

Can intercluster coordination mediate the relationship between supply chain flexibility and humanitarian supply chain performance?

Supply chain flexibility and performance

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Kwame Owusu Kwateng, Francis Kamewor Tetteh, Nancy Asare and Derrick Manu

Department of Supply Chain and Information Systems, KNUST School of Business, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract

Purpose – The occurrence of disaster and crisis is increasing. They are complex as well as challenging for humanitarian organizations (HOs) and societies involved in disaster relief operations. This study examined the nexus between supply chain flexibility (SCF) and humanitarian supply chain performance (HSCP) among HOs with empirical evidence from HOs in Ghana.

Design/methodology/approach – The study employed the quantitative method to explore the interdependencies among the variables. In congruence with this, the study employed the purposive and convenience sampling technique to obtain information from 168 respondents. The analysis was done using SPSS version 23 and Smart PLS version 3.

Findings – The outcome indicates that intercluster coordination (ICC) plays a significant mediating role between SCF and HSCP.

Practical implications – The outcome of the study indicates that a closer and stronger relationship ensures proper channel use among the HOs. This will improve the performance of the supply chain of HOs and their ability to deal with supply chain uncertainties.

Originality/value – The discovery of this study provides empirical support to the resource-based view theory. Thus, practitioners in the humanitarian setting give priority to factors that could enhance flexibility in their supply chain as well as implement coordination strategies to achieve a responsive humanitarian supply chain (HSC) system in the quest to minimize the outcome of disasters.

Keywords Supply chain flexibility, Humanitarian supply chain performance, Intercluster coordination

Paper type Research paper

Introduction

Recently, a number of disasters have prompted HOs to improve their aid operations to deal with critical situations (de Camargo Fiorini *et al.*, 2021). A disaster can be man-made or natural (Maqbool and Khan, 2020; Dennehy *et al.*, 2021). Man-made disasters include chemical spills, war and terrorism while natural disasters include floods, volcanic eruptions, disease pandemic and earthquakes (World Health Organization, 2019). Prominent disasters of the last decade include COVID-19 pandemic, 2018 Tsunami in Indonesia, 2015 flood disaster in Ghana, Hurricane Ida, 2021 floods in Germany, 2021 floods, landslides in China and Super Typhoon Rai in Philippines. Researchers (Scholten *et al.*, 2019a, b; Gutjahr and Nolz, 2016) argue that disaster management is associated with high knowledge intensity, high urgency, high uncertainty and usually the duration is short. The problems and/or challenges associated with disaster management include procurement, planning, how to rapidly mobilize resources, distribution of supplies and warehousing locations (Pedraza-Martinez and Van Wassenhove, 2016; Maghsoudi *et al.*, 2018). The humanitarian supply chain (HSC) ensures that relief and recovery materials reach victims at the right time, at the right location



and in the right amount (Alem *et al.*, 2021). Various stakeholders, including governments, national and international relief organizations and security agencies, are required to engage each other and coordinate their activities to ensure an effective and efficient relief operations (de Camargo Fiorini *et al.*, 2021; Yadav and Barve, 2015). This is necessary because in the humanitarian context no single organization can solve all the ongoing problems and challenges (de Camargo Fiorini *et al.*, 2021). Hence, efficient and effective coordination of aid activities to reduce cost and maximize efficiency requires that different actors in the network should work together (Tomasini and Van Wassenhove, 2009; Dubey *et al.*, 2020). As a result, it is critical that any strategy adopted to manage the HSC should be a multifaceted approach, which will encompass the management of resource procurement and flow of supplies through humanitarian aid organizations and international agencies (Shareef *et al.*, 2019a, b; Yadav and Barve, 2015) with flexibility (Altay *et al.*, 2018a, b) to ensure that affected victims will receive the relief items promptly.

Even though various studies (Abualkhair *et al.*, 2020; Anparasan and Lejeune, 2019; Zhang *et al.*, 2019) have tried to establish optimization models and solutions for the HSC, using optimization of resources alone to manage the HSC is not enough (de Camargo Fiorini *et al.*, 2021; Chandes and Paché, 2010). This is because HSCs are not just about point to point delivery of goods (Tomasini and Van Wassenhove, 2009). Also, each relief operation is distinct in terms of its cultural and political realities (Chandes and Paché, 2010). Lastly, the management of humanitarian supply chain includes organizations which are different in nature and vocation as per the services they offer (Chandes and Paché, 2010; Tomasini and Van Wassenhove, 2009).

In this study, it is proposed that flexibility – which reflects “the ability of a firm to respond to long-term or fundamental changes in the supply chain and market environment by adjusting the configuration of the supply chain” (Parast and Shekarian, 2019, p. 380) – is an important factor that could enhance the performance of HSC. Flexibility in the coordination of operations and resources are very important key factors of HSCP (Scholten *et al.*, 2010). Supply chain flexibility (SCF) is seen as the ability of members in the chain to adjust their key processes by responding or adjusting to the dynamics in the environment and subsequently deliver value to their customers and ensure that profitability of the chain is guaranteed (Swafford *et al.*, 2006; Merschmann and Thonemann, 2011). Aid organizations must have flexible systems and culture in order to function effectively in relief operations and complex environmental settings (Thomas, 2014). Maintaining a rigid and bureaucratic structure could derail the success of relief operations (Wise, 2006; Thomas, 2014). It is advisable for managers of aid organizations to adopt flexible spontaneous response in order to provide quick assistance and support to affected victims of a disaster (Wise, 2006). Being flexible will help the aid organizations to adjust and reconfigure the structure of their supply chain and work collaboratively to achieve success (Baharmand *et al.*, 2017; Jermsittiparsert and Pithuk, 2019). Relief operations include different political systems, actors, cultures and government legislations (Pateman *et al.*, 2013). Understanding the relationship between SCF and HSCP is a key area in research (Maleki Far *et al.*, 2017; Jermsittiparsert and Pithuk, 2019). Studies on SCF are very uncommon and its relationship with firm performance are much fewer (Dangayach and Deshmukh, 2001; Sánchez and Pérez, 2005). This presents an opportunity for a study to examine the relationship between SCF and humanitarian supply chain performance (HSCP). Although, rich knowledge on varied drivers of HSCP (Rucha and Abdallah, 2017; Altay *et al.*, 2018a, b; Banomyong *et al.*, 2019; Najjar *et al.*, 2019; Dubey *et al.*, 2019; Jeble *et al.*, 2019; Ivanov, 2020) exist, studies on how SCF could be used to drive supply chain performance (SCP) in the humanitarian setting is very scanty.

Again, various studies (Angel and Manuela, 2005; Sánche and Pérez, 2005; Candace *et al.*, 2011) have concluded that SCF has a positive effect on performance. On the other hand, Fantasy

et al. (2009) argue that the relationship between SCF and performance is negative. The authors recommended that researchers must carry out empirical studies to examine the nature and sharing of responsibility among the partners in the chain. In highly uncertain situations, such as those involving disaster relief activities, responsibility interdependence is more beneficial than task interdependence. It allows actors to concentrate their efforts on the contributions they make to their own and other clusters (Namagembe, 2020). Due to the complex nature and increase in the number of disasters, coordination and specialization has become essential and challenging (Schulz, 2008; Van Wassenhove, 2006; Oloruntuba, 2005; Beamon, 2004). Humanitarian relief operations involve various organizations (including host government, international and local non-governmental organizations [NGOs], United Nation institutions, military, donors and service providers) which provide different services either before, during or after a disaster (Jahre and Jensen, 2010). These organizations tend to specialize in specific areas, such as sanitation, water, medical care and camp management (Jahre and Spens, 2007). The organizations have their own systems and funding sources as well as operate independently. However, when these specialized and autonomous humanitarian institutions pull together their strength and resources, they can tackle coordination related problems. This was evident in 2004 and 2004/2005 Indian Ocean Tsunami and Darfur crises respectively. In both situations, the large nature of the disaster and complex settings undermined the effectiveness of coordination (Jahre and Jensen, 2010). Situations of this nature depict the importance of coordination with regards to preparedness and response (Oloruntuba, 2005). This explains why intercluster coordination is very key in humanitarian relief operations (Namagembe, 2020, Mutebi *et al.*, 2020a, b; Jahre and Jensen, 2010). “Inter-cluster coordination is a cooperative effort among sectors/clusters” (Namagembe, 2020, p. 170). Even though intercluster coordination has received a lot of attention in the literature, exploratory studies on its role is still very limited (Namagembe, 2020). Thus, it is important to analyze the collaborative role of actors in relief activities and how the role of the organizations involved changes in the various levels of disaster management (namely mitigation, preparedness, response and recovery) (Jensen and Hertz, 2016). Coordination between HOs enables prompt response and enhance the overall effectiveness of relief efforts (Moshtari and Gonçalves, 2017; Singh *et al.*, 2018a, b). This study is motivated by two major issues. First, the relationship between SCF and performance is plagued with mixed results. Thus, ICC as has been introduced as a mediator as recommended by Fantasy *et al.* (2009) to help clarify the ambiguity associated with the relationship between SCF and HSCP. Second, this study attempts to build a model for the integrated relationship between SCF and ICC and HSCP. This relationship has been rarely examined in extant literature, especially in the humanitarian and Sub-Saharan Africa context. The study is also in response to the exigent call by Anjomshoae *et al.* (2022) that researchers in HSCP should focus and examine interorganizational and collaborative performance measurement.

Recently, researchers and practitioners have turned their attention to HSCP (Haavisto and Goentzel, 2015; Tatham and Hughes, 2011; Blecken *et al.*, 2009) because the demand for humanitarian assistance has increased significantly in the last decade (Anjomshoae *et al.*, 2022). Conflict and violence displaced over 82 million people across the globe in 2020 (UNHCR, 2020). The occurrence and continuing consequences of the coronavirus pandemic in 2020 have also caused unprecedented humanitarian crises in the world. As a result, HOs have come under intense pressure to deliver aid in a more cost-effective way. The projects and programs of humanitarian institutions are either at a standstill, disrupted or operating at half capacity (The New humanitarian, 2020). However, there is no sign that future humanitarian crises could receive an effective response (Anjomshoae *et al.*, 2022). Records from the World Bank suggest that by 2030, people who may need assistance in fragile and conflict-affected regions will reach 46% of the total world population (Besiou *et al.*, 2021).

Again, after the Coronavirus crisis, donors have consistently demanded more transparency and accountability from humanitarian institutions (Cardoso *et al.*, 2021). HOs

are greatly scrutinized to ensure efficient and effective spending behaviour. Currently, quick response to crises by HOs is not sufficient anymore (Anjomshoae *et al.*, 2022). Humanitarian institutions are expected to demonstrate sustainable and cost-effective operations (Paciaroni and Valiakhmetova, 2021). Thus, understanding the performance measurement system of HOs will help donors and all other stakeholders to appreciate the impact of humanitarian operations. This will increase the trust and support that stakeholders have for HOs (Anjomshoae *et al.*, 2017, 2021).

Theoretical review and hypothesis development

The study used the resource-based view (RBV) theory to explore the association between flexibility, intercluster coordination and HSCP. According to Barney (1991), the RBV theory identifies factors that can drive HSCP. In the context of relief operations, the RBV argues that the performance of humanitarian supply chain is dependent on the resources that are rare, valuable imperfectly imitable and not substitutable, that is available to relief organizations. This resource could either be tangible or intangible (Barney *et al.*, 2011), and an essential resource in the relief setting is flexibility. Flexibility in the relief supply chain may enhance intercluster coordination. In such regard, HSCP could be traced to the organization's specific resources, such as flexibility and ICC. As such, Theriou *et al.* (2009) argue that an organization's strategy must be defined in line with the organization's unique resources and capabilities.

The concept of organizational capabilities was equated by Grant (1991) to core competencies (Hamel and Prahalad, 1990) and to routines of the organization (Nelson and Winter, 1982). Grant (1991) explicitly envisaged that organizational routines are defined as "regular and can be predicted in patterns of activities and sequence of coordinated actions. Grant (1991) again posits that deploying yielding resources creates a competitive advantage. On the same arguments, Amit and shoemaker (1993) explained the concept of capability as an "information-based, tangible and intangible process that could enhance the productivity of its resources and as well as flexible strategies and protection for its final products and services." The process of information gathering mechanisms represents the capabilities that allow firms to embed their knowledge assets, which include information, know-how and skills that are controlled by the firms into a value addition process (Grant and Baden-Fuller, 1995). More contributions to this perspective have been advanced by scholars, such as Kogut and Zander (1992); Nonaka (1994), who opined on the distinctive properties of knowledge (for example, lack of transferability, imitability, etc). Scholars claim that assets of knowledge represent the core source of economic benefit for a firm (Hall *et al.*, 1992; Spender and Grant, 1996; winter, 1995) and to articulate a more restrictive form of RBV, which is knowledge base view of the firm. While extant literature (Hunt and Davis, 2012; Chae *et al.*, 2014; Huo *et al.*, 2016; Nandi *et al.*, 2020) have employed the RBV to understand the mechanism between supply chain and firm performance, how SCF impact on HSCP through ICC has not yet been examined from the RBV perspective. This study, therefore, argues that building flexibility in the supply chain is a capability that could enable a humanitarian organization to acquire and deploy resources to facilitate prompt response amid ever-increasing and complex as well as challenging for humanitarian organizations (HOs) and societies involved in disaster relief operations. When the supply chain is flexible, the information channeled through the SC networks can be made with consistent conversation machinery to enhance HSCP (Sundram *et al.*, 2018).

Conceptual framework and hypothesis development

The framework in this study hypothesizes that intercluster coordination plays a significant role by mediating the relationship between SC flexibility and HSCP. The entire model expresses three types of variables: independent, mediator and dependent variable. The

hypothesis development section discusses a detailed relationship amongst the variables as depicted in [Figure 1](#) below. The framework ([Figure 1](#)) in this research hypothesizes that SCF has an effect on HSCP, but the relationship may not be direct or bivariate. The relationship may be influenced by ICC.

The effect of supply chain flexibility on humanitarian SC performance

Flexibility is recognized as a major response to ever-growing uncertainty and competition in the business environment. Researchers have acknowledged the relevance of SCF as a driver of competitive advantage and improve SCP ([Olhager and West, 2002](#); [Stevenson and Spring, 2007](#); [Delic and Eyers, 2020](#)). The *first hypothesis* of the study envisages that there exists an interaction between SCF and HSCP. SCF may be achieved via diverse sources, but it is more sustainable if it cannot easily be imitated. For HOs to minimize the implications of disaster, they strive for continuous improvement by making their supply chain flexible ([Un, 2017](#); [Delic and Eyers, 2020](#)). Flexibility has a positive effect on SCP ([Delic and Eyers, 2020](#)). In the humanitarian setting, to enhance the ability of relief organizations to timely respond to chaotic situations during disaster, relief teams or networks are formed by stakeholders to alleviate the suffering of affected victims. Thereafter, the structure of the supply chain (SC) needs to be adjusted according to the problem of quantity and information from the disaster area as the situation changes. As events in disaster areas continue and the problems people face also change, it is important for aid organizations to develop flexible SC designs to deal with the situation effectively. Again, previous studies also showed that flexibility in the SC enable suppliers to operate efficiently ([Chan et al., 2018](#); [Cotteleer and Joyce, 2014](#); [Ford et al., 2014](#); [Giffi et al., 2014](#)). A study conducted by [Vickery et al. \(1999\)](#) emphasized the relevance of SCF in driving the performance of firms SC. Again, studies of [Sanchez and Perez \(2005\)](#); [Fantazy et al., 2011](#); [Lummus et al., 2003](#); [Tiwari et al., 2011](#); [Tipu and Fantazy, 2014](#) confirmed SCF significantly affects SCP; however, how SCF influence SC performance in the humanitarian setting is still not adequately explored ([Mensah et al., 2017](#)). Hence, the effect of SCF on SCP within the humanitarian sector offers a pertinent research opportunity ([Fantazy et al., 2011](#)). In line with the above discussion, this study hypothesized that

H1. SCF significantly affects humanitarian SCP.

The effect of supply chain flexibility on intercluster coordination

Recently, ICC has gained significant attention in the context of the humanitarian organization as an efficient strategy of disaster operations management ([Moshtari, 2016](#); [Prasanna and Haavisto, 2018](#); [Dubey et al., 2019](#)). However, it is important to note that ICC heavily relies on traditional SC concept ([Namagembe, 2020](#)). According to [Moshtari \(2016\)](#), SCF constitutes an important enabler of ICC. Prior studies by [Dubey et al. \(2017\)](#) and [Salem et al. \(2019\)](#) indicated that SCF enhances cluster relief operations and coordination. Again, [Rao et al. \(2010\)](#) indicated that SCF allows firms to tap into a responsive supply base to ensure a reliable supply of products. Hence, ICC remains a strategic resource that managers of a humanitarian organization can design and develop outcomes to meet their needs during disaster relief operations. The ability of firms to change supply networks with time and respond to competitors' changes enables the SC players to take advantage to improve their SCP

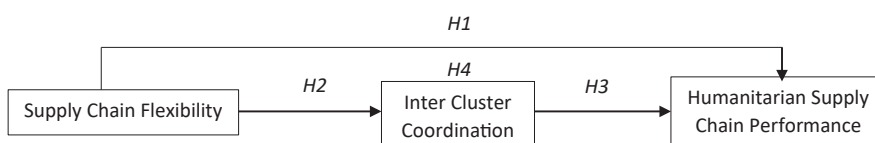


Figure 1.
Research model

(Madhavan, Koka and Prescott, 1998). Though there is yet a study to confirm the direct link between SCF and ICC, it is believed that the ability of a firm to timely respond to changes within and outside the SC could also be traced to enhance coordination within the system. Based on the above argument, the study hypothesized that

H2. SCF significantly influence ICC.

Intercluster coordination on humanitarian supply chain performance

Coordination is seen as the resolution of interorganizational good conflict (Lawrence and Lorsch, 1967), and organizations can achieve high SCP through efficient management of SC activities (Malone and Crowston, 1994). Similarly, ICC is an important driver of SCP, and the need for coordination may arise as a result of pooled independence within the activities of players in the chain. The humanitarian SC is highly uncertain, and this is because systems are loosely coupled by nature (Liu et al., 2021). The players in the humanitarian SC need to balance their interests at all levels during decision-making (Wang et al., 2015). ICC enhances the ability of firms to better withstand uncertain SC operations through close coordination and facilitating intercluster dialogue (Zhao et al., 2019a, b). Several studies have confirmed the relationship between coordination and SCP (Zhao et al., 2019a, b). Previous studies have also shown that SC coordination enhances SCP (Sezen, 2008; Seo et al., 2014). Abdallah et al. (2014) further revealed a direct association between coordination and SC effectiveness. Although studies have not examined the effect of ICC on SCP in the humanitarian context, the study believes that the findings of the previous studies discussed above can be generalized to help understand the relationship between ICC and SCP. Such coordination within the cluster enables both humanitarian organization and their SC patterns to engage in intercluster planning-related practices (Cai et al., 2010). Based on the above discussion, effective coordination within various clusters among relief organization could directly enhance the performance of HSC. Hence, we anticipate that

H3. ICC significantly influences SCP.

The mediating role of intercluster coordination

In terms of interorganizational factors, research in the business organization proves that when organizations face challenges in the SC, they often rely on the episodic network (i.e. short-term plans) as a means of combining internal and external experience with resources for a successful solution. In such cases, they may be strongly involved with other companies (Zacharia et al., 2011). Coordination is mentioned only in a few SCM research studies and in many studies in intraorganizational literature (Dubois et al., 2004). ICC concludes the expectation that all members of the various clusters in the SC network and allows coordination at all levels. ICC has been identified as a critical success factor for enhancing SCP (Hodgetts et al., 1999; Sohal et al., 2001). Several studies have shown that coordination could enhance SCP (Sezen, 2008; Seo et al., 2014; Abdallah et al., 2014; Zhao et al., 2019a, b), and other studies have also found a positive effect of SCF on ICC (Cao and Zhang, 2011; Moshtari, 2016; Dubey et al., 2017; Salem et al., 2019). However, there is yet an empirical study to examine the indirect contribution of ICC as a mediator in the relationship between SCF and SCP. We expect the association between SCF and HSCP to be strengthened through effective ICC. Thus, this study proposes that ICC mediates the nexus between SCF and HSCP.

H4. ICC mediates SCF and HSCP.

Data and methodology

Data were collected from top-level managers or officers of humanitarian institutions including the National Disaster Management Organization (NADMO) and humanitarian nongovernmental organizations (NGOs) in Ghana. These managers were purposively

selected to participate in the survey. This is because they possess the requisite knowledge to help answer the questionnaire. The respondents completed a structured questionnaire. Before distributing the questionnaire, the researcher explained and introduced the questionnaire to the respondents. They were informed that their participation in the survey is purely voluntary. In other words, they have the right to opt-in or opt-out in the survey. Respondents who agreed to participate in the survey used approximately 17 minutes to complete the questionnaire. The researcher responded to all ambiguities identified during the introduction and explanation of the questionnaire. Eligibility of the respondents was not difficult because they were all purposely selected from humanitarian institutions. To ensure a high response rate, respondents were promised that any information they provide would not be shared with a person or organization and that only the researcher would have access to the data. A total of 268 questionnaires were distributed, but 231 questionnaires were received. This represents a response rate of 86.19%. However, 198 questionnaires were used for analysis. Of the respondents, 101 (51%) were male and 97 (49%) were female. The majority of the respondents (91) hold a Higher National Diploma certificate, followed by bachelor's degree holders (54) and master's degree holders (53), respectively.

The instruments used to measure the constructs in the model were sourced from the extant literature. The first part of the questionnaire asked the participants to indicate whether they will like to participate in the survey or not. This was to provide the opportunity for the respondents to freely decide and consent to participate in the survey. The subsequent section of the questionnaire captured the respondents' demographic profile. The last part of the questionnaire contained items that measured the latent variables. A five-point Likert scale indicating 5 = strongly agree to 1 = strongly disagree was used in the questionnaire. The items for HSCP were sourced from [Kunz et al. \(2014\)](#), [Abidi et al. \(2014\)](#); ICC from [Inter-Agency Standing Committee \(2013\)](#) and United Nations Children's Fund (UNICEF) (2015a, b) and SCF from [Kabura and Ramesh \(2016\)](#).

Prior to the data analyses, the raw data were diligently checked for any form of error in an attempt to eliminate redundant, incomplete or incorrect data. The missing data were corrected using the expectation maximization procedure. The cleaned data were imported into the Statistical Package for Social Sciences (SPSS) and Smart PLS for analyses. While the SPSS was used for descriptive, normality, common method bias (CMB), nonresponse bias and exploratory factor analysis (EFA), Smart PLS was used for validation of the measurement items through dimensional reduction. Both direct and indirect relationships between the constructs were explored using Smart PLS-SEM. SEM's stoutness makes it appropriate tool capable of testing the entire model simultaneously and assessing measurement errors. Details of the analysis are presented in the next section.

Result and discussion

Descriptive analysis

The mean and standard deviation are used to measure how well the statistical mean fits the observed data ([Field, 2009](#)). The result of the descriptive analysis is presented in [Table 1](#). The result shows that HSCP scored a mean and standard deviation of ($M = 3.905$; $StD = 1.042$). SCF scored ($M = 4.158$; $StD = 1.154$) and ICC scored ($M = 4.405$; $StD = 1.013$). The result shows that the deviations from the mean values of all the constructs were minimal, indicating that the statistical or calculated mean does not vary from the observed mean. [Table 1](#) further presents kurtosis and skewness, which are used to examine data normality. These two measures are recommended by [Hair et al. \(2010\)](#) as good measures to demonstrate the shape of the probability distribution of a statistical data. The rule of thumb is that majority of the constructs should be within -2 and $+2$. However, the result in [Table 1](#) shows that SCF is not within the acceptable limits. This explains why PLS-SEM was used to analyze the data. The results of the correlation

between the variables as shown in Table 1 indicate that the relationship between ICC, SCF and HSCP is positive ($r = 0.442$; $r = 0.547$). The result also showed a positive association between ICC and SCF ($r = 0.448$). Multicollinearity is absent in this study because the independent variables are not highly correlated (Pavlou *et al.*, 2007; Spector and Brannick, 2010). It also provides evidence that SCF and ICC significantly influence HSCP.

Common method bias and nonresponse bias

With reference to Shashi *et al.* (2019), we evaluated CMB using Harman’s single factor test to validate the suitability of the constructs in the measurement model. According to Podsakoff *et al.* (2003), the one factor test as the Harman considers all the observed variables in an EFA and to assess whether a single factor accounts or explains more than 50% of the calculated variance. The result as presented in Table 2 below shows that the largest variance explained by a single factor is 41%, which is below the 50% threshold of the EFA using the principal component analysis extraction method. This confirms the absence of CMB in the dataset. Additionally, the correlation matrix was used to further validate the absence of CMB following the limitations of the Harman’s one factor approach. As per the recommendation of Saleh Mutar Al-Sukainy *et al.* (2007), the correlations among the main constructs should not exceed a recommended threshold to confirm the absences of CMB. The result in our study

Table 1.
Descriptive and correlation

Items	Mean	StD	Kurtosis	Skewness	1	2	3
HSCP	3.905	1.042	0.839	-1.017	1.000		
SCF	4.158	1.154	-0.543	-3.589	0.442	1.000	
IOC	4.405	1.013	5.63	-1.405	0.448	0.547	1.000

Table 2.
Test for common method variance (CMV)

Component	Total	Initial eigenvalues		Extraction sums of squared loadings		
		% of variance	Cumulative %	Total	% of variance	Cumulative %
1	11.687	40.813	40.813	11.687	50.813	50.813
2	3.377	24.683	65.496	3.377	14.683	65.496
3	1.790	7.783	73.279	1.790	7.783	73.279
4	1.231	5.351	78.630	1.231	5.351	78.630
5	1.123	4.883	83.513	1.123	4.883	83.513
6	0.893	3.884	87.397			
7	0.787	3.421	90.817			
8	0.519	2.255	93.073			
9	0.342	1.486	94.559			
10	0.317	1.380	95.938			
11	0.260	1.129	97.067			
12	0.197	0.855	97.922			
13	0.119	0.519	98.442			
14	0.097	0.421	98.863			
15	0.093	0.405	99.268			
16	0.064	0.278	99.545			
17	0.052	0.226	99.772			
18	0.021	0.092	99.864			
19	0.005	0.021	99.977			
20	0.003	0.015	99.991			
21	0.002	0.009	100.000			

Note(s): Extraction method: principal component analysis

revealed that the correlations among the principal constructs are small ($r < 0.9$). This further confirms the Harman's one factor test result; hence, there is no issue of CMB in this research model.

Again, in any survey, the best procedure to manage nonresponse bias is to ensure a high response rate (Oppenheim, 2001; Armstrong and Overton, 1977). Hence, the researchers in this study made necessary efforts to improve the response rate. The researchers first sought permission from the human resource department of the HOs selected for the study. The respondents were contacted after the researchers have been introduced by the human resource (HR) managers. The questionnaires were personally administered by the researchers. Guidelines and explanations were provided to help the respondents provide accurate answers to the questions. The respondents were assured of the anonymity and confidentiality of their responses. After a scrutiny of the received questionnaires, 198 were used for the analysis. Also, the procedure suggested by Oppenheim (2001, p. 106) was used to investigate nonresponse bias in the survey sample. Following the procedure, the first 99 responses and the last 99 responses were considered as early responses and late responses, respectively. Afterward, a *T*-test analysis was employed to test for nonresponse bias. The results of the *t*-test analysis did not indicate any significant difference (See Appendix 1). Further *t*-test analysis of the sociodemographic characteristics was conducted (Oppenheim, 2001, p. 106; Armstrong and Overton, 1977, p. 397). Once again, there were no significant differences in age, gender and years of experience.

Measurement model

For measurement model validity and reliability, confirmatory factor analysis was conducted using Smart PLS version 3. The process employed the maximum likelihood estimation method for testing the validity and reliability of the constructs. The model measurement evaluation was conducted as a prerequisite for the structural model analysis. The model measurement evaluation comprised reliability and validity using Cronbach alpha (CA), composite reliability (CR) and average variance extracted (AVE). The result in Table 3 below shows that all the constructs had good scale reliability (i.e. CA and CR) were high than 0.7 (Fornell and Larcker, 1981; Henseler *et al.*, 2015); hence, all the constructs had acceptable internal consistency and reliability. Additionally, AVE, which was also used to assess

Variables	Items	Loadings	Cronbach's alpha	Composite reliability	AVE	VIF	
Humanitarian supply chain performance	HSCP1	0.770	0.939	0.952	0.768	2.759	
	HSCP2	0.877					2.805
	HSCP3	0.939					2.955
	HSCP4	0.832					2.220
	HSCP5	0.920					2.683
	HSCP6	0.910					2.577
Intercluster coordination	ICC1	0.838	0.813	0.870	0.582	1.583	
	ICC2	0.870					2.202
	ICC3	0.779					2.252
	ICC4	0.794					2.832
	ICC5	0.761					2.446
Supply chain flexibility	SCF1	0.828	0.935	0.948	0.725	2.909	
	SCF2	0.928					2.270
	SCF3	0.687					2.134

Table 3. Validity and reliability

convergent validity of the constructs, was found above the 0.5 threshold. We further used variance inflation factors (VIFs) to examine the issue of multicollinearity. The collinearity statistics for both inner and outer (VIFs) meet the <3 threshold as recommended by Ringle *et al.* (2014). We also employed the Fornell–Larker criterion and heterotrait–monotrait (HTMT) ratio to assess discriminant validity of the model. The result provide evidence that our model has no issue of discriminant validity as the square root of the AVEs was higher than the within correlation among the variables in the model (see Appendix 2). The discriminant validity test was further explored using the HTMT ratio, and the HTMT threshold (<0.90) was met, which also confirms discriminant validity of the research model (see Appendix).

Testing of hypothesis

Once the measurement model evaluation meets all the reliability and validity thresholds, the next phase of the analysis is the structural model assessment and hypothesis testing via the variances of dependent variables in addition to the model’s predictive relevance using Stone-Geisser’s Q^2 , path coefficients and significance levels (t -values). We used the blindfolding procedure to estimate the Q^2 . The result as provided in Table 4 shows that ICC and HSCP recorded Q^2 values of 0.105 and 0.261, which are above the threshold (>0). Again, the coefficient of determination (R^2) was weak (0.187) and substantial (0.595) for ICC and HSCP, respectively. The implication is that SCF and ICC explain about 60% of variations within the SCP of HOs. The outcome of the analysis showed that the first (H1) hypothesis of the study which sought to examine the effect of SCF on HSCP was confirmed ($B = 0.696$; $t = 17.220$; $p = 0.000$; Sig < 0.005). The analysis also supported H2, which also envisage a positive significant association between SCF and ICC ($B = 0.317$; $t = 4.992$; $p = 0.000$; Sig < 0.005). The third hypothesis (H3), which states ICC positively influences HSCP, is also confirmed ($B = 0.225$; $t = 4.366$; $p = 0.000$; Sig<0.005). Hence, all the three direct hypotheses were supported (Table 5). Additionally, the study envisaged that ICC plays an essential mediating role in the link between SCF and HSCP. The result shows that ICC plays a significant indirect role in strengthening the link between SCF and HSCP ($B = 0.071$; $t = 3.463$; $p = 0.000$; Sig < 0.005) (see Figure 2).

Table 4.
Predictive relevance

Construct	R^2	Q^2
HSCP	0.595	0.416
ICC	0.187	0.071

Table 5.
Testing results of relationships

Hypotheses	Path coefficients	T statistics	p values	Results
Supply chain flexibility → Humanitarian supply chain performance	0.696	17.220	0.000	Supported
Supply chain flexibility → Intercluster coordination	0.317	4.992	0.000	Supported
Intercluster coordination → Humanitarian supply chain performance	0.225	4.366	0.000	Supported
Supply chain flexibility → Intercluster coordination → Humanitarian supply chain performance	0.071	3.463	0.001	Supported

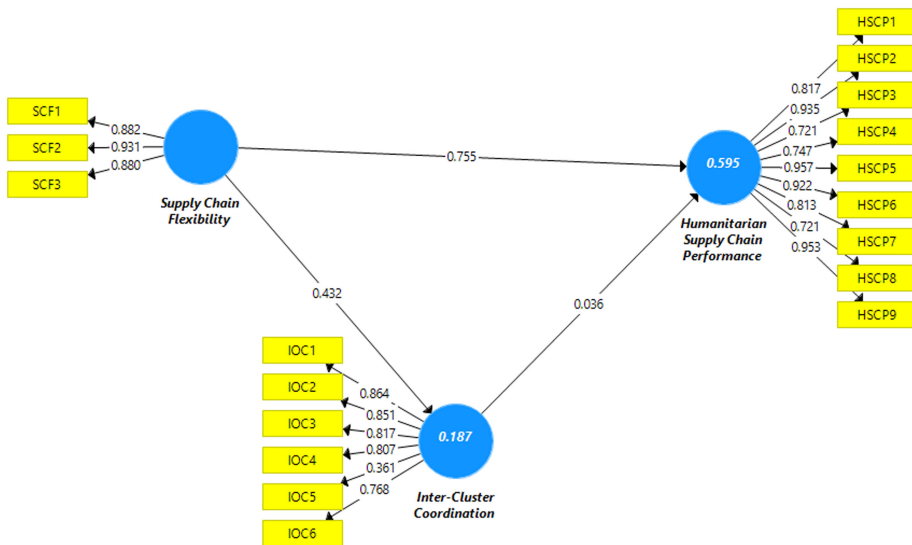


Figure 2. Measurement of model path coefficients

Discussion of results

SC management remains a key component of disaster management since effectiveness, speed and efficiency in the supply of victims with food, health, shelter, water and sanitation remain important in the management of disaster (Abidi *et al.*, 2014). This study assessed how SC flexibility could enhance HSCP via ICC using empirical evidence from HO in a developing country. The outcome of the study revealed that all four (4) hypotheses were supported. The overall predictive relevance of the model was substantial (63%) in predicting HSCP. Our study showed that SCF has a significant direct impact on HSCP. The finding is in line with earlier studies that acknowledged the relevance of SCF as a catalyst of improved SCP (Olhager and West, 2002; Stevenson and Spring, 2007; Delic and Eyers, 2020). For HO to minimize the negative effects of the disaster, they must strive for continuous improvement in SCF (Un, 2017; Delic and Eyers, 2020). Additionally, previous studies also indicated that flexibility in the SC enables suppliers to operate efficiently at all levels of the SC. Eventually, it will affect the performance of the SC which will allow relief network players to quickly adjust and respond to disasters (Chan *et al.*, 2018; Cotteleer and Joyce, 2014; Ford *et al.*, 2014; Giffi *et al.*, 2014). This further demonstrates the relevance of SCF in ensuring prompt relief operations.

While the RBV theory posits that information administration within any SC system is to give accurate information between SC members in aid of functioning effectively to produce good results (Sundram *et al.*, 2018) in a flexible SC, the information channeled through the SC networks can be made with consistent conversation machinery to enhance performance (Sundram *et al.*, 2018). Thus, according to the RBV, SCF has been a catalyst as they can boost the identification, description and forecasting of complicated situations (Defee *et al.*, 2010), which will improve the performance of the SCs to augment the performance of the firm (Leuschner *et al.*, 2013). In the context of humanitarian operations, this finding offers pertinent information for HO. The study is among the few attempts to add to the body of knowledge on the link between SCF and SCP, especially within the humanitarian setting.

Also, SCF has a significant positive effect on ICC. This implies that a more flexible SC has a significant positive effect on ICC among HO. As indicated earlier, ICC has gained significant

attention in the context of HOs as an efficient strategy for disaster operations management (Moshtari, 2016; Prassana and Haavisto, 2018; Dubey *et al.*, 2019). The implication is that SCF constitutes an important enabler of ICC (Moshtari, 2016). Prior studies by Dubey *et al.* (2017) and Selem *et al.* (2019) indicated that SCF enhances cluster relief operations and coordination. Again, Rao *et al.* (2010) indicated that SCF allows firms to tap into a responsive supply base to ensure a reliable supply of products. It can be concluded that the ability of a firm to timely respond to changes within and outside the SC could also be traced to enhance coordination within the system. It is worth noting that this study is among the very first few attempts to confirm the direct link between SCF and ICC.

Additionally, the result demonstrated that ICC significantly impacts HSCP. The HSC is highly uncertain, and this is because systems are loosely coupled by nature (Liu *et al.*, 2021). The players in the HSC need to balance their interests at all levels during decision-making (Wang *et al.*, 2015). This outcome confirms the finding of Zhao *et al.* (2019a, b). ICC enhances the ability of firms to better withstand uncertain SC operations through close coordination and facilitating intercluster dialogue (Zhao *et al.*, 2019a, b). Such coordination within the cluster enables both humanitarian organization and their SC patterns to engage in intercluster planning-related practices, which helps them to identify possible future emergencies or obligations for the SC players (Cai *et al.*, 2010).

Finally, the study demonstrated that ICC plays an important mediating role between SCF and HSCP. ICC remains an essential wheel to drive SCP from a flexible SC (Hodgetts *et al.*, 1999; Sohal *et al.*, 2001). Thus, relief organizations with flexible SC and effective coordination among various clusters stand a high chance of efficiently and effectively alleviating the suffering among disaster affected communities or people.

Contribution to theory

The outcome of this study contributes to existing discourse on RBV theory by looking at the varying resources of HOs to assess their SCP during disaster relief operations. The real issue of the RBV is the uncertainties surrounding disaster occurrence in any jurisdiction, which is pivoted on the resources and capacities HOs possess. The resources that a humanitarian organization has such as workers' understanding, capacities, expertise, essentials, effective actions and operations and automation equipment will help them to perform during disaster relief operations. Based on the RBV, resources such as fallibility in SC expertise and ICC which have information sharing as a sub-component, personnel, science and comparative resources as the proficiency to adapt and merge to have an urge over the negative implications of a disaster, such as the COVID-19 pandemic. The outcome of the study confirms the assertion by the RBV that the rightful information shared between employees of HOs and proper ICC will improve their performance during disaster relief operations. This study provides a better understanding of the subtleties of this relationship value, which is often overlooked during a charity.

The role of SCF and ICC together effectively stimulate HSCs is less discussed in humanitarian literature. This study contributes to the existing literature by showing that SCF and ICC have both direct and indirect significant relationships with HSCP. Various studies (Chan *et al.*, 2018; Cotteleer and Joyce, 2014; Ford *et al.*, 2014; Giffi *et al.*, 2014) have found a positive impact of SCF on firm SCP. This study shows that utilizing both SCF and ICC enhances HSCP. Again, this study bridges the gap in extant literature by showing that both SCF and ICC enhances SCP within the context of humanitarianism. ICC serves as an indirect intervening mechanism that enhances the relationship between SCF and HSCP. Consequently, SCF and ICC add to other known mediating variables (such as agility, SC integration and information sharing) that influence the relationship between SCF and the performance of HSCs.

In this regard, the two main areas of this study show its contribution to the validation of SC theories in a humanitarian setting. First, the study has sought to put forth immediate optimism using the humanitarian lens. Therefore, the study presents the theoretically driving empirical results of previous works by showing how SCF and ICC can enhance HSCP. Also, this study bridges the gap in the extant literature by showing that both SCF and ICC enhances SCP within the context of humanitarianism. Additionally, SCF and intercluster coordination were found to have a direct and significant relationship with the performance of HSCs. It must be stressed that the direct impact of SCF on the performance of HSCs was much higher than that of ICC. This finding adds to existing frameworks that try to identify the critical success factors of HSCs. Further, this study is among the first few attempts to develop a holistic picture of the relevance of SCF and ICC as critical enablers of HSCP and emergency management from a comprehensive approach.

Managerial implications

The study provides practical guidance to HOs involved in relief work. First, the study provides information on building a responsive HSC. Existing studies focus more on long-term relationships without focusing on the short-term relationships that are common in humanitarian operations. Owing to the increasing occurrence of disaster, there is growing discourse on how to reduce the impact of such disasters on human life; hence, there is the need to enhance HSCP by SCF. Second, ICC is found to mediate the relationship between SCF and HSCP. This suggests that managers must empower all levels of staff to make informed decisions on how systems can be coordinated and integrated and depart from the traditional unit-centered approach. In effect, managers must be innovative to understand both their internal and external environments to attain stronger SCP in humanitarian operations. Additionally, given that SCF showed a direct impact both on ICC and HSCP, managers must also pay much attention to the limited nature of resources during disaster relief operations and focus on strategies to adapt promptly to disruptions while minimizing the effects of disaster on victims.

Conclusion

The findings as discussed show that ICC played a significant mediating role between SCF and HSCP. It clearly shows that a closer and stronger relationship ensures proper channel use among members resulting in improved SCP of HOs and their ability to deal with SC uncertainties. The outcome of the study also empirically supports the RBV theory. The real issue of the RBV is the competition amongst different firms, which is pivoted on the resources and capacities they possess. According to the theory, when the SC is flexible, the information channeled through the SC networks can be made with consistent conversation machinery to enhance performance (Sundram *et al.*, 2018). Thus, according to the RBV, SC flexibility has been a catalyst as they can boost the identification, description and forecasting of complicated situations (Defee *et al.*, 2010), which will improve the performance of the SCs to augment the performance of the firm (Leuschner *et al.*, 2013). The study concludes that SCF remains important in SC management in a highly uncertain environment. Even though SCF capabilities are an expensive initiative, it has the propensity to enhance the SC of HOs.

The outcome of this study demonstrated that flexibility play an essential role in improving HSCP; however, how flexibility in the SC is developed is silent in humanitarian literature, and further studies could consider exploring the drivers of SCF in the humanitarian setting. Also, while SCF has proven effective in enhancing HSCP, we believe that this mechanism may be contingent on certain capabilities that enable relief organizations to anticipate and predict effectively. Future studies could therefore explore how environmental orientation, sensing

capabilities and information technology (IT) could moderate the relationship between SCF and HSCP. Additionally, there is the need for further research on the moderating role of IT/managerial capability on HSCP, collaborations and integration in different regions in Ghana with a much larger sample size than this current study. Also, there is the need for the application of the mixed methods of research, which are qualitative and quantitative in subsequent research, to get opinions of industry experts in the HSC.

References

- Abdallah, A.B., Obeidat, B.Y. and Aqqad, N.O. (2014), "The impact of supply chain management practices on supply chain performance in Jordan: the moderating effect of competitive intensity", *International Business Research*, Vol. 7 No. 3, p. 13.
- Abidi, H., De Leeuw, S. and Klumpp, M. (2014), "Humanitarian supply chain performance management: a systematic literature review", *Supply Chain Management: An International Journal*, Vol. 19 Nos 5/6, pp. 592-608, doi: [10.1108/SCM-09-2013-0349](https://doi.org/10.1108/SCM-09-2013-0349).
- Abualkhair, H., Lodree, E.J. and Davis, L.B. (2020), "Managing volunteer convergence at disaster relief centers", *International Journal of Production Economics*, Vol. 220, p. 107399.
- Alem, D., Bonilla-Londono, H.F., Barbosa-Povoa, A.P., Relvas, S., Ferreira, D. and Moreno, A. (2021), "Building disaster preparedness and response capacity in humanitarian supply chains using the Social Vulnerability Index", *European Journal of Operational Research*, Vol. 292 No. 1, pp. 250-275.
- Altay, N., Gunasekaran, A., Dubey, R. and Childe, S.J. (2018a), "Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within the humanitarian setting: a dynamic capability view", *Production Planning and Control*, Vol. 29 No. 14, pp. 1158-1174.
- Altay, N., Gunasekaran, A., Dubey, R. and Childe, S.J. (2018b), "Agility and resilience as antecedents of supply chain performance under moderating effects of organizational culture within the humanitarian setting: a dynamic capability view", *Production Planning and Control*, Vol. 29 No. 14, pp. 1158-1174.
- Amit, R. and Schoemaker, P.J. (1993), "Strategic assets and organizational rent", *Strategic Management Journal*, Vol. 14 No. 1, pp. 33-46.
- Angel, M.S. and Manuela, P. (2005), "Supply chain flexibility and firm performance", *International Journal of Operations and Production Management*, Vol. 25 No. 7, pp. 681-700.
- Anjomshoae, A., Hassan, A., Kunz, N., Wong, K.Y. and de Leeuw, S. (2017), "Toward a dynamic balanced scorecard model for humanitarian relief organizations' performance management", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 7 No. 2, pp. 194-218, doi: [10.1108/JHLSCM-01-2017-0001](https://doi.org/10.1108/JHLSCM-01-2017-0001).
- Anjomshoae, A., Hassan, A., Wong, K.Y. and Banomyong, R. (2021), "An integrated multi-stage fuzzy inference performance measurement scheme in humanitarian relief operations", *International Journal of Disaster Risk Reduction*, Vol. 61, p. 102298, doi: [10.1016/j.ijdr.2021.102298](https://doi.org/10.1016/j.ijdr.2021.102298).
- Anjomshoae, A., Banomyong, R., Mohammed, F. and Kunz, N. (2022), "A systematic review of humanitarian supply chains performance measurement literature from 2007 to 2021", *International Journal of Disaster Risk Reduction*, Vol. 72, p. 102852, doi: [10.1016/j.ijdr.2022.102852](https://doi.org/10.1016/j.ijdr.2022.102852).
- Anparasan, A. and Lejeune, M. (2019), "Resource deployment and donation allocation for epidemic outbreaks", *Annals of Operations Research*, Vol. 283 No. 1, pp. 9-32.
- Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402.
- Baharmand, H., Comes, T. and Luras, M. (2017), "Managing in-country transportation risks in humanitarian supply chains by logistics service providers: insights from the 2015 Nepal earthquake", *International Journal of Disaster Risk Reduction*, Vol. 24, pp. 549-559.

- Banomyong, R., Varadejsatitwong, P. and Oloruntoba, R. (2019), "A systematic review of humanitarian operations, humanitarian logistics and humanitarian supply chain performance literature 2005 to 2016", *Annals of Operations Research*, Vol. 283 No. 1, pp. 71-86.
- Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.
- Barney, J.B., Ketchen, D.J., Jr and Wright, M. (2011), "The future of resource-based theory: revitalization or decline?", *Journal of Management*, Vol. 37 No. 5, pp. 1299-1315.
- Beamon, B.M. (2004), "Humanitarian relief chains: issues and challenges", *Proceedings of the 34th International Conference on Computers and Industrial Engineering*, San Francisco, CA.
- Besiou, M., Pedraza-Martinez, A.J. and Van Wassenhove, L.N. (2021), "Humanitarian operations and the UN sustainable development goals", *Production and Operations Management*, Vol. 30 No. 12, pp. 4343-4355, doi: [10.1111/poms.13579](https://doi.org/10.1111/poms.13579).
- Blecken, A., Hellingrath, B., Dangelmaier, W. and Schulz, S. (2009), "A humanitarian process reference model", *International Journal of Service Technology and Management*, Vol. 12 No. 4, pp. 391-413.
- Cai, S., Jun, M. and Yang, Z. (2010), "Implementing supply chain information integration in China: the role of institutional forces and trust", *Journal of Operations Management*, Vol. 28 No. 3, pp. 257-268.
- Candace, Y.Y., Ngai, E.W.T. and Moon, K.L. (2011), "Supply chain flexibility in an uncertain environment: exploratory findings from five case studies", *Supply Chain Management: An International Journal*, Vol. 16 No. 4, pp. 271-283, doi: [10.1108/13598541111139080](https://doi.org/10.1108/13598541111139080).
- Cao, M. and Zhang, Q. (2011), "Supply chain collaboration: impact on collaborative advantage and firm performance", *Journal of Operations Management*, Vol. 29 No. 3, pp. 163-180.
- Cardoso, B., Fontainha, T., Leiras, A. and Cardoso, P.A. (2021), "Performance evaluation in humanitarian operations based on the beneficiary perspective", *International Journal of Productivity and Performance Management*, Vol. ahead-of-print No. ahead-of-print, doi: [10.1108/IJPPM-06-2020-0295](https://doi.org/10.1108/IJPPM-06-2020-0295).
- Chae, B.K., Yang, C., Olson, D. and Sheu, C. (2014), "The impact of advanced analytics and data accuracy on operational performance: a contingent resource based theory (RBT) perspective", *Decision Support Systems*, Vol. 59, pp. 119-126.
- Chan, H.K., Griffin, J., Lim, J.J., Zeng, F. and Chiu, A.S. (2018), "The impact of 3D Printing Technology on the supply chain: manufacturing and legal perspectives", *International Journal of Production Economics*, Vol. 205, pp. 156-162.
- Chandes, J. and Paché, G. (2010), "Investigating humanitarian logistics issues: from operations management to strategic action", *Journal of Manufacturing Technology Management*.
- Cotteleer, M. and Joyce, J. (2014), "3D opportunity: additive manufacturing paths to performance, innovation, and growth", *Deloitte Review*, Vol. 14, pp. 5-19.
- Dangayach, G. and Deshmukh, S. (2001), "Manufacturing strategy: literature review and some issues", *International Journal of Operations and Production Management*, Vol. 21 No. 7, pp. 884-932.
- de Camargo Fiorini, P., Jabbour, C.J.C., de Sousa Jabbour, A.B.L. and Ramsden, G. (2021), "The human side of humanitarian supply chains: a research agenda and systematization framework", *Annals of Operations Research*, pp. 1-26, doi: [10.1007/s10479-021-03970-z](https://doi.org/10.1007/s10479-021-03970-z).
- Defee, C.C., Williams, B., Randall, W.S. and Thomas, R. (2010), "An inventory of theory in logistics and SCM research", *The International Journal of Logistics Management*.
- Delic, M. and Eysers, D.R. (2020), "The effect of additive manufacturing adoption on supply chain flexibility and performance: an empirical analysis from the automotive industry", *International Journal of Production Economics*, Vol. 228, p. 107689.
- Dennehy, D., Oredo, J., Spanaki, K., Despoudi, S. and Fitzgibbon, M. (2021), "Supply chain resilience in mindful humanitarian aid organizations: the role of big data analytics", *International Journal of Operations and Production Management*, Vol. 41 No. 9, pp. 1417-1441, doi: [10.1108/IJOPM-12-2020-0871](https://doi.org/10.1108/IJOPM-12-2020-0871).

- Dubey, R., Gunasekaran, A., Papadopoulos, T., Childe, S.J., Shibin, K.T. and Wamba, S.F. (2017), "Sustainable supply chain management: framework and further research directions", *Journal of Cleaner Production*, Vol. 142, pp. 1119-1130.
- Dubey, R., Gunasekaran, A., Childe, S.J., Roubaud, D., Wamba, S.F., Giannakis, M. and Foropon, C. (2019), "Big data analytics and organizational culture as complements to swift trust and collaborative performance in the humanitarian supply chain", *International Journal of Production Economics*, Vol. 210, pp. 120-136.
- Dubey, R., Bryde, D.J., Foropon, C., Graham, G., Giannakis, M. and Mishra, D.B. (2020), "Agility in humanitarian supply chain: an organizational information processing perspective and relational view", *Annals of Operations Research*, pp. 1-21, doi: [10.1007/s10479-020-03824-0](https://doi.org/10.1007/s10479-020-03824-0).
- Dubois, A., Hulthén, K. and Pedersen, A.C. (2004), "Supply chains and interdependence: a theoretical analysis", *Journal of Purchasing and Supply Management*, Vol. 10 No. 1, pp. 3-9.
- Fantazy, K.A., Kumar, V. and Kumar, U. (2009), "An empirical study of the relationships among strategy, flexibility, and performance in the supply chain context", *Supply Chain Management: An International Journal*.
- Fantazy, K.A., Kumar, V. and Kumar, U. (2011), "The impact of information sharing on supply chain performance: an empirical study", *International Journal of Procurement Management*, Vol. 4 No. 3, pp. 274-296.
- Field, A. (2009), *Discovering Statistics Using SPSS*, Sage Publications, London.
- Ford, S.J., Routley, M.J., Phaal, R. and Probert, D.R. (2014), "The industrial emergence of commercial inkjet printing", *European Journal of Innovation Management*.
- Fornell, C. and Larcker, D.F. (1981), "Structural equation models with unobservable variables and measurement error: algebra and statistics", *Journal of Marketing Research*, Vol. 18 No. 3, pp. 382-388.
- Giffi, C.A., Gangula, B. and Illinda, P. (2014), "3D opportunity in the automotive industry", in *Additive Manufacturing Hits the Road*, Deloitte University Press, p. 24.
- Grant, R.M. (1991), "The resource-based theory of competitive advantage: implications for strategy formulation", *California Management Review*, Vol. 33 No. 3, pp. 114-135.
- Grant, R.M. and Baden-Fuller, C. (1995), "August. A knowledge-based theory of inter-firm collaboration", *Academy of Management Proceedings*, Briarcliff Manor, NY 10510, Academy of Management, Vol. No. 1, pp. 17-21.
- Gutjahr, W.J. and Nolz, P.C. (2016), "Multicriteria optimization in humanitarian aid", *European Journal of Operational Research*, Vol. 252 No. 2, pp. 351-366.
- Haavisto, I. and Goentzel, J. (2015), "Measuring humanitarian supply chain performance in a multi-goal context", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 5 No. 3, pp. 300-324, doi: [10.1108/JHLSCM-07-2015-0028](https://doi.org/10.1108/JHLSCM-07-2015-0028).
- Hair, J.F., Jr, Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L. (2010), "SEM: an introduction", *Multivariate Data Analysis: A Global Perspective*, Vol. 5 No. 6, pp. 629-686.
- Hall, R.H., Dansereau, D.F. and Skaggs, L.P. (1992), "Knowledge maps and the presentation of related information domains", *The Journal of Experimental Education*, Vol. 61 No. 1, pp. 5-18.
- Hamel, G. and Prahalad, C.K. (1990), "Strategic intent", *Mckinsey Quarterly* No. 1, pp. 36-61.
- Henseler, J., Ringle, C.M. and Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", *Journal of the Academy of Marketing Science*, Vol. 43 No. 1, pp. 115-135.
- Hodgetts, R.M., Kuratko, D.F. and Hornsby, J.S. (1999), "Quality implementation in small business: perspectives from the Baldrige Award winners", *SAM Advanced Management Journal*, Vol. 64 No. 1, p. 37.
- Hunt, S.D. and Davis, D.F. (2012), "Grounding supply chain management in resource-advantage theory: in defense of a resource-based view of the firm", *Journal of Supply Chain Management*, Vol. 48 No. 2, pp. 14-20.

- Huo, B., Han, Z. and Prajogo, D. (2016), "Antecedents and consequences of supply chain information integration: a resource-based view", *Supply Chain Management: An International Journal*.
- Inter-Agency Standing Committee Principals (2013), "The centrality of protection in humanitarian action statement by the inter-agency standing committee (IASC) principals", available at: <https://www.unhcr.org/protection/idps/5ad5a4d47/centrality-protection-humanitarian-action-statement-inter-agency-standing.html> (accessed on 6 May 2019).
- Ivanov, D. (2020), "Viable supply chain model: integrating agility, resilience and sustainability perspectives—lessons from and thinking beyond the COVID-19 pandemic", *Annals of Operations Research*, pp. 1-21, doi: [10.1007/s10479-020-03640-6](https://doi.org/10.1007/s10479-020-03640-6).
- Jahre, M. and Jensen, L.M. (2010), "Coordination in humanitarian logistics through clusters", *International Journal of Physical Distribution and Logistics Management*.
- Jahre, M. and Spens, K. (2007), "Buy global or go local –that’s the question!", *Proceedings from the 1st Conference of Humanitarian Logistics, November CCHLI*.
- Jebble, S., Kumari, S., Venkatesh, V.G. and Singh, M. (2019), "Influence of big data and predictive analytics and social capital on performance of humanitarian supply chain: developing framework and future research directions", *Benchmarking: An International Journal*.
- Jensen, L.M. and Hertz, S. (2016), "The coordination roles of relief organisations in humanitarian logistics", *International Journal of Logistics Research and Applications*, Vol. 19 No. 5, pp. 465-485.
- Jermisittiparsert, K. and Pithuk, L. (2019), "Exploring the link between adaptability, information technology, agility, mutual trust, and flexibility of a humanitarian supply chain", *International Journal of Innovation, Creativity and Change*, Vol. 5 No. 2, pp. 432-447.
- Kabra, G. and Ramesh, A. (2016), "Information technology, mutual trust, flexibility, agility, adaptability: understanding their linkages and impact on humanitarian supply chain management performance", *Risk, Hazards and Crisis in Public Policy*, Vol. 7 No. 2, pp. 79-103.
- Kogut, B. and Zander, U. (1992), "Knowledge of the firm, combinative capabilities, and the replication of technology", *Organization Science*, Vol. 3 No. 3, pp. 383-397.
- Kunz, N., Reiner, G. and Gold, S. (2014), "Investing in disaster management capabilities versus pre-positioning inventory: a new approach to disaster preparedness", *International Journal of Production Economics*, Vol. 157, pp. 261-272.
- Lawrence, P.R. and Lorsch, J.W. (1967), "Differentiation and integration in complex organizations", *Administrative Science Quarterly*, Vol. 12 No. 1, pp. 1-47.
- Leuschner, R., Rogers, D.S. and Charvet, F.F. (2013), "A meta-analysis of supply chain integration and firm performance", *Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 34-57.
- Liu, J., Yang, W., Liu, Y., Lu, C., Ruan, L., Zhao, C. and Huang, L. (2021), "Combination of Hua Shi Bai Du granule (Q-14) and standard care in the treatment of patients with coronavirus disease 2019 (COVID-19): a single-center, open-label, randomized controlled trial", *Phytomedicine*, Vol. 91, p. 153671.
- Lummus, R.R., Duclos, L.K. and Vokurka, R.J. (2003), "Supply chain flexibility: building a new model", *Global Journal of Flexible Systems Management*, Vol. 4 No. 4, pp. 1-13.
- Madhavan, R., Koka, B.R. and Prescott, J.E. (1998), "Networks in transition: how industry events (re) shape interfirm relationships", *Strategic Management Journal*, Vol. 19 No. 5, pp. 439-459.
- Maghsoudi, A., Zailani, S., Ramayah, T. and Pazirandeh, A. (2018), "Coordination of efforts in disaster relief supply chains: the moderating role of resource scarcity and redundancy", *International Journal of Logistics-Research and Applications*, Vol. 21, pp. 407-430.
- Maleki Far, S., Akbari, M. and Clarke, S. (2017), "The effect of it integration on supply chain agility towards market performance (a proposed study)", *Informing Science: The International Journal of an Emerging Transdiscipline*, Vol. 20, pp. 99-117, available at: <http://www.informingscience.org/Publications/3747>.
- Malone, T.W. and Crowston, K. (1994), "The interdisciplinary study of coordination", *ACM Computing Surveys (CSUR)*, Vol. 26 No. 1, pp. 87-119.

- Maqbool, A. and Khan, N.Z. (2020), "Analyzing barriers for implementation of public health and social measures to prevent the transmission of COVID-19 disease using DEMATEL method", *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*, Vol. 14 No. 5, pp. 887-892.
- Mensah, P., Merkurjev, Y., Klavins, E. and Manak, S. (2017), "Supply chain risks analysis of a logging company: conceptual model", *Procedia Computer Science*, Vol. 104, pp. 313-320.
- Merschmann, U. and Thonemann, U.W. (2011), "Supply chain flexibility, uncertainty and firm performance: an empirical analysis of German manufacturing firms", *International Journal of Production Economics*, Vol. 130 No. 1, pp. 43-53, doi: [10.1016/j.ijpe.2010.10.013](https://doi.org/10.1016/j.ijpe.2010.10.013).
- Moshtari, M. (2016), "Inter-organizational fit, relationship management capability, and collaborative performance within a humanitarian setting", *Production and Operations Management*, Vol. 25 No. 9, pp. 1542-1557.
- Moshtari, M. and Gonçalves, P. (2017), "Factors influencing interorganizational collaboration within a disaster relief context", *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, Vol. 28 No. 4, pp. 1673-1694.
- Mutebi, H., Muhwezi, M., Ntayi, J.M. and Munene, J.C.K. (2020a), "Organisation size, innovativeness, self-organisation and inter-organisational coordination", *International Journal of Emergency Services*.
- Mutebi, H., Ntayi, J.M., Muhwezi, M. and Munene, J.C.K. (2020b), "Self-organisation, adaptability, organisational networks and inter-organisational coordination: empirical evidence from humanitarian organisations in Uganda", *Journal of Humanitarian Logistics and Supply Chain Management*.
- Najjar, M.S., Dahabiyeh, L. and Nawayseh, M. (2019), "Share if you care: the impact of information sharing and information quality on humanitarian supply chain performance-a social capital perspective", *Information Development*, Vol. 35 No. 3, pp. 467-481.
- Namagembe, S. (2020), "Enhancing service delivery in humanitarian relief chains: the role of relational capital", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 10 No. 2, pp. 169-203, doi: [10.1108/JHLSCM-06-2019-0038](https://doi.org/10.1108/JHLSCM-06-2019-0038).
- Nandi, M.L., Nandi, S., Moya, H. and Kaynak, H. (2020), "Blockchain technology-enabled supply chain systems and supply chain performance: a resource-based view", *Supply Chain Management: An International Journal*, Vol. 25 No. 6, pp. 841-862, doi: [10.1108/SCM-12-2019-0444](https://doi.org/10.1108/SCM-12-2019-0444).
- Nelson, R.R. and Winter, S.G. (1982), "The Schumpeterian tradeoff revisited", *The American Economic Review*, Vol. 72 No. 1, pp. 114-132.
- Nonaka, I. (1994), "A dynamic theory of organizational knowledge creation", *Organization Science*, Vol. 5 No. 1, pp. 14-37.
- Olhager, J. and West, B.M. (2002), "The house of flexibility: using the QFD approach to deploy manufacturing flexibility", *International Journal of Operations and Production Management*.
- Oloruntoba, R. (2005), "A wave of destruction and the waves of relief: issues, challenges and strategies", *Disaster Prevention and Management*, Vol. 14 No. 4, pp. 506-521.
- Oppenheim, A.N. (2001), *Questionnaire Design, Interviewing and Attitude Measurement*, Bloomsbury Publishing, London.
- Paciarotti, C. and Valiakhmetova, I. (2021), "Evaluating disaster operations management: an outcome-process integrated approach", *Production and Operations Management*, Vol. 30 No. 2, pp. 543-562.
- Parast, M.M. and Shekarian, M. (2019), "The impact of supply chain disruptions on organizational performance: a literature review", in Zsidisin, G. and Henke, M. (Eds), *Revisiting Supply Chain Risk. Springer Series in Supply Chain Management*, Springer, Cham, Vol. 7, pp. 367-389.
- Pateman, H., Hughes, K. and Cahoon, S. (2013), "Humanizing humanitarian supply chains: a synthesis of key challenges", *The Asian Journal of Shipping and Logistics*, Vol. 29 No. 1, pp. 81-102.

- Pavlou, P.A., Liang, H. and Xue, Y. (2007), "Understanding and mitigating uncertainty in online exchange relationships: a principal-agent perspective", *MIS Quarterly*, Vol. 31 No. 1, pp. 105-136.
- Pedraza-Martinez, A. and Van Wassenhove, L. (2016), "Empirically grounded research in humanitarian operations management: the way forward", *Journal of Operations Management*, Vol. 45, pp. 1-10.
- Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, p. 879.
- Prasanna, S.R. and Haavisto, I. (2018), "Collaboration in humanitarian supply chains: an organisational culture framework", *International Journal of Production Research*, Vol. 56 No. 17, pp. 5611-5625.
- Rao, S.S., Liao, Y. and Hong, P. (2010), "Supply management, supply flexibility and performance outcomes: an empirical investigation of manufacturing firms", *Journal of Supply Chain Management*, Vol. 46 No. 3, pp. 6-22.
- Ringle, C.M., Silva, D.D. and Bido, D.D.S. (2014), "Structural equation modeling with the Smartpls", *Revista Brasileira de Marketing*, Vol. 13 No. 2, pp. 56-73.
- Rucha, K.M. and Abdallah, A.N. (2017), "Effect of supplier relationship management on humanitarian supply chain performance at the world food programme in Somalia", *European Scientific Journal*, Vol. 13 No. 16, pp. 250-276.
- Saleh Mutar Al-Sukainy, M., Tahseen Mehsen, R., Habeeb Abid Al-Athari, M. and Abduljabbar Mussa, I. (2017), "D rxf", *Basrah Journal of Surgery*, Vol. 23 No. 1, pp. 58-65.
- Salem, M., Van Quaquebeke, N., Besiou, M. and Meyer, L. (2019), "Intergroup leadership: how Leaders can enhance performance of humanitarian operations", *Production and Operations Management*, Vol. 28 No. 11, pp. 2877-2897, doi: [10.1111/poms.13085](https://doi.org/10.1111/poms.13085).
- Sánchez, A.M. and Pérez, M.P. (2005), "Supply chain flexibility and firm performance: a conceptual model and empirical study in the automotive industry", *International Journal of Operations and Production Management*, Vol. 25 No. 7, pp. 681-700, doi: [10.1108/01443570510605090](https://doi.org/10.1108/01443570510605090).
- Scholten, K., Scott, P.S. and Fynes, B. (2010), "(Le) agility in humanitarian aid (NGO) supply chains", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 Nos 8/9, pp. 623-635, doi: [10.1108/09600031011079292](https://doi.org/10.1108/09600031011079292).
- Scholten, K., Stevenson, M. and van Donk, D.P. (2019a), "Dealing with the unpredictable: supply chain resilience", *International Journal of Operations and Production Management*, Vol. 40 No. 1, pp. 1-10.
- Scholten, K., Scott, P.S. and Fynes, B. (2019b), "Building routines for non-routine events: supply chain resilience learning mechanisms and their antecedents", *Supply Chain Management: An International Journal*, Vol. 24 No. 3, pp. 430-442.
- Schulz, S. (2008), "Disaster relief logistics. Benefits of and impediments to cooperation between humanitarian organizations", in *Kuehne Foundation Book Series on Logistics 15*, Haupt.
- Seo, Y.J., Dinwoodie, J. and Kwak, D.W. (2014), "The impact of innovativeness on supply chain performance: is supply chain integration a missing link?", *Supply Chain Management: An International Journal*.
- Sezen, B. (2008), "Relative effects of design, integration and information sharing on supply chain performance", *Supply Chain Management: An International Journal*.
- Shareef, M.A., Dwivedi, Y.K., Mahmud, R., Wright, A., Rahman, M.M., Kizgin, H. and Rana, N.P. (2019a), "Disaster management in Bangladesh: developing an effective emergency supply chain network", *Annals of Operations Research*, Vol. 283 No. 1, pp. 1463-1487.
- Shareef, M.A., Dwivedi, Y.K., Mahmud, R., Wright, A., Rahman, M.M., Kizgin, H. and Rana, N.P. (2019b), "Disaster management in Bangladesh: developing an effective emergency supply chain network", *Annals of Operations Research*, Vol. 283 No. 1, pp. 1463-1487.

- Shashi, M., Krishna, B.M., Tezeswi, T.P., Kumar, P.R., Gopikrishna, K. and Sivakumar, M.V.N. (2019), "QR code as speckle pattern for reinforced concrete beams using digital image correlation", *Structural Monitoring and Maintenance*, Vol. 6 No. 1, p. 67.
- Singh, H., Garg, R. and Sachdeva, A. (2018a), "Supply chain collaboration: a state-of-the-art literature review", *Uncertain Supply Chain Management*, Vol. 6 No. 2, pp. 149-180.
- Singh, R.K., Gupta, A. and Gunasekaran, A. (2018b), "Analysing the interaction of factors for resilient humanitarian supply chain", *International Journal of Production Research*, Vol. 56 No. 21, pp. 6809-6827.
- Sohal, A.S., Moss, S. and Ng, L. (2001), "Comparing IT success in manufacturing and service industries", *International Journal of Operations and Production Management*.
- Spector, P.E. and Brannick, M.T. (2010), "Common method issues: an introduction to the feature topic in organizational research methods", *Organizational Research Methods*, Vol. 13 No. 3, pp. 403-406.
- Spender, J.C. and Grant, R.M. (1996), "Knowledge and the firm: overview", *Strategic Management Journal*, Vol. 17 No. S2, pp. 5-9.
- Stevenson, M. and Spring, M. (2007), "Flexibility from a supply chain perspective: definition and review", *International Journal of Operations and Production Management*.
- Sundram, V.P.K., Bahrin, A.S., Munir, Z.B.A. and Zolait, A.H. (2018), "The effect of supply chain information management and information system infrastructure", *Journal of Enterprise Information Management*.
- Swafford, P.M., Ghosh, S. and Murthy, N. (2006), "The antecedents of supply chain agility of a firm: scale development and model testing", *Journal of Operations Management*, Vol. 24 No. 2, pp. 170-188.
- Tatham, P. and Hughes, K. (2011), in Christopher, M. and Tatham, P. (Eds), "Humanitarian logistics metrics: where we are and how we might improve", *Humanitarian Logistics: Meeting the Challenge of Preparing for and Responding to Disasters*, Kogan Page, Philadelphia and London, pp. 249-263.
- The New humanitarian (2020), "Coronavirus and aid: what we're watching", available at: <https://www.thenewhumanitarian.org/news/2020/06/11/coronavirus-humanitarian-aid-response> (accessed 23 March 2022).
- Theriou, N.G., Aggelidia, V. and Theriou, G.N. (2009), "A theoretical framework contrasting the resource-based perspective and the knowledge-based view", *European Research Studies Journal*, Vol. 12 No. 3, pp. 177-190.
- Thomas, E.F. (2014), "Platform-based product design and environmental turbulence: the mediating role of strategic flexibility", *European Journal of Innovation Management*, Vol. 17 No. 1, pp. 107-124.
- Tipu, S.A.A. and Fantasy, K.A. (2014), "Supply chain strategy, flexibility, and performance", *The International Journal of Logistics Management*.
- Tiwari, A.K., Tiwari, A. and Samuel, C. (2015), "Supply chain flexibility: a comprehensive review", *Management Research Review*, Vol. 38 No. 7, pp. 767-792, doi: [10.1108/MRR-08-2013-0194](https://doi.org/10.1108/MRR-08-2013-0194).
- Tomasini, R.M. and Van Wassenhove, L.N. (2009), "From preparedness to partnerships: case study research on humanitarian logistics", *International Transactions in Operational Research*, Vol. 16 No. 5, pp. 549-559.
- Un, C.A. (2017), "Absorptive capacity and R&D outsourcing", *Journal of Engineering and Technology Management*, Vol. 43, pp. 34-47.
- UNHCR (2020), "UNHCR global trends - forced displacement in 2020", available at: <https://www.unhcr.org/flagship-reports/globaltrends/> (accessed 23 March 2022).
- Van Wassenhove, L.N. (2006), "Humanitarian aid logistics: supply chain management in high gear", *The Journal of Operations Research Society*, Vol. 57 No. 7, pp. 475-489.
- Vickery, S.N., Calantone, R. and Dröge, C. (1999), "Supply chain flexibility: an empirical study", *Journal of Supply Chain Management*, Vol. 35 No. 2, pp. 16-24.

-
- Wang, Y., Wallace, S.W., Shen, B. and Choi, T.M. (2015), "Service supply chain management: a review of operational models", *European Journal of Operational Research*, Vol. 247 No. 3, pp. 685-698.
- Winter, S.G. (1995), "Four Rs of profitability: rents, resources, routines, and replication", *Resource-based and Evolutionary Theories of the Firm: Towards a Synthesis*, Springer, Boston, MA, pp. 147-178.
- Wise, R.A. (2006), "Keeping patients safe when disaster strikes", *Frontiers of Health Services Management*, Vol. 23 No. 1, p. 35.
- World Health Organization (2019), "Health emergency and disaster risk management framework", available at: <https://apps.who.int/iris/bitstream/handle/10665/326106/9789241516181-eng.pdf> (accessed 7 December 2021).
- Yadav, D.K. and Barve, A. (2015), "Analysis of critical success factors of humanitarian supply chain: an application of Interpretive Structural Modeling", *International Journal of Disaster Risk Reduction*, Vol. 12, pp. 213-225.
- Zacharia, Z.G., Nix, N.W. and Lusch, R.F. (2011), "Capabilities that enhance outcomes of an episodic supply chain collaboration", *Journal of Operations Management*, Vol. 29 No. 6, pp. 591-603.
- Zhang, J., Wang, Z. and Ren, F. (2019), "Optimization of humanitarian relief supply chain reliability: a case study of the Ya'an earthquake", *Annals of Operations Research*, Vol. 283 No. 1, pp. 1551-1572.
- Zhao, H., Song, S., Zhang, Y., Gupta, J.N., Devlin, A.G. and Chiong, R. (2019a), "Supply chain coordination with a risk-averse retailer and a combined buy-back and revenue sharing contract", *Asia-Pacific Journal of Operational Research*, Vol. 36 No. 05, p. 1950028.
- Zhao, X., Lim, A., Guo, H., Ding, C. and Song, J.S. (2019b), "Retail clusters in developing economies", *Manufacturing and Service Operations Management*, Vol. 21 No. 2, pp. 452-467.

Further reading

- Cropley, V.L., Klauser, P., Lenroot, R.K., Bruggemann, J., Sundram, S., Bousman, C. and Zalesky, A. (2017), "Accelerated gray and white matter deterioration with age in schizophrenia", *American Journal of Psychiatry*, Vol. 174 No. 3, pp. 286-295.
- Walumbwa, F.O., Christensen-Salem, A., Perrmann-Graham, J. and Kasimu, P. (2020), "An identification based framework examining how and when salient social exchange resources facilitate and shape thriving at work", *Human Resource Development Review*, Vol. 19 No. 4, pp. 339-361.

Appendix 1

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Table A1.
Test for Non-Response Bias

Variables	Group	N	Levene's test for equality of variances		
			F	Sig	t
SCF	1.00	99	0.792	0.703	1.628
	2.00	99			
ICC	1.00	99	0.029	0.865	1.139
	2.00	99			
HSCP	1.00	99	0.233	0.267	1.490
	2.00	99			

Appendix 2

Table A2.
Fornell-Larcker criterion

	HSCP	ICC	SCF
HSCP	0.848		
ICC	0.311	0.860	
SCF	0.770	0.321	0.898

Appendix 3

Table A3.
Heterotrait-monotrait (HTMT) ratio

	HSCP	ICC	SCF
HSCP			
ICC	0.325		
SCF	0.826	0.347	

Corresponding author

Francis Kamewor Tetteh can be contacted at: kameworfrancis@gmail.com

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