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ABSTRACT

Purpose: The study examined the role of self-organization in facilitating co-evolution and sustainable procurement in Humanitarian Organisations (HOs).

Materials and Methods: Using simple random sampling, data were collected from 79 Hos with respondents purposively selected following a quantitative cross-sectional design, which was analyzed through partial least structural equation modelling (PLS-SEM) using SmartPLS version 4.0.9.0.

Findings: Co-evolution and self-organization play a significant role in the attainment of sustainable procurement, and the relationship between co-evolution and sustainable Procurement is partially mediated by self-organization.

Implications to Theory, Practice and Policy: Co-evolutionary and self-organizing approach are introduced to allow humanitarian agencies procure sustainably during relief operations. HO procurement functions can interact with other partners in their procurement activities by continuously engaging each other and sharing resources.

By confirming mediation, the mediation role of self-organization in the relationship between co-evolution and sustainable procurement among HOs, the study provides critical insights in the evolving literature.

The study shows that co-evolution connects with self-organization and sustainable procurement. Furthermore, it explains how self-organization mediates the relationship between co-evolution and sustainable procurement.

Key Words: *Co-Evolution, Self-Organization, Sustainable Procurement, Humanitarian Organizations, Complex Adaptive System*

INTRODUCTION

Sustainable procurement is increasingly recognized for its profound impact on humanitarian operations, society, and the environment. This approach is essential for long-term success, integrates sustainable procurement practices across all humanitarian operations (Moshtari et al., 2021). Aligned with the United Nations' adoption of the Sustainable Development Goals in 2015, sustainable procurement has become integral to Goals 7 and 12, focusing on environmental and social considerations (Kumar & Rahman, 2016). In the humanitarian aid sector, sustainable procurement refers to acquiring goods and services that effectively meet beneficiary needs (Wirahadikusumah et al., 2021). Procurement in this context encompasses diverse activities such as constructing roads, homes, water extensions, and schools, alongside providing essential services like medical care, protection, education, and WASH products (Mitchell et al., 2020). Given that procurement constitutes a significant portion of humanitarian operational costs (Moshtari et al., 2021), adopting sustainable practices is essential. Such practices not only reduce costs and timelines but also foster stronger stakeholder relationships and mitigate risks (Uyarra & Flanagan, 2010).

Whilst the importance of sustainable procurement in sustaining humanitarian operations and advancing sustainable development, it remains inadequately integrated into established practices within the aid sector (Harvey et al., 2019). Reports from several countries indicate declining sustainability standards in humanitarian operations, underscoring ongoing challenges (Banks et al., 2015). Despite a lack of sustainable procurement practices in Uganda, there is evidence that non-friendly environmental items are procured from Kenya (Cheruiyot, 2018).

In Western Uganda, a significant 73% of HOs fail to incorporate waste collection, recycling reports, and plans into their procurement strategies, as outlined in the UNHCR-OPM (Western Uganda Sectoral Management Report, 2021). This oversight has led to irresponsible waste disposal practices in local areas, with 55.6% of HOs exceeding their procurement budgets as a direct economic consequence. Lagged landscapes make it difficult for humanitarian organizations to meet beneficiaries' needs. Furthermore, there is a prevailing perception among practitioners that sustainable procurement demands excessive resources and may not adequately meet beneficiary requirements in a timely manner (EU, 2021).

Research on sustainable procurement has largely focused on institutional pressure (Raj et al., 2020), innovation capability, and stakeholder involvement culture (Al Nuaimi et al., 2020), as well as top management support (Kannan, 2021). In addition, many of these studies have been conducted in the public sector (Zaidi et al., 2019), environmental performance (Khan et al., 2021), project management (Ershadi, et al., 2021), and drivers of sustainable procurement in the commercial supply chain (Gupta et al., 2018). Few studies have focused on sustainable procurement concepts in HOs (Mutebi et al., 2020); interorganizational coordination (Mutebi et al., 2021), supply chain agility (Mutebi et al., 2021), supply chain performance (Tumusiime, 2022), role clarity (Mutebi et al., 2021), or service delivery (Namagembe, 2020). Although sustainable procurement studies largely ignore sustainable procurement practices, they are critical for the flexibility and resilience of humanitarian operations (Kaur & Singh, 2022). However, prior research suggests that adaptive system mechanisms may influence sustainable procurement in humanitarian operations (Lusiantoro & Pradiptyo, 2022). Yet, humanitarian procurement can be managed sustainably through co-evolution and self-organization (Pryke et al., 2018). This study demonstrates that sustainable procurement can be achieved through interactions with stakeholders (co-evolution) and self-organization within organizations (Mutebi, et al., 2020). In order to identify threats and opportunities, sourcing strategies can be tailored to enhance the effectiveness and sustainability of humanitarian operations (Schoemaker et al., 2018). Research on sustainable procurement within humanitarian operations remains limited, particularly regarding the adaptive mechanisms of complex adaptive systems in humanitarian supply chains. To address this gap, sustainable procurement is explained through a co-evolutionary and self-organizing mechanism (Schiffling et al., 2020).

Sustainable procurement is achieved by reorganizing an organization's structure, processes, and functions in a complex environment. By co-evolving with other independent organizations and scanning the environment, organizations become resilient to change (Lusiantoro & Pradiptyo, 2020). The ability to adapt to change is a function of self-organization, which creates order and coherence through natural, physical, and social interactions (Tzafestas, 2018). Self-organizing organizations can be useful in developing sustainable procurement policies (Grandia & Voncken, 2019) that encourage suppliers to fulfill social obligations and coordinate purchasing (Ahmadya et al., 2016). Likewise, organizations that coordinate economic purchases can adapt their structures, processes, and functions. Based on complex adaptive system (Kompella, 2019), sustainable procurement results from reciprocal agents' evolution. To explain sustainable procurement, complex adaptive system theory is used.

Theoretical review and hypotheses development

Complex Adaptive System (CAS) Theory

CAS theory is used to examine co-evolution, self-organization, and sustainable procurement. Sustainable procurement can be achieved through the co-evolution and self-organization of agents (Jarrar et al., 2020; Carmichael & Hadikadi, 2019). In response to a micro-event, interacting agents self-organize in order to carry out long-term activities (Diop et al., 2022). The procurement of humanitarian aid involves multiple agents working together to achieve a goal (Alaa, 2009). In a constant dynamic operating environment, temporary supply chains must be formed rapidly (Gao, 2019). Many stakeholders are involved in the system, including governments, public and private organizations (Kovacs and Moshtari, 2019). Moreover, in conflict-affected areas, response times must be optimal, as well as long-term recovery and short-term emergency assistance (Dubey et al., 2017). In addition, humanitarian relief procurement is further complicated by uncertainties and risks inherent in the industry, such as funding shortages, skill gaps, and a lack of technological innovation (Falasca & Zobel, 2011). In CAS theory, co-evolution and self-organization are relevant factors for sustainable procurement. By this theory, they enable HOs to adapt to changing environments. Hence adapting to changes, organizations design strategies that will better address the unique challenges of relief operations in diverse environments. This is necessary to encourage sustainable procurement, which is relevant to this study.

Co-Evolution and Sustainable Procurement

Co-evolution is a process in which organizations and their environments interact. Co-evolution is a complex interdependence between humans and their environment (Norgaard,1981, 1994). Humans change their environments both materially and cognitively (Woodgate and Redclift, 1998). Sustainable procurement maximizes social and economic benefits while minimizing environmental and health damage. In sustainable procurement, human rights, labor practices, the environment, fair operating practices, consumer concerns, and community involvement are considered (Bugri et al., 2019; ISO 20400, 2017; Kennard, 2006). Co-evolution can enable sustainability through interactions between business ecosystems. Additionally, it promotes economic, environmental, and social goals (Kolk and Tsang, 2017). In addition, the co-evolution of sourcing portfolio configurations creates, evolves, and governs green businesses (Ma et al., 2020). Lema et al., (2018) argue that co-evolution of novelty and efficiency enhances local innovation capabilities. Similarly, co-evolution facilitates the development of sustainable procurement policies and consumer information tools to measure economic performance over a product's lifetime. The consumer information tools specify recycling options, durability requirements, and recyclable content. Additionally, manufacturing and reusing components can serve as explicit criteria, such as durability, repairability, spare part availability, and recyclability (Thiebault & Tonda, 2018).

Kleindorfer et al. (2005) argue that, co-evolution relies heavily on the willingness and capability of businesses to adapt and evolve their sourcing practices. In reality, many businesses prioritize short-term economic gains over long-term sustainability initiatives. Further, larger corporations with greater resources and influence adopt co-evolutionary strategies to enhance their sustainability credentials, smaller enterprises and suppliers may struggle to keep up. This dynamic could reinforce existing power imbalances in supply chains, where smaller actors face challenges in meeting stringent sustainability criteria or investing in the necessary innovations and technologies (Fleming et al., 2012). Relatedly, Gross and Murthy (2018) argue that the reliance on co-evolution in sustainable procurement assumes a uniform applicability across diverse industries and regions. In reality, the effectiveness of co-evolutionary approaches can vary significantly depending on sector-specific challenges, geographical contexts, and cultural norms. Coevolution has enabled organizations to innovatively navigate humanitarian operations' complexities by designing sustainable solutions that are tailored to their complex and varied environments. Therefore, co-evolving procurement process can foster trust and structural configurations that are crucial to goal congruence and sustainable procurement (Naveed et al., 2017).

H_1. Co-evolution positively affects sustainable procurement

Co-Evolution and Self-Organization

Self-organization refers to the process where interactions among subsystems and other systems bring about gradual or significant changes in self-adjusting systems over time and space. These changes in structure, processes, and functions occur spontaneously due to interactions among elements and agents within the system (Espinosa and Porter, 2011). In the context of humanitarian organizations, self-organizing organisations repurpose energy and actions by optimizing functions, structures, and processes. Yukalov and Sornette (2014) emphasize self-organization as integral part for operational systems. Co-evolution involves Complex Adaptive Systems (CAS) both responding to and shaping their environment, forming feedback loops that enable CAS to self-organize through ongoing interaction and coordination with their surroundings. This relationship suggests that co-evolution facilitates self-organization by fostering dynamic interactions and adaptations (Comes et al., 2020; Kemp et al., 2007).

Co-evolution leads to system redesigns over time corresponding to internal or external stimuli (Schiffling et al., 2020). The process of redesign over time is what reflects self-organization as the process of redesign involves learning from others experience through interactions and coordination (Choi et al., 2001). This makes multi-agent's structures, processes, and functions become flexible and adaptable (Mutebi et al., 2021b) based on the interactions between the environment and the agents (Henk & Arie, 2003). This may imply that different agents at different levels of a CAS share the same concerns, such as increasing delivery speed and reducing costs purchasing costs. As a results individual organization are seen as self-organizing agents aims to address their own concerns but may end up instigating the emergence of similar collective patterns at the wider system level that reflect a common purpose (Schiffling, et al., 2020).

Bakker et al. (2014) argue that, while co-evolution and self-organization in CAS offer promising benefits such as flexibility and adaptability, these processes can also lead to instability and inefficiencies within organizational structures. The decentralized nature of self-organization may result in conflicting priorities and goals among different organisations within the system. In addition, Groot and Maassen (2018) found out that, co-evolution and self-organization have a potential for unequal outcomes and power dynamics among organizations within CAS. Larger, more resource-rich entities may have a greater capacity to influence system dynamics and shape collective patterns to their advantage. Furthermore, the unpredictable nature of self-organizing systems may introduce risks related to compliance, governance, and accountability, particularly in sectors where regulatory oversight and transparency are critical (Saviotti & Pyka, 2013). With the foregoing debate, organizations that co-evolve with others can create more dynamic, adaptive and sustainable systems that respond to changing conditions and community needs (Kwapong et al., 2020) without any singular entity deliberately managing or controlling it (Holland 1995). We therefore hypothesize that:

H_2: Co-evolution and self-organization are positively related

Self-Organization and Sustainable Procurement

Self-organization and sustainable procurement are integral concepts that underscore the dynamic interactions and adaptive responses within organizational ecosystems, known as Complex Adaptive Systems (CAS). These processes enable organizations to effectively respond to and influence their environments through continuous feedback loops, thereby fostering flexibility and adaptability (Comes et al., 2020; Kemp et al., 2007). Schiffling et al. (2020) argue that self-organization promotes innovation and efficiency by allowing systems to autonomously adjust and improve in response to evolving conditions. This iterative process of system redesign and adaptation is crucial for achieving sustainability goals, as organizations learn and evolve based on environmental stimuli (Choi et al., 2001).

However, Bakker et al. (2014) caution that self-organizing systems may also introduce risks such as instability and inefficiency. In the absence of centralized control or coordination, individual entities within the system may prioritize conflicting interests or short-term gains, potentially undermining collective sustainability objectives. Moreover, Groot and Maassen (2018) highlight concerns about power dynamics, where resource-rich entities could exert disproportionate influence, marginalizing smaller or less economically powerful actors. Additionally, Saviotti and Pyka (2013) stress that the effectiveness of co-evolution and self-organization depends on organizations' readiness and capability to adapt to changing circumstances and stakeholder expectations.

In practical terms, many organizations encounter challenges such as resource constraints, gaps in expertise, and issues with regulatory compliance, which can limit their capacity to effectively utilize self-organization processes for sustainable development (Kwapong Baffoe & Luo, 2020; Pahl-Wostl et al., 2007). Addressing these challenges requires initiatives such as enhanced collaboration among stakeholders, capacity-building programs, and robust governance frameworks that promote inclusive decision-making and equitable distribution of benefits (Kwapong Baffoe & Luo, 2020). By strengthening these foundations, organizations can better leverage self-organization to advance sustainable procurement practices and achieve broader sustainability goals. Therefore, we propose the following hypothesis:

H_3. Self-organization positively affects sustainable procurement.

Co-Evolution, Self-Organization and Sustainable Procurement

Based on the CAS theory as agents interact with each other and with the environment, various structures and processes emerge that allow agents to perform different functions (Mitchell, 2009).The emergency of evolving structures and processes allows all the actors to perform activities / functions in a way that protects the environment in which they operate as well as attaining their economic and social goals (Mutebi etal., 2021).Additionally, such emerging structures and processes enable multifaceted agents to work effectively and efficiently with each other and cope with emergency situations and enhance resilience (Dolinskaya et al., 2011). Also, as agents interact new schemas such as policies that require integrating sustainability issues in supplier selection criteria in the purchasing process that facilitate smooth implementation of procurement activities (Grandia & Voncken, 2019). Further, such interations between agents and the operating environment led to adapting of cost-effective procurement solutions like consortium or outsourcing purchasing strategies. As a result, sustainable procurement has been achieved by coordinating purchasing activities, encouraging suppliers to contribute to social goals, and controlling member behavior. Similarly, sustainable procurement is closely related to the co-evolution in today's business environment through self-organizing business ecosystems, designed to create socially and ecologically appropriate economic opportunities for their members.

This has emerged into excellent way of implementing sustainable procurement strategies (Wang et al., 2019). Agents in such ecosystems and business environments play crucial roles in formulating and implementing sustainable procurement strategies necessary to improve human life (Smith & Johnson, 2023). Hence, as organizations interact with the environment, comply with policies and innovate operational solutions, they interact with different stakeholders, and come up with appropriate sustainable procurement practices that are suitable and specific to their areas of operation. As a result, we propose:

H_4. Self-organization positively mediates the relationship between co-evolution and sustainable procurement

The above hypothesizes are based on the conceptual model in Figure 1.

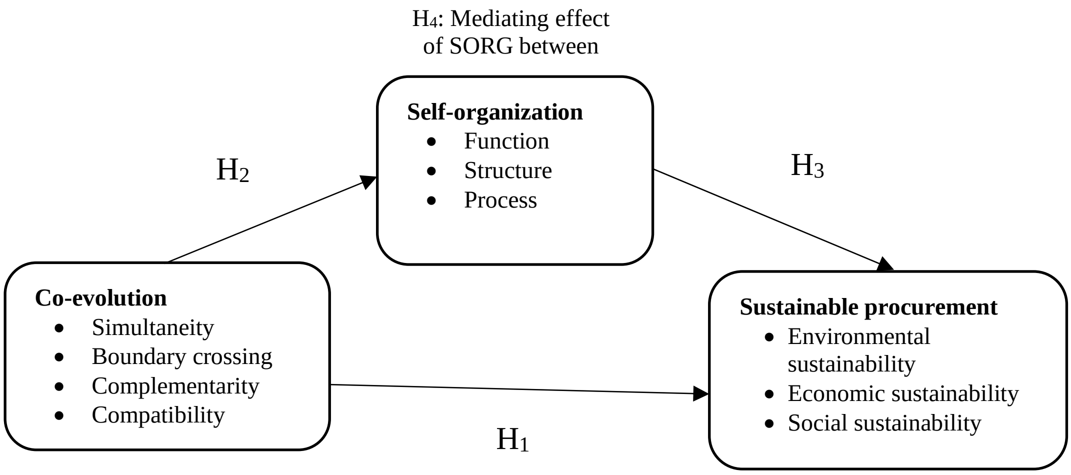

Figure 1: Conceptual Framework

Source: Developed by the Authors

MATERIAL AND METHODS

Research Design, Study Population and Sample Size

This study adapts a quantitative and descriptive cross – sectional survey design to collect large sums of objectively quantifiable data based on respondent perceptions to test pre-determined hypotheses at a given point in time (Setia, 2016). Based on the population of 105 humanitarian organizations (HOs), a sample size of 79 humanitarian organizations was drawn basing on Yamane (1967). HOs were further clustered according to the services they provide, then simple random sampling was applied to ensure equal representation per cluster. Purposive sampling was used to select the respondents in line with their duties. Majority of HOs that responded to the study, operated in Health & Nutrition. This was preceded by those providing core relief, WASH and Food. Additionally, majority of the HOs had operated in settlements for over 20 years, followed by those between 5-10 years. This indicates their ability to provide accurate and relevant information about sustainable procurement practices. Also, most organizations employed above 200 employees, followed by 151-200, this means that these HOs' had capacity to handle the necessary procurement and deliver the required relief to beneficiaries in different locations. In addition, majority of respondents were male. This indicates that HOs employed more men who have the qualities of practicality, flexibility, and motivation for the hectic work involved in humanitarian organizations. In terms of age group most respondents were between 36-40 years, followed by 31- to 35-years and the majority had worked with the HOs for more than 6 years, with an education level above Bachelor's degree as well as professional qualification suggesting that such employees had necessary knowledge and had acquired experience and skills to offer informed opinions regarding sustainable procurement practices. Lastly, majority of respondents were Supply Chain Officers/ Procurement Officers followed by Logistics / Supply Chain Coordinators. The results indicate that most respondents had a thorough understanding of their organization's procurement operations.

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Table 1: Organizational and Respondent's Characteristics

	Org. Tenure	F	%	NGO Sector	F	%
Organizational Characteristics	< 5 years	10	13.2	Food	8	10.5
	5 - 10 years	26	32.5	Wash	9	11.4
	11 - 15 years	8	10.5	Education	6	7.9
	16 - 20 years	7	8.8	Health & Nutrition	24	29.8
	> 20 years	28	35.1	Shelter & infrastructure	3	4.4
	Total	**79**	**100**	Core relief	17	21.1
	No. of Employees	**F**	**%**	Logistics	3	4.4
	< 50	2	2.6	Protection	7	8.8
	50 -100	8	9.6	Energy & environment	2	1.8
	101 - 150	13	16.7	Total	79	100
	151 - 200	21	27.2			
	> 200	35	43.9			
	Total	79	100			
Respondents Characteristics	**Gender**	**F**	**%**	**Educ Level**	**F**	**%**
	Male	59	51.8	Diploma	3	2.6
	Female	55	48.2	Bachelor's Degree	61	53.5
	Total	114	100	Post Graduate	25	21.9
	Age Bracket	**F**	**%**	Master's Degree	25	21.9
	< 25 years	6	5.3	**Total**	**114**	**100**
	26 - 30	22	19.3	**Professional Qualification**	**F**	**%**
	31 - 35	33	28.9	CPA	15	13.2
	36 - 40	34	29.8	ACCA	21	18.4
	41 - 50	17	14.9	CIM	17	14.9
	> 50 years	2	1.8	CIPS	28	24.6
	Total	**114**	**100**	None	33	28.9
	Employee Tenure	**F**	**%**	**Total**	**114**	**100**
	< 5 years	41	36	**Position Held**	**F**	**%**
	6 - 10 years	42	36.8	Logistics / Supply Chain Coordinator	33	28.9
	11 - 15 years	25	21.9	Project Manager	26	22.8
	16 - 20 years	4	3.5	Operations Managers	21	18.4
	> 20 years	2	1.8	Supply Chain Officers/ Procurement Officer	34	29.8
	Total	**114**	**100**	**Total**	**114**	**100**

Source: Analysis of Descriptive Statistics

Measurement and Operationalization of Study Variables

For reliability and validity purposes measures for study variables are adapted from previous scholarly work as indicated in Table 2.

Table 2: Measurement and Operationalization of Study Variable

Study variable	Constructs	items	Source (Author/s)
Co-evolution	Boundary crossing Complementarity Compatibility Simultaneity	Measured with 21 items capturing the four measures of boundary crossing, complementarity, Compatibility and Simultaneity. Each item will be scored on a five –point Likert scale (1) = completely disagree, (5) = completely Agree.	Mayanja, Ntayi, Omeke, Kibirango, and Mutebi (2021); Richter, Schlaegel, Midgley, and Tressin (2019)
Self-organization	Process Structure Function	Measured with 14 items capturing the three measures of Process, Structure and Function. Each item was scored on a five –point Likert scale (1) = completely disagree, (5) = completely Agree	Mutebi et al. (2020)
Sustainable procurement	Economic sustainability Social sustainability Environmental sustainability	Measured with 14 items capturing the three measures of Economic sustainability, social sustainability, and environmental sustainability. Each item will be scored on a five –point Likert scale (1) = completely disagree, (5) = completely Agree	Islam et al. (2019); Ghadge et al. (2019)

Source: Reviewed Literature

Sampling Design and Techniques, Data Collection and Ethical Considerations

HOs in refugee settlements were selected using simple random sampling approach because it ensures that all organizations have equal chance of inclusion in the study regardless of the different sectors and size they operate in, they all need to practice sustainable procurement (Saunders et al., 2019). Specifically, a sampling frame for the HOs was constructed basing on information obtained from the HOs in Uganda. Thereafter, a lottery method was employed, where numbers 1-105 was written on different small pieces of paper, then placed in a box, and picked one by one without replacement till the required sample size of 79 was achieved and the names contained on the 79 papers picked were written down to create a sample distribution frame which helped to specify the population of interest when distributing questions for questionnaire to the human resources (HR) department of each HO, after securing participation acceptance. The HR manager was requested to distribute the questionnaire to respondents (logistics/supply chain coordinator, project managers, operations managers and supply chain officers'/procurement officers). The questionnaires were accompanied by a cover letter explaining the purpose of the study (safeguarding about anonymity and assuring them that their names will not to be disclosed), but also requesting the respondents to spare some 30-60 minutes to respond to the study items that capture the practices of sustainabile procurement in humanitarian organisation and its independent variables. A minimum of one and a maximum of two weeks was deemed adequate for the respondents to fill out the questionnaires based on their convenience. After filling, the respondent returned the completed survey instrument to the HR, who then called the researcher to pick the closed-filled questionnaire in an envelope from the HR office.

Non-Response and Common Method Bias

The non-response bias as the response rate was only 75 %. The independent t-test was used for the non-response bias assessment by comparing the early and late responses, as suggested by (Armstrong, & Overton, 1977). The early respondents were those who had returned their responses within the first month prior to the gentle reminders. The late respondents were those who had returned their responses after the stated response time period, i.e., after the gentle reminder was given. The independent t-test results demonstrated that all the p-values were above 0.05 which indicate an insignificant difference between the two samples. This establishes the fact that there was no non- response bias in the dataset. However, there was a potential for the occurrence of common method bias (CMB) since the data were collected from only one source (Podsakoff & Organ, 1986). The study opted for procedural remedies at the time of the questionnaire development in order to reduce the potential bias, thus statistical techniques (Podsakoff et al., 2012) were applied to examine whether the CMB had significantly influenced the results. Firstly, the independent and dependent variables were presented using different scales so as to reduce the CMB effect. Secondly, the respondents were promised confidentiality by clearly specifying this as a statement on the cover page of the survey questionnaire. In addition to these procedural remedies, statistical measures were also performed. First, we performed the conventional technique of measuring the CMB through (Harman, 1976) single factor test. The results showed that single factor accounted for 28.28% of the total variance, showing that the CMB did not influence the result of the overall analysis (Podsakoff, & Organ, 1986). However, this technique has been criticized in recent literature (Guide & Ketokivi, 2015), and it is no longer acceptable in modern literature, hence the marker variable technique, which has been widely adopted and recommended in recent literature (Podsakoff, et al, 2012) was applied. In the current study, we also incorporated the social desirability scale of four items as marker variables. It is then followed by evaluation of R^2 with and without the marker variables. The results showed an insignificant change (<10%) in R, demonstrating the insignificance of the common method variance in the dataset.

RESULTS AND DISCUSSIONS

Data Analysis and Results

The study employed the PLS-SEM (Partial Least Square Structural Equation Modeling) method for the assessment of the inter relationship among the different latent variables. This helped to test the theoretical model which has been widely recognized and used in finance studies.

Measurement Validation

After collection, data was cleaned, coded and captured in the Statistical Package for Social Scientists (SPSS) version 26. We validated the instrument for both internal consistency (reliability) and validity by running PLS-SEM measurement model following the repeated approach (Sarstedt et al., 2019). Since we used higher-order constructs (HOC), which were modeled as reflective-formative (co-evolution and adaptive capability), we ran a standard repeated indicators approach to evaluate both the lower-order construct and higher-order construct reliability and validity (Hair et al., 2021).

The lower-order constructs (LOC) and higher-order constructs (HOC) were evaluated in terms of; Cronbach's alpha Coefficient (α) and composite reliability where values of 0.7 and above meant that the instrument was reliable (Hair et al., 2021); validity in terms convergent (indicator reliability, & average variance extracted of greater than 0.5) and divergent validity using Hetero-monotrait ratio of 0.85 and below (Hair et al., 2021) for reflective lower order constructs. Formative lower-order construct was evaluated in terms of convergent validity, collinearity between indicator and significance of outer weights (Sarstedt et al., 2019) while the higher –order construct (HOC) was evaluated in term of internal consistency (Cronbach's alpha Coefficient (α) and composite reliability) convergent validity (average variance extracted of greater than 0.5) and discriminant (in terms of Hetero-monotrait ratio of 0.85 and below) as in case of lower-order constructs (Sarstedt et la., 2019).

According to Sarstedt et al (2019) item loadings for a particular construct should be above 0.708 in order to be considered reliable. The results in Table 4 confirm that all items met this criterion. Additionally, we tested for reliability of the constructs in terms of Cronbach Alpha and Composite reliability. The rule of thumb for both Cronbach Alpha and composite reliability for the lower constructs is that it should be above 0.7 to yield consistent results.

Results in Table 3 further confirm that all the constructs and study variable met this requirement which confirms the construct reliability of all the study variables under study (Hair et al. 2021; Shamim et al. 2017). Thereafter, we looked at construct convergent validity in terms of Average Variance Extracted (AVE) and the rule of thumb is that AVE should be above 0.5(Sarstedt et al (2019). The results show that all the constructs met this requirement. In addition to evaluating the lower order constructs, Sarstedt, et al. (2019) recommends assessment of the higher order construct reliability Cronbach and composite reliability.

Table 3: Construct Reliability and Validity Lower Order Construct (LOC) and Higher Order Constructs (HOC)

Constructs	Item Codes	Item Loading	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Complementarity	C1	0.783	0.828	0.83	0.886	0.659
	C2	0.807				
	C3	0.824				
	C4	0.833				
Boundary Spanning	CE1	0.798	0.739	0.742	0.852	0.657
	CE5	0.852				
	R2	0.781				
Compatibility	CO3	0.874	0.698	0.698	0.869	0.768
	CO7	0.878				
Simultaneity	SS2	0.905	0.647	0.694	0.847	0.735
	SS4	0.807				
Economic Sustainability	ECS2	0.92	0.606	0.715	0.827	0.707
	ECS6	0.753				
Environmental Sustainability	ES2	0.76	0.53	0.563	0.806	0.676
	ES5	0.88				
Social Sustainability	HR2	0.824	0.785	0.787	0.875	0.701
	HR3	0.883				
	SA2	0.803				
Process	PCS1	0.785	0.849	0.853	0.893	0.625
	PCS4	0.763				
	PCS7	0.771				
	PCS8	0.851				
	PCS9	0.779				
Structure	STR7	0.857	0.563	0.569	0.82	0.695
	STR8	0.809				
Function	FN3	0.805	0.813	0.814	0.877	0.641
	FN4	0.82				
	FN5	0.824				
	FN6	0.752				
Study Variables	**Cronbach's alpha**	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**		
Sustainable procurement	0.735	0.807	0.81	0.695		
Self-organization	0.816	0.834	0.856	0.654		
Co-evolution	0.861	0.872	0.89	0.714		

Source: PLS-SEM Measurement Model

Discriminant Validity for LOC and HOC

To ensure that the constructs are distinct, we tested discriminant validity using the Hetero-monotrait (HTMT) ratio. The rule of thumb is that the HTMT ratio of the lower order constructs should be below 0.85 in order to confirm the discriminant validity (Hair et al., 2021). Results confirm that the inter-construct correlation ratio (HTMT) for both high and lower order construct are below the recommended value of 0.85 which implies that the constructs are distinct from each other as presented in Table 4 and Figure 2.

Table 4: Discriminant Validity (LOC) and (HOC)

Constructs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Study Variables**	**1**	**2**
Boundary crossing (1)											Sustainable procurement (1)		
Compatibility (2)	0.694										Self-organization (2)	0.48	
Complementarity (3)	0.837	0.85									Co-evolution (3)	0.43	0.43
Economical (4)	0.298	0.422	0.331										
Environmental (5)	0.407	0.363	0.224	0.632									
Function (6)	0.267	0.185	0.307	0.195	0.311								
Process (7)	0.362	0.196	0.314	0.087	0.403	0.248							
Simultaneity (8)	0.492	0.533	0.496	0.234	0.353	0.105	0.206						
Social (9)	0.122	0.243	0.152	0.173	0.887	0.132	0.306	0.397					
Structure (10)	0.321	0.434	0.366	0.297	0.447	0.417	0.649	0.237	0.385				

Source: *PLS-SEM Measurement Model*

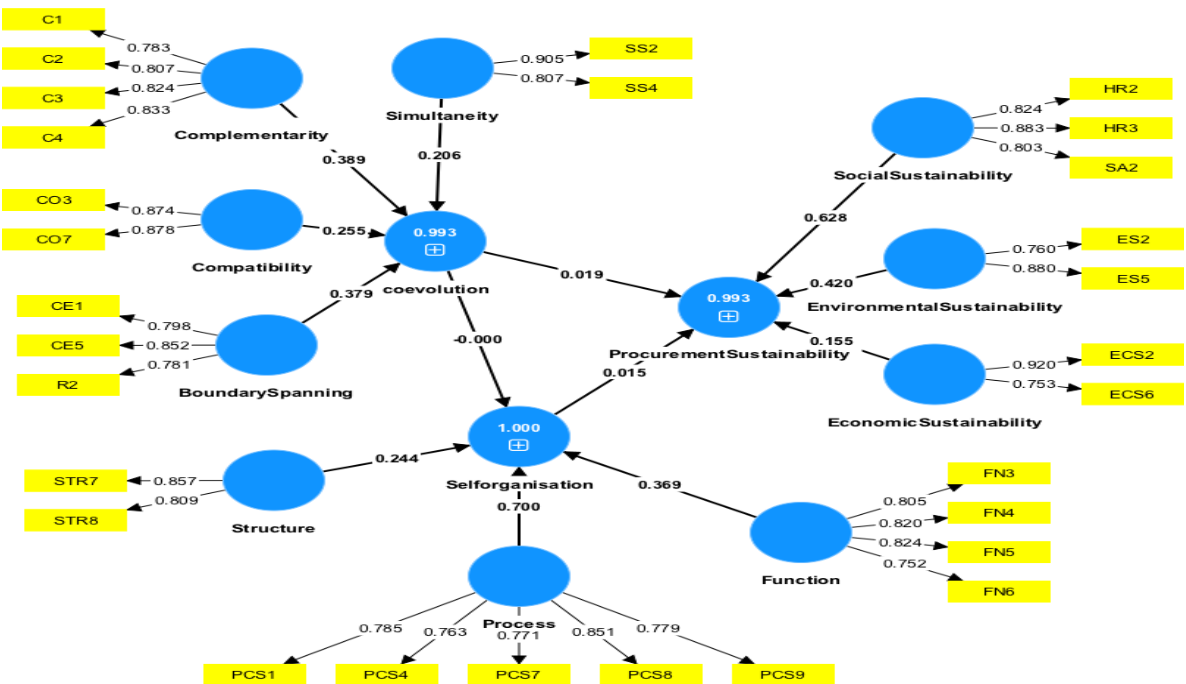

Figure 2: Measurement Model for Sustainable Procurement.

Structural Model Evaluation

After ensuring that the measurement model is reliable and valid, a variance-based regression analysis was conducted using Partial least square structural equation modeling (PLS-SEM). PLS-SEM was preferred because it allows testing for both direct and the indirect associations (Ramli et al., 2018) at the same time as the theoretical model assumes using SmartPLS version 4.0.9.0 for this purpose. The PLS-SEM model was evaluated in regard to collinearity between constructs, significance and relevance of the path coefficients, explanatory power R^2, and PLs-predict (Q^2) according to RMSEA and MAE (Sarstedt et al., 2019). To test for the significance of the associations between the study variables in the PLS-SEM, used bootstraping with 5000-sub samples iterations (Hair et al. 2021) with the help of SmartPls version 4.0.9.0.

Hypothesis Results

The results in Table 5 and Figure 3 show that there is a significant and positive relationship between co-evolution and sustainable procurement practices (β=0.179, p=0.040). Additionally, the findings reveal a significant positive relationship positive between co-evolution and self-organization (β=0.345, p=0.000). Further, the results reveal significant positive relationship between self-organization and sustainable procurement (β= 0.270, p=0.000).

Also, we assessed the mediating role of self -organization in the relationship between co-evolution and sustainable procurement. The results show that self-organization partially mediates the relationship between co-evolution and sustainable procurement (β=0.093, p=0.006 with lower and upper boundaries of the 95th Bca values of 0.042 - 0.173) which accounts for variation of 34.19%. The effect size (f^2) is .033 (Co-evolution & sustainable procurement); .0.075 (self-organisation and sustainable procurement) while 0.135 for co-evolution and self-organisation. Cohen (1988) considers these sizes small and medium, respectively. Additionally, R^2 values of 0.119 and 0.138 for self-organisation and sustainable procurement confirm the predictive relevance of the model (Hair, et al., 2016). Similarly, Q^2predict values for sustainable procurement (0.034) and self-organisation (0.084) confirm the model's predictive relevance (Peng and Lai, 2012). Finally, we tested the model's out-of-sample predictive power using Shmueli et al.'s (2016) PLSpredict procedure (ten folds, ten repetitions). The MAE and RMSE values for sustainable procurement (0.993; 0.778) and self-organisation (0.965; 0.5736) support the model predictive power for Sustainable procurement as the PLS-SEM analysis produces smaller predictive errors compared to the naïve linear benchmark model (Sarstedt et al. 2019).

Table 5: Hypothesis Testing Results

Direct Path	B	T stat	P values	Bca		F^2	VIF
Self-organization -> sustainable procurement	0.270	3.907	0.000	0.139 - 0.409		0.075	1.242
Co-evolution -> sustainable procurement	0.179	2.053	0.040	0.024 - 0.373		0.033	1.202
Co-evolution -> Self organization	0.345	4.597	0.000	0.190 - 0.484		0.135	1.138
Indirect Path	**B**	**T stat**	**P values**	**Bca**			
Co-evolution -> Self organization -> sustainable procurement	0.093	2.726	0.006	0.042 - 0.173			
Total Effects	**B**	**T stat**	**P values**	**Bca**			
Self-organization -> sustainable procurement	0.270	3.907	0.000	0.139 - 0.409			
Co-evolution -> Sustainable procurement	0.272	3.244	0.001	0.116 - 0.442			
Co-evolution -> Self organization	0.345	4.597	0.000	0.190 - 0.484			
Predictive quality assessment model	R^2	Adj.R^2	Q^2predict	RMSE	MAE		
Sustainable procurement	0.138	0.123	0.034	0.993	0.778		
Self-organization	0.119	0.111	0.084	0.965	0.736		

***Source**: PLS-SEM*

Discussion

There is a positive and significant relationship between co-evolution and sustainable procurement practices among HOs. This means that HOs interactions are likely to encourage suppliers to comply with labor standards, provide fair wages to their employees and ensure that the suppliers are not using child labor. When agents within HOs collaborate closely with suppliers, they not only exchange crucial information but also pinpoint opportunities to embed sustainability into procurement decisions. This could involve sourcing materials from minority- or women-owned businesses, selecting suppliers with recognized environmental or social certifications, and sharing best practices that promote sustainable and efficient procurement methods. For instance, HOs can explore innovative models like the circular economy, prioritize the recycling and reuse of materials, and adopt energy-efficient technologies to minimize product carbon footprints. Such collaborative efforts among agents within HOs promote a comprehensive approach to sustainable procurement, acknowledging the interconnectedness of environmental, social, and economic factors.

The findings align with studies by Ma et al. (2020) and Lema et al. (2018), which emphasize that co-evolution stimulates the structural configuration, innovation, and efficiency of sustainable sourcing practices. Similarly, co-evolution supports the development of policies and tools that inform consumers about a product's economic performance throughout its lifecycle. These tools typically include information on recycling options, durability standards, and recyclable content, enhancing transparency and accountability in sustainable procurement initiatives.

Furthermore, there exists a significant and positive relationship between co-evolution and self-organization among (HOs). This means that when HOs engage with their agents in the procurement environment, they are more likely to procure products and services that are environmentally sustainable and align with social and economic goals. The interactions between suppliers and the HO can lead to the emergence of novel partnerships and behaviors that are not centrally planned, fostering innovative and adaptive solutions. This dynamic capability enhances the organization's ability to deliver effectively and efficiently, especially in response to the needs arising from disasters or other urgent situations. Relatedly, HOs that are responsive to new information from their agents can adjust their formal procurement schedules regularly, thereby identifying and capitalizing on new opportunities for sustainable procurement. Examples include the use of recycled materials, sourcing from local suppliers to reduce environmental impacts, minimizing waste, and enhancing social and environmental outcomes. Such adaptive practices contribute to the development of a more resilient procurement system. Additionally, involving suppliers in procurement processes enables HOs to procure sustainable products that are environmentally safe at competitive prices. This collaborative approach not only promotes transparency and reduces risks but also ensures compliance with ethical and sustainability standards throughout the procurement lifecycle.

The findings resonate with Schiffling et al. (2020) who posits that co-evolution drives ongoing system redesigns in response to internal and external stimuli. This iterative redesign process reflects self-organization, where adaptation occurs through learning from interactions and coordination with others' experiences (Choi et al., 2001). Consequently, multi-agent systems within HOs become more flexible and adaptable (Mutebi et al., 2021b), evolving dynamically in response to interactions between the organizational environment and its agents.

The study further established positive and significant relationship between self-organization and sustainable procurement. It suggests that when HOs engage actively with suppliers during procurement, it gains crucial information about product specifications and availability in the market. This knowledge allows the organization to adjust its procurement policies and programs to better acquire products and services that meet its needs. Furthermore, an HO that can adapt and reallocate resources, and implement new strategies in response to emerging operational challenges without external directives, demonstrates swiftness. By regularly adjusting its formal procurement schedules, an HO can identify new partners who offer environmentally friendly relief items while ensuring value for money based on quality-price criteria. Such flexibility in operational guidelines enhances the organization's ability to respond promptly to changing circumstances, thereby improving its procurement effectiveness. Moreover, incorporating new strategies enables HOs to efficiently direct their activities and complete procurement tasks, ensuring timely delivery of products and services. This approach not only supports local economic development but also contributes to the long-term sustainability of procurement operations.

The findings are consistent with Comes et al. (2020) and Kemp et al. (2007), who emphasize the importance of interaction in forming effective procurement structures. They highlight that HOs adapting their procurement plans and operational guidelines can effectively procure relief items that meet evolving disaster victim needs. This conclusion aligns with Mutebi et al. (2020), who argue that HOs must adjust logistics operations to deliver timely relief in complex environments.

Finally, this study found that self-organization partially mediates the relationship between Co-evolution and Sustainable procurement. It indicates that co-evolution directly correlates with sustainable procurement, and additionally influences sustainable procurement through self-organization, accounting for 34.19% of the variation in this relationship. This indirect effect implies that when a humanitarian organization (HO) engages with suppliers during procurement, it can adapt its plans and operational guidelines based on feedback from these interactions. This adaptability enhances the HO's ability to procure relief items that effectively meet the evolving needs of disaster victims. Moreover, collaboration between HOs and procurement partners fosters a shared understanding, facilitating the development of new strategies and operational resources to navigate changes and challenges in complex environments.

These findings align with the principles of complex adaptive theory, which posits that organizations consist of diverse agents that interact and influence each other, leading to adaptive changes in operational procurement activities. This adaptability enables HOs to effectively procure relief items in dynamic environments. The study's conclusions are supported by Diop et al, (2022), who underscore the role of interaction among procurement partners in enabling organizations to adjust their procurement plans and operational guidelines, thereby enhancing procurement flexibility in acquiring goods and services.

CONCLUSION

In line with the purpose of the study we confirmed a significant positive relationship between co-evolution, self-organization and sustainable procurement. Additionally, we found that self-organization partially mediates in the relationship between co-evolution and sustainable procurement. This means that self-organization is conduit through co-evolution influences sustainable to procurement among HOs in developing country like Uganda.

Implications

Theoretical Contribution

The study offers two theoretical implications. First by examining new associations, it offers a useful and logical integration of complex adaptive systems characteristics. These include co-evolution and self-organization and how they influence sustainable procurement among HOs. The study also confirms the mediation role of self-organization in the relationship between co-evolution and sustainable procurement among HOs, there by providing relevant insights to the evolving literature which as emphasized to need to consider co-evolution in the attainment of self-organization and sustainable procurement (Mutebi et al., 2020).

Managerial

Humanitarian organizations (HOs) in Uganda should actively encourage their procurement functions to engage with suppliers during procurement activities. This interaction should involve continuous sharing of resources such as data, information, knowledge, and infrastructure. This collaborative approach helps HOs understand suppliers' perspectives, leading to cooperative re relationships that can reduce costs, including maintenance expenses.

HOs should empower their procurement personnel in Uganda to handle multiple tasks simultaneously. This capability allows for flexibility in procurement processes and minimizes total procurement costs. By efficiently managing several procurement assignments, HOs can achieve sustainable procurement practices while meeting diverse operational needs.

To adapt to changing circumstances and improve sustainable procurement, HOs in Uganda are recommended to continuously revise and adjust their operational guidelines, procurement principles, and plans. This flexibility enables HOs to effectively procure relief items that align with the evolving needs of disaster victims.

Policy

HOs in Uganda should establish clear policies on how procurement activities should be conducted to achieve sustainability. This includes dynamically changing operational guidelines and procurement plans during the procurement process to meet disaster victims' needs efficiently.

HOs can develop innovative strategies and operational resources to navigate complex environments effectively. Additionally, HOs should develop flexible procurement plans and operational guidelines based on feedback from these partnerships to enhance responsiveness and efficiency in procuring relief items for disaster victims.

HOs regularly update the logical flow of procurement activities and formal procurement schedules. By adapting to new challenges and opportunities, HOs can ensure timely acquisition of products and services necessary for disaster relief efforts in Uganda.

Limitations of the Study and Areas for Further Study

This study covered only humanitarian organizations in Western Uganda. Therefore, there is need to expand this study to cover the whole country and other hosting countries using the same variables of the study. This will help capture the picture in the whole country and the world at large in humanitarian organizations. The current study adopted a quantitative design to collect and analyze the data. This calls for usage of mixed method approach which combines both quantitative and qualitative to gain in depth understanding of how co-evolution and self-organization explain sustainable procurement.

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