PROCUREMENT AUTOMATION AND SUPPLY CHAIN PERFORMANCE IN NIGERIA'S OIL AND GAS SECTOR

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ABSTRACT

Automation of supply chain function is widely reported in the literature, but little is known about how the adoption of automated or e-procurement improves oil and gas supply chain performance. We provide this insight by investigating the effect of procurement automation on oil and gas supply chain performance in Nigeria. The study utilizes the survey approach through the closed-ended structured questionnaire to collect data from 164 oil and gas supply chain engineers and business executives. Data were analyzed using structural equation modeling. Findings showed that the adoption of four e-procurement strategies (i.e e-requisition, e-sourcing, e-tendering, and e-invoicing) is positively related to improved supply chain performance in the form of reduced inventory costs, and reduced contract delivery delay. From these findings, the study suggests building technological capacity to implement procurement that integrates the basic requirements of e-sourcing, e-tendering, e-requisition, and e-invoicing in order to boost supply chain performance.

Keywords: E-procurement, supply chain management, electronic tendering, supply chain performance, contract management.

1. INTRODUCTION

Automated procurement or e-procurement for short, refers to a comprehensive information technology (IT) system designed to manage the entire activities involved in the acquisition of products or services in exchange for payment (Bartai and Kimutai, 2018; Lyson and Farrington, 2013). It integrates IT system capabilities for the efficient performance of procurement functions, such as sourcing, negotiation, ordering, receipt, and post-purchase evaluation (Mishra and Agarwal, 2010). Ageshin, (2001) characterized e-procurement as online indents and demand aggregation, online expression of interest, and online bid submission. Similarly, Weingarten et al, (2010) describe it as a system-supported sourcing evaluation, online release of a purchase order, and post-procurement assessment process.

The adoption of e-procurement is rooted deeply in the theoretical underpinning of e-business, and the utilization of information technologies to facilitate the efficiency and effectiveness of business-to-business (B2B) operations (Harvard Business Review, 2019). With the advancement of digitalization, a range of technologies (e.g. e-commerce, e-collaboration, material requirement planning, customer relationship management, supply chain analytics) has emerged that can enhance the operational capability of business whether in the formal or informal sectors, and e-procurement promises to be a performance booster (Althabatah et al.,2023).

In many industries such as manufacturing, banking, and automotive, electronic procurement is advocated as a supply chain strategy that offers many benefits including lead time reduction, reduced procurement cycle time, better monitoring and control, and automatic workflows (Kirui and Mukulu, 2019; Nawi, et al., 2016). Similarly, Sibel and Bulent, (2019) argued that when a procurement activity is automated, supply chain operations become more efficient, and the rate at which the supply chain management tasks are performed increases (Sibel and Bulent, 2019). Scholars have also argued that automating procurement functions like sourcing, tendering, and invoicing helps to streamline the design and performance of supply chain networks (Akhavan et al., 2009; Bof and Previtali, 2007).

Like the manufacturing and banking sectors, e-procurement was introduced into the Nigerian oil and gas industry to enable the virtual community of buyers and suppliers to have access to online tendering and sourcing of petroleum materials and products. It was supposed to eliminate the operational inefficiencies associated with manual contracting such as delivery delays, compromised tendering, incongruent specification, payment irregularities, information distortion, and a host of other irregularities (Kirui and Mukulu, 2019). However, disappointedly, a baseline observation of the Nigerian Oil and Gas supply chain sector would reveal existing cases of long waiting lines, tardy invoicing, porous tendering, and prequalification, wasteful supplier tracking efforts, and poor management of supplier relationships (Afande and Wanjiru, 2015).

Despite the sad outcomes, there has not been sufficient knowledge of the process or mechanism through which e-procurement would yield supply chain performance improvement for the oil and gas industry. In other words, there seems to be a dearth of empirical evidence articulating its effect on oil and gas supply chain performance (Davila et al., 2002; Griffiths & Payab, 2010). The few available ones concentrate on the prospects and barriers to the adoption of e-procurement (Adebanjo et al., 2006; Nawi, et al., 2016; Eei et al, 2012), but provide no suggestions on how its implementation can impact the performance of the oil and gas supply chain (Adebanjo, 2010; Eei et al, 2012; Maureen and Josphat, 2016).

In the current study, we bridge this knowledge gap by considering how e-sourcing, e-requisition, e-tendering, and e-invoicing, provide the necessary mechanism through which automated procurement contributes to boosting oil and gas supply chain performance. Therefore, this study contributes to the extant literature by testing the theoretical underpinning of e-business and information technology applications in e-procurement. In addition, undertaking this research is urgently necessary for policy direction and intervention not only for a formal sector like the oil and gas industry but also for the benefit of the informal sector of the economy that might be contemplating e-procurement as a productivity strategy. Hence, the overall objective of this study is to examine the effect of e-procurement on oil and gas supply chain performance.

The rest of the paper is structured as follows: Section 2 focuses on the review of extant literature to provide theoretical and conceptual insight into e-procurement and supply chain performance. The relevant hypotheses are proposed at the end of the theoretical review. In section 3, the methods through which the study participants were determined and reached as well as the data collection procedures are explained. Following the methodology, section 4 reports the results of data analysis, and section 5 discusses the findings and their implications. Section 6 establishes the conclusion made from the findings, and in section 7, the areas of future research are suggested, and some of the limitations of the current study are highlighted.

2. LITERATURE REVIEW

2.1 E-Sourcing

The use of the internet or automation to find possible suppliers who will be pre-qualified for contract awards in order to meet organizational requirements is known as electronic sourcing. According to Maureen and Josphat (2016), the procurement function is in charge of acquisition by purchase, rental agreements, leasing and hiring, acquiring licenses for the organization, tenancy discussions and agreements, franchising agreements, and any other contractual roles that may be necessary. Through the use of online negotiation, reverse (decreasing bid) auctions, and other related tools, e-sourcing is the deployment of web-based applications and related decision-support tools to produce a competitive and collaborative interface between buyers and sellers (Baily, 2010). With the help of an e-sourcing tool, it is possible to create electronic specifications and send them to suppliers along with all the data gathered. According to Bartai and Kimutai (2018), it also entails an e-Request for Quotation/e-Invitation to Tenders. According to studies (Maureen and Josphat, 2016; Bruno & Billentis, 2019), e-sourcing lowers costs, improves timely delivery of goods and services, fosters flexibility, improves the quality of supplies, and makes it easier to communicate with suppliers and user departments (Afande & Wanjiru, 2015). So, it stands to reason that e-sourcing would considerably enhance supply chain performance for the oil and gas industry. As a result, it is proposed that:

H1: E-sourcing is positively related to oil and gas supply chain performance.

2.2 E-Requisitioning

The automated procurement process starts with an e-requisition. This is started when an internal consumer learns that something has to be replenished or restocked (Eei et al, 2012). The sole difference between the e-requisition and the manual process is that the e-requisition is raised and transmitted to the procurement department electronically (Lyson & Farrington, 2013). Over the years, both privately held businesses and the public sector have become more interested in using e-requisitioning tools. This is because it enhances the supply chain as a whole and the procurement process in particular (Amin, 2012; Weingarten et al., 2010). Using an e-requisitioning lowers risk since there is complete traceability of who uses the requisition, who it has been delivered to, and when, and because an electronic document has a lower probability of becoming lost than one that is paper-based (Turban, 2015). The procurement function and purchasing managers can quickly communicate with many suppliers in a condensed amount of time, thanks to e-requisition. Sending emails to suppliers asking for quotes or bids for all of a complex product's components is another benefit of e-requisition (Harvard Business Review, 2019; Bartai and Kimutai, 2018; Lynson and Farrington, 2013). Consequently, it is anticipated that:

H2: E-requisitioning is positively related to oil and gas supply chain performance.

2.3 E-Tendering

A platform called "e-tendering" allows for the automated (online) pre-qualification and selection of suppliers for a contract. It is a procedure that promotes simplicity for bidders and fairness, transparency, and auditability (Griffith and Payab, 2010). Improved work processes, effective information sharing and reuse, the development of strategic alliances within the sector, and decreased expenses and preparation time are some benefits of implementing e-tendering in a company (Eadie et al., 2012). The advantages of e-tendering for an organization include lower costs (up to 90% in preparing, copying, and distributing tender documents), shorter travel distances, faster distribution of tenders, improved communication between parties, improved tender management, and less time spent on administrative tasks (Ronald and Omwenga, 2015; Moon, 2005). Given these advantages, this study anticipates that e-tendering would further enhance supply chain management. Therefore, hypothesis three proposes as follows:

H3. E-tendering is positively related to oil and gas supply chain performance.

2.4 E-Invoicing

Automating the invoicing and payment process enables data to be compared to contracts, purchase orders, service orders, and good receipt papers (Nasara, 2013; Bruno & Billentis, 2019). With an automated invoicing and payment system, invoices can be routinely validated prior to posting for payment as they move through the network after being programmed with the appropriate paperwork and pertinent rules (Lyson & Farringdon, 2013). The use of an e-invoicing solution is a responsible and effective process because it enables dashboard management of complicated duties that call for specific compliance. It makes it easier to collaborate with internal partners and outside vendors. It optimizes working capital and makes the entire payment system effective for collecting all discounts for on-time or quick payments. Bruno & Billentis (2019) also highlighted some circumstances in which e-invoicing enables the performance of supply chains, including the need to stop manual handling and the use of paper in invoice processing, the need for operational efficiency, the need to eliminate invoice fraud and improve transparency, and the need to reduce the high proportion of invoice-related discrepancies resulting from manual processing. We, therefore, anticipate that the use of e-invoicing will significantly improve the performance value of supply chains in the oil and gas industry. As a result, hypothesis four is suggested:

H4. E-invoicing is positively related to oil and gas supply chain performance.

3. METHODOLOGY

All oil and gas servicing firms in the upstream petroleum sector in Nigeria's Niger Delta region constituted the study area. As a crucial element of the Nigerian economy, the oil and gas industry accounts for a significant portion (86.9%) of the country's GDP (Central Bank of Nigeria (CBN, 2022). In terms of operational activities, the study area is classified as both upstream (exploration and production) and downstream (refining, distribution, and marketing of oil and gas services). The Niger Delta region is the primary area of oil production. As early adopters of innovative technologies and business solutions (Alomar & de Visscher, 2007), the oil and gas industry became the focus of this study because figuring out how e-procurement adoption can boost supply chain performance would further the growth of the industry in particular, and Nigeria's economy in general.

The human population of the study consisted of all supply chain professionals, and engineers working in the oil and gas companies within the area of study. The sample for the study was chosen based on the purposive sampling approach. The reason for adopting the purposive sampling was because of the need to specifically select procurement and supply chain professionals who are knowledgeable and would understand the decision around automated procurement and its role in the management of the oil and gas supply chain. Hence, the purposive sampling method produced 164 willing participants.

Those selected were mainly supply chain engineers and executives working in procurement (34.6%), warehousing (22.8%), logistics (16.2%), stores (8.5%), operations (7.9%), and IT (10.0%) units. The majority (74.8%) of respondents have been in the oil and gas industry for at least 5 years. In addition, about 55% of participating oil and gas companies maintained a large pool (350-500) of suppliers. Of the 164 respondents, only 83 filled the survey instrument appropriately, yielding a valid response rate of 50.6%.

The structured questionnaire was used to collect the relevant primary data. The questionnaire was chosen because of its ease of use, economy, and standardization in data collection (Creswell and Plano-Clark, 2018). Moreover, many studies on supply chain management use survey questionnaires to collect data (Nawi et al., 2014; Udofot and Nsikan, 2021).

The questionnaire was developed by the authors, in designing the questionnaire, inputs were taken from existing literature on supply chain management, procurement, and information technology (Adebiyi et al., 2010; Ajay & Thobeng, 2015; Bartai & Kimutai, 2018). A cover letter, seeking informed consent, and explaining the purpose of the study preceded and introduced the survey questionnaire. In it, respondents were guaranteed confidentiality, data security, and privacy. There were 36 closed-ended items meant to evaluate, on a 5-point Likert scale, the effect of e-procurement variables on supply chain performance. The questionnaire was distributed through the use of email addresses of potential respondents who were purposively selected for the study. Their e-mail addresses and other contact information were obtained from the directory of the Chattered Institute of Supply Management of Nigeria, South-South region office.

The measurement of variables adopted e-procurement as the independent or predictor variable. It has four dimensional measures including e-sourcing, e-requisition, e-tendering, and e-invoicing. Example of items measuring the constructs includes e-sourcing (*Our company selects the most preferred supplier electronically*); e-requisitioning (*Our company has relevant ICT tools to make a requisition of items*); e-tendering (*Transmission of tenders between our company and suppliers is achieved by electronic means*); and e-invoicing (*Our e-invoicing tool corrects discrepancies between suppliers and us*). On the other hand, Supply chain performance, measured by two indicators- reduced contract delays (*Our response time to fulfill a contract has become faster*) and cost reduction *(Our company's total procurement cost has been reduced)*, constituted the dependent variable.

To determine the construct validity and reliability of the research instrument, some measures were taken. First, inputs for the design the of questionnaire were taken from previous empirical studies with established validity and reliability (Kirui and Mukulu, 2019; Eei et al, 2012). Furthermore, the construct's operationalization was consistent with relevant models and concepts, and the questionnaire items were checked and adjusted by three experts in operations, and supply chain management prior to being distributed to respondents.

In addition, the Cronbach alpha test and composite reliability (CR) tests on the questionnaire items produced a coefficient value greater than 80% to guarantee their reliability. As indicated by Nunnally and Bernstein (1994), the alpha coefficient of 0.70 or more affirms that the survey instrument is reliable and fit to use for data gathering. We also conducted a pilot survey on 20 respondents who were supply chain managers but operated in the manufacturing industry. The outcome of the pilot study was used to modify some of the items in the final survey instrument. The evaluation of construct reliability and validity, and the test of the hypothesized relationship as shown in the conceptual model were all done using structural-equation-model analysis.

In addition, the Confirmatory Factor Analysis (CFA), (factor loadings, and average variance extracted (AVE) shown in Tables 1 and 2 indicate that over 80% of the e-procurement and supply chain performance elements loaded with high values greater than 0.70. This is an indication that the scale truly measured the constructs as expected (Saunders, Lewis, & Thornhill, 2019).

The study adopted structural equation modeling (SEM) to analyse data. This comprises the descriptive model, measurement model, and structural model. The descriptive model analysis comprises the mean and standard deviation (SD); the measurement model includes items loadings (l_k), Cronbach's Alpha (α), composite reliability (CR), and average variance extracted (AVE), and the structural model includes correlation coefficient (r), and regression analysis. The choice of the SEM was based on its ability to test the model, robustness in providing results that are reliable, and a guarantee of replicability of findings (Hair et al., 2017; Hsin, et al., 2013; Althabatah, Yaqot, Menezes & Kerbache, 2023).

4. ANALYSIS

4.1 Descriptive Analysis and Measurement Model

Results in Tables 1 and 2 present the outcome of descriptive analysis (Mean and standard deviation (SD), and measurement model (items loadings (l_k), Cronbach's Alpha (α), composite reliability

(CR), and average variance extracted (AVE). The measurement model items were meant to assess model validity and reliability (Gannon *et al*., 2017). The mean score for each Likert scale questionnaire item is evaluated for significance on a benchmark mean score of 3.0. Thus, an item is significant if the mean score is equal to or less than the benchmark score derived by averaging the Likert scale point used in the study.

All the factors loaded above the benchmark 0.70. The highest factor loading score for each automated procurement construct are: e-sourcing (l_k = 0.82); e-requisitioning ($l_k = 0.85$); e-tendering (l_k = 0.81); and e-invoicing ($l_k = 0.83$) ProCost (l_k = 0.84); and Contract (l_k = 0.83). Similarly, all the measures of supply chain performance loaded above 0.70, as follows: procurement cost reduction (ProCost) (l_k = 0.84); contract delay minimisation (Contract) ($l_k = 0.83$). The loading scores imply that each corresponding indicator is a significant contributor to the applicable variable. Thus, the higher the factor loading score, the greater its indicator contribution to forming the study variables. Furthermore, results indicate that values for Cronbach's Alpha, CR and AVE for each variable yielded above the recommended cut-off values: 0.7, 0.7 and 0.50 respectively; thus, satisfying conditions for construct reliability and internal consistency (Hair et al., 2017).

In addition, most of the constructs that define the relationship between e-procurement and supply chain performance were rated beyond the 3.0 benchmark mean score. For instance, the highest mean scores and standard deviation were found as follows: e-sourcing (Mean= 4.05, SD=0.83), e-requisitioning (Mean=3.85, SD= 0.81), e-tendering (Mean= 3.86, SD=0.88), e-invoicing (Mean= 3.61, SD=0.81), ProCost (Mean= 4.05, SD=1.04), and Contract (Mean= 4.20, SD=0.77). These results simply suggest that the oil and gas firms are embracing automation, and are poised to reap the attendant benefits.

Table 1 Descriptive Score and Model Measurement

Variable	**Construct**	**Mean**	**SD**	**Loading**	**AVE (>0.50)**
e-Sourcing (CR=0.79), (α=0.87)	Our company collects the supply proposals through an electronic system	4.05	0.83	0.70	0.65
	Our company selects the most preferred supplier electronically	3.41	1.10	0.74	
	Our company makes requests for quotation and bid submission electronically	3.46	1.07	0.81	

	Our company notifies the supplier of an authorized contract through an electronic system	3.30	0.49	0.82	
	Our company negotiates with suppliers through the internet	3.27	1.09	0.78	
	Our company documents past supply and purchasing information in electronic form.	3.86	1.06	0.75	
e-Requisitioning (CR=0.72), (α=0.75)	Our company has fully implemented E-requisitioning	2.70	1.06	0.72	0.63
	Our company has relevant ICT tools to make requisition of items.	2.33	1.15	0.73	
	Our company track orders through web-based facilities	3.31	1.12	0.78	
	Our company traces shipment/consignment routes through electronic means	3.80	0.95	0.71	
	Stock keeping and retrieval is done via electronic means	3.85	0.81	0.85	
	Our internal purchasing processes and that of our major suppliers are linked electronically.	3.61	0.80	0.72	
e-Tendering (CR=0.76), (α=0.71)	Submitted bids/tenders are processed electronically	3.42	1.08	0.76	0.64
	Transmission of tendering document between our company and suppliers is achieved by electronic means	3.12	0.84	0.75	
	Screening of bids to remove those that do not conform with specified criteria is done electronically	3.20	0.85	0.80	
	Our company communicates with suppliers using the internet	2.94	1.17	0.79	
	Our company sets up a database of procurement process for all units	3.86	0.88	0.71	
	Our company builds supplier trust and confidence through e-tendering	3.75	0.81	0.81	

Table 2 Continuation of Descriptive Score and Model Measurement

Variable	Construct	Mean	SD	Loading	AVE (>0.50)
e-Invoicing (CR=0.73), (α=0.77)	Our online payment system is fast	3.44	0.93	0.74	
	Our company adopts a convenient online payment system	3.23	1.93	0.80	
	Our e-invoicing system is secure	3.46	1.90	0.83	
	Our e-invoicing system is sensitive to change in transactions	3.27	1.95	0.76	
	Our e-invoicing tool corrects discrepancies between suppliers and us	3.22	0.97	0.79	
	Our e-invoice system eliminates fraud and increases transparency	3.44	0.93	0.72	
	Our online payment system is fast	3.61	0.81	0.75	
Procurement cost reduction (ProCost) (CR=0.81), (α=0.89)	Our company's total procurement cost has been reduced	3.35	1.09	0.72	0.59
	The cost of monitoring the quality of products supplied has become lower	3.15	0.95	0.69	
	Our inventory management cost has been reduced	3.45	1.15	0.82	
	The error rate of product order has been reduced	4.05	1.04	0.76	
	The quality of delivered products has become higher	3.60	0.88	0.84	
	The products provided by our suppliers have conformed to our requirements more precisely.	2.89	0.64	0.71	
Contract delay minimisation (Contract) (CR=0.76), (α=0.85)	The product delivery time from suppliers has become more precise	4.20	0.77	0.83	0.61
	Our response time to fulfill a contract has become faster	3.45	1.15	0.71	

	Our purchasing time has become shorter	3.60	0.88	0.68
	The time between contract endorsement and delivery has become shorter	3.41	1.35	0.79
	Our contract process has become more transparent	4.06	0.82	0.77
	Our company has become more satisfying in relating with suppliers	3.64	0.84	0.81

4.2 Goodness of Fit Assessment

The goodness of fit (Gof) test evaluates the suitability of the proposed model for this study. It is a measure of the soundness of the relationship between the variables (Henseler & Sarstedt, 2013). Table 3 provides summarised results for measurement of model fitness. It can be observed that all criteria reached the recommended critical value limit for goodness of fit index (Henseler & Sarstedt, 2013; Wetzels et al., 2009). Hence, the proposed model is robust and worth analysing.

Table 3: Goodness of fit Analysis

No	Model Fit Indicator	Criteria	Value	Conclusion
1	Average path coefficient (APC)	$p < 0.05$	APC = 0.278 p = 0.002	Significant
2	Average R2 (ARS)	$p < 0.05$	ARS = 0.268 p = 0.001	Significant
3	Average R2-adjusted (ARSA)	$p < 0.05$	ARSA = 0.258 p = 0.005	Significant
4	Tenenhaus Gof	Small if Gof ≥ 0.1 Medium if Gof ≥ 0.25 Big if Gof ≥0.36	GoF = 0.375	Big
5	Sympson's paradox ratio (SPR)	Acceptable if SPR ≥ 0.7; Ideal if SPR = 1	SPR=0.872	Acceptable

6	R2 contribution ratio (RSCR)	Acceptable if RSCR ≥ 0.9; Ideal if SPR =1	RSCR= 0.985	Acceptable

4.3 Structural Model- Hypothesis Testing

Table 4 demonstrates the results of hypothesis testing of the effect of automated procurement on supply chain performance. It shows the correlation coefficient (r), path coefficients (β), the P and t-values. According to Hair et al., (2017) only predictor variables with β values above 0.1 can be accepted as having influence on the response variable. In addition, a t-value greater than 1.645 is required for a positive relationship between the independent and dependent variables (Hair *et al.*, 2017). Therefore, the results yielded positive effects of all automated procurement variables on overall supply chain performance (SCP), namely: e-sourcing (r: 0.53, β: 0.392 and t-value: 2.835), e-requisitioning (r: 0.59, β: 0.324 and t-value: 2.689), e-tendering (r: 0.68, β: 0.307 and t-value: 2.412), and e-invoicing (r: 0.41, β: 0.314 and t-value: 2.785). Hence, hypotheses (H1-H4) are supported by the model.

Table 4 Structural Equation Model Results

Hypothesis	R	Path Coefficient(β)	P-value	T-value	Conclusion
H1: e-sourcing→SCP	0.53	0.392	0.003	2.835	Significant/Supported
H2: e-requisitioning→SCP	0.59	0.324	0.001	2.689	Significant/Supported
H3: e-tendering→SCP	0.68	0.307	0.000	2.412	Significant/Supported
H4: e-invoicing→SCP	0.41	0.314	0.001	2.785	Significant/Supported

Note: SCP= Supply Chain Performance.

5. DISCUSSION

Generally, the findings in this study show that automating oil and gas procurement processes (sourcing, tendering, and invoicing) is very helpful to improve their supply chain performance. The descriptive results revealed a considerate level of automated procurement adoption in the oil and gas industry thus, substantiating the works of Aithabatah et al., (2023), Bartai and Kimutai, (2018), and Kirui and Mukulu, 2019). These authors all pointed to the important benefits of adopting advanced technologies in the procurement processes for both private organizations and public-owned institutions. For instance, Ahmed et al, (2019) explicitly call for the attention of managers to the delays in project contract completion which can be addressed by developing intervention policies, capacity, structure, and organizational resources to implement automation in all procurement and supply chain contract management processes.

Furthermore, the structural findings showed that the adoption of automation in the procurement function (sourcing, requisitioning, tendering, and invoicing) impacts strongly and positively on the supply chain performance in terms of reduced operating costs and minimized contract delivery delay. In other words, embracing automation in the entire oil and gas procurement ecosystem can lead to improvement in major supply chain performance measures. The results further imply that oil and gas firms' propensity to improve their supply chain performance is directly linked to having in place a reliable system of procurement automation system.

6. CONCLUSION AND IMPLICATIONS

The study concludes that automated procurement is a positive booster of supply chain performance in the Oil and Gas industry. Specifically, automation of material sourcing, requisitioning activities, tendering and documentation, and order invoicing positively impact supply chain outcomes by lowering the entire procurement and supply chain costs and lowering delays in contract delivery. We further conclude that automated sourcing is capable of enhancing oil and gas supply chain performance by encouraging online ordering, planning, and scheduling orders, paying vendors, easy approvals of purchases, order tracking, and enhancement of the use of software services of an electronic procurement solution. Likewise, automating the order invoicing function is capable of making payment less cumbersome, reducing bottlenecks in the procurement processes, and making the process faster for vendors and supply chain personnel. There are theoretical and practical implications of these findings: First, this study enriches the existing literature by analyzing the mechanism through which automation of procurement functions can positively impact oil and gas supply chain performance. Existing literature mainly focuses on e-procurement implementation strategies, barriers to implementation success, and the effect on overall business performance. Second, this study contributes to the growing theoretical literature on the adoption of technologies, or digital tools (a process generally known as digitization) to transform a firm's operating capabilities resulting in an enhanced level of organizational performance. Finally, as a practical contribution, we suggest that oil and gas services firms should pay attention to developing in-house capacity to track orders using web-based facilities, build an electronic approval or authorization process to ensure due diligence, and further enhance the cycle time involved in materials and services procurement.

7. LIMITATIONS AND FURTHER STUDIES

In carrying out this study, one major limitation abounds in its choice of a few automated procurement elements (e-requisitioning, e-sourcing, e-tendering, e-invoicing) whereas several other forms of automated procurement exist in the literature. Probably, the inclusion of these other e-procurement practices (such as e-negotiation, vendor management process, and contract approval process) might also have a significant positive influence on oil and gas supply chain performance. In addition, this study targeted selected oil and gas firms in the upstream petroleum sector only. For future studies, a survey of both the upstream and downstream oil and gas industry would probably yield insightful results on how procurement automation can boost supply chain performance in the entire industry. Future studies could also include some moderating variables to see the extraneous factors that could influence the effect of procurement automation on supply chain performance. Finally, future research could expand the scope of performance beyond the operational perspective to probably include financial, social, and environmental perspectives in line with ongoing sustainable development thinking.

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