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Impact of Supply Chain Collaboration on Logistics Performance: Evidence from a Sub-Saharan Africa Nation's petroleum downstream

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ABSTRACT

The need for firms to collaborate effectively with supply chain partners is a subject of interest to researchers. We conduct an extension study to explore the impact of supply chain collaboration on the logistics performance using firms in Ghana's petroleum downstream. The results showed relatively higher levels of external collaboration than internal collaboration among surveyed firms, even though internal collaboration had a stronger impact on a firm's logistics performance. The study also revealed a positive impact of internal collaboration on external collaboration. The study identifies internal collaboration as an important variable deserving great attention by firms in the petroleum downstream.

KEYWORDS: Supply Chain Collaboration, Performance, Sub-Saharan Africa, and Petroleum

INTRODUCTION

The Council of Supply Chain Management Professionals defines supply chain management (SCM) as "the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies" (Vitasek, 2010). A core capability of SCM is Supply Chain Collaboration (SCC). SCC is seen as the major driver of effective SCM (Bowersox, 1990; Ellram and Cooper, 1990). Many definitions have been propounded for SCC (Mentzer et al., 2001; Sriram et al., 1992). However, the definition by Simatupang and Sridharan (2002) is the most widely accepted. They define SCC as "two or more independent companies working jointly to plan and execute supply chain operations with greater success than when acting in isolation" (Simatupang and Sridharan, 2002, p.19). Due to intense global competition and recent global trends such as the adoption of outsourcing, today's firms operate in "networked" business environments. Over the past few years, there has been considerable progress in the interconnection among firms in all industry segments (Baldwin, 2012; Trienekens et al., 2012). Most modern supply chains have become extremely complex, global, and with

several touch points from raw materials handling to finished goods delivery to customers (Baldwin, 2012; Fawcett et al., 2006). In such interconnected environments, supply chains are expected to show high degrees of flexibility, responsiveness, and collaboration.

SCM does not only involve the effective management and coordination of individuals and organizations involved in the design and execution of activities involved in procuring, manufacturing, and management of logistics, but also includes the integration and coordination of all actors in the supply chain (Naspetti et al., 2009). For competitive advantage to be obtained and sustained, collaboration among members of a supply chain must be achieved (Naspetti et al., 2009). The collaboration includes information sharing, decision synchronization, complementary resource sharing, and aligning other activities with collaborative chain members. This generates competitive advantage for the business organization (Harrison and Now, 2002; Horvath, 2001). Collaboration within organizations and between members of a supply chain is therefore usually associated with organizational benefits.

Studies that empirically explored the effect of SCC on the performance of firms have presented differing results (see Table 1). Some studies point to clear organizational level benefits arising from SCC including access to complementary resources (Park and Song 2004); improving revenue and operational efficiency (Fisher, 1997; Lee et al., 1997); and supply chain cost reductions especially those regarding inter-organization transactions, stock and production (McLaren et al., 2004), and shared risk (Kogut, 1988). Other studies (e.g., Gimenez and Ventura, 2005; Stank et al., 2001) observed no significant performance improvement arising from firms' SCC initiatives. This points to an unclear relationship between SCC and firm performance. SCC efforts also encounter several challenges, resulting in many collaborative efforts becoming unsuccessful or failing to garner the expected level of benefits to stakeholders (Richey et al., 2010). Taken together, these conflicting findings point to the need for more studies to advance our understandings on SCC, in particular the influence of context on SCC initiatives.

Table 1: Varying results from studies on the impact of SCC on performance

Author	Findings
Vickery et al. (2003)	Insignificant direct impact of supply chain Integration on the financial performance of firms.
Gimenez and Ventura (2005)	External Integration stronger than Internal Integration and is motivation for Internal Integration.
Stank et al. (2001)	Indirect impact of External Collaboration on Logistics Service Performance through improved Internal Collaboration. Internal Collaboration occasions External Collaboration.
Germain et al. (2008)	Downstream integration only informs higher logistics performance when organizational performance was high.
Rodrigues et al. (2004)	Cumulative influence of internal and external operations significantly impacts the organization's performance, but individually they do not.
Stock et al. (2000)	Logistics Integration does not always result in performance improvements for firms. Gains accruing from logistics Integration can be obtained only in conjunction with complementary aspects of the organization's supply chain network.
Hakansson and Persson (2004)	The specific network involved plays a role in the level of organizational performance that can be obtained. Gains within one supply chain could well be detrimental in a different supply chain.

In this study, we conduct an extension study and focus on the petroleum and sub-Saharan African contexts that lack SCC studies. Specifically, we study the impact of SCC on firms'

logistics performance by considering organizations operating in Ghana's petroleum downstream. The petroleum downstream encompass activities ranging from refinery of crude oil, to storage, transportation, distribution and retailing of petroleum and petroleum products to meet the needs of the Ghanaian economy (Amponsah and Opei, 2014). Due to the expansive nature and scope of the petroleum downstream, as well as some legislations governing the sector, no one firm acts alone in fulfilling end-to-end customer orders. Firms in the petroleum sector must collaborate with other actors within the supply chain to meet the country's energy demands (Greg, 2003). However, despite decades of SCC initiatives in Ghana's petroleum downstream, the supply chain is still fraught with issues of stock-outs, fuel shortages, high operational costs, and other logistics challenges (Amponsah and Opei, 2014; Dasmani, 2014; Ministry of Energy, 2010). In this study, we survey a cross section of firms operating in Ghana's petroleum downstream to explore whether their SCC initiatives have led to improvements in their logistics performance. The current study offers both theoretical and practical contributions. First, we are studying new contexts: sub-Saharan Africa, and the petroleum industry. Results from the study offer new insights into SCC and therefore expands our understanding of SCC initiatives and associated benefits. Second, findings will provide new specific knowledge that organizations operating in the contexts where the study was performed can use to enhance success of SCC initiatives. The results also suggest the need for subsequent studies to take contextual variables into consideration to enhance both their theoretical and practical relevance.

The rest of the paper is organized as follows. A brief review of pertinent literature is presented in the next section, followed by the theoretical background of the study and the research model and hypotheses. Then, we present the methodology leading to the presentation of the results, discussion of the results, and the conclusion.

LITERATURE REVIEW

Supply Chain Collaboration and Performance

Collaboration affords two or more firms to share resources to perform a specific, mutually beneficial undertaking (Pereira and Soares, 2007). In such situations, there is explicit consensus between the parties to leverage combined resources for purposes of delivering sustainable mutual advantages, with emphasis on efficiency throughout the supply chain, profitable areas of growth, and a holistic improvement in performance of the entire chain. In collaboration agreements, each party retains its autonomy but succeeds in gaining new opportunities. A strategic arrangement can for instance enable firms create more effective processes, access new markets and achieve a competitive edge over rivals (Cooke, 1998). With respect to the SCM discipline, the concept of collaboration may be seen as yet being in its infantile stages, having emerged in mid-1990s (VICS, 1998) from the most popular form – Collaboration, Planning, Forecasting and Replenishment (CPFR). It is largely held that before the advent of CPFR, firms practiced more basic types of collaborations such as Vendor Managed Inventory and Continuous Replenishment Programs (Barratt and Oliveira, 2001). More and more manufacturers have concluded that success is impossible without a collaborative pull of resources and skills from partners in the supply chain (Skjoett-Larsen et al., 2003).

Dyer et al. (1998) observed that competitive advantages are achieved in inter-organizational contexts, arguing that arm's-length exchanges, typically characterized by nonspecific investments, limited information sharing and coordination devices, and low interdependence, are incapable of generating profits beyond what strategic collaboration can generate because of their lack of resource and knowledge sharing. They suggest that organizations would have competitive advantages when they move from arm's-length transactions and specialize in collaborative building by investing in relation-specific assets, information

sharing, complementary capabilities, as well as instituting control systems that work more effectively. Collaborating firms must be willing to rethink their priorities and move beyond traditional individualistic initiatives. They must be ready and willing to align their goals, strategies, systems, people and processes with key supply chain partners, commit themselves to the collaborative process, establish confidence and industrious communications, share knowledge and information, share risks and rewards, and provide the necessary resources required to support the collaborative effort (Skjoett-Larsen et al., 2003).

Cao and Zhang (2011) in their survey of U.S. manufacturing firms explored the impact of SCC on firm performance from a collaborative advantage paradigm. They found that SCC resulted in both positive collaborative advantage and stronger firm performance. Still in the U.S., Won Lee et al. (2007) studied the effect of supplier linkages, customer linkages, and internal linkages on supply chain performance and observed that supplier linkages positively impacted performance reliability and overall performance, whilst internal linkages positively impacted cost containment performance. The findings of Vereecke and Muylle (2006) also suggest that improving collaboration with both suppliers and customers enabled European firms reap maximum benefits in terms of improvement of performance, whilst collaboration with only one resulted in only minor benefits. The study of Lorentz (2008) explored SCC in an uncertain cross-border context (Finland and Russia) and explored whether it positively impacted supply chain performance. Their findings weakly supported the proposed positive impact of SCC on supply chain performance. Singh and Power (2009) surveyed Australian manufacturing plants in their study and hypothesized that strong customer relationships and strong customer involvement positively impacted firm performance. Their findings supported both hypotheses, although the effect customer relationship on firm performance was greater. Their findings also suggest a strong inter-relationship between collaboration with suppliers and customers. Finally, Stank et al. (2001) explored the impact of internal collaboration and external collaboration on logistics performance using data from firms in North America. Their findings indicated that external collaboration influences increased internal collaboration, which in turn improves service performance.

While the results of prior studies are interesting, the impact of SCC initiatives on performance has not been explored properly with the context of developing countries. Specifically, no study on the subject have originated from Africa. This study exploring the impact of SCC initiatives within the sub-Saharan African context is the first of its kind and provides findings on the impact of SCC on performance that are more specific to the African context.

Overview of Ghana's Petroleum Sub-sector

Ghana has five sedimentary basins that are considered to have prospects for oil and gas: the Tano Basin, Saltpond Basin, Accra/Keta Basin, Cape Three Points Basin which are all off-shore and are fairly well explored; and the Voltaian Basin which is on-shore and is hardly explored (Ministry of Energy, 2010; Owusu and Nyantakyi, 2011). In July 2007, Ghana National Petroleum Corporation (GNPC) and its partners discovered oil in commercial quantities in the Jubilee field in the offshore Tano/Cape Three Points Basin of the Ghanaian continental shelf. Appraisal work conducted on the field has estimated reserves of oil at about 800 million with an upside estimate of 3 billion barrels. The field also has substantial associated natural gas reserves (Ministry of Energy, 2010). Currently, oil production in Ghana occurs at the Saltpond fields and the Jubilee fields. The Saltpond fields is matured and drying up with production in 2014 dropping to 97,300 barrels from 98,289 barrels in 2013. Production in the Jubilee fields on the other hand is on the ascendency rising to 38.7 million barrels in 2014 from 30.4 million barrels in 2013 and 27.4 million in 2012 (Energy Commission, 2015).

The petroleum industry is segmented into upstream, midstream and downstream which covers activities from exploration and production of petroleum through transportation to the marketing of the final products (Ministry of Energy, 2010). The petroleum upstream activities cover mainly petroleum exploration and related operations. Currently, oil production in Ghana occurs at the Saltpond fields and the Jubilee fields. The midstream sector involves all activities between the well-head and the refinery. It includes transportation of oil and gas from the extraction points to refineries onshore and storage of petroleum. Oversight responsibility of the petroleum upstream and midstream is in the hands of the Ghana National Petroleum Corporation, acting on behalf of the Ministry of Energy and Petroleum.

The downstream activities include refinery, processing, storage, transportation, distribution, marketing and sale of petroleum products and natural gas, and trading activities that take place in between. The downstream sector is regulated by the Ghana Petroleum Authority (Amponsah and Opei, 2014). The petroleum downstream fulfils most of the energy needs of the country; the transport needs, and also forms the foundation for many other industries (Greg, 2003). The petroleum products marketed in Ghana are premium gasoline, kerosene, gas oil, residual fuel oil, LPG, and premix. Some of the challenges facing the petroleum downstream include inadequate refining infrastructure, infrastructure for the transportation of petroleum products, storage infrastructure, sales outlets, inefficient distribution of petroleum products, ineffective implementation of petroleum pricing mechanism, and weak institutional and regulatory environment (Ministry of Energy, 2010).

Actors in the Ghana's Petroleum downstream

The Ghana Energy commission indicates that the primary actors in the petroleum downstream sector are the Tema Oil Refinery (TOR), National Petroleum Authority, Bulk Oil Storage and Transportation (BOST) companies, and Oil Marketing Companies (OMCs) (Energy Commission, 2015).

TOR is charged with refining crude oil to address the oil and gas related needs of the country, with the exception of crude oil for power generation. It comprises a Crude Distillation Unit of production capacity of 45,000 barrels per day and a 14,000 barrels per day Residual Fluid Catalytic Cracker unit to process residual fuel oil, a by-product of crude oil processed by the Crude Distillation Unit, into more diesel, gasoline and LPG. Production from TOR has been consistently nose-diving in recent years due to considerable operational challenges, reaching its lowest of about 129,000 tons in 2014 from its average annual peaks of 1.5 million tons in the early to middle of last decade (Energy Commission, 2015). In 2010, TOR produced approximately 70% of the country's needs, but this has dropped to 3% as at 2014. TOR was operating at 3.5% capacity in 2014, further down from 5% capacity in 2013. Meanwhile, based on international standards, 95% capacity utilization is required for refineries to achieve economic viability (Energy Commission, 2015).

The second major actor in Ghana's petroleum downstream is the BOST companies. These companies perform the functions of storage of petroleum products and strategic stocking (Amponsah and Opei, 2014). In Ghana, aside from the facilities for petroleum products storage at TOR, there are also storage facilities at Accra Plains, in Buiepe in the Northern Region, near Akosombo in the Eastern Region and at Takoradi in the Western Region (Ministry of Energy, 2010). However, these storage facilities are still considerably limited given the demand in the country. Their locations are far from majority of Ghanaians who demand them. There is therefore the need to have an effective system for transporting and distributing the petroleum products throughout the country.

Thirdly, OMCs and other private firms are also involved in distribution of petroleum products in Ghana usually with Bulk Road Vehicles. They purchase petroleum products from TOR and sell to retailers at a marked-up price. Lastly, the National Petroleum Authority sets and implements pricing policies for petroleum and petroleum products in Ghana. Up till 2001, the Government was the regulator of the prices for petroleum products. This however resulted in debt creation for TOR as the government failed to mark prices up accordingly in 2000 when crude oil prices shot above US\$30 per barrel from an initial average price of below US\$20 per barrel. Since then, oil prices have risen considerably, with average prices exceeding the \$100 mark in 2011 to 2013, but has since dropped to below \$50 in 2015 (Arezki and Blanchard, 2015; Bowler, 2015). The considerable fluctuation in oil prices led to the institution of the automatic price adjustment formula. At present, the NPA determines the price margins and based on these, OMCs announce rates indicating a maximum indicative pump prices to the general public (Energy Commission, 2015).

THEORETICAL BACKGROUND

The arguments and hypothesized relationships of this study is founded on the network theory for managing supply chains. Supply chain relationships in the early 1980s were structured around arms-length dealings which are more compatible with the tenets of transaction cost theory (TCT) (Hoyt and Huq, 2000). But, TCT appears to be losing its ability to explicate modern day collaborations based on mutual trust and information sharing found in current day markets (Ghoshal and Moran, 1996). As a result, collaboration based theory is deemed more appropriate. Collaborative relationships founded on trust, thereby reducing transaction related risks under conditions of uncertainty and dynamic change, dominate current supply chain theory (Halldorsson et al., 2007). Collaboration in this period stresses buyer-supplier relationships exhibiting appreciable levels of trust and collaboration not falling to the temptation of discontinuing the collaborative agreements even though a chance to make short-term gains may exist elsewhere. Lamming (1996) presents a theory of SCM arguing the need for collaboration to be long-term and for issues of relationship management to be considered in SCM theory.

The Network perspective posits openness and trust between the parties as a condition for gaining the best possible results from cooperation. Over time, mutual adjustments improve supply chain efficiency and therefore, make them more efficient. Examples of adjustment processes might include an electronic data interchange and B2B connections between the partners for the implementation of a quality control system. By entering into close cooperation with partners who possess complementary competencies, the individual firm is able to utilize resources and skills controlled by other players (Halldorsson et al., 2007). In close and long-term cooperation, the parties are able to establish mutual and strong relations of trust, which may result in the disappearance of cost-consuming, contractual safeguards.

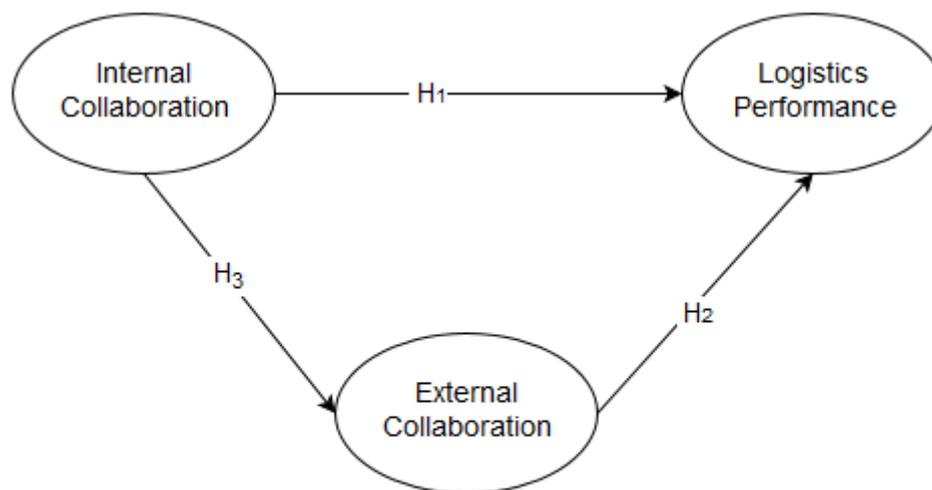
RESEARCH MODEL AND HYPOTHESES

This study adapted the constructs in Stank et al. (2001) developed to explore SCC and logistics performance among firms in North America (Canada, Mexico, and the United States). The original research model has three major constructs: Internal Collaboration, External Collaboration, and Logistics Performance. Internal Collaboration as conceptualized by Stank et al. (2001) refers to the degree of cooperation and teamwork that exists within an organization and among its departments. External Collaboration on the other hand deals with the degree of cooperation and teamwork between the firm and its supply chain partners (Stank et al., 2001). Logistics is viewed as a value-adding supply chain process. Logistics customer value is generally created through effectiveness, efficiency, and/or differentiation (Holcomb, 1994). Logistics Performance as conceptualized by Stank et al. (2001) refers to

the measure of how well firms are able to generate logistics customer value. The conceptualization and operationalization of the constructs of the Stank et al. (2001) model was adopted in our study. The original study hypothesized that Internal Collaboration and External Collaboration positively impacted Logistics Performance, and that Internal Collaboration and External Collaboration were positively related.

The research model used in this study as well suggests that both Internal Collaboration and External Collaboration positively impact Logistics Performance. We however varied the relationship between Internal Collaboration and External Collaboration to suit the sub-Saharan African context of this study. Most businesses within the region would only attempt collaborating closely with external entities after they have been able to achieve some level of internal collaboration and have enjoyed benefits of internal collaboration (Chinomona and Pooe, 2013). We therefore hypothesize Internal Collaboration as a precursor for achieving External Collaboration in the sub-Sahara African region. The adapted research model is presented in Figure 1 below.

Figure 1: Research Model and hypotheses



The study proposes that managers who adopt a collaborative perspective to work usually succeed in building esprit de corps across departments or organizations. This usually allows organizations to unite efforts and achieve collective goals of the organization through synergy, in line with the network theory (Stank et al., 2001). Also, trading partners who adopt a collaborative perspective are able to jointly develop long-term demand projections rather than rely upon separate, independently generated forecasts. This results in a better matching between supply and demand (Stank et al., 1999). Both internal collaboration and external collaboration enhance an organization's ability to create logistics value, thereby enabling them to achieve higher logistics performance (Fisher, 1997; Harrison and Now, 2002; Horvath, 2001; Lee et al., 1997). This leads to the following hypotheses:

H₁: Internal Collaboration is positively associated with Logistics Performance

H₂: External Collaboration is positively associated with Logistics Performance

Furthermore, it is proposed that internal collaboration is a necessary condition for realization of external collaboration by organizations in sub-Saharan Africa. A collaborative mechanism should already be in place in-house before firms tackle the relatively more complicated task of collaborating with external firms. The level of internal collaboration is thus an important determinant of the level of external collaboration that can be achieved (Stank et al., 2001). Firms would usually venture out into collaboration with external supply chain partners only after internal collaboration is achieved to a reasonable degree, and has been evidently

beneficial. It is perceived that external collaboration results from an extension of successful internal collaboration. This leads to the hypothesis that:

H₃: Internal collaboration is positively associated with External Collaboration.

METHODOLOGY

The present study can be considered an extension (Berthon et al., 2002) of the original Stank et al. (2001) study. An extension study can be described as “a duplication of a target study in which one or more key parameters are altered. Thus, certain parameters are held constant and certain parameters are changed between the target and focal studies” (Berthon et al., 2002, p.419).

The research constructs and research items of Stank et al. (2001) were largely adopted in this study with minor modifications made in order to ensure that they fit the Ghanaian context within which they were to be deployed. In addition, the relationships between the constructs was varied slightly in our study. The adopted research items have the 1995 World Class Logistics Research at Michigan State University as their foundation and had been further refined by Stank et al. (2001) after a pilot survey completed by almost 3,700 respondents in North America, Europe, and the Pacific Rim. This was followed by further refinements through in-depth interviews with 111 top logistics firms to establish a tool for assessing logistical proficiency across a range of integrative and collaborative elements. The Internal Collaboration construct had five measurement items, External Collaboration had six items, and Logistics Performance had six items as well. Details of the research items are presented in Table 2 below.

Construct	Acronym	Items
Internal Collaboration	IC1	We maintain an integrated database to facilitate information sharing
	IC2	We effectively share operational information between departments
	IC3	We have adequate ability to share both standardized and customized information internally
	IC4	We provide objective feedback to employees regarding integrated logistics performance.
	IC5	Our compensation, incentive, and reward systems encourage integration
External Collaboration	EC1	We effectively share operational information externally with selected suppliers and/or customers.
	EC2	We have developed performance measures that extend across supply chain relationships.
	EC3	We experience improved performance by integrating operations with supply chain partners.
	EC4	We have supply chain arrangements with suppliers and customers and operate under principles of shared rewards and risks.
	EC5	We have increased operational flexibility through supply chain collaboration.
	EC6	We benchmark best practices/processes and share results with suppliers

Logistics Performance	LP1	Our firm's ability to reduce the time between order receipt and customer delivery to as close to zero as possible.
	LP2	Our firm's ability to meet quoted or anticipated delivery dates and quantities on a consistent basis.
	LP3	Our firm's ability to respond to the needs and wants of key customers.
	LP4	Our firm's ability to provide desired quantities on a consistent basis.
	LP5	Our firm's ability to modify order size, volume or composition during logistics operation.
	LP6	Our firm's ability to accommodate delivery times for specific customers

To test the research model, we conducted a survey of 90 different organizations that operate in Ghana's petroleum downstream, with target respondents being the CEOs of the organizations, heads of logistics or supply chain departments, and other suitably high ranking managers of firms. Twenty actors in Ghana's petroleum downstream were initially identified, notified and surveyed. Snowballing techniques were then used to identify other firms in Ghana who operate in the petroleum downstream. The questionnaires were delivered to managers of the 90 identified firms, and 76 were successfully retrieved, representing a response rate of 84.4%. Only one questionnaire was sent to each responding organization. Respondents were asked to use 5-point Likert scales to indicate the extent to which they agreed to statements measuring internal collaboration, external collaboration, and their logistics performance.

DATA ANALYSES AND RESULTS

Analysis of the model and hypothesized structural paths was performed using SmartPLS version 2.0 (Ringle et al., 2005), a structural equation modelling (SEM) software package (Hair et al., 2012). SEM is a family of statistical procedures that depicts multiple relationships among latent constructs through the use of equations quite similar to multiple regression equations (Hair et al., 2014). Results from the SEM analyses are compared to the results of Stank et al. (2001), and deductions and conclusions are presented.

Estimating the level of Internal and External Collaboration

Based on the responses obtained for the collaboration research items, we estimated the perceived level of internal and external collaboration among firms in Ghana's petroleum downstream. The five measures of internal control, as well as the six measures of external control, were analyzed to provide this information and is presented in Table 3 below. For each research item, the lowest and highest ratings are indicated in the "Min" and "Max" columns respectively, and the mean response for each measure calculated together with its standard deviation (S.D). The higher the mean, the stronger the level of collaboration for that measure as it shows a higher level of "agreement" with the research instruments which were positively framed.

Table 3: Level of Internal and External Collaboration				
	Min	Max	Mean	S.D
Level of Internal Collaboration				
IC1: Integrated database to facilitate information sharing	1	4	3.55	.773
IC2: Share operational information between departments	1	5	3.78	.810
IC3: Share standardized and customized information internally	1	5	3.53	.739
IC4: Objective feedback to employees regarding integrated logistics performance.	2	5	3.67	.681
IC5: Compensation, incentive, and reward systems that encourage integration	1	5	3.76	.764
Average Level of Internal Collaboration			3.564	.753
Level of External Collaboration				
EC1: Share operational information externally with selected suppliers and/or customers.	1	5	3.67	.719
EC2: Performance measures that extend across supply chain relationships.	1	5	3.57	.869
EC3: Experience improved performance by integrating operations with supply chain partners.	1	5	3.63	.763
EC4: Supply chain arrangements with suppliers and customers and operate under principles of shared rewards and risks.	1	5	3.80	.611
EC5: Increased operational flexibility through supply chain collaboration.	1	5	3.54	.824
EC6: Benchmark best practices/processes and share results with suppliers	2	5	3.83	.719
Average level of External Collaboration			3.752	.751

The respondents' view on level of collaboration in Ghana's petroleum downstream ranged from a least rating of 3.53 for Item IC3 (our firm possess adequate ability to share both standardized and customized information internally) to a highest rating of 3.83 for Item EC6 (we benchmark best practices/processes and share results with suppliers). The range of the item means was only 0.3 suggesting that respondents viewed the level of collaboration across all measures to be fairly even. Overall, the mean level of internal collaboration was found to be 3.564 which is well above average, whilst the average level of external collaboration was even higher at 3.752. This result indicates respondents perceive both internal collaboration and external collaboration to be high in Ghana's petroleum downstream, but the level of internal collaboration that existed within their firms was lower than the level of external collaboration that existed between them and their supply chain partners. The responses of respondents showed very little variation over items. Also, standard deviation values across items were not significant suggesting a high level of consistency of responses.

Measurement model analyses

The study also sought to explore the impact of both internal collaboration and external collaboration on the logistics performance of the sampled firms. To achieve this objective, partial least squares structural equation modelling (PLS-SEM) techniques were employed to explore the research model presented in Figure 1.

Achieving high validity and reliability of the measurement items is important to make the findings and relationships valid. Validity and reliability of the constructs and measurement

items can be confirmed by measuring the average variance extracted (AVE), composite reliability, and Cronbach's Alpha, and ensuring that they meet the acceptable benchmarked standards. The parameter Cronbach alpha measures the correlation among the indicators of a latent variable. A rule of thumb benchmark of 0.7 is used as the acceptance criteria for Cronbach alpha (Chin, 1998). Results presented in Table 4 show that all the Cronbach alpha values for the constructs pass this test. Composite reliability measures the ability of the indicators to explain the variance of their latent variable (Chin, 1998). A rule of thumb benchmark of values of at least 0.7 is used to assess acceptability of unidimensionality of a latent variable. The results in Table 4 show that all latent constructs passed this test. Further, AVE according to Fornell and Larcker (1981) measures the amount that a latent variable component captures from its indicators as opposed to the amount due to measurement error. Typically a value greater than 0.5 is recommended (Fornell and Larcker, 1981). AVEs for the all constructs in the research model meet this requirement (see Table 4). Given that the research model passes validity tests, we conclude that the research model is very sound.

Construct	AVE	Composite Reliability	Cronbach's Alpha
External Collaboration	0.6503	0.9027	0.8669
Internal Collaboration	0.7651	0.9071	0.8471
Logistics Performance	0.5718	0.8406	0.7498

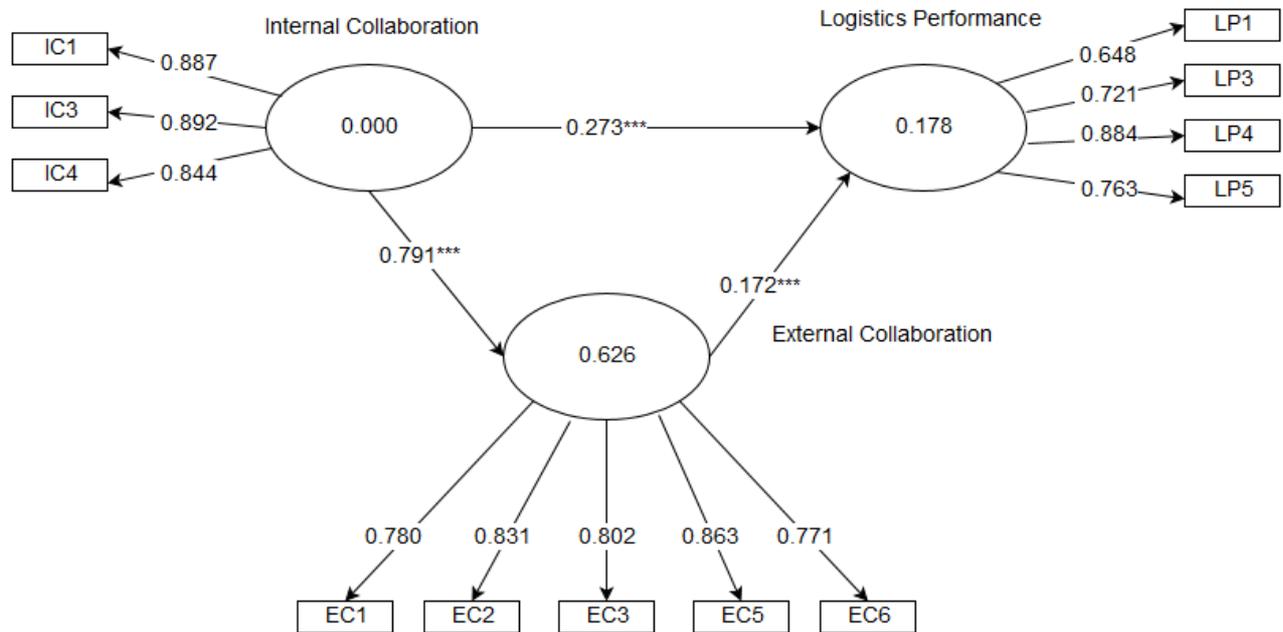
We next conducted factor analyses to ensure the measurement items were of adequate quality. There were initial instances of poor loadings for some items (IC1, IC5, EC4, EC5, LP2, and LP6) and these were excluded from the SEM analysis as recommended (Hair et al., 2010). Given the reflective nature of the constructs, removing these items would not adversely affect the constructs or the results (Bollen and Lennox, 1991). Next we tested for discriminant validity. Discriminant validity examines the extent to which a measure correlates with measures of constructs that are different from the construct the measure is intended to assess (Barclay et al., 1995). Discriminant validity is achieved if the AVE for each construct is greater than 0.5 and the square root of the AVE for a construct is greater than the correlation of that construct with other constructs (Fornell and Larcker, 1981). In Table 5, the bold numbers on the diagonals are the square root of the AVEs. Off-diagonal elements are the correlations among constructs. Although the correlation between Internal Collaboration and External Collaboration was high (similarly observed in the original Stank et al. results), all diagonal numbers are greater than the corresponding off-diagonal ones, indicating satisfactory discriminant validity of all the constructs.

	AVE	External Collaboration	Internal Collaboration	Logistics Performance
External Collaboration	0.6503	0.8064		
Internal Collaboration	0.7651	0.7911	0.8747	
Logistics Performance	0.5718	0.3879	0.4090	0.7562

Measuring the impact of SCC on Logistics Performance

PLS provides the magnitude and significance of the hypothesized causal relationships as standardized path coefficients. The parameter estimate of the hypothesized structural path should be statistically significant in the hypothesized direction of the effect (Chin, 1998). The research model of the study showing factor loadings for the research items and path coefficients is shown in Figure 2. R² values are shown inside each construct.

Figure 2: Results of hypotheses test

*** $p < 0.01$

The research sought to ascertain the strength of the relationship between Internal Collaboration and Logistics Performance (H_1) as well as the relationship between External Collaboration and Logistics Performance (H_2) among firms in Ghana's petroleum downstream. The results show that there exists a positive relationship between Internal Collaboration and Logistics Performance, with a path coefficient of 0.273. This relationship was significant at $p < 0.01$, which is a very high level. This agrees with the findings of Stank et al. (2001) who also obtained a strong positive relationship between Internal Collaboration and Logistics Performance. The results of our study also indicated that there existed a positive effect of External Collaboration on Logistics Performance, demonstrated by a path coefficient of 0.172, which was also significant at $p < 0.01$ even though the path coefficient and the t-statistic was slightly lower. This result is different from that of Stank et al. (2001), who did not observe a significant impact of External Collaboration on Logistics Performance. We also sought to ascertain the extent of the effect of Internal Collaboration on External Collaboration (H_3). Results of the SEM analyses reveals a very strong positive impact of Internal Collaboration on External Collaboration, with a path coefficient of 0.791 and the relationship was significant at $p < 0.01$. The results of Stank et al. (2001) study observed a similarly strong positive correlation between the two constructs. All three hypotheses of our study were thus supported. The details of the results of the tests of the hypotheses are summarized in Table 6 below and compared to the results of the Stank et al. (2001).

Table 6: Results of Hypotheses test

H _s	Hypothesized paths	Our results		Stank et al. (2001)	
		Effect size	Hypothesis Support	Effect size	Hypothesis Support
H ₁	Internal Collaboration → Logistics Performance	0.273 (3.619 ^{***})	Supported	0.40 (2.98 ^{***})	Supported
H ₂	External Collaboration → Logistics Performance	0.172 (2.401 ^{**})	Supported	0.01 (0.08)	Not Supported
H ₃	Internal Collaboration → External Collaboration	0.791 (35.687 ^{***})	Supported		
H ₃	Internal Collaboration ↔ External Collaboration			0.79 (9.76 ^{***})	Supported

^{***}p < 0.01;

DISCUSSION OF RESULTS

The study suggests that there was high level of internal and external collaboration existing among firms in petroleum downstream of the sub-Saharan African country. It was also revealed that the level of external collaboration among firms was slightly higher than the level of internal collaboration. This result is perhaps not surprising as actors in petroleum downstream typically depend on each other to fulfil customer orders, and as such firms are more likely to focus on improving external collaboration. As noted earlier, no actor in the petroleum downstream performs end-to-end petroleum activities and each typically plays only a small defined role within the petroleum supply chain (Amponsah and Opei, 2014).

Even though the study confirmed positive impacts of both Internal Collaboration and External Collaboration on Logistics Performance, it was revealed that the effect of External Collaboration on Logistics Performance (0.172) was not as strong as the effect of Internal Collaboration on Logistics Performance (0.273). This means that increasing the level of internal collaboration within firms would cause a relatively stronger impact on their logistics performance than increasing the level of collaboration with their external collaboration partners. Actors in the petroleum downstream would therefore stand to gain more by dedicating more resources to improving the level of internal collaboration within their organizations through maintaining integrated databases to facilitate information sharing within the firm, enhancing their ability to share both standardized and customized information internally, and endeavoring to provide objective feedback to employees regarding integrated logistics performance (Stank et al., 2001).

In addition to the positive impact of Internal Collaboration on Logistics Performance, Internal Collaboration was observed to have a strong impact on External Collaboration, suggesting that high levels of internal collaboration achieved by firms should lead to improvements in the level of external collaboration as well. When firms set out to improve the level of internal collaboration, they as well acquire relevant skills, competencies, and gain experiences which serves as a platform for smoother execution of external collaboration initiatives. This further strengthens the case for sub-Saharan African firms focusing efforts on increasing their level of internal collaboration as it has positive impacts on both external collaboration and logistics performance. The differences between the results of this study and that of Stank et al. (2001) do not in any way invalidate the original study, and may have arisen due to the different environmental and contextual factors surrounding the two studies (Asamoah et al., 2015; Asamoah et al., 2016).

CONCLUSION

The study revealed that firms in the Sub-Saharan nation's petroleum downstream focused more on external collaboration compared to internal collaboration even though internal collaboration contributed more to their logistics performance. By way of implication of the study for practice, we call for firms operating within the context of this study to shift focus from concentrating on external collaboration initiatives to focusing more on enhancing internal collaboration. Working towards achieving higher levels of internal collaboration should reflect positively on both external collaboration and logistics performance. Managers of firms in the petroleum downstream and beyond should thus concentrate on developing a culture that fosters effective internal collaboration within their firms.

There are important implications of the study for research. Given the importance that has been attached to the Internal Collaboration construct by the findings of this study, there is the need to more fully explore the dimensions of Internal Collaboration, and to ascertain the antecedents of higher internal collaboration among firms in the petroleum downstream. Also, it would be worth exploring the conditions under which the effects of internal collaboration on external collaboration and logistics performance can be maximized.

The study has few limitations. Even though the study considers the entire petroleum downstream of Ghana, data collection was restricted only to firms physically involved in the moving, storing and sales of petroleum and products. The full petroleum downstream supply chain is conceivably bigger and more complex with banks, financial institutions, government and non-governmental agencies all playing diverse direct and indirect roles. This study has revealed a positive impact of internal collaboration on both external collaboration and logistics performance. Future research would be guided at studying these relationships further and exploring what factors enhance, moderate, and repress the relationships between internal collaboration, external collaboration and logistics performance. Future research should also be directed to exploring how managers can drive the behavioral change necessary to achieve significant internal collaboration within their firms.

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