

# How the dimensions of culture influence supply chain collaboration: an explanatory sequential mixed-methods investigation

Culture and supply chain collaboration

241

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## Abstract

**Purpose** – This study aims to demonstrate how integration is achieved in an explanatory sequential mixed-methods design by assessing the effect of collaborative cultural dimensions on supply chain collaboration amongst firms in Ghana's downstream petroleum sector. Specifically, the study examined how collectivism, long-term orientation, power symmetry, as well as uncertainty avoidance influence supply chain collaboration. Besides, it also demonstrates how integration is achieved in an explanatory sequential mixed-methods design.

**Design/methodology/approach** – Using an explanatory sequential mixed-methods design, the study employed a partial least squares structural equation modelling (PLS-SEM) analysis of quantitative data ( $N = 166$ ), followed by a thematic analysis of eight semi-structured interviews to explain how and why the dimensions of collaborative culture impact supply chain collaboration.

**Findings** – The quantitative findings suggest that three out of the four dimensions of culture significantly predict supply chain collaboration. Integrating the quantitative and qualitative findings suggests convergence between the results of the quantitative and qualitative phases of the study as the qualitative results compliment the quantitative findings and offer more nuanced understanding of the cultural mechanisms responsible for successful supply chain collaborations.

**Practical implications** – The findings provide managers in the downstream petroleum sector with insights into how and why the dimensions of collaborative culture influence supply chain collaboration. These managers should, therefore, build corporate cultures characterized with high levels of long-term orientation, power symmetry and uncertainty avoidance.

**Originality/value** – Owing to the role of culture in successful supply chain collaborations, this study, through a mixed-methods design, links the dimensions of collaborative culture with supply chain collaboration in the downstream petroleum sector. Moreover, it demonstrates how integration and complementarity are achieved at the study design, methods, as well as the interpretation and reporting levels of an explanatory sequential mixed-methods design.

**Keywords** Ghana, Culture, Supply chain collaboration, Explanatory sequential mixed methods, Petroleum sector, Joint display

**Paper type** Research paper

## 1. Introduction

Advances in information and communications technology (ICT), as well as globalization, have resulted in organizations becoming increasingly conscious of the fact that optimizing



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the performance of the whole supply chain, rather than individual organizations that constitute a supply chain, is the way to go. Uncertainty, as well as changing customer expectations, made it abundantly clear that no single individual organization has a monopoly over the efforts that lead to increased customer satisfaction. Supply chain collaboration is critical to performance advances that result in a sustained competitive advantage (Cao & Zhang, 2011). Superior supply chain collaboration, where members leverage the capabilities of suppliers and customers, is vital to survive and flourish in this competitive business climate (Fawcett, Fawcett, Watson & Magnan, 2012).

Cao & Zhang (2012) posit that collaboration in the supply chain denotes a situation where more than one independent firm teams up in planning as well as executing their supply chain activities. Fawcett, McCarter, Fawcett, Webb & Magnan (2015) note that collaboration entails not only the relationship amongst the members of the supply chain but also the sharing of resources that assist in responding adequately to customer requirements. As Verdecho, Alfaro-Saiz, Rodriguez-Rodriguez & Ortiz-Bas (2012) observe, collaborative partners gain significant advantages and benefits in the form of complementary resources, share the risk, reduce product development costs, thereby enhancing productivity and competitive advantage.

It is, therefore, a truism that managing the flows that exist in a supply chain would not be possible without working and robust supply chain relationships. Cao & Zhang (2012) note that collaboration as a supply chain strategy has one of the worst histories among the numerous supply strategies that firms ever introduced. For supply chains to realize the value of supply chain collaboration, further investigation is needed, even though it seems to have enormous potential (Cao & Zhang, 2012).

Prior research on the role of a collaborative culture in influencing supply chain collaboration suggests that a collaborative culture positively predicts supply chain collaboration (Cao & Zhang, 2012; Kumar, Banerjee, Meena & Ganguly, 2016; Lei, Le & Nguyen, 2017; Zhang & Cao, 2018). Further, a common theme that runs through the literature on collaborative culture and supply chain collaboration is the conceptualization of a collaborative culture construct as an all-embracing composite. These studies also tested only the construct-level structural models – thereby ignoring the nature of relationships between the dimensions of collaborative culture and supply chain collaboration. However, assessing these sub-construct-level relationships could help explore alternative models that make the findings more useful for decision-makers (Cao & Zhang, 2012).

More so, previous studies on collaborative culture and supply chain collaboration failed to sufficiently explain the contexts behind reported quantitative relationships (Cao & Zhang, 2012; Kumar *et al.*, 2016; Lei *et al.*, 2017; Nyaga, Whipple & Lynch, 2010; Piboonrunroj, 2012; Zhang & Cao, 2018; Acquah, Naude & Sendra-García, 2021). Hence, there is a need to not only obtain quantitative results but to explain such results in more detail in terms of detailed respondent views and perspectives.

Furthermore, literature has no evidence on the use of mixed-methods design in assessing how a collaborative culture influences supply chain collaboration. These studies are mostly quantitative (Cao & Zhang, 2012; Kumar *et al.*, 2016; Ralston, 2014; Seo, Dinwoodie & Roe, 2016) and focused primarily on whether collaborative culture predicts supply chain collaboration (Cao & Zhang, 2012). Adopting a purely quantitative research design does not give a comprehensive picture of how and why the dimensions of a collaborative culture influence supply chain collaboration. These strictly quantitative designs raise issues that pose validity risks relating to common method variance (CMV), which occurs when associations between constructs are exaggerated or subdued due to the method used to examine the constructs (Acquah *et al.*, 2021; Schindler & Burkholder, 2016).

Consequently, and to help overcome the above-mentioned limitations of prior research, this study employs an explanatory mixed-methods design to investigate how and why the

specific facets of collaborative culture (i.e. collectivism, long-term orientation, power symmetry and uncertainty avoidance) influence supply chain collaboration in the downstream petroleum sector of an emerging economy. As a result, the study used mixed-methods research to explore the following broad research question: How do the dimensions of collaborative culture influence supply chain collaboration?

This study makes a three-fold contribution to the literature; the first contribution stems from the use of an explanatory sequential mixed-methods design where qualitative results from the second phase are used to complement and explain the nuances behind the quantitative findings in the first phase. Secondly, this study brings the petroleum sector perspective to the debate on how the dimensions of collaborative culture influence supply chain collaboration (Acquah *et al.*, 2021). Thirdly, this study brings an emerging economy perspective that augments the developed country-dominated literature on how collaborative culture influences supply chain collaboration.

The subsequent sections of this paper are structured as follows: we present the literature and hypotheses as well as methodology in Sections 2 and 3, respectively. In Section 4, we present the results, while Section 5 is dedicated to discussion and integration of the findings.

## 2. Literature, theoretical framework and hypothesis

### 2.1 Supply chain collaboration

Supply chain collaboration denotes the development of close longstanding relationships that enable members of a supply chain to work together and share resources, information, as well as risk in accomplishing common goals and objectives (Baah, Acquah & Ofori, 2021; Cao & Zhang, 2012; Ralston, Richey & Grawe, 2017). Moreover, collaboration is not only the catalyst behind effective and efficient management of the supply chain but the eventual core capability in a contemporary global economy and a path to sustained competitive advantage (Banchuen, Sadler & Shee, 2017; Al-Abdallah, Abdallah & Hamdan, 2014, p. 193). Supply chain collaboration is about how a firm purposefully collaborates with other members of its supply chain to enhance their ability to administer its internal as well as external operations to achieve effectiveness and efficiency in the movement of goods, services, information and decisions (Arvitrida, Robinson, Tako & Robertson, 2016; Baah *et al.*, 2021).

### 2.2 Organizational culture

Organizational culture denotes the configuration of collective ideals and principles that aid individuals in comprehending the way organizations operate, which then serve as the basis for the norms for behaviour in the organization (Kumar *et al.*, 2016). Alternatively, organizational culture is a collection of fundamental conventions established by the organization as it discerns how to cope with challenges within the organization besides variations in its external environment (Acquah *et al.*, 2021; Van Dijk, 2016). Collaborative culture denotes relationship orientations where supply chains give critical attention to establishing as well as preserving long-term relationships, to the extent that organizational goals and objectives are revised in certain situations to safeguard the partnership (Lei *et al.*, 2017). In other words, collaborative culture embodies the customs, principles and fundamental ideas of the firm about acceptable practices in the supply chain (Yilmaz, Çemberci & Uca, 2016). Four dimensions of collaborative culture, namely, collectivism, long-term orientation, power symmetry and uncertainty avoidance (Acquah *et al.*, 2021), are considered for this study.

### 2.3 Theoretical framework and hypothesis development

In the resource-based theory (RBT), collaborative culture is explained as the embodiment of the customs, principles and fundamental ideas of the firm, which constitute rare and valuable

resources to the entire supply chain (Yilmaz *et al.*, 2016). Hence, collectivism, long-term-orientation, power symmetry and uncertainty avoidance are adopted as the dimensions of collaborative culture. Since the RBT suggests a direct relationship between resources and supply chain performance (Acquah *et al.*, 2021), it provides the basis to hypothesize a link between collaborative culture and supply chain collaboration. In line with the above discussions, a research framework in Figure 1 is proposed.

Since prior literature has been consistent on the direct relationship between collaborative culture and supply chain collaboration (Cao & Zhang, 2011; Kumar *et al.*, 2016), it is postulated that the individual dimensions of collaborative culture would predict supply chain collaboration. Accordingly, directional hypotheses are deemed appropriate and hence formulated to examine these links as follows:

*2.3.1 Collectivism and supply chain collaboration.* Collectivism is the dimension of collaborative culture denoting the degree to which an organization embraces a collective rather than an individualistic consciousness when dealing with supply chain members (Kumar *et al.*, 2016). Collectives treasure common characteristics and norms rather than individual goals and objectives, making collectivists more cooperative (Yilmaz *et al.*, 2016). They emphasize communal and shared effort towards the collaboration (Seo *et al.*, 2016). They adore working jointly and harmonizing each other's activities. Collectivism orientation signifies cooperation, teamwork, joint problem-solving and partnership amongst supply chain partners (Cao & Zhang, 2012). They build a sense of responsibility and obligation in collaborative relationships as opposed to arm's length, transactional and short-term relationships (Nikol'chenko & Lebedeva, 2017). Therefore, the following hypothesis is proposed:

- H1. There is a positive relationship between the level of collectivism amongst supply chain partners and supply chain collaboration.

*2.3.2 Long-term orientation and supply chain collaboration.* Long-term orientation suggests the degree to which supply chain partners are desirous of exercising efforts in building lasting relationships with supply chain members (Cao & Zhang, 2012; Van Dijk, 2016). In other words, it is the extent to which businesses are committed to developing enduring and successful inter-organizational relationships (Kumar *et al.*, 2016). The amount and quality of time, money and facilities earmarked for the relationship prove it (Seo *et al.*, 2016). Another key ingredient of a long-term-oriented relationship is the extent to which members are willing

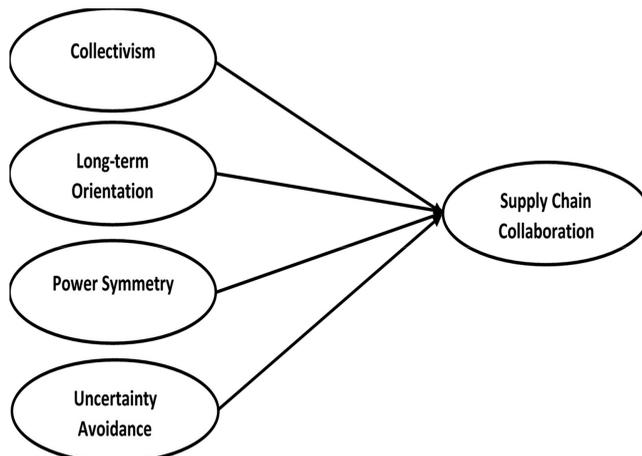


Figure 1.  
Research framework

to assist each other during periods of difficulty (Seo *et al.*, 2016). Consequently, the following hypothesis is proposed:

*H2.* There is a positive relationship between the level of long-term orientation amongst supply chain partners and supply chain collaboration.

*2.3.3 Power symmetry and supply chain collaboration.* Power symmetry or balance denotes the measure to which a member of a supply chain trusts that the other members should have the same level of power, influence or authority in the relationship (Cao & Zhang, 2012; Lei *et al.*, 2017). Low power distance or power asymmetry signifies equal distribution of power, authority and control amongst the members of the supply chain and vice versa (Kumar *et al.*, 2016). Hence, the lower the power distance, the more probable it is for a firm to partake in egalitarian and participatory decision-making (Seo *et al.*, 2016). However, the higher the power distance, the more likely it is for a supply chain member to participate in liberal, relaxing and fair decision-making (Kumar *et al.*, 2016). Hence, a principled application of power encourages behaviours that foster the development of mutual cooperative and enduring inter-organizational relationships (Acquah *et al.*, 2021; Seo *et al.*, 2016; Van Dijk, 2016). Thus, the following hypothesis is proposed:

*H3.* There is a positive relationship between lower levels of power symmetry amongst supply chain partners and supply chain collaboration.

*2.3.4 Uncertainty avoidance and supply chain collaboration.* Uncertainty avoidance denotes the degree to which a firm seeks to eschew ambiguity (Seo *et al.*, 2016). In other words, it describes the extent to which a firm feels threatened by and tries to evade woolly circumstances of its supply chain (Acquah *et al.*, 2021; Lei *et al.*, 2017). The higher a supply chain member's level of uncertainty avoidance, the higher the need for consistency, reliability and predictability, as well as the proclivity to instituting formal governance mechanism in the form of procedures, rules and processes for collaboration (Kumar *et al.*, 2016; Seo *et al.*, 2016). Supply chain partners differ in the level of uncertainty, ambiguity and vagueness with which they can put up. Hence, the following hypothesis is proposed:

*H4.* There is a positive relationship between the level of uncertainty avoidance amongst supply chain partners and supply chain collaboration.

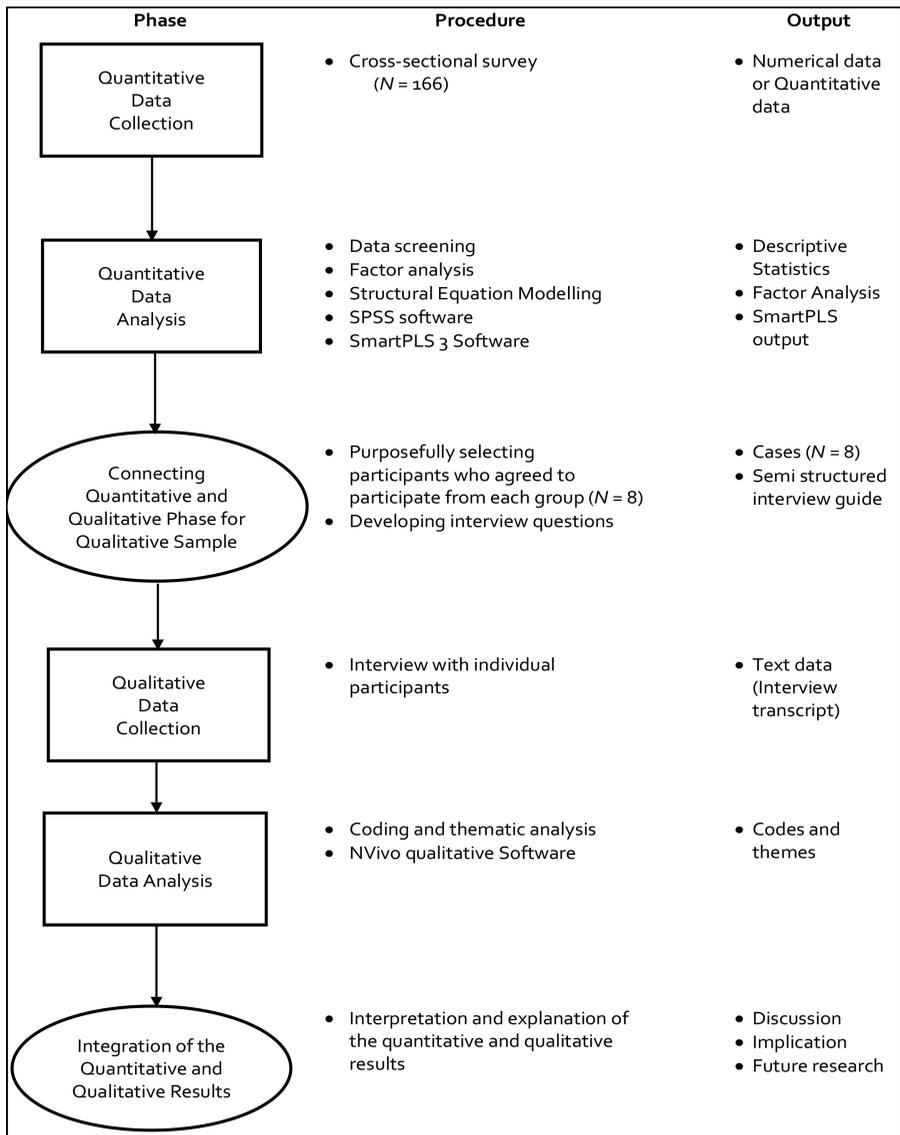
### 3. Methodology

#### 3.1 Design, population and sample

An explanatory sequential design was the means through which this study implemented integration at the study design level. This study purported to investigate how the dimensions of collaborative culture influence supply chain collaboration, using structural equation modelling (SEM) and thematic analysis with participants in Ghana's petroleum downstream sector. This design involved a two-phase design (Figure 1) where quantitative data were collected and analyzed, followed by a subsequent gathering and analysis of qualitative data (Fetters, Curry & Creswell, 2013; McCrudden & McTigue, 2019; Maleku, Kim, Kagotho & Lim, 2021).

The sample frame for the study (as obtained from the National Petroleum Authority) was 180, consisting 33 bulk oil distribution companies (BDCs), 107 oil marketing companies (OMCs) and 40 liquefied petroleum gas marketing companies (LPGMCs), representing 18, 60 and 22%, respectively. The usable sample for the study was made up of 30 BDCs, 98 OMCs and 38 LPGMCs, resulting in a total 166 respondents. Whereas the data collection for the first phase of the study took place between 13 November 2018 and 15 February 2019, that for the second qualitative phase was between 15 May 2019 to 05 June 2019.

In the quantitative phase, respondents indicated the degree to which they agree with or disagree with statements on a Likert scale. Using the partial least squares (PLS) approach to SEM, we analyzed these responses to determine the degree to which each dimension of collaborative culture predicts supply chain collaboration. In the subsequent qualitative phase, we purposely sampled eight participants from respondents who participated in the quantitative phase of the study and interviewed them to gain a better understanding of why they think these dimensions of collaborative culture, influence supply chain collaboration. Figure 2 provides a visual display for the explanatory sequential study design procedure.



**Figure 2.** Visual display for the explanatory sequential study design procedure

### 3.2 Integration

Core to mixed-methods research is integration – a conscious effort at combining qualitative and quantitative research approaches to achieve a form of synergy that results in a better understanding of a phenomenon or topic (Creamer, 2018; Fetters *et al.*, 2013; Fetters & Molina-Azorin, 2019; McCrudden & McTigue, 2019). A critical component of mixed-methods research without which research involving quantitative and qualitative phases may, at best, qualify as multimethod research design and not a mixed-methods design is integration (Bazeley, 2012; Plano Clark & Ivankova, 2016). It is, therefore, imperative to understand not only when, but also how to achieve integration between quantitative and qualitative research approaches (Bazeley, 2018). This background makes it necessary for researchers to indicate how and the degree to which they integrate quantitative and qualitative approaches in their studies (Bazeley, 2012). Though there has been some consensus on the role integration plays in mixed-methods research, the same does not apply to the views on achieving integration because the mixed-methods literature is awash with a variety of perspectives on the same (Fetters & Freshwater, 2015).

Consequently, this study approached integration from the perspective proposed by Fetters *et al.* (2013) because it is not only comprehensive but also comes handy to up-and-coming researchers. It proposes integration at three different levels, namely, at the study design, methods and interpretation and reporting levels. Accordingly, this study sought to use Ghana's petroleum downstream as the context, to exemplify how integration is achieved at the methods level as well as at the interpretation and reporting levels in a sequential explanatory design where complementarity is an important goal. Table 1 summarizes the levels of integration, implementation strategy besides details of how the study achieved the same.

### 3.2 Setting

The study took place in Ghana, a lower-middle-income country in West Africa. The target population was the firms in the petroleum downstream that are responsible for distributing and marketing petroleum products throughout the country. Specifically, the study targeted BDCs, OMCs as well as LPGMCs.

While BDCs are responsible for the primary storage and distribution of refined petroleum products (that may be imported or procured from local refineries in Ghana), OMCs and LPGMCs (who are specialized in the distribution of liquefied petroleum gas products), on the

Level of integration	Implementation strategy	Details
Study design	Explanatory sequential design	A two-phase design involving the collection and analysis of quantitative data from 166 respondents, followed by the collection and analysis of eight semi-structured interviews
Methods	Connecting	Respondents who participated in the first quantitative phase served as the sampling frame for the qualitative phase
	Building	Quantitative data were used as a basis for developing the semi-structured interview protocol
Interpretation and reporting	Narrative	Presented quantitative and qualitative results in different sections (using the contiguous approach) of a single report
	Joint display table	Contrasted the quantitative results and qualitative findings in a single table (the combined results matrix) to allow for side-by-side comparison

**Table 1.**  
Summary of integration level and implementation strategy

other hand, act as intermediaries between the BDCs and the final consumers of petroleum products.

In Ghana, the availability as well as the price of petroleum products determine the survival of most governments. Therefore, academic research within this setting is essential because of its role in guaranteeing, for both developed and emerging economies, not only the security of energy supply, but also the stability of the prices of petroleum products. However, despite the importance of the petroleum sector to both developed and emerging economies, the literature on the antecedents of supply chain collaboration insinuates the lack of studies that explore this phenomenon in the petroleum downstream sector of an emerging economy. Accordingly, assessing the role of collaborative culture in ensuring successful supply chain collaborations in such emerging economy context might be both interesting and revealing (Acquah *et al.*, 2021), besides being important for to a comprehensive understanding of the industry by downstream petroleum companies (i.e. BDCs, OMCs and LPGMCs), policymakers, together with other industry watchers. Despite the fact that supply chain collaboration is a very broad subject in business, this study zooms in on collaborative cultural dimensions as drivers of supply chain collaboration in the downstream petroleum sector of an emerging economy, Ghana.

Both phases of the study received institutional approval from the Universities' institutional review board with approval numbers HSS/1211/018D and HSS/0375/019D for the quantitative and qualitative phases, respectively. Additionally, we obtained gatekeepers' permission and participant consent (from each participant) before the study commenced.

### 3.3 Quantitative phase

**Data collection:** We used a 59-item self-administered questionnaire to collect data from respondents ( $N = 166$ ). The first set of questions related to the dimensions of collaborative culture (collectivism, long-term orientation, power symmetry and uncertainty avoidance) and supply chain collaboration. These were measured using a seven-point Likert scale, which ranged from 1 = strongly disagree to 7 = strongly agree. For the supply chain collaboration scale, we performed factor analysis to form items that measure supply chain collaboration. The second category of questions was on the demographic characteristics of the respondents. These are gender, age, department, specialization, their highest academic qualification, position in the organization and their years of work experience.

Collaborative culture (20 items; Cao & Zhang, 2012): The collaborative culture scale included questions assessing the perception of respondents regarding the four dimensions of collaborative culture. We measured each dimension of collaborative culture with five items each. In all cases, higher scores suggest a more substantial degree of collectivism, long-term orientation, power symmetry and uncertainty avoidance than lower scores.

Supply chain collaboration (30 items; Cao & Zhang, 2012; Piboonrunroj, 2012): The study used a supply chain collaboration scale to measure participants' perception of the degree of supply chain collaboration. We used principal axis factoring and promax rotation with the Kaiser normalization procedure to extract and rotate the factors resulting in eight factors (with their respective reliability scores). These factors include joint activities (0.93), information, risk and resource sharing (0.84), decision synchronization (0.90), incentive alignment (0.90), joint knowledge creation (0.85), collaborative communication (0.76), synchronized performance measurement (0.77) and goal congruence (0.76).

**Data analysis:** Using the PLS approach to SEM, we developed and empirically tested the quantitative model with survey data of 166 useable responses. This model included four exogenous constructs (collectivism, long-term orientation, power symmetry and uncertainty avoidance) and an endogenous construct (supply chain collaboration). Each construct was reflectively operationalized based on theory (Cao & Zhang, 2012; Piboonrunroj, 2012). The structural model was, therefore, made up of five constructs, while the final measurement

model had 23 items (four for each dimension of collaborative culture and seven for supply chain collaboration). We used SmartPLS 3.8 for data analysis.

### 3.4 Qualitative phase

**Data collection.** Participants for this phase of the study were those who agreed to participate in the follow-up interview. We conducted standard open-ended interviews with eight participants with higher scores on the dimensions of collaborative culture, supply chain collaboration in the quantitative phase. The results from the first phase of the study informed the content of the semi-structured interview guide. Sample questions included, “Which dimension of collaborative culture, influences supply chain collaboration?”, “why do the dimensions of collaborative culture significantly predict supply chain collaboration?”, “can you elaborate a little on this?”, “Can you give your reasons?”, “Can you give me some examples?” Even though the survey results informed the structure of the interview questions, they nonetheless remained open-ended to enable the responses to be respondent directed. Also, these questions were based on what exists in the literature; they were incomplete and were finalized after the results of the first phase were obtained (Creswell & Plano Clark, 2017).

**Data analysis.** We recorded and transcribed the interviews and e-mailed the transcripts to respondents for checking and confirmation. We used NVivo version 12 to analyze the semi-structured interview data in the second qualitative phase. Descriptive coding was employed to enable the identification and classification of data relating to the key constructs in the study. At the same time, accounts and portions were grouped in a manner consistent with descriptive codes and mapped to determine the relationships that existed. To be able to encapsulate impulsive ideas and thoughts about the data during pattern coding and mapping, memoing was used (Schindler & Burkholder, 2016). We also created individual accounts made up of structure, significance and the quintessence of each opinion that exemplified each respondent’s perception, after which we sent these accounts to the respondents for checking and validation (Schindler & Burkholder, 2016). Themes developed from the pattern coding, mapping and memoing were used to create effect matrixes that explained how and why the dimensions of collaborative culture influenced supply chain collaboration (Schindler & Burkholder, 2016).

## 4. Results

### 4.1 Quantitative results

**Respondents characteristics.** Respondents were 166 representatives from downstream operators. The sample included 101 (60.8%) males and 65 (39.2) females, of which 96 (58%) fell within the 31–40 year age range, while 35 (21.1%), 33 (19.9%) and two (1.2%) were within the 41–50, 20–30 and 51–60 year age groups, respectively. Most respondents (33.1%) had a specialization in procurement, operations and logistics, while 25.9 and 25.3% had a specialization in management/administration and marketing, respectively. Most respondents had masters’ (56%) or a first degree (37%), while the rest had a certificate (2.4%), Higher National Diploma (HND) (4.2%) or a PhD (0.6%). Regarding professional experience, most of the respondents (51%) had between six and ten years’ work experience, (44%) had one and five years of experience, while and 4.8% above ten years of work experience.

**Measurement model results.** Table 2 shows that Cronbach’s alpha and composite reliability values were all above the recommended threshold of 0.7 (Hair, Hult, Ringle & Sarstedt, 2016; Sarstedt, Hair, Ringle, Thiele & Gudergan, 2016), suggesting that the model had internal consistency reliability. Likewise, the factor loadings and the average variance extracted (AVE) values were also above the recommended threshold of at least 0.5, thereby confirming the model’s convergent validity status (Hair, Howard & Nitzl, 2020; Hair, Risher, Sarstedt & Ringle, 2019).

Construct	Indicator	Initial loadings	Final loadings	Cronbach's alpha	Composite reliability	AVE
Collectivism	CC_COL1	0.782	0.782	0.833	0.886	0.661
	CC_COL2	0.762	0.762			
	CC_COL3	0.877	0.877			
	CC_COL4	0.825	0.825			
Long-term orientation	CC_LTO1	0.749	0.749	0.821	0.882	0.652
	CC_LTO2	0.806	0.807			
	CC_LTO3	0.853	0.853			
	CC_LTO4	0.817	0.817			
Power symmetry	CC_POS1	0.766	0.766	0.804	0.872	0.630
	CC_POS2	0.791	0.792			
	CC_POS3	0.843	0.843			
	CC_POS4	0.772	0.772			
Uncertainty avoidance	CC_UNA1	0.751	0.751	0.873	0.914	0.728
	CC_UNA2	0.917	0.917			
	CC_UNA3	0.906	0.906			
	CC_UNA4	0.828	0.828			
Supply chain collaboration	COC_AVG	0.594	0.594	0.875	0.904	0.576
	DES_AVG	0.764	0.763			
	GOC_AVG	0.706	0.706			
	IRRS_AVG	0.744	0.744			
	JOA_AVG	0.854	0.854			
	JOK_AVG	0.854	0.854			
	SLAVG	0.767	0.767			
	SYP_AVG	0.011	Deleted			

**Table 2.**  
Internal consistency  
and convergent  
validity results

Likewise, the results displayed in Table 3 indicate that the model had discriminant validity per Fornell–Larcker criterion because the squared AVEs of each construct is higher than the correlation between the said construct and other constructs used in the model (Hair, Ringle, Sarstedt, & Gudergan, 2017; Hair et al., 2019; Hair et al., 2020). Similarly, the results of the heterotrait-monotrait (HTMT) ratio criterion in Table 4 confirm the model's discriminant validity status. Since none of the HTMT values (in bold) exceeds 0.85 and none of the upper and the lower bound values of the biased-corrected 95% confidence intervals contain 1 (Hair et al., 2020; Henseler, Ringle & Sarstedt, 2015), it is, therefore, concluded that the measurement model results demonstrate the conditions of PLS-SEM regarding internal consistency reliability, convergent validity, as well as discriminant validity (Acquah et al., 2021; Hair et al., 2020; Henseler et al., 2015).

**Structural model results.** The model was first checked for multicollinearity; it can be seen from Table 4 that the variance inflation factor values for the exogenous constructs in this model ranged from 1.492 for power symmetry to 2.214 for long-term orientation. These are above the critical values, thereby confirming the absence of multicollinearity amongst the exogenous constructs (Hair et al., 2019, 2020). *Coefficient of determination ( $R^2$ ):* Results, as shown Table 4, indicate an  $R^2$  value of 0.516, implying that the exogenous constructs account for 51.6% of the variation in supply chain collaboration, and hence, the structural model met the requirement of predictive power (Acquah, Agyabeng-Mensah & Afum, 2020; Hair et al., 2017; Hair et al., 2019). *Predictive relevance ( $q^2$ ):* Also, a  $q^2$  value of 0.249 for the endogenous construct confirms the structural model's predictive relevance (Hair et al., 2017; Hair et al., 2019), while the  $q^2$  effect sized ranged from 0.001 to 0.050, suggesting a small effect size regarding the predictive accuracy of the structural paths (Hair et al., 2019; Sellitto, Camfield & Buzuku, 2020). *Effect-size ( $f^2$ ) assessment:* Table 4 displays the effect sizes of the various

Construct	Fornell–Larcker criterion				
	1	2	3	4	5
1. Collectivism	<i>0.813</i>				
2. Long-term orientation	0.650	<i>0.807</i>			
3. Power symmetry	0.324	0.520	<i>0.794</i>		
4. Supply chain collaboration	0.475	0.615	0.577	<i>0.710</i>	
5. Uncertainty avoidance	0.452	0.520	0.472	0.561	<i>0.853</i>

Construct	HTMT ratio				
	1	2	3	4	5
1. Collectivism					
2. Long-term orientation	<i>0.754</i>				
3. Power symmetry	[0.627;0.857]	<i>0.627</i>			
4. Uncertainty avoidance	[0.222;0.521]	[0.490;0.766]	<i>0.578</i>		
5. Supply chain collaboration	[0.360;0.690]	[0.429;0.774]	[0.402;0.718]	<i>0.631</i>	
	[0.394;0.636]	[0.594;0.812]	[0.538;0.805]	[0.509;0.746]	

**Note(s):** Diagonal values in italic represent the square root of AVEs, while off-diagonal values represent the correlation between constructs  
 Items in italic represent HTMT values, while items in parenthesis represent the upper and lower bounds of the 95% biased-corrected and accelerated confidence intervals

**Table 3.** Discriminant validity results

exogenous constructs with the effect sizes of 0.007 (small), 0.064 (small), 0.158 (small) and 0.050 (small) for collectivism, long-term orientation, power symmetry and uncertainty avoidance, respectively. *Size and significance of structural model path coefficients:* Structural model results indicate direct significant effects between long-term orientation ( $\beta = 0.283$ ,  $p = 0.001$ ), power symmetry ( $\beta = 0.289$ ,  $p = 0.000$ ) and uncertainty avoidance ( $\beta = 0.227$ ,  $p = 0.001$ ) and supply chain collaboration. However, the relationship between collectivism and supply chain collaboration, though positive, was not significant. ( $\beta = 0.091$ ,  $p = 0.213$ ). The results suggest that only three out of the four dimensions of collaborative culture are significant predictors of supply chain collaboration (Table 4 and Figure 1).

4.2 Qualitative results

**Participants’ characteristics:** Participants were eight representatives from downstream operators. The qualitative sample (which was selected from respondents who participated in the quantitative study) consisted of six (75%) males and two (25%) females, of which six (75%) fell within the 31–40-year age range. In comparison, one (12.5%) respondent each fell within the 51–60 and the 20–30-year age groups. Regarding the specialization of the participants, 37.5% had specialization in procurement, operations and logistics, while a similar percentage (37.5%) were also specialized in marketing. Further, 12.5% of the participants were in management and administration, while the same percentage (12.5%) were specialized in accounting and finance. Most participants (50%) had a bachelor’s degree, while the rest had a master’s degree (25%) and HND/diploma (25%). Regarding years of professional experience, most of the participants (62.5%) had between one and five years’ work experience, while the rest (37.5%) had 6–10 years of work experience.

Table 5 summarizes the themes, meaning, frequency and sample quotations relating how the dimensions of collaborative culture predict supply chain collaboration.

**Table 4.**  
Structural model  
results

Structural path	VIF	Mean	STD	B	p-values	$f^2$	$f^2$ effect size	$q^2$	$q^2$ effect size
Collectivism → supply chain collaboration	1.796	0.093	0.073	0.091	0.213	0.009	Small	0.001	Small
Long-term orientation → supply chain collaboration	2.214	0.290	0.083	0.283	0.001	0.065	Small	0.021	Small
Power symmetry → supply chain collaboration	1.492	0.295	0.064	0.289	0.000	0.155	Medium	0.050	Small
Uncertainty avoidance → supply chain collaboration	1.539	0.227	0.073	0.236	0.001	0.061	Small	0.016	Small
		$R^2$				$R^2$ adjusted			$R^2$
Supply chain collaboration		0.516				0.504			0.249

Theme	Frequency	Meaning	Sample quotes
Collectivism	5	Collectivism enhanced participants' collaborative culture, which in turn may have increased participants' likelihood to engage in supply chain collaboration	<p>"I think that I will not look at just myself, but I will look at the "we" content where both of us will sit down to lay our plans out and also make sure that it works and brings in money" (Participant B_ OMC)</p> <p>"We can cite an example of the issue that happened a few years back concerning the deregulation where our regulators instructed us to set our prices. Although there are price ceilings and price floors, we must be within this group" (Participant C_ BDC)</p> <p>"We also take matters like gas distribution-related issues from the public through the OMCs to the BDCs to the National Petroleum Authorities. So, when one chain is broken, and you refer to the whole chain as 'I' and not 'we', there will be problems" (Participant E_ OMC)</p> <p>"My firm and their partners get together to have a stronger bond where we can rely on each other to get the business growing and moving" (Participant D_ OMC)</p> <p>"Once we establish stronger bonds with the supply partners, we know that we are both on the same page and there wouldn't be problems working together" (Participant D_ OMC)</p> <p>"I think that because we have that 'we' rather than 'I' consciousness, we can have a long-term orientation where we can have excellent and enduring relationships with our partners and suppliers because they will have to give us the products" (Participant E_ OMC)</p> <p>"We have one customer who is a dealer, and because of the relationship that we have, it is a long-term relationship, we trust him and then he also trusts us so, we can do business" (Participant G_ LPGMC)</p> <p>"So, it's more like a family that we build more than a company seeking to employ services from another company at a one-stop place. No, we build that family together, so we all benefit" (Participant C_ BDC)</p> <p>"The supplier's needs do not override our needs; neither do our needs override the needs of the suppliers" (Participant C_ BDC)</p>
Long-term orientation	4	Long-term orientation contributed to participants' collaborative culture, which in turn made it easier for participants to collaborate with members of their supply chain	
Power symmetry	1	Power symmetry enhanced participants' collaborative culture, which in turn increased participants' likelihood to engage in collaborative activities	

**Table 5.** Themes and sample quotations for the dimensions of collaborative culture

## 5. Discussion and integration of findings

As expected in a sequential mixed-methods study, mixing the findings of the quantitative and qualitative phases led to a situation where the qualitative findings helped explain the quantitative findings (Bazeley, 2018; Fetters & Molina-Azorin, 2019). Existing literature shows an association between collaborative culture and supply chain collaboration (Cao & Zhang, 2013; Kumar *et al.*, 2016; Kucharska & Kowalczyk, 2016; Zhang & Cao, 2018), hence our expectation that specific dimensions of collaborative culture would positively influence supply chain collaboration (Acquah *et al.*, 2021). To facilitate easy comparison, both the quantitative and qualitative results are presented in the form of a joint display matrix in Table 6.

### 5.1 Collectivism

While the findings from the quantitative phase strongly rejected the hypothesized relationship between collectivism and supply chain collaboration suggesting that collectivism does not predict supply chain collaboration, the qualitative findings suggested otherwise. A further analysis of the semi-structured questionnaire as well as participant responses suggested that the majority of participants' assigned explanations to collectivism, which, to a large extent do not reflect the collectivism construct as measured in the first quantitative phase of the research. Additionally, the interview responses do not also provide examples of teamwork, joint problem-solving, cooperation and partnership, which are words and phrases that support the concept. Another reason for the contradictory quantitative and qualitative findings might be due to fact that the prevalent non-significant relationship between collectivism and supply chain collaboration in the petroleum sector, as captured by the quantitative survey, may not have been noticed in the interviews due to the relatively small sample of the interview respondents.

### 5.2 Long-term orientation

Long-term orientation positively predicts supply chain collaboration, implying that long-term-oriented supply chain members are likely to participate in collaborative initiatives. This finding further suggests that collaborative culture is an impetus of supply chain collaboration. Qualitative findings corroborated the quantitative results and provided further explanations to support how long-term orientation influences supply chain collaboration. Notwithstanding the lack of extant empirical support in the literature, the finding of long-term orientation as a predictor of supply chain collaboration provides support for several conceptual claims (Cao & Zhang, 2012). It is also harmonious with the theoretical assertions of Mandal, Roy, & Raju (2016) as well as those of Kauppila (2015) and Wernerfelt (2016) that supply chain partners who are desirous of developing a long-term relationship are more inclined towards collaboration than those with a short-term orientation.

### 5.3 Power symmetry and supply chain collaboration

The quantitative findings reveal that power symmetry significantly predicts supply chain collaboration. This finding suggests that members of a supply chain are likely to collaborate when they have or believe in having an equal say in the supply chain relationship. The qualitative result corroborated the quantitative findings. It, therefore, suggested that when partners believe in an equitable distribution of power in the supply chain and that the more privileged partners should respond to the needs of the less privileged in beneficial circumstances to the parties, it would result in collaboration amongst the members of the supply chain. Though this finding is novel to empirical literature, it provides validation for many conceptual claims that a supply chain culture characterized by the belief that high levels of power symmetry aid the cultivation of not only efficient but effective supply chain collaborations (Lei *et al.*, 2017; Seo *et al.*, 2016). This finding is also harmonious with

Dimensions	$\beta$ (t stats: p-value)	Quantitative findings Summary	Qualitative findings Sample quote	Summary
Collectivism	0.091 (1.247; 0.213)	Collectivism does not predict supply chain collaboration	"I think that I will not look at just myself, but I will look at the 'we' content where both of us will sit down to lay our plans out and also make sure that it works and brings in money" (Participant B_ OMC)	Collectivism positively influences supply chain collaboration
Long-term orientation	0.283 (3.395; 0.001)	Long-term orientation predicts supply chain collaboration	"My firm and their partners get together to have a stronger bond where we can rely on each other to get the business growing and moving" (Participant D_ OMC) "Once we establish stronger bonds with the supply partners, we know that we are both on the same page and there wouldn't be problems working together" (Participant D_ OMC)	Long-term orientation positively influences supply chain collaboration
Power symmetry	0.289 (4.519; 0.000)	Power symmetry predicts supply chain collaboration	"The supplier's needs do not override our needs; neither do our needs override the needs of the suppliers" (Participant C_ BDC) "So, it's more like a family that we build more than a company seeking to employ services from another company at a one-stop place" (Participant C_ BDC)	Power symmetry positively influences supply chain collaboration
Uncertainty avoidance	0.236 (3.241; 0.001)	Uncertainty avoidance predicts supply chain collaboration	Nil	Uncertainty avoidance does not influence supply chain collaboration

Table 6. Joint display matrix

Cao & Zhang's (2012) assertion that supply chain collaborations involve working together as mutual rather than as individuals. This finding also corroborates the argument that power symmetry is an essential part of firms' collaborative culture that enables successful supply chain collaborations (Zhang & Cao, 2018).

#### 5.4 Uncertainty avoidance

The quantitative findings suggest a significant positive relationship between uncertainty avoidance and supply chain collaboration. The qualitative findings, on the other hand, failed to corroborate the role of uncertainty avoidance in successful supply chain collaboration. Nonetheless, upon a further analysis of participant's responses, it emerged that the majority of participants' responses and explanations on the uncertainty avoidance dimension of collaborative culture, to a large extent, do not reflect how the construct was operationalized in the first quantitative phase of the research. For example, participants suggested that they collaborate to minimize their exposure to uncertain situations in the supply chain; however, they do not collaborate because they want to avoid uncertainty. A further reason for the divergence between the quantitative and qualitative findings might be as a result of the low levels of uncertainty avoidance in the petroleum sector, as depicted by the quantitative survey, may not have been noticed in the interviews due to the relatively small sample of the interview respondents. Prior literature (Acquah, 2020; Kumar *et al.*, 2016; Seo *et al.*, 2016; Yilmaz *et al.*, 2016) and theory (Williamson, 2014, 2016) submit that firms with uncertainty increases in a supply chain, members in that supply chain resort to collaboration as an antidote. Hence, without collaboration, supply chain partners lose the opportunity to deal comprehensively with supply chain uncertainty.

## 6. Implications and conclusions

### 6.1 Implications

*6.1.1 Implications for theory and research.* Cao & Zhang (2012) underscored the role of a collaborative culture in supporting and enabling supply chain collaboration. However, the literature on how the individual dimensions of collaborative culture influence supply chain collaboration is non-existent. This study responded to the call for a sub-construct-level study that examines how the individual dimensions of collaborative culture influence supply chain collaboration, thereby making the findings handier for stakeholders. Hence, the foremost contribution of this study is in the operationalization and assessment of the effect of collaborative culture on supply chain collaboration at the sub-construct level. Accordingly, we identified four sub-dimensions of collaborative culture (collectivism, long-term orientation, power symmetry and uncertainty avoidance) that influence supply chain collaboration, thereby extending prior literature on supply chain collaboration that modelled collaborative culture as an all-inclusive composite construct (Acquah *et al.*, 2021; Cao & Zhang, 2012; Zhang & Cao, 2018).

Beside the above theoretical contributions, the study also makes some methodological contributions in its demonstration of how to implement integration at the methods level and the interpretation and reporting level in an explanatory sequential mixed-methods design. At the design level, integration was achieved through the deliberate use of an explanatory sequential design involving a follow-up collection and analysis of qualitative data, based on the results of the first quantitative phase. Integration at the methods level was implemented through connecting and building. Connecting occurred when we used data from the quantitative phase to purposefully select the follow-up interview participants, in that extreme case sampling was used to select eight participants from respondents who agreed to partake in the qualitative phase of the study. Further, we implemented building through designing the semi-structured interview guide to enable participants to explain why they think a

dimension of collaborative culture predicts or does not predict supply chain collaboration. Finally, we implemented integration at the interpretation and reporting level through narrative and the use of the joint display. To achieve integration through narrative, we engaged in a contiguous description of the quantitative and qualitative data. By contrast, integration via joint display occurred using a joint display matrix (Table 6), which visually displayed the quantitative and qualitative data in a single display.

*6.1.2 Implications for practice.* In terms of practice, our findings profess significant implications for supply chain collaboration. Supply chain managers can use our findings to create the enabling cultural environment for supply chain collaboration by identifying and positively tinkering with the dimensions of collaborative culture for successful supply chain collaboration.

More specifically, the study suggests that the dimensions of culture have varying effects on supply chain collaboration; however, firms in the petroleum sector do not have limitless resources, hence, the need to not only identify, but also to prioritize the specific dimensions of collaborative culture that significantly influence supply chain collaboration. For instance, the findings of the study suggest that long-term orientation, power symmetry as well as uncertainty avoidance are significant predictors of supply chain collaboration, whereas collectivism is not. Accordingly, long-term orientation, power symmetry as well as uncertainty avoidance dimensions of collaborative culture require the highest levels of attention and investment so as to achieve successful supply chain collaboration. Generally, firms in Ghana's petroleum sector should deploy their resources in a way that create a culture of long-term thinking, low levels of uncertainty avoidance as well as power symmetry for ensuring successful supply chain collaboration in a highly competitive environment.

## 6.2 Conclusions

The study assessed the effects of collectivism, long-term orientation, power symmetry and uncertainty avoidance on supply chain collaboration. The relevance of a collaborative culture, besides its dimensions, to the success of supply chains continues to be of great importance to supply chains and hence, cannot be overemphasized. The study employed an explanatory sequential mixed-methods design made up of a first quantitative phase with a follow-up second qualitative phase. Whereas in the quantitative phase, hypothesized relationships between the dimensions of collaborative culture and supply chain collaboration were tested using PLS-SEM, the qualitative phase ensured the collection and analysis of semi-structured interview data that helped complement and explain the quantitative results. The results of this study reveal that apart from collectivism, which could not predict supply chain collaboration, the remaining three out of the four dimensions of collaborative culture, namely, long-term orientation, power symmetry and low levels of uncertainty avoidance, result in supply chain collaboration. Accordingly, the study offers theoretical, research as well as practical implications for researchers, supply chain managers and policymakers within the downstream petroleum sector.

## 7. Limitations and future research

The study is not only the first to investigate the influence of the dimensions of a collaborative culture on supply chain collaboration but also the first to employ a mixed-methods research approach in investigating the same. Hence, because of the exploratory nature of the study, further research is required not only to validate but also to replicate the findings. Single key informants per organization were relied upon to respond to a set of multifaceted issues on collaborative culture and supply chain collaboration because these informants are arguably

the most knowledgeable about the phenomenon. As a result, the results may suffer from common method bias, which may hamper the stability of the findings. Future research may test these findings using multiple respondents from each organization. Also, because the quantitative part of the study used self-reported questionnaires to ascertain how the dimensions of collaborative culture predict supply chain collaboration, there may be the tendency of respondents falsely reporting favourable findings. Finally, the quantitative part of this study was based on net-effects logic where a single sufficient, but not necessary, condition for supply chain collaboration was assessed. Future research, might adopt the necessity logic to examine the dimensions of collaborative culture as a single necessary, but not sufficient, condition for supply chain collaboration.

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