (5).	Chen et al. (2020)

3.4. Data Management and Analysis

To address the objectives of the study and examine the associations among the research variables, Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed using SmartPLS ver-

sion 4.0.9.0. This technique was deemed appropriate given the study's objective of simultaneously assessing both direct and indirect relationships within a complex theoretical model (Ramli, Latan, & Nartea, 2018). Consistent with established PLS-SEM procedures, the measurement model was first assessed to establish construct reliability and validity. This involved examining indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Subsequently, the structural model was assessed to test the hypothesized relationships among the study constructs. PLS-SEM was particularly suitable because of its robustness and capacity to estimate both direct and mediating effects concurrently. Structural model evaluation included an assessment of collinearity among the predictor constructs, the significance and relevance of the path coefficients, and the model's explanatory power using the coefficient of determination (R^2). The model's predictive performance was further examined using PLSpredict, with Q^2 predict, Root Mean Square Error (RMSE), and Mean Absolute Error (MAE) used as relevant prediction statistics (Shmueli et al., 2019). To determine the statistical significance of the hypothesized direct and indirect relationships, a bootstrapping procedure with 5,000 resamples was performed, following recommended PLS-SEM guidelines (Hair, Hult, Ringle, & Sarstedt, 2022).

4. Results

4.1. Measurement validation

Following data collection, the data were preliminarily processed through coding, cleaning, and entry into the Statistical Package for the Social Sciences (SPSS) version 26. The measurement instrument was subsequently assessed for reliability and validity using the PLS-SEM measurement model. Given that the study incorporates higher-order constructs (HOCs), specifically co-evolution and adaptive capability modelled as reflective-formative constructs, the assessment considered both the lower-order constructs (LOCs) and their respective higher-order constructs in accordance with established PLS-SEM procedures (Hair et al., 2022; Sarstedt, Hair, Cheah, Becker, & Ringle, 2019).

Reliability of the reflective constructs was assessed using composite reliability, with values of 0.70 and above indicating satisfactory internal consistency reliability (Hair et al., 2022). Convergent validity was evaluated using indicator loadings and Average Variance Extracted (AVE), with AVE values exceeding 0.50 considered acceptable. Discriminant validity among the reflective constructs was examined using the Heterotrait-Monotrait (HTMT) ratio, with values below the conservative threshold of 0.85 indicating adequate distinctiveness between the constructs (Henseler, Ringle, & Sarstedt, 2015; Hair et al., 2022).

For the formative components of the higher-order constructs, the assessment focused on collinearity among the dimensions and the significance and relevance of their outer weights (Sarstedt et al., 2019). Collinearity was assessed using the Variance Inflation Factor (VIF), while the significance and relevance of the outer weights were examined to establish the contribution of the respective lower-order dimensions to the higher-order constructs. These criteria were considered appropriate because co-evolution and adaptive capability were specified as reflective-formative higher-order constructs.

Consistent with established guidelines, indicator loadings were expected to exceed 0.708 to demonstrate adequate indicator reliability (Hair et al., 2022). The results presented in Table 4 confirm that all retained measurement items satisfied this requirement, with indicator loadings ranging from 0.717 to 0.872. Furthermore, composite reliability values ranged from 0.773 to 0.886, exceeding the recommended threshold of 0.70 and, therefore, indicating satisfactory internal consistency reliability across the lower-order reflective constructs.

Finally, convergent validity was confirmed, as all constructs reported AVE values above the recommended threshold of 0.50. Specifically, the AVE values ranged from 0.632 to 0.683, indicating that each construct explained more than 50% of the variance in its respective indicators. These results provide evidence of satisfactory convergent validity and, together with the indicator loadings and

composite reliability results, demonstrate adequate reliability and validity of the lower-order reflective measurement models. (Table 4).

Table 4. Reliability and validity of Lower Order Constructs (LOC)

Constructs	Item Codes	Item Loading	Composite reliability (rho_c)	Average variance extracted (AVE)
Complementarity	C1	0.784	0.886	0.659
	C2	0.806		
	C3	0.825		
	C4	0.832		
BoundarySpanning	CE1	0.801	0.852	0.657
	CE5	0.850		
Sustainable Procurement practices	SPP2	0.869	0.846	0.648
	SPP7	0.773		
	SPP8	0.768		
Resilience	RE1	0.717	0.777	0.637
	RE2	0.872		
HorizontalScanning	HS2	0.799	0.811	0.683
	HS5	0.853		
ChangeMangement	CM2	0.730	0.773	0.632
	CM4	0.855		

In addition to evaluating the lower-order constructs, the measurement properties of the higher-order constructs were examined in accordance with established PLS-SEM guidelines (Hair et al., 2022; Sarstedt et al., 2019). As presented in Table 5, Cronbach's alpha values ranged from 0.841 to 0.879, while rho_A values ranged from 0.868 to 0.886. Similarly, composite reliability (rho_C) values ranged from 0.903 to 0.943. These values exceeded the recommended threshold of 0.70, indicating satisfactory internal consistency reliability of the construct scores.

Convergent validity was also assessed using the Average Variance Extracted (AVE). The AVE values ranged from 0.718 to 0.892, exceeding the recommended minimum threshold of 0.50. These results provide evidence of satisfactory convergent validity. However, because adaptive capability and co-evolution were specified as reflective–formative higher-order constructs, further assessment of their formative higher-order components was undertaken by examining collinearity and the significance and relevance of the outer weights, consistent with the recommendations of Sarstedt et al. (2019). (Table 5).

Table 5. Reliability and validity of Higher Order Constructs (HOC)

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
AdaptiveCapability	0.879	0.886	0.943	0.892
Coevolution	0.869	0.876	0.911	0.718
Sustainable procurement practices	0.841	0.868	0.903	0.756

4.2. Discriminant Validity for LOC and HOC

Discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio to determine the degree to which the constructs are empirically distinct. Consistent with the recommended thresholds, HTMT values below 0.85 indicate adequate discriminant validity (Hair et al., 2022). The results demonstrate that all inter-construct HTMT values for both the lower-order constructs (LOCs) and higher-order constructs (HOCs) fall below the prescribed threshold. This confirms that the constructs exhibit sufficient distinctiveness and are not capturing overlapping conceptual domains, as presented in Tables 6 and 7. (Table 6).

Table 6. Discriminant Validity (LOC)

Constructs	1	2	3	4	5	6
BoundarySpanning						
ChangeMangement	0.688					
Complementarity	0.690	0.635				
Sustainable procure- ment practices	0.588	0.647	0.430			
HorizontalScanning	0.482	0.377	0.615	0.556		
Resilience	0.674	0.726	0.390	0.419	0.631	

Discriminant validity for the higher-order constructs is reported (Table 7).

Table 7. Discriminant Validity (HOC)

	AdaptiveCapacity	Coevolution	SP
Adaptive Capability			
Coevolution	0.839		
Sustainable Procurement practices	0.740	0.731	

Finally, the significance and relevance of the formative lower-order construct (LOC) outer weights were assessed in line with established guidelines (Sarstedt et al., 2019). The findings indicate that all outer weights are statistically significant, with p-values below 0.001 and bias-corrected and accelerated (BCa) confidence intervals further supporting their significance. These findings provide strong evidence for the adequacy of the reflective–formative measurement specification, as presented in Table 8. (Table 8).

Table 8. Significance of the outer path weights

	Estimates	T stat	P values	Bca
BoundarySpanning -> Coevolution	0.388	6.759	0.000	0.302 - 0.530
ChangeMangement -> AdaptiveCapacity	0.386	6.969	0.000	0.306 - 0.520
Complementarity -> Coevolution	0.370	11.607	0.000	0.318 - 0.446
HorizontalScanning -> AdaptiveCapacity	0.518	8.078	0.000	0.431 - 0.694
Resilience -> AdaptiveCapacity	0.379	5.989	0.000	0.279 - 0.510

4.3. Hypotheses Testing Results

The results presented in Table 9 indicate a statistically significant and positive association between co-evolution and sustainable procurement practices. This finding suggests that, through continuous interaction and collaboration, humanitarian organizations (HOs) can influence supplier behavior

toward adherence to ethical labor standards, including the provision of fair wages and the elimination of child labor practices. Moreover, close engagement with suppliers facilitates enhanced information exchange, enabling organizations to identify and integrate sustainability considerations into procurement decisions. For instance, HOs are better positioned to prioritize sourcing from minority- and women-owned enterprises, as well as from suppliers that adhere to recognized environmental and social certification standards.

In addition, collaborative relationships promote the diffusion of knowledge and best practices, thereby encouraging the adoption of innovative and sustainable procurement approaches. These may include exploring circular economy initiatives, promoting resource reuse and recycling, and adopting energy-efficient technologies aimed at reducing environmental impacts. Overall, such interactions foster a more integrated and systemic approach to procurement that accounts for the environmental, social, and economic dimensions of sustainability.

The results further show a significant positive relationship between co-evolution and adaptive capability, indicating that increased interaction among organizational actors enhances the development of critical capabilities such as change management and resilience. These capabilities are essential for coping with the complex dynamics associated with the implementation of sustainable procurement practices. Additionally, adaptive capability is significantly and positively associated with sustainable procurement practices, suggesting that organizations with stronger resilience and change-management capabilities are better equipped to design and implement procurement policies that incorporate sustainability criteria, including the integration of sustainability considerations into supplier evaluation during tendering processes.

Following the mediation assessment procedures recommended by Nitzl et al. (2016), the mediating role of adaptive capability in the relationship between co-evolution and sustainable procurement practices was examined. The results reveal a significant indirect effect of co-evolution on sustainable procurement practices through adaptive capability ($\beta = 0.296$, $t = 2.374$, $p = 0.018$; BCa 95% CI [0.068, 0.556]). The direct effect of co-evolution on sustainable procurement practices remained positive and significant after the inclusion of adaptive capability ($\beta = 0.348$, $t = 4.883$, $p < 0.001$), while the total effect was $\beta = 0.644$. The indirect effect therefore accounts for approximately 46.0% of the total effect ($0.296/0.644 \times 100$). This indicates that a substantial proportion of the influence of co-evolution on sustainable procurement practices is transmitted through adaptive capability. Because both the direct and indirect effects are significant and operate in the same positive direction, the findings support complementary partial mediation (Nitzl, Roldán, & Cepeda-Carrión, 2016). Thus, co-evolution influences sustainable procurement practices both directly and indirectly through the development of adaptive capability.

Effect size (f^2) analysis was further undertaken to determine the substantive contribution of each exogenous construct to the explained variance of the respective endogenous constructs. Following Cohen's (1988) conventional benchmarks of 0.02, 0.15, and 0.35 for small, medium, and large effects, respectively, co-evolution demonstrates a large effect on adaptive capability ($f^2 = 1.246$). In contrast, the effects of co-evolution on sustainable procurement practices ($f^2 = 0.105$) and adaptive capability on sustainable procurement practices ($f^2 = 0.137$) are classified as small, although both approach the threshold for a medium effect. These results indicate that co-evolution makes a particularly substantial contribution to the development of adaptive capability.

The explanatory power of the structural model was assessed using the coefficient of determination (R^2). The model explains 55.5% of the variance in adaptive capability ($R^2 = 0.555$) and 48.6% of the variance in sustainable procurement practices ($R^2 = 0.486$). These results indicate that the model possesses meaningful explanatory power for the endogenous constructs (Hair et al., 2019).

Predictive relevance was further assessed using the Stone–Geisser Q^2 statistic. The Q^2 values for adaptive capability ($Q^2 = 0.249$) and sustainable procurement practices ($Q^2 = 0.190$) are both greater than zero, indicating that the model possesses predictive relevance for the endogenous constructs (Hair et al., 2019; Peng & Lai, 2012).

Furthermore, the model's out-of-sample predictive performance was assessed using the PLSpredict procedure with ten folds and ten repetitions, consistent with the predictive assessment approach advocated by Shmueli et al. (2016). The resulting MAE and RMSE values for sustainable procurement practices (0.638; 0.642) and adaptive capability (0.568; 0.560) were compared with those of the naïve linear benchmark model. The lower prediction errors generated by the PLS-SEM model relative to the benchmark model provide evidence of its out-of-sample predictive performance (Hair et al., 2019; Shmueli, Ray, Velasquez Estrada, & Chatla, 2016).

Overall, the findings provide empirical support for the proposed structural model. Co-evolution directly enhances sustainable procurement practices while simultaneously strengthening adaptive capability, which in turn contributes to sustainable procurement practices. The significant complementary partial mediation further demonstrates that adaptive capability represents an important mechanism through which co-evolution translates into sustainable procurement outcomes. The model also demonstrates meaningful explanatory and predictive capabilities, as summarized in Table 9 and Figure 2. (Table 9).

Table 9. Hypotheses results

Direct Path	β	T stat	P values	Bca	f2	VIF
AdaptiveCapability -> SPP	0.397	2.777	0.006	0.097 - 0.657	.137	2.246
Coevolution -> AdaptiveCapability	0.745	6.072	0.000	0.396 - 0.873	1.246	1.000
Coevolution -> SPP	0.348	4.883	0.000	0.318 - 0.825	.105	2.246
Indirect Path	β	T stat	P values	Bca		
Coevolution -> AdaptiveCapability -> SPP	0.296	2.374	0.018	0.068 - 0.556		
Total Effect	β	T stat	P values	Bca		
AdaptiveCapacity -> SPP	0.397	2.777	0.006	0.097 - 0.657		
Coevolution -> AdaptiveCapability	0.745	6.072	0.000	0.396 - 0.873		
Coevolution -> SPP	0.384	4.883	0.000	0.318 - 0.825		
Predictive criteria	R2	Adj. R2	Q2Pre-dict	RMSE	MAE	
Adaptive Capability	.555	.547	.249	.568	.560	
SPP	.486	.468	.190	.638	.642	

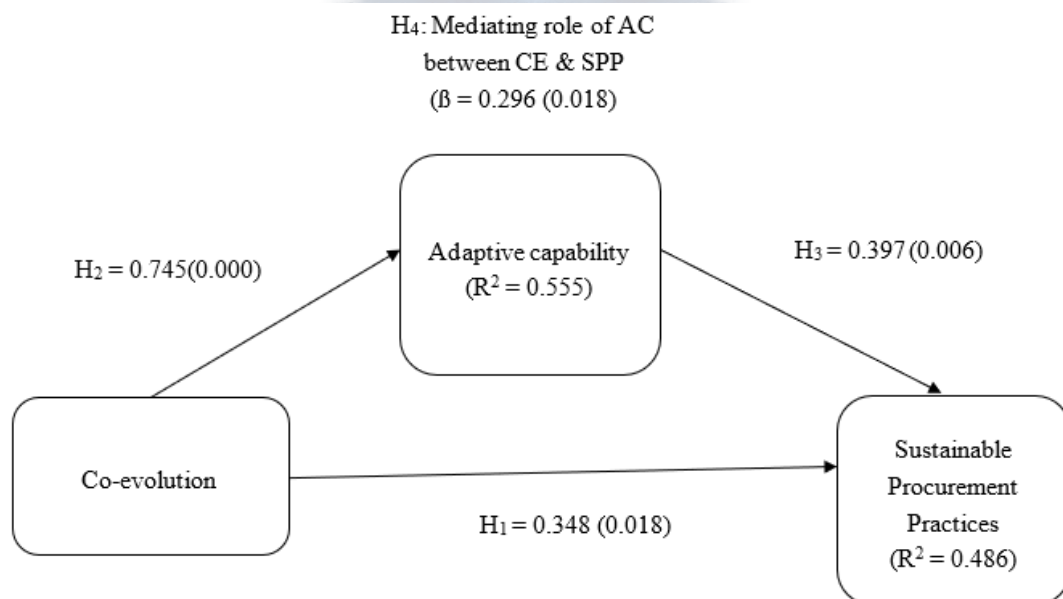


Figure 2. Tested Model.

5. Discussion of Findings

The study sought to examine the integrated role of complex adaptive system characteristics specifically co-evolution and adaptive capability—on sustainable procurement practices. The empirical findings strongly support the proposed model and offer important theoretical and practical insights.

First, the results confirm a significant positive relationship between co-evolution and sustainable procurement practices, thereby supporting Hypothesis 1. This suggests that increased interaction among humanitarian organizations (HOs) and their procurement partners enhances the adoption of environmentally, socially, and economically sustainable procurement practices. Through continuous engagement and information exchange, organizations are better positioned to align their procurement decisions with sustainability objectives. These findings reinforce prior research emphasizing the role of interactions among agents in achieving sustainable outcomes (Levin et al., 2013).

Furthermore, collaborative procurement practices, such as consortium purchasing and joint decision-making, enable organizations to reduce total procurement costs and lead times while maintaining sustainability standards. Open and reciprocal communication channels also facilitate the sharing of knowledge, experiences, and best practices, which can foster innovation in procurement processes. In this regard, HOs that actively engage with suppliers and other partners are more likely to enhance transparency, effectively monitor supplier performance, and ensure compliance with ethical and sustainability requirements.

Second, the study indicates a significant positive relationship between co-evolution and adaptive capability, thereby supporting Hypothesis 2. This finding indicates that interactions among organizational actors contribute to the development of important capabilities, such as change management and resilience. By engaging across organizational boundaries, HOs are better able to anticipate and respond to environmental uncertainties. This finding is consistent with the literature that emphasizes the importance of interaction and collaboration in shaping adaptive organizational structures (Kemp, Parto, & Gibson, 2005; Schiffling et al., 2022).

Moreover, collaboration enables organizations to develop a shared understanding of external conditions, including beneficiary needs, regulatory dynamics, and emerging procurement trends. Such shared understanding enhances the ability of organizations to design and implement responsive strategies and make appropriate operational adjustments. Additionally, continuous information sharing promotes the identification of new sustainability opportunities, including local sourcing, waste reduction, and environmentally responsible procurement practices. Importantly, these interactions may also give rise to emergent partnerships and innovative solutions that improve the efficiency and effectiveness of humanitarian response efforts.

Third, the findings confirm a significant positive relationship between adaptive capability and sustainable procurement practices, thereby supporting Hypothesis 3. Organizations with robust and flexible capabilities are better equipped to scan their operating environments, identify emerging trends, and adjust their procurement processes accordingly. For instance, continuous training of procurement personnel and the decentralization of procurement functions can enhance organizational flexibility and responsiveness.

In addition, organizations that regularly review and adjust their procurement schedules and operational procedures are more likely to identify and engage suppliers that meet sustainability criteria. Such adaptive practices not only improve procurement efficiency but also strengthen the integration of sustainability considerations into procurement decision-making. These findings are consistent with prior studies linking adaptive capability to improved organizational performance and sustainability outcomes (Abbasi, Nilsson, & Syntetos, 2018; Mutebi et al., 2020).

Finally, the study shows that adaptive capability partially mediates the relationship between co-evolution and sustainable procurement practices, accounting for approximately 46% of the total effect. This indicates that while co-evolution directly influences sustainable procurement practices, it also exerts an indirect influence through the development of adaptive capabilities. In practical terms,

organizations that engage in collaborative interactions are better able to scan their operating environments, manage change, and enhance supplier sustainability performance through mechanisms such as supplier auditing, monitoring, and evaluation.

This finding is consistent with the principles of complex adaptive systems (CAS) theory, which postulates that organizations operate as interconnected networks of agents whose interactions drive system evolution and adaptation. Through these interactions, HOs continuously learn and reconfigure their procurement practices, enabling them to operate effectively in complex and uncertain environments. The findings also align with empirical evidence suggesting that collaborative engagement among procurement partners enhances flexibility, responsiveness, and sustainability in procurement processes (Diop et al., 2022).

6. Conclusions

Grounded in Complex Adaptive Systems (CAS) theory as a theoretical lens, this study investigated the key antecedents of sustainable procurement practices. The empirical findings reveal that both co-evolution and adaptive capability exert significant positive effects on sustainable procurement practices. Furthermore, the results show that adaptive capability plays a partial mediating role in the relationship between co-evolution and sustainable procurement practices, suggesting that the influence of co-evolution is both direct and indirectly transmitted through the development of adaptive organizational capabilities.

Overall, the findings demonstrate that sustainable procurement practices are strengthened when humanitarian organizations continuously interact, learn, and co-evolve with relevant actors while simultaneously developing the capability to adapt to changes in their operating environment. From a CAS perspective, these findings highlight the importance of interconnectedness, continuous learning, and adaptation in enabling humanitarian organizations to respond effectively to environmental, social, and economic sustainability demands. The study therefore concludes that co-evolution and adaptive capability are important and complementary mechanisms through which humanitarian organizations can strengthen and sustain responsible procurement practices in complex and dynamic operating environments.

6.1. Theoretical Implications

The theoretical contributions of this study are twofold. First, the study extends Complex Adaptive Systems (CAS) theory by integrating co-evolution and adaptive capability to explain sustainable procurement practices in humanitarian organizations. While dynamic capabilities theory emphasizes internal organizational adaptation and inter-organizational collaboration perspectives focus on relationships among actors, CAS provides a broader systemic explanation of how interconnected actors continuously interact, adapt, and collectively shape procurement practices. The study therefore contributes to understanding sustainable procurement as an emergent outcome of interactions and adaptive processes within complex humanitarian systems.

Second, the study provides empirical support for the partial mediating role of adaptive capability in the relationship between co-evolution and sustainable procurement practices, extending the application of CAS theory to humanitarian operations (Schiffeling et al., 2022). Uganda's humanitarian context, characterized by resource constraints, environmental uncertainty, institutional complexity, and multiple interdependent stakeholders, provides a theoretically meaningful setting for examining these relationships. The findings suggest that adaptive capability represents an important mechanism linking co-evolutionary interactions with sustainable procurement practices under conditions of uncertainty and complexity.

6.2. Practical Implications

This study provides several actionable proposals for enhancing sustainable procurement practices within humanitarian organizations (HOs).

First, given the established positive relationship between co-evolution and sustainable procurement, HOs are encouraged to strengthen collaborative engagement with procurement partners throughout the procurement process. This entails fostering continuous interaction with suppliers, including systematic resource and information sharing. Such collaboration enables organizations to better understand supplier perspectives, promote mutual learning, and enhance buyer–supplier coordination, ultimately contributing to cost efficiencies, including reductions in maintenance and operational costs.

Moreover, HOs should prioritize partnerships with suppliers whose systems and operational practices are compatible, as this facilitates smoother coordination and supports adherence to ethical and sustainability standards, including fair labour practices and the avoidance of exploitative working conditions. Strong collaborative relationships also create an enabling environment for transparent communication, allowing both parties to proactively address procurement challenges and co-develop effective solutions.

In addition, HOs are encouraged to adopt a more integrative approach to procurement by aligning their needs with those of their suppliers and leveraging shared resources to achieve collective objectives. Such collaboration can enhance procurement efficiency and effectiveness by enabling organizations to achieve outcomes beyond what could be realized independently. Furthermore, developing the capacity to manage multiple procurement activities concurrently can enhance flexibility and responsiveness, thereby supporting sustainable procurement outcomes while minimizing total procurement costs.

Second, in light of the positive relationship between adaptive capability and sustainable procurement, HOs should invest in strengthening their adaptive capacities. This includes fostering strong relational ties with procurement stakeholders to facilitate access to timely and relevant information necessary for informed decision-making. Additionally, effective change management practices are critical. Managers should promote continuous communication, actively engage procurement personnel during periods of change, and ensure that organizational adjustments are well understood and effectively implemented. Such practices enhance organizational responsiveness and support the successful integration of sustainability considerations into procurement processes.

6.3. Limitations and Future Research Directions

Whereas the study provides important insights, it has some limitations. First, the use of a cross-sectional quantitative survey design, grounded in theory-driven hypotheses, constrains the ability to capture the underlying mechanisms explaining why and how the observed relationships occur. Future research could address this limitation by employing qualitative approaches, such as in-depth case studies and interviews, to provide richer insights into the dynamics of sustainable procurement practices.

Second, the research was conducted within the Ugandan context, which may limit the generalizability of the findings. Replicating this research in other developing-country contexts would enhance external validity and allow for comparative analyses across different institutional and operational environments.

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