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Enhancing supply chain agility through e-procurement in a volatile frontier market

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Background: The business environment is increasingly becoming volatile, uncertain, complex and ambiguous (VUCA) because of globalisation, increased competition, random consumer tastes changes and environmental factors. Traditional procurement strategies are becoming increasingly redundant because of the volatility of the global business environment. The market has thus called for increased agility to conquer the VUCA nature of the supply chain environment.

Objectives: The study sought to examine the role that e-procurement plays in augmenting the agility of supply chains. The four determinants of e-procurement, that is, e-design, e-sourcing, e-evaluation and e-negotiation, were linked directly with supply chain agility.

Method: A census approach was taken to gather data from 219 supply chain and procurement employees of Zimbabwe's telecommunications and technology industry. A self-administered survey questionnaire was used based on a scientifically developed and validated supply chain agility measurement scale from the extant literature.

Results: Using structural equation modelling (SEM), the study's results confirmed that e-procurement significantly predicts supply chain agility. All determinants of e-procurement were statistically significantly explaining supply chain agility in a volatile business environment.

Conclusion: The study concludes that e-procurement augments the agility of the supply chain in volatile business environments, as e-procurement can increase swiftness and agility as it fosters ubiquitous business processes on a seamless real-time basis. It emerged from the study that the supply chain vulnerabilities volatile industries face could be eliminated through supply chain agility, augmented through e-procurement systems. The study's findings also implore supply network members from upstream to downstream to adopt e-procurement.

Contribution: The study has practical implications for all supply network members from upstream to downstream. It implores these members to adopt e-procurement to revive supply networks amid environmental volatility and alleviate miscommunication. Study also offers theoretical implications for e-procurement and supply chain management. The study also contributes to the body of knowledge by extending the existing theories on e-procurement and supply chains in the context of environmental volatility.

Keywords: E-procurement; supply chain agility; performance; volatile market; VUCA.

Introduction

The business environment has become volatile, uncertain, complex and ambiguous (VUCA) because of globalisation, intense competition, ever-changing customer tastes and environmental factors (Persis, Venkatesh & Raja 2021). Global pandemics such as coronavirus disease 2019 (COVID-19) aggravated the situation, causing unprecedented volatility along the supply chain. The global political landscape is equally witnessing a shift in the balance of power from the West to the East. China is pulling the levers from its corner, challenging the dominance of the United States and its alliance partners (Fridgeirsson et al. 2021). As a result of the increased business volatility, there have been production delays, difficulties with outsourcing and increased supply chain vulnerability, resulting in decreased supply chain performance.

Traditional procurement strategies that used to be effective, such as formal tendering systems and face-to-face procurement committee meetings, have been deemed redundant because of the COVID-19 pandemic (Yang, Wang & Hu 2021). Traditional procurement methods of going

around shopping, sight-seeing and visiting plants are now less likely, as product life cycles become shorter and competition is increasing. Where the bargaining power of large suppliers is high, procurement of component supplies is negatively affected by unequivocal negotiation terms. It was therefore prudent for Huang, Li and Zhang (2021) to conclude that the volatility in the business has mainly affected the stability of the supply chain through the procurement aspect. Conversely, the same notion was supported by Cen et al. (2018), who view traditional procurement as under attack.

Emerging trends, however, posit that e-procurement may drive supply chain effectiveness and efficiency by promoting agility in response to environmental volatility. A more agile supply chain is flexible and adaptable (Irfan, Wang & Akhtar 2019). In an agile supply chain, component products are outsourced faster, vendors are well connected to the organisation, and they can respond to requisitions quickly before any significant changes take place downstream of the value chain. As the consumer is increasingly becoming nomadic in taste and preference, an agile supply chain enhances the performance of the entire chain through the satisfaction of the customers in real time.

While some scholars have examined traditional procurement, logistics and supply chain challenges from developing economies' perspectives (Langa & Naude 2022; Manyathi, Burger & Moritmer 2021; Saruchera 2020; Tukuta & Saruchera 2015), some have partially examined the differential role of e-procurement on supply chain agility (Faheem & Siddiqui 2020; Huang et al. 2021; Persis et al. 2021; Yang et al. 2021). However, there does not seem to be much focus specifically on turbulent developing countries, let alone Zimbabwe. Zoogah, Peng and Woldu (2015) succinctly noted that Africa has not been on researchers' radar screens despite the unique peculiarities of African institutions, resources and organisational effectiveness. Of the studies that examined these variables, none ever examined the effect of the association between e-procurement and supply chain agility in a volatile business environment. This study therefore aims to address both the practical and the knowledge problems of e-procurement and supply chain agility in the volatile business environments of frontier markets.

Literature review

Electronic procurement

Electronic procurement (e-procurement) is the application of the Internet and digital technological systems for the purchasing function of the organisation (Ibem, Aduwo & Afolabi 2021). E-procurement replaces the traditional procurement function and covers all stages of the procurement process, such as search, sourcing, negotiation, ordering, receipt and postpurchase review (Chen et al. 2021). Sain, Owens and Hill (2014) concur with the definition of Ibem et al. (2021) and add that e-procurement is an order management function of using digital technology in searching for supplies, taking orders and processing orders. A simplified way of understanding e-procurement is procurement conducted using electronic resources (Faheem & Siddiqui 2020).

Therefore, it is crucial to understand that e-procurement is an information technology–based purchasing system located at the supply chain's input end (Presutti 2018). The use and adoption of digital technologies have therefore necessitated the use and application of e-procurement (Firmansyah, Halimah & Dai 2021). Lee, Vanui and Chai (2021) considered e-procurement to be the acquisition and sale of products and services using the Internet and other information and networking systems like electronic data interchange (EDI) and enterprise resource planning. Wangui (2018) concludes that e-procurement is the value-added use of the Internet and e-commerce. It involves streamlining, integrating and facilitating the procurement process from buyer to supplier and back.

Koorn and Gariba (2019) indicate the various forms of e-procurement, including e-tendering, e-marketplace, e-auction or reverse auction and e-catalogue. Presutti (2018) also adds that some critical aspects of e-procurement include e-ordering, e-bidding, e-sourcing and e-information. In line with other scholars, Ibrahim (2020) posits that e-procurement is a function of e-sourcing, e-design, e-negotiation and e-evaluation. The e-procurement application can be viewed more broadly as an end-to-end solution that integrates and streamlines many procurement processes throughout the organisation (Koorn & Gariba 2019).

Supply chain agility

Supply chain agility refers to the ability of the supply network to respond swiftly to an unpredictable environment and succeed by exploiting business opportunities (Irfan et al. 2019). It is a network of suppliers of component products and services who are adaptable, fast and flexible in response to internal or external influence (Chen 2019). For that reason, Irfan et al. (2019) concluded that a more agile supply chain is flexible and adaptable. In an agile supply chain, component products are outsourced faster, vendors are well connected to the organisation, and they can speedily respond to requisitions before any significant changes take place downstream of the value chain (Zhu, Shah & Sarkis 2018). As the consumer is increasingly becoming nomadic in taste and preference, an agile supply chain enhances the performance of the entire chain through the satisfaction of the customers in real time (Chen 2019). For an agile supply chain, flexibility and adaptability are two fundamental aspects added to a typical supply chain (Chen 2019). The source of dexterity, in this case, is a combined effort of all players on the supply network, not just one.

Therefore, for the supply chain to be agile and flexible, the whole network of suppliers upstream of the value chain should have the same culture (Eckstein et al. 2015). The opposing aspect of agility is supply chain rigidity, which is anchored on stability against flexibility. Usually, rigid supply

chains take ages to respond to environmental dynamics, yet agile supply chains respond swiftly (Zhu et al. 2018).

Thus, supply chain agility is the firms' capability, in conjunction with suppliers and other stakeholders, to confront market challenges and respond quickly to disruptions in demand (Irfan et al. 2019). If one firm is agile on its own, that does not make the entire supply chain network agile (Gligor et al. 2019). Supply chain agility is a function of the combined flexibility of the entire value chain, not just one focal firm on a network of suppliers (Gligor et al. 2019).

Volatile business environment

When a business environment is volatile, it is not stable with turbulent internal and/or external forces (Persis et al. 2021). Business environmental volatility refers to large-scale, frequent changes in the internal, micro and macro environments with no predictable pattern (Bennett & Lemoine 2014). Organisations operating in volatile markets require robust structures to obtain and process reliable and current information to be buoyed by the stringent demands of such environments (Felin & Powell 2016). Organisations have historically depended on expertise, routines, learning and scale in stable settings. However, the business environment's volatility is forcing organisations to connect with stakeholders beyond external borders, bringing them into the process of learning and innovation (Felin & Powell 2016).

While change is quite likely in a volatile environment, its timing and scope are still undetermined. Volatility is a statistical measure which describes an amount of uncertainty. On the other hand, it refers to a phenomenon's speed, volume, nature and magnitude that may or may not be in a pattern form (O'Sullivan & Tomljanovich 2012). Volatility instances include stock market fluctuations, centralisation or decentralisation trends in organisations, radical innovations and digitalisation, and much more (Persis et al. 2021).

A volatile business environment is less desirable for many companies. It follows that in a volatile business environment, business threats are high, and typical opportunities prevalent in stable business environments are scarce (Rimita, Hoon & Levasseur 2020). In most volatile business environments, inflation is usually high, and economic fundamentals are negatively affected (Ahmed et al. 2019). When the economy crumbles, it becomes difficult for companies on the supply chain network to function correctly. Another key driver of environmental volatility is the political landscape of the country. Political instability, such as wars, uprisings and general political instability, is tantamount to environmental volatility and uncertainty (Rimita et al. 2020).

Theories of e-procurement and supply chain agility

The study was primarily informed by the configuration theory (Miller 1986). The supply chain agility and information technology (IT) dimensions may be thoroughly examined using the configuration theory. 'The configuration approach involves dominant gestalts or configurations of observable characteristics or behaviours that may lead to an outcome' (Madzimure, Mafini & Dhurip 2020:2). The theory posits that if the systems and structures of a firm are well configured and supported with technology and human interaction, firms can handle complicated organisational aspects in an agile and flexible manner (Sinha et al. 2005).

The configuration theory was further refined to be incorporated into supply chain management (Sinha et al. 2005). The ability of several companies on the supply chain to be well configured, networked and integrated is the function of IT and the need to respond swiftly to environmental demands. Through the configuration theory, technology enhances the supply chain's unity and adaptability (Sinha et al. 2005). However, the configuration theory has some major drawbacks emanating from the theory's assumptions, especially the assumptions of equifinality and holistic synthesis. These assumptions make it very difficult to determine an objective model when the premise of equifinality posits numerous means of reaching an end. The permutations of configurations among personal, structural, strategy and environmental variables become empirically too complex.

Another theory of interest is the agile supply chain model, which was introduced by Van Hoek (2001) and further refined by Lin, Chiu and Chu (2006). The model considers supply chain agility a competitive advantage for the survival of nodes on the supply network. The agile supply chain model indicates that changes in the market drive supply chain agility. Environmental volatility is the primary driver and is informed by market factors, competitive aspects, technology and social factors (Makudza, Sandada & Madzikanda 2021). For an agile supply chain to be implemented effectively, there is a need for agility enablers which include collaboration, integration and customer sensitivity. The model further explains the characteristics of an agile supply chain as accountability, competency, flexibility and speed. The effect and goals of agile supply chains include cost-saving, time-saving and satisfaction of customers (Lin et al. 2006).

According to the paradigm, e-procurement is using technology to make organisational purchases. According to Chang, Wang and Chiu (2008), e-procurement comprises four components: e-design, e-sourcing, e-negotiation and e-evaluation. Different steps of e-procurement provide variables used as constructs in the e-procurement and supply chain performance model (Faheem & Siddiqui 2020). Supply chain performance, which was characterised as the capacity of the supply chain network to provide desired outcomes, served as the model's dependent variable.

The model defines e-design as preparing the requirements of all organisational purchases through an electronic

procurement system. E-sourcing was defined in the model as selecting a list of available suppliers in the market, collecting information about them, analysing the information and selecting the best supplier among several through an electronic procurement system. E-negotiations were understood as creating a contractual agreement with the selected supplier through an electronic procurement system. In contrast, e-evaluation was defined as the collection of information about pledged suppliers and their progress for evaluation and planning for further transactions (Chang et al. 2008; Faheem & Siddiqui 2020).

Conceptualising the effect of e-procurement on supply chain agility in a volatile business environment

The study looked at the body of research on e-procurement and supply chain agility. No model has ever connected e-procurement to supply chain agility in a volatile pre-emerging market. Thus, there must be a glaring theoretical gap. The 2013 model by Chang, Tsai and Hsum helped to clarify the e-procurement factors. However, it could not establish a connection between the four variables – e-design, e-sourcing, e-negotiation and e-evaluation – and supply chain agility. Instead, their concept was connected to the efficiency of the supply chain. In contrast, the supply chain agility components and the business environment's volatility are better described by the Van Hoek (2001) and Lin et al. (2006) models, which were quiet regarding the predictive e-procurement factors. Similarly, the Miller (1986) and Sinha et al. (2005) models highlight the effects of configurations and volatility of the environment but were also silent about the actual variables of e-procurement and supply chain agility.

Guided by the deductive approach, a theory can be extended to close an emerging theoretical gap (Siti 2016). In extending the existing theory, the study adopts and adapts Chang et al.'s (2008) e-procurement variables and links them with Van Hoek's (2001) supply chain agility scale. In so doing, Miller's (1986) configurations within a supply chain network are augmented, and the effect of environmental volatility is taken into consideration. The conceptual framework is thus presented in Figure 1.

Hypotheses development

E-procurement and supply chain agility in a volatile business environment

Supply chains were equally thwarted and negatively affected by environmental volatility (Waithaka & Kimani 2021). The major drawback experienced in history is the closure of some key supply chain players because of environmental volatility. In that manner, critical supplies of component products could not be procured as the value chain was distorted (Wu 2019). That calls for e-procurement, an antecedent driver for supply chain agility (Alobaidi 2021). Through e-procurement, sourcing can be performed online as e-sourcing, tendering becomes an online process through e-tendering and even negotiations can go virtual. Payments can be simply processed online (Alobaidi 2021). Such e-procurement practices then enhance the agility of supply chains amid increased environmental volatility.

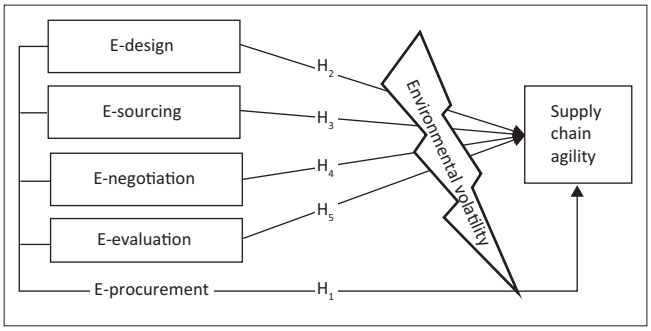
Downstream volatility, which emanates from customers and is customer-driven, is also an integral part of supply chain distortions which have affected traditional procurement, leading to the need for e-procurement to enhance supply chain agility (Wu 2019). When customers' demand is poorly construed upstream as a result of environmental volatility, the supply chain is likely to develop and produce a product and/or service that will likely be rejected by the customer (Madhani 2017). However, when the supply chain adopts technology in supply chain management, e-procurement may be applied, which easily drives purchase efficiency and supply chain agility (Waithaka & Kimani 2021). Fast and swift responses drive supply chain agility to downstream volatility (Yang et al. 2021).

The association between e-procurement and supply chain agility was previously tested by some scholars (Faheem & Siddiqui 2020; Madzimure et al. 2020). According to Faheem and Siddiqui (2020), there is a direct and positive association between e-procurement and supply chain agility. This acts as a promoter for e-procurement adoption, as the more supply chain players embrace e-procurement, the more their network of suppliers becomes agile. The same positive association between supply chain agility and e-procurement was discovered by Madzimure et al. (2020), who then concluded that every supply chain needs to be flexible to provide the value that consumers want. Companies may be flexible by looking outside of their own organisation. We therefore hypothesise that:

> **H_1:** E-procurement positively and significantly affects supply chain agility in a volatile business environment.

E-design and supply chain agility in a volatile business environment

E-design is the process of building a system for online purchasing goods and services (Chang et al. 2008). E-design entails electronic order specification and order description.



Source: Adapted from Chang, H.L., Wang, K. & Chiu, I., 2008, 'Business–IT fit in e-procurement systems: evidence from high-technology firms in China', Information Systems Journal, 18(4), 381–404; Van Hoek, R.I., 2001, 'Epilogue-moving forward with agility', *International Journal of Physical Distribution & Logistics Management* 31(4), 290–301. https://doi.org/10.1108/09600030110394941 and Miller, D., 1986, 'Configuration of strategy and structure: Towards a synthesis', *Strategic Management Journal* 7(3), 233–249. https://doi.org/10.1002/ smj.4250070305

FIGURE 1: The conceptual framework.

Given that the procurement function works closely with the supplier, there is a need for a good working relationship to design the procurement order. Thus, e-design has been brought up as a modern business process re-engineering technological strategy that enhances effective online procurement functions (Makudza, Muridzi & Chirima 2019).

E-design makes it easier for suppliers to participate in product specification development. In addition, eliminating the silo effect of the conventionally sequential design operations makes it possible for shorter time-to-market cycles (Presutti 2018). Thus, the relationship between the supplier and the procurer is augmented through the practical application of e-design systems in procurement. Madzimure et al. (2020) also noted that e-design enhances collaborations between the two industrial companies, the buying and selling companies. Improvements in dyadic working relationships are instrumental in enhancing the quality of the order and satisfaction of customers downstream (Chang et al. 2008).

In an unstable business market, product prices change constantly, consumer taste is highly nomadic and the survival of businesses is on the brink (Rimita et al. 2020). It is therefore worth noting that Madzimure et al. (2020) indicate that e-design aids speed in processing the order. This entails a fast and adaptable way of setting purchasing requirements. Speed in order specification through e-design systems is directly related to supply chain agility (Presutti 2018). As supply chain agility entails the need for fast-moving and adaptable structures, e-design develops such, guaranteeing agility for all the supply chain players who embrace it.

Suppose supply chain players use e-design systems and incorporate strategic collaboration partners in their product design process that could further reduce the time and cost of developing and introducing new products, thereby enhancing the agility of the entire supply chain (Chang et al. 2008). Therefore, there is a direct positive association between e-design systems and supply chain agility (Chang et al. 2008).

In light of the preceding discussion, the study presents the following hypothesis:

> **H_2:** E-design positively and significantly affects supply chain agility in a volatile business environment.

E-sourcing and supply chain agility in a volatile business environment

Electronic sourcing involves soliciting new potential suppliers using digital technologies to cut costs (Lysons & Farrington 2012). E-sourcing is the application of digital technologies and Internet platforms to search for potential suppliers of products and services or component products (Madzimure et al. 2020). Traditionally, supplier sourcing was associated with shopping around and making physical site visits comparing supplier offers. However, with technological advancements in e-procurement, companies can perform all strategic sourcing of components online to enhance supply chain agility (Yang et al. 2021).

The e-sourcing–supply chain agility relationship is therefore deemed positive and closely related (Chang et al. 2008). As supply chain players select the most appropriate suppliers through information and digital system, flexibility is enhanced. This is typical of e-procurement systems such as Scoduv®, which allows various suppliers of a component product to register their offers to the system (Rowland 2022). Each supplier creates a portal online of their products and services, pricing and other augmented services. The buying companies will merely peruse through Scoduv®. Scoduv® also has a comparative view and multibrowsing system, thereby allowing buyers to electronically search and source for supplies in an agile and adaptive manner.

However, although e-sourcing has more benefits in a volatile business environment, it has also suffered major drawbacks. Some technology-savvy suppliers may present an eye-catching show of their services online, which may not be essentially aligned with the actual product offerings (Valashiya 2019). That delays the entire supplier chain, as returns and replacement policies are affected. In electronic buying, the product will likely be felt and tested at delivery (Masengu et al. 2022). The purchased and the delivered order may vary in quality, strength and performance. This is typical in international business management, where a product is shipped and only verified on receipt in the foreign buying country. For that reason, Rowland (2022) advocates for a blended approach whereby e-sourcing is used in line with physical supplier visits.

Based on the previous discussion, the following proposition is presented for analysis:

> **H_3:** E-sourcing positively and significantly affects supply chain agility in a volatile business environment.

E-negotiation and supply chain agility in a volatile business environment

Electronic commerce (e-commerce) is understood as the direct application of digital and Internet technologies in negotiations between the supplier and the customer (Madzimure et al. 2020). E-negotiation, according to Simkova and Smutny (2021), is the process of carrying out talks between business partners using electronic means. Business partners negotiating online or using IT platforms is known as 'e-negotiation' (Madzimure et al. 2020). Because it facilitates the participation of several vital parties, notably suppliers, e-negotiation is a crucial instrument in e-procurement. E-negotiation is thus the role of communication between supply chain participants to optimise the whole supply chain (Simkova & Smutny 2021). Neatly weaved and optimised supply chains are more adaptable, highly flexible and agile.

Supply chain agility and flexibility are greatly improved through e-negotiations. This is essentially true of the recent COVID-19 pandemic, which has introduced business volatility and barricades of face-to-face physical meetings (Persis et al.

2021). Therefore, amid COVID-19-induced volatility, flexibility and agility are boosted through communications online. In most countries, governments impose travelling restrictions to curb the spread of COVID-19. That halted some static supply chains, yet those with online communication and negotiation platforms remained viable. As supply networks embraced the new normal in the COVID-19-induced business volatility, flexibility was enhanced (Rimita et al. 2020).

However, e-negotiations are filled with deceptive practices because of the absence of nonverbal cues. This is typical for nonvideo discussions, such as Internet voice-only calls. In recent days, however, video teleconferencing procedures have been used more, and they address the weaknesses of voice-only conversations. Even when negotiations are settled on paper, as written negotiations, the actual values of strategic bidding, negotiations and justifications are limited, owing to the absence of human interaction. Therefore, a more blended negotiation system is encouraged, where one part can occur online, and the other may be arranged face to face. However, with the COVID-19 restrictions prevalent in most countries, these days may deter physical site negotiations, thereby affecting the agility of the entire supply and value chain, upwards and downstream (Braz et al. 2018; Chang et al. 2008; Madzimure et al. 2020; Presutti 2018).

Guided by the foregoing discussion, the study presents the following hypothesis:

> **H_4:** E-negotiations positively and significantly impact supply chain agility in a volatile business environment.

E-evaluation and supply chain agility in a volatile business environment

E-evaluation is gathering in-depth data about suppliers online in preparation for future assessments and online transactions (Chang et al. 2008). Presutti (2018) asserts that an organisation must assess and enhance its purchasing procedure to reap the full benefits of deploying e-procurement solutions. The final phase in the purchasing process is evaluating and rating e-suppliers, which calls for detailed and precise performance data (Madzimure et al. 2020). E-procurement systems offer data warehousing capabilities that record and retrieve data to carry out effective and efficient supplier performance assessments, in contrast to the conventional paper-based method (Wagner & Sweeney 2020). Whether in an offline or online procurement system, e-evaluation is a necessary component. Nonproductive suppliers are dropped from the online procurement system, or they are blacklisted, so they do not keep infiltrating the procurement process online. Effective evaluations and screening of poorly performing supply chain players are vital steps toward maintaining fast, adaptable and agile players, thereby promoting the creation of an agile supply network, even in harsh business environments (Zhu et al. 2018).

An in-house e-evaluation system builds the entire agility of the entire supply chain. This follows the recommendation of Faheem and Siddiqui (2020), who found out that a supply network is built by individual companies that act as nodes. Thus, the connection of these nodes develops a supply chain (Buttle 2015). Hence, if a supply chain is made up of adaptable and agile players who e-evaluate their suppliers, it leads to solid and agile supply chains which can respond to environmental challenges and volatility in a more adaptable, flexible and faster manner.

In light of the foregoing discussion, the following hypothesis is presented:

> **H_5:** E-evaluation positively and significantly affects supply chain agility in a volatile business environment.

Methodology

The positivist research philosophy drove the study. The research questionnaire was developed so that the data collected could be quantified in line with the quantification requirement of the positivism philosophy. To that end, close-ended questions were used to enhance objectivity and the quantification process, as required by the philosophy adopted.

Population and sampling

The target population for the study was comprised of supply chain and procurement employees of the telecommunications and technology industry in Zimbabwe, comprising 219 such employees. The targeting of the telecommunications and technology industry was justified because the industry has been adversely affected by environmental volatility and supply chain distortions that warrant an agile and adaptive supply chain. Core supply chain investments, such as base station technology and adoption of next-generation network technology, which shift from 2G to 4G, and from 4G to 5G, operate in a highly volatile supply environment. Only supply chain employees were considered as the target group because they were the ones who dealt directly with supply chain and e-procurement aspects. Information from these employees would be more credible than from any other source. Therefore, their selection was justifiable to enhance the credibility of the results and minimise bias and research errors that could emanate from collecting data from the wrong group. The study used the census approach to collect data from the target population, given that the target population was not huge. According to Saunders, Lewis and Thornhill (2016), the census approach to data collection is where all cases of the target population are considered. All 219 respondents were therefore sampled for this study.

Data collection instrument

The research objectives and the conceptual framework governed the development of the questionnaire. The questions were crafted to clearly address the study's independent variables as follows: e-design (ED 1 to ED 5), e-sourcing (ES 1 to ES 5), e-negotiation (EN 1 to EN 4) and e-evaluation (EE 1 to EE 5). The measurement scales for the independent variables were adapted from Chang et al. (2008).

The dependent variable, supply chain agility, was well covered with five items (SCA 1 to SCA 5). The supply chain agility measurement scale was adapted from Macclever, Annan and Boahen (2017).

Results

Sample characteristics

The sample statistics recorded gender, age and qualifications as presented in Table 1.

The survey attracted 219 responses, which were adequate for structural equation modelling (SEM) (Hair, Gabriel & Patel 2014). There were rejections of questionnaires. Male respondents made up 41% of all replies, while female respondents made up 59%. This demonstrates the gender gap in the workforce in the supply chain and procurement of the telecommunications and technology industry in Zimbabwe. Such statistics support the increased number of women preferring 'soft' professions that do not require stamina (Chisholm-Burns et al. 2017). Responses were obtained from different age groups. The modal age group was 26 to 35 years (41%). This means that young adults were mainly the ones in the procurement departments of the telecommunications and technology industry in Zimbabwe. All study respondents had a minimum of a first degree, with a majority frequency of 54%. A significant number of respondents had master's degree qualifications, with a good frequency percentage of 44%. Only 2% of all respondents had a post-master's graduation qualification. All respondents had procured goods or services using e-procurement services before. In addition, all respondents confirmed that they work in procurement departments and had knowledge about their companies' supply chains. Essentially, the majority of respondents had 5 to 8 years of experience (n = 47%). A considerable number of respondents also had e-procurement experience of 9 to 12 years (frequency 32%). Few respondents had experience above 12 and below 4 years. These results provide supporting statistics that the respondents had good experience with e-procurement. The majority of respondents used computers for e-procurement purposes (56%), followed by smartphones (28%), tablets (15%) and phablets (1%). Although the instrument had a category for non-smartphones, no takers were recorded. Therefore, the study concludes that computers were mainly used by supply chain professionals in Zimbabwe.

Measurement model fit

Data for the study were analysed using a two-step data analysis procedure in line with the recommendation of Hair et al. (2010). A two-step procedure for data analysis involves subjecting data to confirmatory factor analysis and SEM (Byrne 2013).

The confirmatory factor analysis (CFA) results indicated a good model fit: minimum discrepancy divided by degree of freedom (CMIN/DF) = 1.84, goodness-of-fit index (GFI) = 0.941, adjusted goodness-of-fit index (AGFI) = 0.923, comparative fit index (CFI) = 0.952, root mean square error of approximation (RMSEA) = 0.052. The model fit statistics were within acceptable ranges stipulated by Hair et al. (2014) and Byrne (2013), which validated the study's measurement model.

Unidimensionality

Using the results in Figure 2, unidimensionality was inspected using the standardised factor loadings. A threshold of 0.5 was applied, which was informed by Hair et al. (2010). A closer examination of the results shows that all factor loadings were above 0.50. The least loading was 0.672, while the highest loading was 0.915.

Convergent validity

The study further examined the average variances explained (AVEs) for convergent validity. Hair et al. (2010) suggest that AVE represents the variance shared by the indicators on the

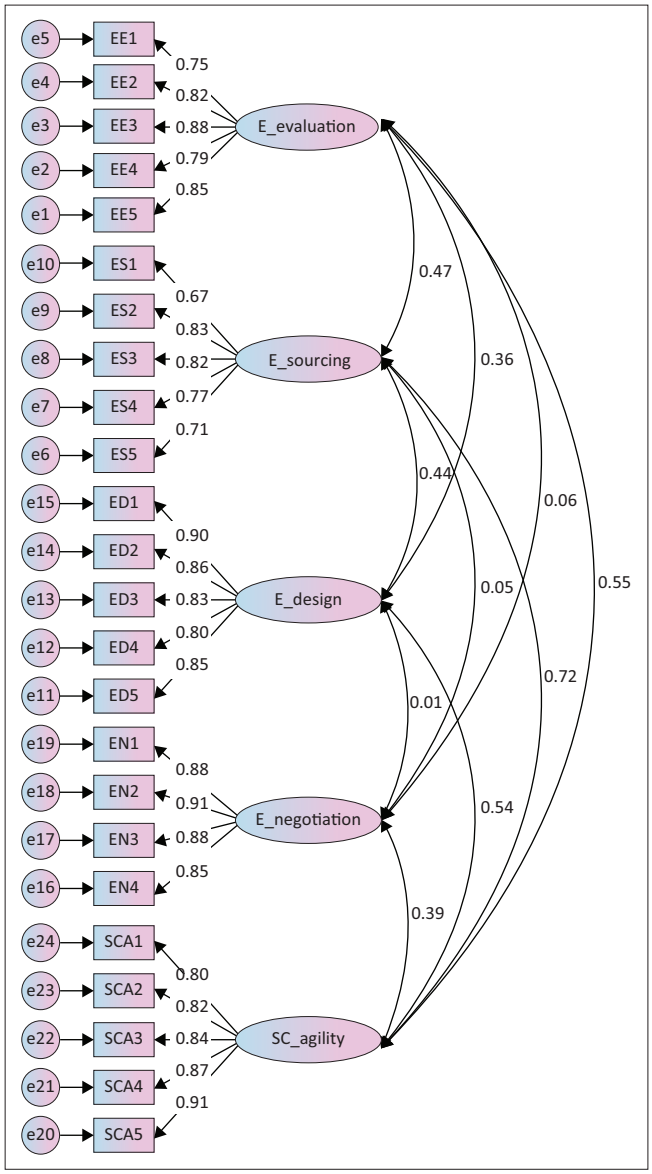


FIGURE 2: The measurement model.

TABLE 1: Demographic profile of the respondents.

Variable	Category	*N*	Percentage (%)
Gender	Male	90	41
	Female	129	59
Age (years)	18–25	7	3
	26–35	90	41
	36–45	70	32
	46–55	52	24
	Above 55	0	0
Qualifications	Undergraduate degree	118	54
	Master's degree	96	44
	Post-master's qualification	5	2
E-procurement experience	Below 1 year	2	1
	1–4 years	18	8
	5–8 years	103	47
	9–12 years	69	32
	Above 12 years	27	12
E-procurement gadgets	Smartphone	62	28
	Phablets	2	1
	Tablet	32	15
	Computer	123	56
	Non-smartphone	0	0

TABLE 2: Discriminant validity.

Factor	E-evaluation	E-sourcing	E-design	E-negotiation	SC agility
E-evaluation	**0.818**	-	-	-	-
E-sourcing	0.474	**0.763**	-	-	-
E-design	0.356	0.443	**0.847**	-	-
E-negotiation	0.059	0.049	0.007	**0.879**	-
SC agility	0.547	0.719	0.541	0.390	**0.850**

SC, supply chain.

latent variable. The acceptable cut-off threshold for the AVE is 0.5 (Hair et al. 2010).

All AVE coefficients for the measurement model were higher than 0.5, with e-sourcing recording the least AVE of 0.582, while the highest AVE was recorded for e-negotiation (0.774). Therefore, all items of the measurement model had the least share of 58% of the total variance of the latent variables.

Discriminant validity

According to Hair et al. (2014), discriminant validity is guaranteed if the shared variance between a pair of constructs is greater than their average variance extracted. Results for discriminant validity are shown in Table 2.

Results in Table 2 demonstrate evidence for discriminant validity. An examination of the results in Table 2 shows that all shared variance is more significant than the individual AVE. Thus, the study concludes that each latent variable was distinct and measured its unique aspects.

Reliability

In addition, Table 3 shows the Cronbach's alpha (CA) and construct reliability (CR) results. These two tests are used to measure the reliability and internal consistency of the

TABLE 3: Measurement model statistical output.

Factor	Item	SFL	CA (α)	CR	AVE
E-evaluation	EE1	0.746	0.908	0.909	0.669
	EE2	0.817	-	-	-
	EE3	0.883	-	-	-
	EE4	0.79	-	-	-
	EE5	0.846	-	-	-
E-sourcing	ES1	0.672	0.872	0.874	0.582
	ES2	0.833	-	-	-
	ES3	0.815	-	-	-
	ES4	0.771	-	-	-
	ES5	0.713	-	-	-
E-design	ED1	0.902	0.926	0.927	0.717
	ED2	0.857	-	-	-
	ED3	0.826	-	-	-
	ED4	0.8	-	-	-
	ED5	0.846	-	-	-
E-negotiation	EN1	0.875	0.932	0.931	0.774
	EN2	0.915	-	-	-
	EN3	0.878	-	-	-
	EN4	0.849	-	-	-
Supply chain agility	SCA1	0.801	0.925	0.929	0.723
	SCA2	0.822	-	-	-
	SCA3	0.84	-	-	-
	SCA4	0.875	-	-	-
	SCA5	0.909	-	-	-

SFL, standardised factor loading; AVE, average variance explained; CR, construct reliability.

measurement model. In conclusive studies, a cut-off of 0.7 is expected for composite reliability and CA tests. Table 3 shows that all items recorded higher CA and composite reliability scores, which were all above 0.7, with the least being 0.87.

Hypotheses testing

The cause-and-effect associations between e-procurement and its determinants on supply chain agility in a volatile business environment were tested in this study using the structural model. The results are shown in Figure 3 and summarised in Table 4. However, before the tests, Hair et al. (2010) recommend that data pass normality and multicollinearity assumptions. Multicollinearity was diagnosed using the variance inflation factor (VIF) and tolerance tests. The study variables' tolerance values were higher than the minimum threshold of 0.2 (Laed 2017).

Conversely, using the VIF test, all variables recorded values below the acceptable cut-off of 5.0 (Laed 2017). Thus, the study passed the multicollinearity assumption and concluded that data were not too correlated. In addition, the normality assumption was passed, as data were subjected to the univariate normality test using the skewness and kurtosis values. All values were within

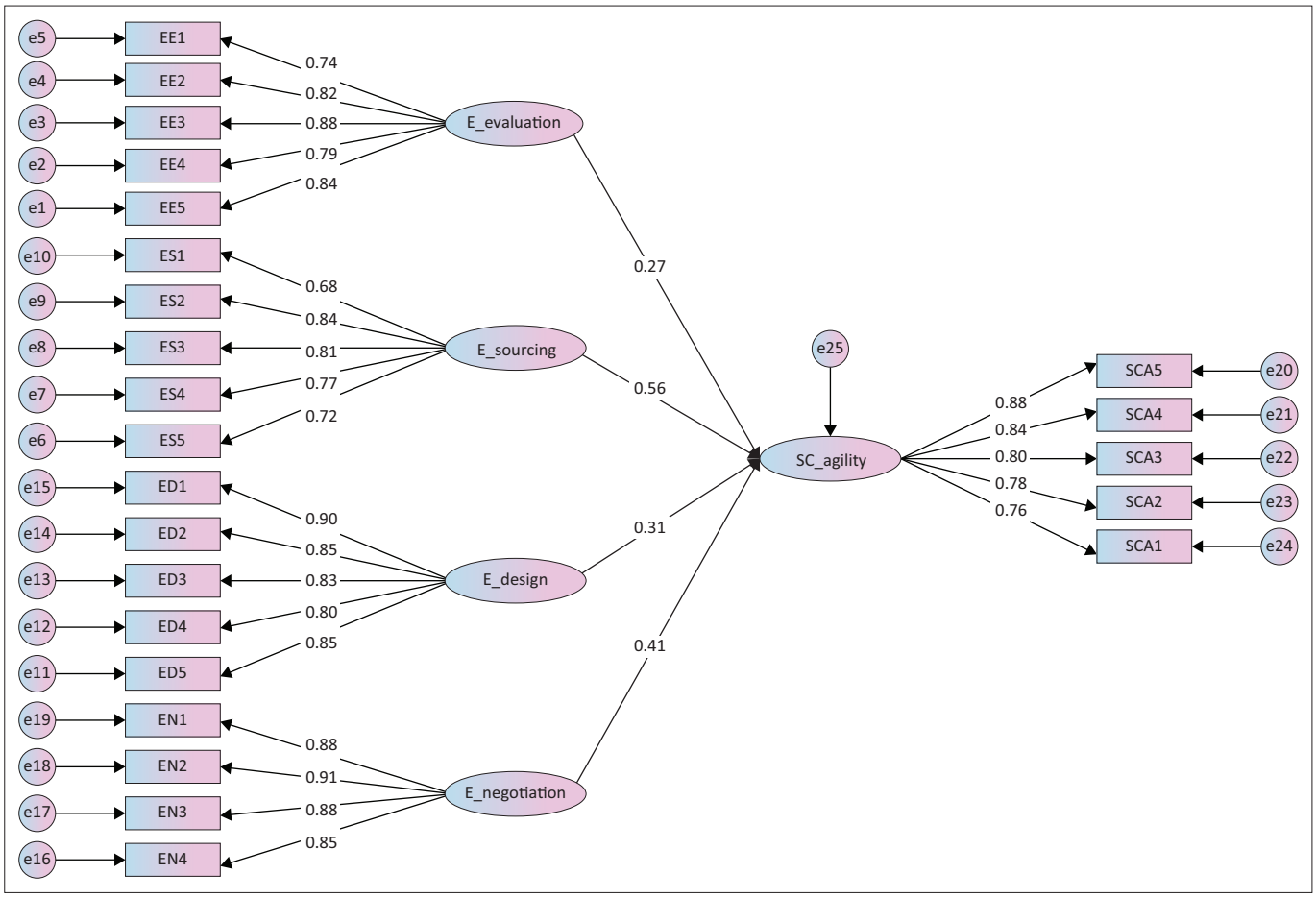


FIGURE 3: The structural model.

TABLE 4: Hypotheses testing summary.

Causal path			Estimate	SE	*T*	*P*	Label
Supply chain agility	←	E-evaluation	0.269	0.027	7.007	***	Accepted
Supply chain agility	←	E-sourcing	0.563	0.027	11.602	***	Accepted
Supply chain agility	←	E-design	0.313	0.021	8.115	***	Accepted
Supply chain agility	←	E-negotiation	0.409	0.018	10.282	***	Accepted
Supply chain agility	←	E-procurement	0.651	0.0.19	13.856	***	Accepted

***, p = significant at $p < 0.001$.
SE, standard error.

acceptable ranges of −2 to +2 for skewness and kurtosis (Kline 2005).

The model fit statistics assessed for the structural model in Figure 3 were all within the acceptable region: CMIN/DF = 2.86, CFI = 0.926, GFI = 0.911 and RMSEA = 0.063. The coefficient of determination of 0.65 means that e-procurement's model variables explained 65% of the aspects that affect supply chain agility. Consequently, Table 4 presents the results of the hypotheses.

Structural equation modelling analysis revealed that supply chain agility is significantly predicted by e-valuation ($\beta = 0.269$, $T = 7.007$, $p < 0.001$); e-sourcing ($\beta = 0.563$, $T = 11.602$, $p < 0.001$); e-design, ($\beta = 0.313$, $T = 8.115$, $p < 0.001$); e-negotiations ($\beta = 0.409$, $T = 10.282$, $p < 0.001$); and e-procurement ($\beta = 0.651$, $T = 13.856$, $p < 0.001$).

Discussion

The study predicted that e-procurement positively affects supply chain agility in a volatile business environment. That proposition (H_1) was accepted in this study ($\beta = 0.651$; $P = 0.00$). The study thus concludes that e-procurement has a strong positive impact on supply chain agility. The interpretation of the results is that e-procurement determines the level of agility of the supply chain. Section 4.1 shows that the business environment is highly volatile, and therefore to augment the swiftness and flexibility of supply chains, there is an impending need to use e-procurement. The results affirmed past findings in literature, as other scholars confirmed a positive statistical effect between e-procurement and supply chain agility in a volatile business environment (Ahmed et al. 2019; Benzidia & Makaoui 2020). Yang et al. (2021) found that traditional procurement strategies that used to be effective, such as

formal tendering systems and procurement committee meetings, have been deemed redundant because of the COVID-19-induced volatility, hence the need for e-procurement systems to improve swiftness. Conversely, Braz et al. (2018) found that an agile supply chain, driven through e-procurement, is instrumental in managing the volatility that causes the bullwhip effect.

The study's second hypothesis (H2) posits that e-design positively and significantly affects supply chain agility in a volatile business environment. Using the results in Table 4, the proposition that e-design affects supply chain agility (H_2) was accepted ($\beta = 0.313$, $P = 0.00$, $r = 0.541$). Thus, when e-procurement is implemented through e-design systems, supply chain agility is further enhanced. E-design systems may gather information at the procurement request stage, formulate order creation digitally, receive internal purchase requests and design the purchase requirement. According to Madzimure et al. (2020), effective implementation of e-design systems increases supply chains' prospects of integrating and working with their suppliers, which might reduce supply chain costs and improve supply chain performance. When e-design introduces a high degree of supplier–buyer dependency, integration and collaboration, the agility of the entire supply network is improved while the entire network's performance is enhanced, even in a volatile business environment (Irfan et al. 2019).

The third hypothesis (H_3) suggests that e-sourcing positively affects supply chain agility in a volatile business environment. Table 4 shows that e-sourcing significantly impacts supply chain agility in a volatile business environment ($\beta = 0.563$, $P = 0.00$, $r = 0.719$, $P = 0.00$). This therefore follows that if e-sourcing systems are improved, environmental volatility is managed through supply chain agility. Actually, of all the determinants of e-procurement, e-sourcing has the greatest impact on supply chain agility. Tripathi and Gupta (2020) found related results. They found that e-sourcing is a direct determinant of supply chain agility regardless of the volatility of the environment because of the ability of e-sourcing to gather demand proposals and other relevant information through the system. The same result was found by other researchers, too (Valashiya 2019; Yang et al. 2021).

The fourth hypothesis (H_4) predicted that e-negotiations positively and significantly impact supply chain agility in a volatile business environment ($\beta = 0.409$, $P = 0.00$, $r = 0.390$). The fourth hypothesis was thus accepted. The results mean that negotiating with suppliers on electronic platforms effectively ensures supply chain agility in a volatile business environment. Prior studies made the same conclusion. Persis et al. (2021) found that supply chain agility and flexibility are greatly improved through e-negotiations. E-negotiations also aid supply chain agility in international procurement (Chang et al. 2008). Chen (2019) also found that an agile supply chain minimises time and effort in all stages of the procurement process.

The fifth hypothesis (H_5) indicated that e-evaluation has a positive and significant effect on supply chain agility in a volatile business environment ($\beta = 0.269$, $P = 0.00$, $r = 0.547$). The study found a weak-to-moderately strong positive and significant impact of e-evaluations on supply chain agility ($\beta = 0.313$, $P = 0.00$). Accepting the alternate hypothesis means that supply chain evaluations are critical in augmenting the flexibility and adaptability of supply chains in turbulent business environments. E-evaluations effectively eliminate all supply chain bottlenecks, thereby promoting an adaptable supply network (Rowland 2022). Wagner and Sweeney (2020) also found that through e-evaluations, nonproductive suppliers are dropped from the online procurement system, or they are blacklisted so that they do not keep infiltrating the procurement process online. That promotes efficiency and agility of the supply chain. In addition, Faheem and Siddiqui (2020) found that using an in-house e-evaluation system builds the entire supply chain's agility because a supply network is built by individual companies that act as nodes.

Managerial implications

The study results inform procurement strategies for the telecommunications and technology industry. Amid the COVID-19 pandemic, which has negatively impacted business (Pathak 2022) and other environmental volatility drivers, there is a need to implement e-procurement strategies. In implementing e-procurement systems, the study recommends considering the four elements of e-procurement analysed in this study. The swift adoption of e-procurement through e-design, e-sourcing, e-negotiations and e-evaluations comes after.

By doing this, a business ensures that it will support the supplier network's overall agility, flexibility, adaptability and ultimate resilience (Mukucha & Chari 2022). The study also has implications for all supply network members from upstream to downstream. There is an impending need for all supply network members to adopt e-procurement as a way of life. That will help revive supply networks amid environmental volatility and alleviate miscommunication (Pathak & Ahmad 2016, 2018). Supply network agility can only be achieved when all parties to a supply network are agile. Hence, this study has offered reasons to unfreeze the status quo and drive supply network members towards agility and adaptability through electronic procurement adoption.

The study also offers theoretical implications for e-procurement and supply chain management. The study contributes to the body of knowledge by extending the existing theories on e-procurement and supply chains. In extending the existing theory, the study adopts and adapts Chang et al.'s (2008) e-procurement variables and links them with Van Hoek's (2001) supply chain agility scale. In so doing, Miller's (1986) configurations within a supply chain network are augmented, and the effect of environmental volatility is taken into consideration.

Limitations and future research

The study suffered a theoretical limitation. There has never been any testing of the model utilised in this work. The model was developed using a deductive and theory extension strategy. This offers limitations on the applicability of the model and its reliability. To counter such a limitation, the study used reliability statistics to validate the model's reliability.

The study focused only on four determinants of e-procurement. Future studies could focus on broadening the model to include other variables of e-procurement, such as e-tendering, e-marketplace, e-auction or reverse auction and e-catalogue. In addition, the study recommends that future studies retest the conceptual model used in this study in related environments to substantiate it and augment its reliability. There is a need to unravel the behavioural attributes of e-procurement personnel, taking a cultural perspective in terms of beliefs and values. Future studies could also consider procurement categories (see Aboelmaged 2010) and e-procurement in the context of direct and indirect sourcing. Public procurement regulations (Laikram & Pathak 2021) could also be studied in terms of how they can be enhanced through e-technologies.

Conclusion

In light of the above findings, the study concludes that e-procurement augments the agility of the supply chain in volatile business environments. This is because e-procurement can increase swiftness and agility as it fosters ubiquitous business processes on a seamless real-time basis. Of the determinants of e-procurement, the study validates and concludes that e-sourcing, e-negotiations, e-design and e-evaluation, in that order, significantly drive agility and flexibility of supply chain in volatile business environments. The Zimbabwean business environment was also validated to be volatile based on economic unrest, COVID-19 instabilities, competition, inflation, poor investor relations, technological volatility and political and social unrest.

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Authors' contributions

The authors equally contributed to the manuscript.

Ethical considerations

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Data availability

The data set for the study can be provided on request for academic purposes only. The request must be made in writing to the corresponding author specifying the purpose of the request.

Disclaimer

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