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Investigating the factors affecting e-procurement adoption in supply chain performance: An empirical study on Malaysia manufacturing industry

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A B S T R A C T

Global business is getting more and more cutthroat. Digital technology plays a significant role in giving companies a competitive advantage and improving the effectiveness of corporate processes. The Malaysian government has advanced by implementing e-government to use digital technologies to improve operations. In line with the objective of Malaysia's government, this study examines the impact of e-procurement adoption and e-procurement determinants on supply chain performance among Malaysian manufacturing companies. Using a quantitative research design with an online survey questionnaire, 99 responses from manufacturers listed in the Federation of Malaysian Manufacturers directory were obtained, representing 19.41% of the response rates. It fulfilled the minimum sample size of 92, and the data were examined using PLS-SEM. A total of 13 hypotheses are supported, accepted hypotheses one and two in which top management support and information communication technology infrastructure do not directly affect supply chain management. Besides, the findings prove this study's mediating effect on e-procurement adoption. It indicates that most Malaysian manufacturing companies have embraced e-procurement to support their supply chain operations.

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1. Introduction

As Malaysia is a developed country, the government must keep pace due to dynamic changes. To apply digital technology to improve government operations, the Malaysian government has advanced by introducing e-government as one of the Multimedia Super Corridor (MSC) Flagship Applications. E-procurement, or *e-Perolehan* in Malaysia, was one of the initiatives of e-Government. The government spent RM78 billion on procurement in 2016 (Priyashani & Gunarathne, 2021). Malaysia is a prime manufacturing location (Zhu, Sarkis, & Lai, 2012). The statistics division stated that Malaysia's manufacturing sector accounts for 24.9% of the country's economy (Zhu et al., 2012). Likewise, Malaysia Productivity Corporation announced that the manufacturing industry has the highest rate of productivity growth, with a productivity growth of 7.1 (Malaysia Productivity Corporation). This circumstance pressures Malaysia's manufacturing industry to improve its supply chain and production efficiency to compete internationally. However, competition in the manufacturing industry is fierce, driven by decreasing cycle time for technological innovation. Methods for manufacturing implementation and control

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have therefore changed. Thus, members in the supply chain have acquired significant responsibilities for a firm's competitive advantage.

E-procurement is used in many industries, such as hotel management, manufacturing, construction project, agriculture, and even small and medium enterprise (SMEs). Electronic procurement, or e-procurement, is part of the ICT movement that fundamentally changes how companies and individuals perform their everyday activities (Saeed, 2017). E-procurement technologies are developed to simplify workflows, integrate and optimize corporate purchasing power and find new sourcing opportunities through the Web (Saeed, 2017). Based on the definitions given by researchers, e-procurement is a generic term for an innovation that creates added value to the network communication system. It integrates all procurement activities to ensure the efficiency of supply chains in a business. Adopting e-procurement in a company is not easy, and it is challenging. Many companies still hesitate to adopt e-procurement due to several factors. The factors encompass start-up fees, doubt about the usefulness and security of the system, external factors from the market and government, lack of infrastructure, and weakness in government policies and legislation (Suryanto et al., 2018). These factors hinder companies from maximizing the potential values of an e-procurement system.

The Ministry of Finance kept records of about 30,000 government vendors in Malaysia. Since e-procurement was formed in 2002, they have not yet provided the infrastructure necessary to implement the system (Tan, Yeo, & Low, 2018). This scenario happens probably due to several factors discouraging some companies from implementing e-procurement. The difficulty businesses have in integrating the e-procurement system is one of the causes. Another barrier companies encounter is the compatibility of ICT infrastructure with the existing software in the market to implement e-procurement (Suryanto et al., 2018). That is because several of these sets of apps are not consistent with the internal technologies of the enterprise. Additionally, suppliers are hesitant to implement e-procurement due to their level of involvement with e-procurement technologies (Kamarulzaman & Mohamed, 2013). Determining which vendors to accept raises challenges, as Van Weele (2005) mentioned. The issue is whether they would be willing to engage in electronic communication and be able to adhere to and advance this electronic mode of procurement and purchase functions (Kamarulzaman et al., 2013). Furthermore, organizations failed to discuss how e-procurement can improve supply chain efficiency from supply chain management practices. However, many workshops and discussions were conducted throughout procurement to increase supply chain quality (Omai, 2013).

Fortunately, even though there are challenges to the e-procurement system, there are immense benefits to adopting e-procurement. According to Burki and Ersoy (2019), e-procurement will improve the transparency of government procurement as all transactions are registered, accounted for, and made available online. The nation's transformation to a capitalist economy is supported by the e-procurement platform, which offers more competitive and secure procurement processing (Mallikarathna & Silva, 2019). In line with the country's transition to a knowledge-based economy (K-economy), Nasrun, Nawi, Deraman, Bamgbade, and Zulhumadi (2017) also claimed that e-procurement technologies offer a more effective and efficient procurement process. E-procurement will minimize efforts in handling procurement job scopes such as monitoring purchase orders to vendors, keeping track of inventory and supplier performance, and avoiding risks such as duplicate purchase orders, invoices, and payment delays. Consequently, one strategy that will improve the efficiency of firms' supply chains is e-procurement. Therefore, the main goal of this analysis is to investigate the factors that led companies to embrace e-procurement and how these drivers would impact the efficiency of the supply chain.

As noticed, implementing e-procurement into businesses added value to the companies with many benefits. Companies' values also directly affect supply chain performance (Eketu, 2018). However, many companies already neglect these technologies and depend on conventional sourcing when purchasing indirect products (Husin & Hamzah, 2019). Several businesses may not clearly understand how e-procurement can generate value for the procurement process or what advantages and milestones may be gained from conventional procurement and transitioning to e-procurement (Mahdillou & Akbary, 2014). The influences on e-procurement adoption have been investigated in a number of earlier research. This research will determine which significant determinants affect e-procurement adoption and compare if some results were aligned. Studies by Suryanto et al. (2018) show that supply chain performance is closely correlated with e-procurement. As a result, this study investigates the relationship between supply chain performance and e-procurement determinants and adoption.

2. Literature Review

The term "procurement" refers to a series of actions that may include hiring, leasing, buying, tenancy, licensing, franchising, or any other kind of contractual employment, as well as the acquisition of assets and the provision of services or the purchase of goods (Yusof, 2020). Conventional procurement was conducted by administering requests for procurement to the purchasing department via phone or paper form. Administrative tasks like creating the request for proposals (RFP) or quotations (RFQ), managing the submitted proposal or quotation, inviting potential candidates, and carrying out the bidding process were thought to be less strategic and cost-oriented in the short term, so less effort was made to address more strategic procurement issues (Trade Statistics Unit, 2020). According to the Ministry of Finance Malaysia (2020), those manual processes were time-consuming and costly. A procurement order needed to pass step by step through employees from the administration workers (A. Alzoubi, 2021). They completed the purchase order, gave it to the purchasing manager for

evaluation and signature, and then gave it to the accounting team in charge of budget acceptance. Eventually, a postal employee will fax or send the purchase order.

The Technology Acceptance Model (TAM), which typically looks at the user's reason for adopting e-procurement, was utilized in most studies on e-procurement adoption in Malaysia (A. Al Ali, 2021). One of the research papers was conducted by Kamarulzaman, Mukherjee, and Zainal (2013) on e-procurement adoption in the agricultural industry. The research used extended TAM where the dependent variable is behavior intention to use e-procurement. The research's hypotheses were supported in that all relationships were correlated positively. Users' attitudes toward e-procurement may be influenced by perceived ease of use and perceived usefulness, and both notions are essential predictors of users' intentions toward e-procurement systems (Diab et al., 2015; Lee & Ahmed, 2021). The analysis of this result was hypothesized and indicates that the company intends to adopt e-procurement because of its benefits, which ease the procurement process, minimize costs, decrease the buying cycle time, decrease purchasing price levels, and reduce inventories within agribusinesses (Zsidisin & Siferd, 2001). This study highlights the value of e-procurement adoption by outlining the advantages that e-procurement technology may bring to a business. E-procurement is one of the vital tools as it can respond fast to integrated supply chains nowadays.

Various studies showed that many companies adopted e-procurement because of its immense benefits of e-procurement. Perceived ease of use and perceived usefulness are essential factors that affect how often e-procurement is used. Nonetheless, this research will focus on other determinants aside from beliefs of the TAM model. According to Christopher (1998), the Technology-Organization-Environment (TOE) paradigm recognizes three contextual determinants, including technological, organizational, and environmental determinants, which may affect the e-procurement decision of management about innovation (Aziz & Aftab, 2021). As a result, four determinants will be used by the TOE framework, where supplier selection and SCM practices are the environmental factors, top management support is the organizational component, and ICT infrastructure is the technological element. Since more research in Malaysia utilizes the TAM model to evaluate the features of e-procurement adoption, this study seeks to fill the gap by examining the determinants of e-procurement adoption by applying the TOE framework.

Compared to the internal emphasis of traditional logistical techniques, supply chain management focuses more on managing upstream and downstream contacts and the function of supply chain integration to maximize customer satisfaction at a lower cost (Puschmann & Alt, 2005). According to Eakin (2003), extreme benefits that are explicitly evaluated to boost shareholder value may be the key and fundamental indicators used to calculate the benefits of e-procurement. Demand reduction and production cost reduction are both positive effects (Radwan & Farouk, 2021). Instead, the more subdued advantages, which are typically indirect, start to show up. Although it continues to be challenging to measure the soft benefits, such as the amount of time saved by productive operations for each individual, these advantages may also accurately reflect improvement (Mahdillou & Akbary, 2014).

Quick and inexpensive supply chains were critical for business growth (Kopecka et al., 2004). Therefore, a company must have a flexible supply chain to adapt or respond quickly to variations in demand. When supply networks are flexible, they are more likely to adjust to strategic and systemic changes in the supply chain environment and short-term changes in demand or supply caused by other external disruptions (Geng et al., 2017). Flexibility performance is the capacity of a business strategy to successfully manage or respond to variations in time, expense, pricing, or output with minimum cost (Laari, 2016). Zhu, Sarkis, and Lai (2013) explained that in a supply chain, where materials move sequentially from one trade partner to the next (Cruz, 2021). It is emphasized that businesses recognize that all chain participants must adapt quickly.

Supply chain management aims to enhance the efficiency of the particular firm and the supply chain as a whole (Sukati et al., 2019). Supply chain performance refers to evaluating supply chain management and involves substantial costs and insubstantial capacity usage factors (Presutti Jr, 2003). Organizations need to learn more than warehouse locations, arrival schedules, and fill speeds to aggressively control the performance of supply chains (Oteki, 2018). Supply chain performance often benefits from the efficiency of businesses. Improved output cost savings and shorter lead times can be achieved through increased efficiency, including but not limited to stock distribution, manufacturing speed, order processing lead time, supply chain sensitivity, sourcing flexibility, inventory costs, and better pricing. (Presutti Jr, 2003). The dependent variable in this study is supply chain performance, which is measured by supply chain costs and flexibility. Fig. 1 shows the framework of the proposed study.

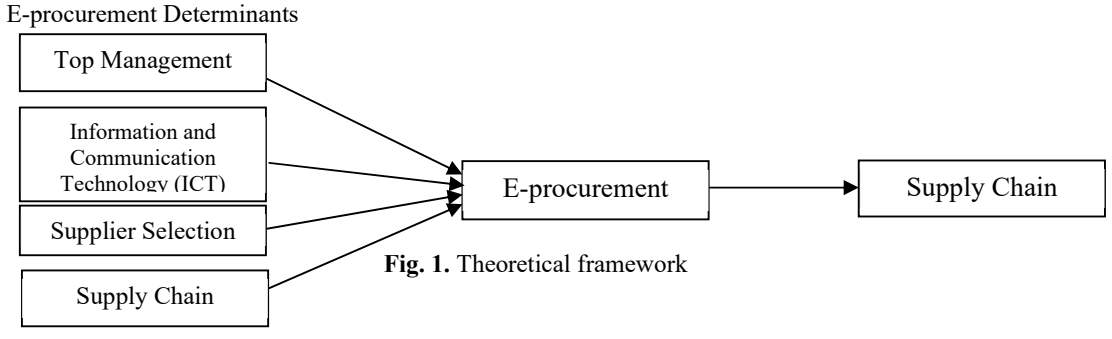

Fig. 1. Theoretical framework

2.1 Hypotheses development

Considering the supply chain systems' management and organizational capabilities is essential. The goal is divided into two primary components that each require a more in-depth explanation: "the responsibility of top management" and "supply chain performance" (Mohd Zureehan & Lee, 2022). Cigolini and Perona (2004) state that managers' function affects the supply chain's efficiency. Based on the strategic advancement of the supply chain management philosophy, as empirical knowledge from external studies accumulates, as the scope of competitive business innovation grows, it ultimately has an impact on the competitiveness of firms and their successful strategic goal in their sector (Akdogan & Demirtas, 2014). They mentioned that supply chains might have such managerial levels according to the different institutional, managerial qualities (Kashif et al., 2021). This is because executives have several spheres of influence and exercise ownership over and control over other participants in the supply chain. This helps the phases of the supply chain change. Thus, with the prior literature study, the following hypothesis is developed in the present study.

H_1: *Top management support has a positive impact on supply chain performance*.

Information and Communication Technology (ICT) infrastructure is essential in e-procurement adoption for hardware and software. Hardware components are crucial as they are the electrical and mechanical components that are a platform for the software to operate the computer system. The improvement of infrastructure appears to be the result of today's revolution in information technology, which has high demand in today's modern world, thus bringing significant transformation in economic perspectives. Information technology in Malaysia has become more accessible due to the large-scale development of the fixed network. Müller (2019) presented a statistic that indicates the number of internet users in Malaysia from 2017 to 2023. The data shows that there were 25.3 million users in 2017, and this number is predicted to rise to 29.4 million by 2023. This increase in internet users has led the government to prioritize the development of ICT infrastructure. The government invested heavily in developing the Multimedia Super Corridor in 1996 to create greater accessibility for attracting domestic and foreign investment in the ICT sector (Ahmad et al., 2011).

ICT use aims to improve information quality and accessibility, give a single point of access to data, enable choices to be made using data acquired from all points along the supply chain, and promote collaboration between market participants all along the supply chain (Simchi-Levi et al., 2001). The performance of the supply chain will increase with increased ICT readiness, and vice versa for companies lacking these capabilities (Lee et al., 2015, 2022, 2014, 2016; Lee & Lim, 2019; Tannady & Andry, 2020). Wu, Yeniyurt, Kim, and Cavusgil (2006) concluded that ICT infrastructure and enough training for staff on ICT use and advancements would improve the supply chain's capabilities and favor businesses' performance. Based on the discussion, the following hypothesis is proposed.

H_2: *ICT infrastructure has a positive impact on supply chain performance.*

Procurement has several key responsibilities, according to Albinkali (2021). These include identifying and evaluating new vendors, improving the sourcing portfolio to align with organizational goals, strengthening partnerships with key strategic partners, and selecting appropriate ICT tools to streamline procurement processes (Akhtar et al., 2021). When choosing vendors and partners, it is essential to consider factors such as their track record, production capacity, technical expertise, financial position, and reputation for dependability, integrity, and honesty. Other important factors include warranties, pricing, quality of goods and services, and delivery timelines. On top of that, e-procurement is intended to achieve quicker and more effective organizational procurement activities and allow certain people to focus on higher-value functions(K. L. Lee & Peing, 2019). E-procurement is becoming a practical instrument since there are excessive online retail purchases to help businesses with more manufacturers sell the same product to the client (Kar, 2014). The use of information-flow services has a significant positive effect on the creation of value-added services, whereas the use of cash-flow services does not appear to impact the value of e-procurement, in other words, it has no noticeable influence (Wu & Chien, 2016). To effectively reduce buying costs and eliminate the hassle of searching for supplies, customers should provide value-added tools to their upstream vendors on the e-procurement website. These tools may include inventory monitoring, sourcing awareness portals, and updates on procurement within the enterprise. By doing so, customers can attract a group of vendors and establish beneficial partnerships.

Tracey and Tan (2006) used confirmatory factor analysis and route analysis to investigate the relationships among supplier sourcing needs, suppliers' involvement in design teams and continuing development initiatives, customer loyalty, and overall business performance. Their findings indicate that selecting suppliers based on factors such as product performance, distribution efficiency, and quality has a significant positive impact on all four dimensions of customer loyalty, including competitive pricing, product quality, product range, and delivery service. Additionally, it positively impacts firm performance. From the literature review, a hypothesis has been developed.

H_3: *Supplier selection has a positive impact on supply chain performance.*

The supply chain encompasses all the processes involved in creating and selling goods or services. To enhance the quality of the supply chain, a variety of actions are taken as part of supply chain management (SCM) techniques. These techniques cover

six dimensions of SCM practices, which include supply chain alignment, information exchange, customer service, physical proximity, just-in-time interaction capability in long-term collaboration, support function, and supplier involvement. (Chen & Paulraj, 2004). This study used partner connections, information exchange, and supply chain integration as the criterion for SCM practices (Chang et al., 2013; Chirchir et al., 2015; Omai, 2013). According to Lambert (1996), there are three types of partnerships. Type one is the organizations concerned consider each other partners and minimally coordinate activities and preparation. Typically, the relationship operates in the short term and includes only one division or functional region of each company (Eli, 2021). Type two refers to the organizations involved in progress beyond coordinating activities for activity integration. There is a long-term horizon in it. The partnership involves multiple divisions and functions within the company. While type three refers to organizations with a wide degree of organizational convergence. A growing group treats the other as an extension of its own business. Usually, there is no 'end date' for the collaborations.

The sharing of information in supply chain management involves exchanging information in a timely and transparent manner with integrity and accessibility. Simatupang and Sridharan (2002) describe information exchange as the exchange of confidential information between business partners, which enables them to track the production of goods and orders as they move through different stages of the supply chain. They discussed a variety of information-sharing components, such as data collection, preparation, storage, distribution, recovery, and dissemination of demand and forecast information, stock levels and positions, order tracking, web, intranet, and extranet output status based on features like networking, user, and description (Alsharari, 2021). Yu and Cheng (2001) mentioned that sharing information with companies' partners can eliminate the supply chain's bullwhip effect. Li et al. (2005), cited from another research paper, stated that while exchanging information is significant, which information is exchanged, at what time and what tools it is used to exchange, and to whom will be affected by SCM. Sharing information can establish continuity across the supply chain but requires timely and reliable data.

The terms arrangement and integration pertain to the organization and integration of supply chain operations within companies and their clients, including suppliers, distributors, and other related partners. The significance of the supply chain structure is linked to its level of integration, which involves combining internal and external integration (Chirchir et al., 2015). Internal integration has structured and streamlined logistics, production, engineering, and distribution to achieve customer loyalty and satisfaction (Zhang, Anosike, & Lim, 2006). External integration has two directions: backward synchronization of IT and data transmission from customers to producers to vendors and forward synchronization for the actual movement of supplies between vendors, producers, and customers Trkman and Groznik (2006) highlighted that supply chain integration reduces the cost of controlling economic exchanges and transactions between partners and prevents opportunistic behavior resulting from the interests of others. Based on the above discussion, the following hypothesis is developed.

H_4: *SCM practices have a positive impact on supply chain performance.*

Organizational changes or reforms must be undertaken with complete cooperation from top management. Top management must pledge their commitment to implement e-procurement, as the successful introduction of any technology needs support and cooperation from top-level executives. Top management support and collaboration will ensure progress moves smoothly; participation from them is critical to successful e-procurement solutions (Zhu et al., 2008). Top management support or involvement seemingly is an essential factor for a project to be successful (Young & Jordan, 2008); in this case, the project is e-procurement adoption (Mehmood, 2021). Further research into the roles played by top management in selecting how to use e-procurement is advised by Daoud and Ibrahim (2017). According to them, top management support determines whether to accept or reject e-procurement. Undoubtedly, top management support is highlighted key determinant because they could create a supportive environment and provide sufficient resources to adopt e-procurement.

In a study by Yu-hui (2008) factor analysis was employed to investigate the factors that impact the adoption of e-procurement. The outcomes indicated that the top management recognizes the benefits of e-procurement (with a factor loading of 0.854) and strongly influences top management support. This implies that top management's support is linked to the implementation of e-procurement. Priyashani and Gunarathne (2018) contend that senior management's commitment to innovation and goal-setting is essential for securing the support and resources needed to carry out the innovation. For a long time, the literature on implementing information systems has claimed that top management support is required to adopt new information systems successfully. Thus, with the prior literature study, the following hypothesis is developed in this study.

H_5: *Top management support has a positive relationship with e-procurement adoption.*

Research by Ronald and Omwenga (2015) on factors contributing to adopting e-procurement also found that the availability of ICT infrastructure is a factor in adoption. B2B auctions, e-procurement software, B2B market exchanges, and buying consortiums are necessary to implement ICT infrastructure in e-procurement. These tools are used to automate workflows, integrate and optimize corporate purchasing capacity, and identify potential markets for electronic procurement. (Jermsittiparsert et al., 2019). Research conducted by Kahiu (2014) showed that ICT infrastructure for adopting e-procurement was further revealed to be a significant determinant of the successful adoption of e-procurement. A study by Oteki (2018) further demonstrated the impact of e-procurement on supply chain performance in Kenya. It suggests using IT infrastructure capable of connecting with suppliers and partners, system usage capable of recording sensitive and transmitting point-of-sale

data, the use of EDI in the exchange of business information, ensuring that suppliers have access to their customers' inventory data, and introducing systems that are speeding up the cycle time for new products to enter the market. Enhancing ICT infrastructure for e-procurement will benefit the company by lowering transaction costs, improving the knowledge flow, and making markets more competitive and productive (Jermsittiparsert et al., 2019; Amemba et al., 2013). Based on the above discussion, the following hypothesis is developed.

H_6: *ICT infrastructure has a positive relationship with e-procurement adoption*.

According to McKinnon (2010), there are seven main factors that organizations use to decide which suppliers to source from abroad: finances, quality, perceived risks, service performance, partnerships, hurdles to communication and culture, and trade restrictions. Bottani and Rizzi (2005) research on supplier selection identified management efficiency, manufacturing capability and versatility, design and technical efficiency, financial stability, skill attributions, location, and electronic transaction as essential factors affecting businesses' selection of suppliers. E-procurement has undoubtedly made it possible for companies to have direct ties to suppliers, thus minimizing paperwork, eliminating overheads associated with buying processes, and shortening the purchase period (Atmadja et al., 2018). Additionally, e-procurement combines many supplier catalogs into a single view of a purchaser-managed catalog (Hirawaty, 2013). Reducing the number of suppliers, restructuring contracts and suppliers, and involving preferred and strategic suppliers in e-procurement planning were highlighted as success factors by Pandian and Kader (2017). The practical implementation of the e-procurement process will largely depend on the ability to narrow down the pool of potential suppliers who applied for a tender to those who would be more suited after the prequalification stage. Thus, with the prior literature study, the following hypothesis is developed.

H_7: *Supplier selection has a positive relationship with e-procurement adoption.*

Yeoh, Idrus, and Ong (2017) found that e-procurement adoption has a strong interaction with supply chain integration, partner relationships, and information exchange. The researchers used the Pearson product-moment correlation coefficient to investigate the impact of e-procurement adoption on supply chain management activities of tea companies. The results showed that implementing e-procurement has improved supply chain integration, information exchange, and partner relationships (Miller, 2021; Pandiyan et al., 2018). According to Chirchir et al. (2015), e-procurement helps tea enterprises communicate their anticipated product demand to suppliers, leading to improved supply chain efficiency, stronger partner relationships, and better information exchange. The authors propose three intermediate variables, namely partner relationships, knowledge exchange, and supply chain integration, as predictors of the impact of e-procurement on supply chain performance (Fauzi et al., 2010; Flynn et al., 2010). Thus, with the prior literature study, the following hypothesis is developed.

H_8: *SCM practices have a positive relationship with e-procurement adoption*.

Electronic procurement (e-procurement) as an application for information management is a valuable method for managers to save resources and increase the performance and productivity of companies (Lee & Shaharud-din, 2022). Fauzi et al. (2010) state transaction cost savings, decreased management costs, lowered labor costs, greater efficiency through increased demand, reduced time through better internal processes, and shorter average procurement cycle times are some of the advantages of the e-procurement process. Lenz (1980) suggested that e-procurement systems can aid in decreasing market cycle times, material and transaction costs, and stock levels. On the other hand, Chaffey (2004) asserted that the advantages of e-procurement encompass quicker payment processes, better information management, lower purchasing cycle times and expenses, enhanced budgetary control, removal of administrative mistakes, boosted buyer productivity, and reduced prices owing to the standardization of products and merging of purchases.

Costs are determined in this study by how adopting e-procurement can cut costs and save money. Johnson, Klassen, Leenders, and Awaysheh (2007) have demonstrated that financial performance has improved due to e-business technology designed to lower the cost of dyadic coordination. Presutti Jr (2003) said that transaction costs could be drastically reduced by up to 65 percent, while production expenses could be decreased by 5 to 20 percent. These cost reductions affect the bottom line directly and entirely, significantly increasing the operational profit component's economic worth. By limiting ad-hoc spending, defining the usage of approved suppliers, and giving improved power for contract negotiation services, e-procurement will lower the costs of materials and services for MRO items by about 5 to 10% (Donaldson & Preston, 1995). Fauzi et al. (2010) discovered that process automation and upgrades favorably affected cost savings by removing manual labor and preventing data re-entry into numerous backend systems. Automating the procurement procedure can decrease the average cost per purchase order (Ramakrishna & Alzoubi, 2022). Due to the openness of e-procurement, they could track prior expenditure trends and patterns and negotiate better prices for future contracts, resulting in cost savings.

The manufacturing industry is under pressure to adopt e-procurement in order to maintain a competitive edge and improve production quality by ensuring timely product delivery, quick response times, and prompt order confirmation. Flexibility is further subdivided into the speed of capabilities and how much a company's supply chain size, destination, and volume change (Chandrakar et al., 2015). According to Zhu et al., (2008), substantial aspects referred to cost and advantage, while insubstantial parts apprehended the element of spontaneous assessments of capacity usage and judgments of flexibility. SCM

systems are more likely to benefit high-tech companies undergoing rapid change and ongoing technological development, requiring flexibility and the ability to respond quickly to the actions of competitors (Priyashani & Gunarathne, 2018). Under certain circumstances, an e-procurement system's insufficient flexibility can prevent the system's use and make necessary exceptions, thus jeopardizing the expected benefits (Lee & Gebauer, 2006). Wu and Chien (2016) found that e-procurement value positively impacts flexibility performance. In a study conducted by Lee and Gebauer (2006), it was hypothesized that three business process factors, namely uncertainty, variability, and time sensitivity, influence IS consistency needs. The challenge of estimating the necessary resources and actions for carrying out a business process in a given situation is known as uncertainty. The variability of business processes impacts the actual and potential occurrences of a process. Time-criticality, on the other hand, relates to the level of urgency involved in completing a procurement task. Thus, with the prior literature study, the following hypothesis is developed.

H_9: *E-procurement adoption has a positive relationship with supply chain performance.*

Sandberg and Abrahamsson (2010) believe that top management support is crucial for the success of SCM practices within an organization. They strongly assume that senior managers have a significant impact on realizing and implementing SCM practices. Without effective top management support, SCM practices would be just an unfulfilled promise (Kurdi et al., 2022). Top management will evaluate strategies and projects at their expense and ability and then follow up on the results (Mohd Zureehan & Lee, 2022). To be actively involved, they must direct operating management and be accountable for the results achieved (Young & Jordan, 2008). There has been limited study on the correlation between top management backing and supply chain performance. The majority of research concentrates on the influence of executive support in introducing a new system. As a result, the following hypotheses are based on the notion that top management support has a positive impact on the performance of the supply chain. Since top management is responsible for making choices, this study makes the following assumptions. Thus, with the prior literature study, the following hypothesis is developed.

H_{10}: *E-procurement adoption mediates the relationships between top management support and supply chain performance.*

Technology is an enabler in SCM to help supply chain participants develop relationships to improve the efficiency of supply chain processes (Yu et al., 2014). Tan et al. (2016) have established that an optimized supply chain network will significantly increase efficiency and customer loyalty by making electronic, real-time knowledge networks around the enterprise accessible and providing access to the entire supply chain. Fast and effective implementation of e-procurement was a significant determinant of ICT infrastructure. Hence strong relations with suppliers and stakeholders in customer information systems contribute to successful implementation of e-procurement. ICT infrastructure for adoption of e-procurement may incurred higher costs but the benefits are indeed excellent for firm’s supply chain integration. ICT resources are essential to help increase productivity and effectiveness in e-procurement adoption (Ma, 2018). Thus, with the prior literature study, the following hypothesis is developed in this present study.

H_{11}: *E-procurement adoption mediates the relationships between ICT infrastructure and supply chain performance.*

Min and Galle (2003) define e-procurement as a process in which electronic commerce is used for business-to-business (B2B) transactions, such as identifying potential suppliers, communicating with them, and making payments. The adoption of e-procurement can lead to significant cost reductions through automated negotiations, which can change the demand and operating costs of online transactions. In addition, collective sales of commodities may have a significant impact on reducing prices (Kurdi et al., 2023). Implementing e-procurement systems can also improve inventory control for both customers and suppliers. For suppliers, e-procurement allows them to base their predictions on real-time usage reports rather than order history. This helps them better control their replenishment processes by providing accurate information on what is required, when, where, and in what quantities (Shafique & Rahman, 2017). Thus, with the prior literature study, the following hypothesis is developed in this study.

H_{12}: *E-procurement adoption mediates the relationships between supplier selection and supply chain performance.*

Sharing information described here entails formal and informal information sharing with related associates. The shared data needs to be accurate, timely, adequate, credible, and critical in guaranteeing quality (Younis, Sundarakani, and Vel (2016). Kocmanová and Dočekalová (2011) suggested that, at the e-design level, buyers and sellers exchange knowledge in real time to create requirements that increase the value of product outcomes. The coordination helps reduce the design's complexity and prevents additional costs from being added to the specification (Alshurideh et al., 2023). Organizations can concurrently collaborate with various partners and consumers to minimize the time and expense of creating and launching new products. Via customer-supplier partnership experience, both parties found ways to reduce or eradicate unnecessary costs, boost efficiency and reliability, and maximize speed and flexibility. Saeed, Jun, Nubuor, Puwakpitiyage, and Priyankara (2018) supported that the convergence of the supply chain primarily affects product eminence and client service levels, stating that the increased alignment enhances both customer and distributor efficiency. Thus, with the prior literature study, the following hypothesis is developed in this present study.

H_{13}: *E-procurement adoption mediates the relationships between SCM practices and supply chain performance.*

3. Methodology

The methodological approach is quantitative research via survey instrument and was developed through Google Forms. The survey questionnaire has been constructed into five parts. In Sections A and B, the questions are regarding the demographic profile of respondents and company profiles. These questions are objective and related to personal information and the background of the sample. The following questions included: age, gender, and professional experience. While in Sections C, D, and E will ask questions about the respondent's level of agreement. Respondents will have to be picked from a five-point Likert scale. Some portions of the questions will concentrate on the analysis variable. Variables used in this study have three categories: independent variable, dependent variable, and mediating variable. Each variable needs instruments to measure all listed dimensions and gather data to analyze the data to satisfy the hypotheses. The Independent variable used in this research is IT capability which has four elements: top management support, ICT infrastructure, supplier selection, and SCM practices. The dependent variable is supply chain performance, which has two parts: financial and flexibility. The mediate component in this analysis is the e-procurement adoption.

This study will use G*Power Analysis to determine the required sample size, which is 92 respondents from the 1020 manufacturing companies in Malaysia listed in the Federation of Malaysian Manufacturers. The questionnaire will be distributed to one respondent per company. The collected data will be analyzed using Partial Least Square Structural Equation Modeling (PLS-SEM) for sections C and D, while Excel will be used to analyze data from sections A and B. The analysis will be performed using version 3 of Smart PLS, and the significance of the path coefficients will be tested using the bootstrapping approach. A one-tailed or two-tailed distribution was used to determine the significant degree of the t-value (F. Ali et al., 2016). The evaluation of the structural model will follow a five-step process: checking for collinearity issues, assessing the path coefficient, evaluating the R^2 level, examining the impact size F^2, and assessing the predictive significance Q^2, as suggested by Hair, Sarstedt, Hopkins, and Kuppelwieser (2014).

Verifying the hypothesis that $\beta > 0$ is at the significant point of 0.05 (i.e. 1-95 percent) as the calculation of the one-size p-value compared with the direction coefficient. Since $p \leq 0.05$ accepts the hypothesis. Otherwise, it would be denied. The t-ratio calculation should be used as a variant of this measure, as the t-ratio measured as β/σ is used instead as a p-value for comparing to a threshold such as 1.64 or 1.96. (Cohen, 1988). Researchers are attracted to the PLS-SEM approach because it enables them to estimate intricate models with numerous constructs, indicator variables, and structural paths without imposing distributional assumptions on the outcomes. SEM has been the primary computational method for analyzing models of latent variables for cause-effect relationships (Hair et al., 2014). According to Hair et al. (2014), many analytical researchers pay lip service to the distribution of the variables used in the study. Nevertheless, most scientific evidence from the business and social sciences is distinguished by non-normal data. More considerations include estimating complex models, performing a moderation analysis, and concentrating the research on prediction (Ali et al., 2016; Elkington, 1994).

4. Results

The targeted population to be sampled in this study is Malaysia's manufacturing companies. According to FMM Directory (2020), there are 3365 manufacturing companies listed under FMM as of 2020. The questionnaires were distributed to 510 manufacturing companies in Malaysia through email. The minimal sample size that was needed in this study was 92 only. The number of responses that had been received was 99 responses representing 19.41% of the response rate.

4.1 Descriptive Statistics

Table 1 provides the average values for each variable, which were obtained through descriptive analysis of the interval scale. The respondents used a 5-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree," with 1 to 5, respectively. Mean values are used in this study to assess the level of e-procurement determinants and supply chain performance, while standard deviation values describe the homogeneity of e-procurement across companies and supply chain performance. Top management support received the highest mean value of 4.051 with a standard deviation of 0.999, indicating that organizations with greater financial capacity, infrastructure, and organizational power are more likely to support ICT innovation and adoption (TMS2).

There are six key items for mediating variable, which is e-procurement adoption. These six key items are perceived usefulness (PRU), perceived ease of use (PEU), behavior intention (BEI), perceived trust (PET), attitude (ATT), and compatibility (COM). BEI1 has the highest mean value (mean = 0.869, standard deviation = 0.928) among the other item codes for e-procurement adoption. BE1 is where respondents found it very good to use e-procurement for business purchasing activities.

Table 1
Descriptive Statistics

Variables	Item code	Sample Size (N)	Mean	Standard Deviation
Top Management Support	TMS1	99	3.869	1.079
	TMS2	99	4.051	0.999
	TMS3	99	4.040	1.004
	TMS4	99	3.697	1.068
	TMS5	99	3.939	1.081
ICT Infrastructure	ICT1	99	3.788	1.037
	ICT2	99	3.636	1.068
	ICT3	99	3.626	1.031
	ICT4	99	3.535	1.104
	ICT5	99	4.010	1.040
Supplier Selection	SPS1	99	3.747	1.028
	SPS2	99	3.838	1.002
	SPS3	99	3.778	0.949
	SPS4	99	3.798	1.005
	SPS5	99	3.899	0.980
SCM Practices	INS1	99	3.798	0.964
	INS2	99	3.768	0.973
	INS3	99	3.737	1.040
	INS4	99	3.747	0.988
	INS5	99	3.758	0.944
	PAR1	99	3.687	0.906
	PAR2	99	3.788	0.868
	PAR3	99	3.687	0.895
	PAR4	99	3.778	0.871
	PAR5	99	3.980	0.841
	SCI1	99	3.737	0.848
	SCI2	99	3.566	1.027
	SCI3	99	3.717	0.899
	SCI4	99	3.636	0.937
	SCI5	99	3.586	0.910
Supply Chain Performance	CST1	99	3.606	0.941
	CST2	99	3.697	0.948
	CST3	99	3.677	0.973
	CST4	99	3.798	0.953
	CST5	99	3.758	0.877
	CST6	99	3.778	0.980
	FLE1	99	3.545	0.946
	FLE2	99	3.717	0.911
	FLE3	99	3.758	0.877
	FLE4	99	3.687	0.960
E-Procurement Adoption	PRU1	99	3.758	0.975
	PRU2	99	3.838	0.896
	PRU3	99	3.859	0.921
	PEU1	99	3.545	1.057
	PEU2	99	3.788	0.956
	PEU3	99	3.525	1.028
	BEI1	99	3.869	0.928
	BEI2	99	3.778	0.949
	BEI3	99	3.798	0.964
	PET1	99	3.717	0.899
	PET2	99	3.747	0.968
	PET3	99	3.768	0.930
	ATT1	99	3.798	0.995
	ATT2	99	3.828	0.995
	ATT3	99	3.828	0.985
	COM1	99	3.657	0.945
	COM2	99	3.657	0.976

Normality analysis is an evaluation to determine whether the data set is in the normal distribution or not (Hair et al., 2014). The threshold value for skewness varies from -2 to 2, while kurtosis varies from -7 to 7. Based on **Table 2**, The indicators of e-procurement determinants (i.e., top management support, ICT infrastructure, supplier selection, and supply chain management practices) have skewness values ranging from -1.31245 to -0.65263 and kurtosis values ranging from 0.38445 to 2.102. The skewness value for supply chain performance is -0.92596, while the kurtosis value is 1.4057. As all the skewness and kurtosis values are within the acceptable range, the data distribution in this study is considered normal. **Table 2** shows

that the value of multivariate kurtosis is 6.0368, indicating that there is not far from the normality distribution. However, the value of multivariate kurtosis is higher than the critical ratio value, which is 5.0. Therefore, this issue is considered non-normal data. As Hair Jr et al. (2016) suggested, these issues can be overcome by performing bootstrapping.

Table 2
Normality Assessment

Construct	Skewness	Kurtosis
E-procurement Determinants		
Top Management Support	-1.3125	2.1662
ICT Infrastructure	-0.6526	0.3845
Supplier Selection	-1.1244	1.6663
Supply Chain Management Practices	-1.3187	2.9292
Supply Chain Performance	-0.9260	1.4058
E-procurement Adoption	-1.1804	2.2068
Multivariate		6.0368

4.2 Assessment of Measurement Model

This research employed Smart-PLS 3 software to conduct Partial Least Square-based Structural Equation Modeling (PLS-SEM) and produce research findings. According to Joseph F Hair, Risher, Ringle, and Sarstedt (2018), to begin with, the measurement models in Fig. 2 and Fig. 3 are reflective, and indicator loadings exceeding 0.708 are recommended, as they indicate that more than half of the indicator's variance is accounted for by the model, indicating acceptable item reliability. The reflective measurement model is then evaluated for internal consistency reliability, convergent validity, and discriminant validity. The independent variables in this study are top management support, ICT infrastructure, supplier selection, and supply chain management practices, which include information sharing, partner relationship, and supply chain integration. The dependent variables are supply chain performance, which includes supply chain costs and flexibility. Each independent variable is linked to the dependent variables to test their relationship.

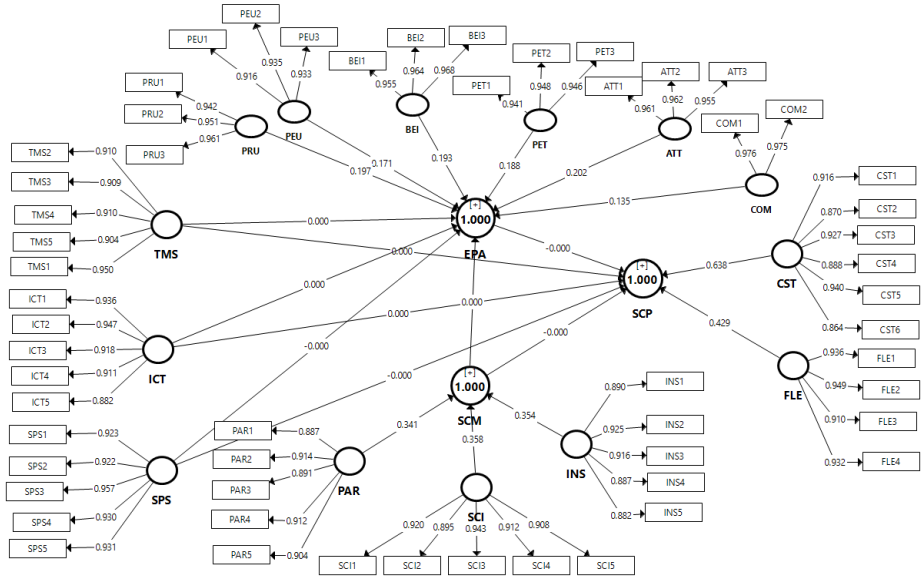

Fig. 1. Initial PLS Path Model

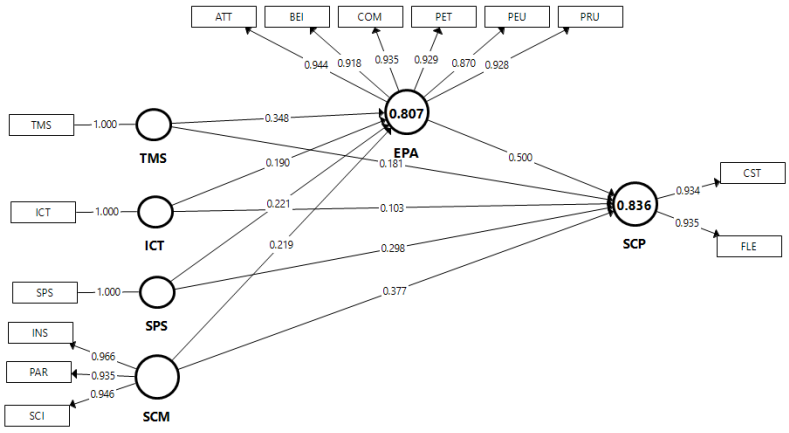

Fig. 2. Modified PLS Path Model

Internal consistency is a reliability approach in determining how well the items presented on a test to evaluate the same construct generate identical outcomes (Chapel & Williams, 2015). Higher values typically indicate higher confidence levels. Therefore, the factor loading should surpass 0.50 to suggest that the measurement items are acceptable (Ramayah et al., 2017). The factor loading value for all indicators exceeds the suggested threshold of 0.5. The factor loading value for ICT infrastructure (ICT) is 1.00, and this value same goes for supplier selection (SPS) and top management support (TMS). At the same time, the factor loading value for supply chain management practices is between 0.935 and 0.966. At the same time, the value of factor loading for supply chain performance (SCP) is between 0.934 and 0.935. Then, the factor loading value for e-procurement adoption is between 0.870 and 0.944. Thus, the criterion for convergent validity is fulfilled.

Table 3
Results Modified Research Model

Constructs	Items	Total Items	*Factor Loading	Composite Reliable	Average Variance
ICT	ICT	1	1.00	1.00	1.00
SPS	SPS	1	1.00	1.00	1.00
TMS	TMS	1	1.00	1.00	1.00
SCM	INS	3	0.966	0.965	0.901
	PAR		0.935		
	SCI		0.946		
SCP	CST	2	0.934	0.932	0.873
	FLE		0.935		
EPA	PRU	6	0.928	0.971	0.848
	PEU		0.870		
	BEI		0.918		
	PET		0.929		
	ATT		0.944		
	COM		0.935		

Note: E-Procurement Adoption (EPA), ICT infrastructure (ICT), Supplier selection (SPS), Supply chain management practices (SCM), Supply chain performance (SCP), Top management support (TMS)
Note: *Factor loading for items

To ensure that the model is distinct from others, it is essential to determine discriminant validity, especially when using latent variables to prevent multicollinearity issues. The HTMT criterion is used and compares the predefined threshold. According to Ab Hamid, Sami, and Sidek (2017), the HTMT value should not surpass the threshold of 0.9. Table 4 indicates that all the HTMT value within the threshold of 0.9.

Table 4
Discriminant Validity: HTMT criterion

	EPA	ICT	SCM	SCP	SPS	TMS
EPA						
ICT	0.797					
SCM	0.814	0.744				
SCP	0.885	0.753	0.842			
SPS	0.826	0.754	0.831	0.834		
TMS	0.847	0.798	0.777	0.795	0.803	

4.3 Assessment of Structural Modal

4.3.1 Hypotheses Testing

Thirteen hypotheses were tested in this study, with nine direct hypotheses and four indirect hypotheses. To test these hypotheses, the Smart-PLS 3 bootstrapping method was employed. A one-tailed test with a confidence level of 0.05 was used to generate these hypotheses. In order to be considered statistically significant, the t-value must exceed 1.645 and the p-value must be less than 0.05, meeting the significance point (Hair et al., 2019).

Table 5 presents the results of the directional hypotheses. Hypothesis 1, which suggests a positive impact of top management support (TMS) on supply chain performance (SCP), is not supported as the relationship between the two variables is insignificant (t-value = 0.096 and p-value = 0.462). Hypothesis 2, which predicts a positive impact of ICT infrastructure on SCP, is also not supported as the relationship between the two variables is insignificant (t-value = 0.088 and p-value = 0.465). However, Hypothesis 3, which predicts a positive impact of supplier selection (SPS) on SCP, is supported with a significant result in the test (t-value= 1.852 and p-value= 0.032). Hypothesis 4, which predicts a positive impact of supply chain management practices (SCM) on SCP, is also supported with a statistically significant result (t-value=2.953 and p-value=0.002).

Besides, hypotheses on the relationship between e-procurement determinants and e-procurement adoption (EPA) show a significant positive relationship. As for hypothesis H5, TMS and EPA show a positive relationship with a t-value=3.162 and a p-value is 0.001. Thus, H5 is supported in this study. As predicted in H6, the test supported the theory that ICT positively impacts EPA with t-value=2.224 and p-value=0.013. Furthermore, H7 is supported with a t-value=2.685 and a p-value is 0.004. The two variables between SCM and EPA show a significant positive relationship at (t-value=2.191, p-value=0.014). Hence, H8 is supported in this study. The outcomes displayed the positive relationship between EPA and SCP, which is H9 and supported at (t-value=4.633, p-value=0.000). In conclusion, seven hypotheses out of 9 directional hypotheses have been supported in this research.

Table 5
Result of Hypotheses Testing

Hypotheses	Path	Std. Beta	Std. Error	t-value	p-value	F^2	Confidence Interval		Decision
							0.05	0.95	
H1	TMS → SCP	0.007	0.069	0.096	0.462	0.000	-0.109	0.107	Not Supported
H2	ICT → SCP	0.008	0.090	0.088	0.465	0.000	-0.159	0.150	Not Supported
H3	SPS → SCP	0.188	0.101	1.852	0.032**	0.048	0.027	0.349	Supported
H4	SCM → SCP	0.267	0.091	2.953	0.002**	0.109	0.123	0.423	Supported
H5	TMS → EPA	0.348	0.110	3.162	0.001***	0.162	0.181	0.544	Supported
H6	ICT → EPA	0.190	0.085	2.224	0.013*	0.059	0.058	0.328	Supported
H7	SPS → EPA	0.221	0.082	2.685	0.004**	0.061	0.088	0.362	Supported
H8	SCM → EPA	0.219	0.100	2.191	0.014**	0.066	0.037	0.363	Supported
H9	EPA → SCP	0.500	0.108	4.633	0.000***	0.294	0.324	0.678	Supported

Note: one-tailed test, > t-value = p-value: > 2.58(***p<0.001), >1.96(**p<0.05), >1.65(*p<0.10)

This study utilizes e-procurement adoption (EPA) as a mediator variable to examine four indirect relationships between the independent and dependent variables. **Table 6** presents the results of the hypotheses for the indirect relationships, with e-procurement adoption as a mediator. The results indicate that EPA has a positive impact on the relationship between top management support (TMS) and supply chain performance (SCP) (H10), ICT infrastructure (ICT) and SCP (H11), supplier selection (SPS) and SCP (H12), and supply chain management practices (SCM) and SCP (H13). The outcomes of all four hypotheses demonstrate statistically significant positive relationships between e-procurement determinants and supply chain performance.

Table 6
Mediating Effect Results

Hypotheses	Path	Std. Beta	Std. Error	t-value	p-value	Confidence Interval		Decision
						0.05	0.95	
H10	TMS → EPA → SCP	0.174	0.069	2.528	**0.006	0.076	0.299	Supported
H11	ICT → EPA → SCP	0.095	0.049	1.935	**0.027	0.025	0.177	Supported
H12	SPS → EPA → SCP	0.111	0.044	2.485	**0.007	0.042	0.187	Supported
H13	SCM → EPA → SCP	0.11	0.056	1.946	**0.026	0.018	0.196	Supported

Note: one-tailed test, > t-value = p-value: > 2.58(***p<0.001), >1.96(**p<0.05), >1.65(*p<0.10)

In summary, the results of hypothesis testing mostly supported as their t-values and p-values fall within acceptable ranges. A total of 510 questionnaires were sent via email to manufacturing firms, but only 99 responses were received, resulting in a response rate of 19.41%. Demographic data were used to select suitable respondents for this study. The convergent and discriminant validity of the measurement model was analyzed using Partial Least Square Structural Equation Modelling (PLS-SEM) or SmartPLS Version 3, and Fornell-Larcker was used for discriminant analysis. The results of bootstrapping show that

H3, H4, H5, H6, H7, H8, H9, H10, H11, H12, and H13 are supported with t-values exceeding 1.645, while H1 and H2 are not supported.

5. Discussion

No prior research supports the notion of a negative relationship between support from top management and supply chain performance. The statement also applies the same for ICT infrastructure. However, both determinants were important factors in adopting e-procurement. Findings from Akdogan and Demirtas (2014) study suggested that relationships exist between managerial roles and supply chain performance. According to Sandberg and Abrahamsson (2010), SCM's promised effects, such as lower total cost, service enhancements, and lower inventory levels, should be achieved more efficiently through management concepts. In Sandberg and Abrahamsson (2010) dissertation, then, top management is involved with dynamic capabilities. For instance, dynamic capability, which can be regarded as the capacity of the organization to retain and improve distinguishing capabilities over time, means; facilitating coordination within the company by constructing a flat organizational system that promotes staff initiatives and direct communication between employees and managers at different organizational hierarchical levels; attend regular top-management sessions, both formal and informal. Help and push IT infrastructure growth towards better integration. Facilitate and push investment in such facilities as warehouses and other associated logistics. Wu et al. (2006) conducted a study on the relationship between information technology, supply chain capabilities, and company performance. The study found that supply chain managers believed that providing ICT facilities and training employees on their use could enhance supply chain capabilities, leading to positive effects on company performance. The study concluded that IT can help companies improve their learning and response speed, enabling them to respond better to market changes than their competitors.

The effectiveness of the supply chain was positively impacted by other factors, particularly supplier selection and supply chain practices. Selecting the appropriate supplier is crucial for every company. Procurement departments exist to support the company’s operations. Every company has different ways of assessing and selecting their suppliers, which means they have criteria for choosing suppliers, such as reliability, quality, costs, etc. Thus, these criteria on the suppliers will impact the supply chain performance because having good suppliers means the company has a reputable relationship with its suppliers. Manufacturers are thought to be able to achieve customer satisfaction by carefully choosing and assessing suppliers, as well as managing their involvement in the supply chain: competitive pricing, superior products, a wide selection of products, and timely service (Ramachandran, 2019).

The three SCM practices indicators are supply chain integration, partner relationships, and information sharing. The utilization of IT allows much greater knowledge to be circulated more easily, and the variety of goods and resources offered to staff is stated to have given much greater versatility regarding the opportunity to provide accessibility to a vast list of manufacturers (Wurster & Evans, 2001). Benjamin and Malone (2014) concluded that this electronic interaction, combined with the supply chain, should make it easier to reduce the costs of managing business transactions and organizing output. Barratt and Rosdahl (2002) said quick searching and visibility presented benefits for the purchaser. Manufacturer search markets reduce procurement expenses, and the e-contribution marketplace's to SCM is examined from three angles: lower unit costs, increased effectiveness, and streamlined processes. The supply chain will undoubtedly become more efficient as a result of interorganizational partnerships, which will also result in greater future gains for both supply chain stakeholders. Because it aims to ensure the supply chain's efficient flow while producing high-quality customer levels and cutting costs, supply chain integration improves the performance of the supply chain.

6. Conclusion and Implications

Understanding the relationship between e-procurement determinants and supply chain performance pertinent to the manufacturing industry is the main goal of this study. This study closes a theoretical gap left by the earlier study suggested by Chang et al. (2013). He recommended that future analyses adopt various measurement methods for assessing supply chain performance (e.g., the supply chain processes comparison structure, agility, and flexibility). He added relative effects on supply chain performance could be further evaluated from various measurement viewpoints. Finally, this analysis is carried out at the company's level; subsequent studies investigate possible linkages depending on the person's level. For a cross-level study, the issue of how employee conduct regarding technology use affects the relationship between e-procurement and supply chain efficiency is worth examining. This paper will help future researchers understand the direct effect of e-procurement determinants on supply chain efficiency and the indirect interaction between e-procurement adoption with e-procurement determinants and supply chain performance. This study proposed top management support, ICT infrastructure, supply chain management practices, and supplier selection as relevant factors in adopting e-procurement. The research will provide top managers with decision-making criteria for adopting e-procurement based on the relationship between e-procurement determinants and supply chain performance. Furthermore, the element variables in this study will guide management to cross-check whether to adopt e-procurement. For example, they can ask themselves if their company has enough allocation of budget to buy the technologies support for e-procurement implementation.

Although this study might provide fruitful insights to academicians and practitioners, the study's limitations need to be addressed. This quantitative study investigates the relationship between e-procurement determinants and supply chain performance with e-procurement adoption as mediates effect. Hence, the research questions should only answer "what" questions and not "how". Thus, it would be interesting to have another research to address the company's strategies for implementing and resolving the issues in e-procurement adoption. Besides, this study was only limited to manufacturing companies in Malaysia. Future research can considers to survey and exploring other industries. Another limitation is time constraints. Getting the minimum sample size of 92 responses from the survey sent through Email is pretty challenging. The respondents answered the survey three days or more after the questionnaires were sent. Thus, dragging the time to analyze the data. Some companies are also unwilling to participate in the survey because of the company's confidentiality. The targeted respondents who require an executive position and higher experience in the supply chain department make the data collection process even harder. Hence, the respondents were also categorized as admins, accountants, and engineers who answered the survey. Furthermore, some of the companies' emails are inaccessible, making it more challenging to get more respondents. The questionnaires can only be distributed through email, with a link to Google Forms. The physical questionnaires could not be distributed directly to the company due to the pandemic Covid-19 faces today. Plus, it would cost more to print out the physical questionnaires.

In conclusion, this study aims to investigate the impact of e-procurement determinants on supply chain performance in terms of cost and flexibility. The four determinants considered are top management support, ICT infrastructure, supply chain management practices, and supplier selection. The results show that top management support and ICT infrastructure have a negative effect on supply chain performance, but when e-procurement adoption mediates the effect, both variables have a positive impact. The study has contributed to filling gaps in the literature and offers insights for future researchers.

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