Shaping a Digital Future: Examining Technology, Organisation and Environment (TOE) Framework

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Abstract

The uptake of e-commerce (EC) has seen a rise, increasing from 27.8% in 2019 to 37.9% in 2021, leading to a greater emphasis on online sales. However, according to SME Corporation Malaysia's 2021 report, 65.5% of SMEs believe EC is unnecessary and prefer physical stores, while 16.6% cited a lack of skilled employees to initiate, maintain, and manage online systems. Therefore, this study examines the critical constructs surrounding the adoption of EC by SMEs in the service and other sectors in Malaysia. Utilizing the constructs of perceived benefits (H1), EC complexity (H2), top management attitude (H3), competitors' pressure (H4), and government support (H5), the adoption of EC by Malaysian SMEs was measured and analysed. This study is supported by the Technology, Organisation, and Environment (TOE) framework dimension. The data were collected through an online questionnaire-based survey, and 155 responses were used for this study. Two of the most recognised statistical software are utilised to analyze the collected data. First, the R software was used to perform descriptive statistics. The majority of the respondents (56.77%) stated that their enterprise's sales turnover was below RM300,000, with an additional 26.45% of respondents' firms falling within the sales turnover range of RM300,001 to RM3,000,000. Second, the SmartPLS was utilized to test measurement and structural models. The findings indicated that the perceived benefits and EC complexity are positively associated with EC adoption by SMEs. In contrast, the results concerning top management attitude, competitor pressure, and government support indicated otherwise. As SMEs navigate the path to digitalisation, this study may be helpful to investors, owners, researchers, policymakers, and any individuals interested in knowing more about the progress of EC adoption among Malaysian SMEs.

1. Introduction

Small and Medium-sized Enterprises (SMEs) in the service sector (such as food and beverage), and other sectors (such as agriculture, construction, mining, and quarrying) often encounter significant challenges when integrating emerging technologies (such as e-commerce (EC)) into business operations. Service-oriented SMEs often struggle to find technologies that can be effectively tailored to meet their specific business needs, compared to the manufacturing sector, where technology frequently boosts production efficiency directly. Further, researchers noted that SMEs in the service and other sectors face challenges in adopting emerging technologies due to lower financial resources compared to manufacturing companies (Nguyen et al., 2024). Addressing these challenges in a comprehensive way typically involves applying the Technological, Organisational, and Environmental (TOE) framework to fully assess and adapt to the factors influencing technology integration. For example, the

technological dimension of the TOE framework highlights the necessity for SMEs to develop the required technical expertise. This ensures the effective implementation of new technologies tailored to their specific service operations (Hu et al., 2019). In this regard, extant researchers noted the under-developed service and other sectors in Asia have the potential to become a new engine of economic growth, highlighting the need for strategies to address productivity concerns and infrastructural gaps in the service and other sectors of SMEs (Kim & Wood, 2020). Additionally, adopting digital technology in the service and other sectors of SMEs is essential for their survival, especially as the COVID-19 pandemic has accelerated the shift towards digital payment (Mishrif & Khan, 2023). In particular, SMEs need help to keep up with the rapid pace of technological advancements (Zheng et al., 2013). Moreover, integrating emerging technologies requires changes to existing systems and workflows, which can be complex and costly for SMEs (Nguyen et al., 2024).

With regards to the TOE framework, the organisational dimension focuses on SMEs' organisational structure, including management style and adaptability, which can impact their ability to adopt new technologies. While, SMEs need more employees with digital skills to manage technological changes, and there may be resistance to change from employees accustomed to traditional methods. Furthermore, the leadership of SMEs may be risk-averse, primarily when investing in unproven technologies (Salah & Ayyash, 2024). The environmental dimension delves into the external environment in which SMEs operate, including market trends, competitive pressures, and governing requirements, which can influence EC adoption. Global and local economic conditions, customer demands, and the availability of technology support services play a role. Additionally, SMEs may face cybersecurity and data privacy challenges, which are increasingly significant as they integrate more digital technologies (Mukherjee et al., 2023).

To this end, numerous research studies have explored contemporary insights on SMEs' EC adoption. For example, Alrousan and Jones (2016) presented a model to comprehend the extent of EC adoption in Jordan. Furthermore, the degree to which Egyptian manufacturing SMEs have adopted business-to-business (B2B) EC was investigated by Hamad et al. (2018). Additionally, Abebe (2014) delved into the impact of entrepreneurial orientation on the relationship between EC adoption and SMEs' performance. Using leadership theory and the TOE framework, Sihotang et al. (2024) conducted an empirical study of 184 villages in Indonesia to confirm the attributes influencing the adoption of the Village-Information-System (VIS). Nasution et al. (2021) explored the differences among SMEs in North Sumatra, Indonesia, concerning entrepreneurship, knowledge management, and the capacity to adopt EC rapidly. Furthermore, Fonseka et al. (2022) explored senior managers' insights into how EC usage influenced business performance in Sri Lankan SMEs. Ahmad & Siraj (2023) examined the determinants of EC assimilation in 384 North Indian SMEs, applying the TOE framework while incorporating individual aspects such as top management support and innovativeness.

Ghobakhloo et al. (2011) explored the attributes influencing EC adoption decisions and the level of EC adoption within the TOE framework. In addition, Awa et al. (2015) introduced a context-dependent construct to understand the relationship between EC adoption and top management (TM) practices in counted SMEs across five sectors located in three geopolitical regions of Nigeria. Meanwhile, Yin (2023) investigates the connection between digital transformation and green innovation in line with the TOE framework in China. Kurnia et al. (2015) delved into an investigation examining the effect of administrative, industrial, and national readiness and environmental pressure on adopting EC in the Malaysian grocery sector. More recently, Samat et al. (2024) conducted a study in Kelantan, Terengganu, and Pahang of Malaysia to investigate the presentation of SMEs utilizing social commerce. Using the TOE framework, Kechik et al. (2023) employed content analysis to study social media adoption as a mediating factor and its impact on SME performance in Kelantan, Malaysia. Applying the TOE framework, Hassan et al. (2023) investigated the attributes prompting the purpose of adopting cold transport between logistics providers in Malaysia.

These studies have explored diverse issues, encompassing organisational, technological, and environmental dimensions. Investigations have been conducted in Jordan, Egypt, Nigeria, Ghana, Thailand, Indonesia, Sri Lanka, India, Malaysia and China. The study's results demonstrated the possibilities and limitations SMEs face in embracing EC across the globe, highlighting the influential constructs that shape EC adoption. However, upon careful examination of the available literature, it becomes apparent that there is a notable gap in studies concentrating on the adoption of EC by SMEs in the service and other sectors in Malaysia. Despite the growing demand and rewards of EC, limited studies have been conducted on the implementation practices of Malaysian services and other sectors. Hence, there is a clear need for additional empirical research to comprehend the critical constructs influencing SMEs in Malaysia when adopting EC, in order to identify the most effective strategies.

Given these identified shortcomings, this study examines the critical constructs affecting the adoption of EC by SMEs in Malaysia's service and other sectors. The TOE framework is employed as a research model, and the constructs are Technology (perceived benefits and EC complexity), Organisation (top management attitude), and Environment (competitors' pressure and government support). The measured constructs were carefully selected to suit the needs of SMEs in Malaysia's service and other sectors, addressing the following to answer the research questions (RQs): RQ1: What are the perceived benefits of adopting EC? RQ2: Is EC complex for SMEs to adopt? RQ3: Does top management attitude impact EC adoption? RQ4: Do competitors pressure SMEs into adopting EC?

RQ5: Does the government support adaptation of SMEs to EC during the COVID-19 pandemic? The outcome of these research questions (RQs) is expected to provide valuable insights to relevant stakeholders and SMEs, enabling them to embrace EC's ongoing evolution and develop business strategies that sustain the digital marketplace. The rest of the paper is organized as follows: First, it critically reviews the relevant literature covering the topics of EC, delving into the theory and the development of hypotheses. Second, the TOE framework is then employed to establish a conceptual model. Subsequently, the method, results, discussions, implications, limitations, future research, and conclusions are presented.

2. Literature Review

2.1 E-commerce Adoption

Turban et al. (2008; p.4) define EC as *"buying, selling, or exchanging products, services, and information via computer networks, including the Internet."* Hence, EC facilitates the diverse showcasing of products and services, encompassing physical goods like clothing, electronics, household items, and digital products such as software, e-books, and online courses. In addition, big data analysis can be done to monitor EC performance (Gopal et al., 2024; Reddy & Nalla, 2024). Thus, businesses can tailor product enhancement, promotions, and communication to personalized customer experiences through user-friendly interfaces. As a result, Small and Medium Enterprises (SMEs) can leverage customer data to gain insights into purchasing behaviors, preferences, and market trends. That being so, it empowers SMEs to make well-informed business decisions and customise their offerings to consumer demands through EC adoption, which is SMEs' key strength. Consequently, SMEs can stay agile and adapt to changing consumer preferences and trends, ensuring their sustainability in the business. In essence, this adaptation allows SMEs to quickly introduce new products, respond to market shifts, and remain competitive in dynamic business environments.

EC adoption also includes digital marketing (e.g., live streaming, social media marketing, and email campaigns) (Elhabib & Maroua, 2024; Salhab, 2024; Zhang & Erturk, 2022). Specifically, Dallocchio et al. (2024) noted that social media marketing has an optimistic impact on SMEs. Especially, digital marketing involves creating high-quality business-relevant content that educates, entertains, and engages the targeted customers. This content includes websites, blogs, social media posts, articles, product descriptions, commercial and promotional videos, as well as infographics. In essence, it connects SMEs to (i) achieve digital marketing objectives, (ii) build brand awareness, and (iii) drive customer engagement through comments, likes, shares, and direct communication (Wei et al., 2023). Specifically, Wu et al. (2024) illustrate that digital marketing is influenced by innovativeness, proactiveness, and managerial capabilities to positively impact SMEs. Essentially, digital marketing plays a pivotal role in driving the online victory of EC in SMEs.

Regarding the unique benefits of EC, it is necessary and timely to conduct a study to examine the critical constructs surrounding the adoption of EC by Malaysian SMEs in the service and other sectors. Further, the issue of the low technology adoption rate among SMEs has remained a persistent focus of research in the past decade, drawing continued attention to existing studies (Senarathna et al., 2018; Rastogi et al., 2018). In 2021, 65.5% of SMEs believe EC is unnecessary and prefer physical stores, in Malaysia (SME Corporation Malaysia, 2021). This could limit SMEs' market potential and growth opportunities, especially in a globalized economy where online presence is increasingly pivotal. SMEs must adopt EC to reach a broader customer base and tap into the growing trend of online shopping. This is attributed to the rapid digitalization, posing challenges for SMEs in terms of adoption and keeping up with the pace of change. By addressing this gap, this study aims to contribute to a deeper understanding of the critical constructs affecting EC adoption in Malaysia. Essentially, the current study identifies the benefits realized by these SMEs through EC adoption and investigates the relationships among those constructs.

2.2 TOE Framework

The TOE framework was created by Tornatzky & Fleischer (1990) to describe the technological, organisational, and environmental factors that influence a firm's decision to hold innovation (Venkatesh & Bala, 2008). According to Kim et al. (2015), the TOE framework serves as the basis for justifying innovation through organisational identification in the implementation of technology and EC. Specifically, the TOE framework can be employed to evaluate the readiness of SMEs to adopt EC (Awa et al., 2017; Makame et al., 2014). Thus, this research has used the TOE framework for its research methodology. Firstly, the adoption of innovation and novel technology is significantly influenced by technological factors. These factors encompass the features of technology itself, along with the associated infrastructure's perceived benefits, which collectively contribute to shaping firms' inclinations toward its utilization (Iranmanesh et al., 2023). Additionally, complexity and expensive costs within technological systems can exert a pessimistic impact on technology adoption (Matikiti et al., 2018).

Organisational factor comprises the firm's size, owner or top management attitude, and the firm's readiness to adopt and use technology (Puklavec et al., 2018). Organisational factors play a crucial role in determining the

compatibility of the organisational structure with the adoption and utilization of technology (Sharma et al., 2022). This factor is vital for the victory of the technology adoption process as it assists in providing material and moral support to stakeholders (Baig et al., 2023). Therefore, firms stand to benefit from technology adoption by being early adopters in the industry, allowing them to maximize their benefits by harnessing both direct and indirect returns from technology (Tseng et al., 2023). The last component of the TOE framework is the environmental factor. It includes pressure from competitors and government support. Competitive pressures compel firms to adapt their strategy in adopting new technology to keep up with evolving market trends (Merhi & Harfouche,2023). Meanwhile, the victory of EC depends on government support, such as incentives and internal staff training (Hassan et al., 2023).

Contrasting other frameworks, TOE only mentions the dimension (Technology-Organisation-Environment) that influences technology adoption without specifying the constructs of each dimension. This makes the TOE framework widely applicable to different disciplines and contexts (Sihotang et al., 2024). Researchers have the flexibility to select constructs based on the specific characteristics of the organisation and technology being considered for adoption. Consequently, the present study focuses primarily on utilising the TOE framework (technological (perceived benefits and EC complexity), organisational (top management attitude), and environmental (competitors' pressure and government support) to examine the critical constructs surrounding the adoption of EC by SMEs in Malaysia's service and other sectors. Refer to Figure 1.

2.2.1 Introduction Perceived Benefit (PB)

The process of adopting EC begins with the establishment of a robust online presence to realize its perceived benefits. In comparison to traditional brick-and-mortar establishments, EC provides cost-effective solutions for SMEs. Their online presence on EC platforms (e.g., Lazada, Shoppe, and Mudah) reduces overhead costs, allowing SMEs to allocate resources more efficiently and invest in other business areas (Hu et al., 2019). This is supported by Grooss (2024), who has noted that unsophisticated and affordable digital solutions are sufficient for the overall digitalization of SMEs. When EC adoption becomes an integral part of business operations, it empowers SMEs to engage in online transactions. In particular, the surge in smartphone usage has driven businesses and customers to embrace mobile commerce (M-commerce), facilitating transactions through mobile applications (e.g., mobile payments). Importantly, mobile-friendly websites and apps enhance accessibility and convenience for users on the move. SMEs should seize the opportunity to embrace EC while recognizing that transitioning from offline to online can be tricky for some of them. Building upon the above discussion, hypothesis H1 is formulated as follows.
H1: *Perceived benefits positively affect EC adoption*

2.2.2 EC Complexity (COMP)

According to Chong & Olesen (2017), the complexity of EC adaptation occurs when EC interfaces and platforms require constant updates. Updates are required for high-density fiber-optic cable, increasing employee mobile use capacity, modernising interface design, and implementing a secured payment system (Yin, 2023). However, keeping everything up-to-date for SMEs is tough and requires financial resources (Zheng et al., 2013). Consequently, the complexity of EC can act as a discouraging factor for SMEs when considering adoption. Besides, Hamad et al. (2018) found that complexity plays a weighty role in influencing the adoption of digital marketing within the domain of EC. According to Ali et al. (2015), the reluctance of SMEs to embrace digital marketing is commonly correlated with their perception of the complexity associated with using EC. Further, having multiple EC platforms (e.g., Lazada, Shoppe, Mudah) for actively promoting products and services can be challenging for SMEs to navigate. Porter & Heppelmann (2015) demonstrate that individuals who have confidence in their ability to perform at a high level can quickly adopt new technologies, drawing from their prior experiences. Hence, implementing a user-friendly interface (e.g., those requiring only a few clicks) can significantly reduce the complexity for SMEs. In accordance with existing literature, it is proposed that increased complexity tends to hinder the adoption of EC. Hence, hypothesis H2 is structured as follows.
H2: *The complexity of EC positively affects EC Adoption*

2.2.3 Top Management Attitude (TOP)

Top Management Attitude (TOP) refers to the way corporate leaders and managers perceive the significance of adopting EC and how they establish a lasting deliberate vision while allocating resources for its effective operations (Alsaad et al., 2019). TM refers to SME owners and organisational decision-makers in this examination. The involvement of TM is vital in the decision-making process, as they allocate necessary IT human and financial capital and influence the behaviors of organisational affiliates to foster greater EC adoption (Mousavizadeh et al., 2015; Zheng et al., 2013). Sun et al. (2020) and Zheng et al. (2013) argued that highly motivated managers can have a significant impact on an SME's EC adoption when their support encompasses strategic path, consultant, and allocation of IT human and financial capital. Thus, TOP is crucial in fostering the success of SMEs by providing

necessary IT human and financial capital and managing the adaptation of EC to enhance market competitiveness, attract additional customers, and facilitate improved business ventures. Hence, hypothesis H3 is formulated.
H3: Top Management attitude positively affects EC adoption

2.2.4 Competitor Pressure (COP)

Intense competition among industry players profoundly influences the entire sector, and adopting EC is a pivotal factor in driving industrial transformation (Porter & Millar, 1985). Zhong & Moon (2023) suggest that SMEs, under competitive pressure, are more inclined to quickly embrace new EC solutions. In the face of competition from rivals, SMEs tend to react promptly and closely monitor their competitor's behavior (Hasani et al., 2023). This vigilance makes SMEs better prepared to adopt new technology at a similar pace to their competitors. Furthermore, Mukherjee et al. (2023) found that competition plays a crucial role in compelling SMEs to increase their investment in Industry 4.0 technologies, such as cybersecurity, big data, additive manufacturing, blockchain, and Artificial Intelligence (AI). Therefore, the hypothesis H4 is developed as below.
H4: Competitor Pressure positively affects EC Adoption

2.2.5 Government Support (GOV)

Malaysian government regulations serve as a driving force encouraging SMEs to embrace EC solutions. In existing literature, numerous studies have found that government support significantly influences EC adoption among SMEs (Al-Alawi & Al-Ali, 2015; Rahayu & Day, 2015). Specifically, SMEs are more inclined to adopt technological advancement when the government provides incentives (e.g., financial aid and tax relief) (Chen & Chang, 2014). Effendi et al. (2020) also argued that GOV through legislation stimulates the adoption of EC; while stringent regulation tends to hinder its adoption. In particular, EC adoption is more likely to be encouraged when regulations provide financial and IT human resources support (Effendi et al., 2020). In Malaysia's context, the government, via the eBelia program, has allocated a notable sum of RM75 million for youths aged between 18 and 20, providing them a RM50 credit in their e-wallet. Recognizing the crucial role of youths as technology adopters, this initiative aims to foster a cultural shift in Malaysia towards cashless financial transactions and concurrently motivate SMEs to embrace EC (Cheah, 2020). Hence, hypothesis H5 is structured as follows.
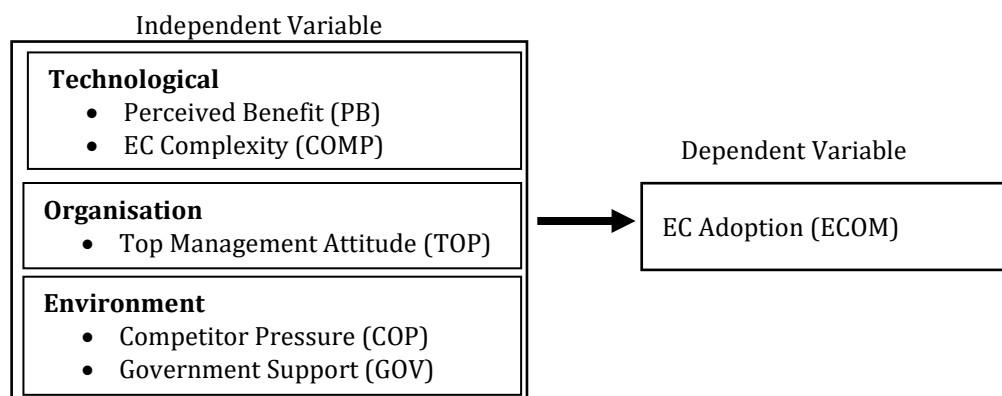*H5: Government support positively affects EC adoption*

Independent Variable

| Technological |
| • Perceived Benefit (PB) |
| • EC Complexity (COMP) |

| Organisation |
| • Top Management Attitude (TOP) |

| Environment |
| • Competitor Pressure (COP) |
| • Government Support (GOV) |

Dependent Variable

EC Adoption (ECOM)

Fig. 1 *Conceptual framework*

3. Method

3.1 Sampling

According to Alam (2009), SMEs in Malaysia need to adopt EC quickly. In the Malaysian context, nonetheless, it was noted that: (i) 65.5% of SMEs think there is no need for EC and opt for physical stores (e.g., repair of motor vehicles, motorcycles, and agriculture); (ii) 17.2% of Malaysian SMEs lack familiarity with online business and EC platforms; (iii) 16.6% reported insufficiently skilled employees to inaugurate, uphold, and regulate online systems; and (iv) 12.4% prefer traditional brick-and-mortar set up (SME Corporation Malaysia, 2021). On the other hand, it is worth noting that the online presence of Malaysian SMEs has seen significant growth, doubling from 35.3% in 2019 to 75.8% in 2021, with a remarkable increase among those in the services sector (e.g., food and beverage). The adoption of EC also witnessed a rise, climbing from 27.8% in 2019 to 37.9% in 2021, thereby contributing to a higher intensity of online sales. In essence, the pandemic has substantially accelerated the

adoption of EC in recent years. This particular circumstance serves as a pivotal reason for selecting Malaysia as the focal point of the study.

The research methodology involves the collection of quantitative primary data. First, a list of SMEs was acquired from The Ministry of Entrepreneur Development and Cooperatives (MEDAC). Through purposive sampling, 2537 SMEs were selected. In Malaysia, the two criteria used to define SMEs are the sales turnover and the number of full-time employees. For the scope of this study, the participants consist of SMEs within the service and other sectors (such as agriculture, construction, mining, and quarrying) with sales turnovers not exceeding RM20 million, or those having a number of full-time employees not exceeding 75. This study excludes SMEs in the manufacturing sector with either sales turnover not exceeding RM50 million or fewer than 200 full-time employees. This approach is necessary as the manufacturing sector has a unique sales turnover and full-time employees' number, which differ significantly from those in the service and other sectors.

After obtaining ethical clearance on 19th October 2021 (Ref: 20215974-8639), the MS Form was created and the link was sent through email and WhatsApp to invite SME managers, executives, senior managers, and employees in administrative leadership positions (EALP) within SMEs to voluntarily participate in the survey between 5th January 2022 to 20th April 2022. The determination of sample size was determined using G*Power Version 3.1, a robust statistical tool widely recognized for its ability to calculate statistical power and sample size requirements in research studies. (Faul et al., 2009). By employing parameters that include a power level (1-β err probability of 0.95), an alpha significance level (α err probability of 0.05), an effect size f^2 (0.15), and 5 independent constructs (IV) as predictors, the analysis shows that a total sample of 138 is required to effectively test the regression model (Cohen, 1992; Faul et al., 2009). A total of 2537 emails were sent, along with 502 WhatsApp invites, and 171 responses were received; however, only 155 responses were used with sixteen responses being discarded due to not meeting the SME criteria. In this study, the R software was employed to conduct a range of descriptive statistics as well as Smart PLS 4.0 software to scrutinise both the measurement and structural models for evaluating the hypotheses.

3.2 Measurement and survey instrument

The 10-15-minute survey consists of two parts. In Part 1, the verification of whether the respondent's firm meets the SME criteria was carried out, and demographic information, including age, the state they belong to, as well as their organisation's annual sales turnover and number of full-time employees, was collected, along with their current position. In part 2, the measurement of critical constructs influencing the success of EC adoption among SMEs in Malaysia is conducted using a 7-point Likert scale where the value '1' indicates 'strongly disagree,' and the value '7' represents 'strongly agree'. The independent variables (IVs) are technology (perceived benefits and EC complexity), organisation (top management attitude), and environment (Competitor pressure and government support), while the dependent variable (DV) is EC adoption. As shown in Table 1, there is a total of 30 items adapted from previous studies and adjusted to suit the Malaysian context.

Table 1 *Questionnaire measurement items*

Constructs	Items	Item Code	Source
EC Adoption	Our organisation maintains an interactive webpage	ECOM1	(Venkatesh & Bala, 2008)
	Our organisation conducts online marketing (e.g., e-catalogue and online advertisement)	ECOM2	
	Our organisation conducts online sales (e.g., receive enquiries and customer orders)	ECOM3	
	Our organisation receives online payments (e.g., electronic payments and e-wallet payments)	ECOM4	
	Our organisation conducts online purchases	ECOM5	
Perceived Benefits	Our organisation finds EC useful in our daily business	PB1	(Gibbs & Kraemer, 2004)
	Using EC improves the effectiveness of our daily business	PB2	
	EC enables us to complete specific tasks quickly	PB3	

	Using EC in our organisation increases our productivity	PB4	
	Using EC enhances our organisational performance	PB5	
EC Complexity	Our organisation finds EC to be complicated to use	COMP1	(Ali et al., 2015)
	Our organisation does not have skilled employees to operate EC	COMP2	
	Our organisation's interaction with EC is confusing	COMP3	
	It is time-consuming for us to use EC	COMP4	
	It is challenging to choose a service provider for EC	COMP5	
Top Management Attitude	Our TM regards EC as a high priority	TOP1	(Fitriati & Mulyani, 2015)
	Our TM is excited about the adoption of EC	TOP2	
	Our TM supports all EC initiatives	TOP3	
	Our TM is willing to invest in EC initiatives	TOP4	
	Our TM thinks EC will benefit us	TOP5	
Competitor Pressure	Competitors influenced our organisation's decision to use EC	COP1	(Oliveira et al., 2014)
	Our organisation is under pressure from competitors to adopt EC	COP2	
	Our organisation will lose out to competitors if we do not adopt EC	COP3	
	Our organisation is forced to adopt EC to gain a competitive advantage	COP4	
	Many competitors are switching to EC since the pandemic	COP5	
Government Support	The government promoted the benefits of EC during the COVID-19 pandemic	GOV1	(Ocloo et al., 2020)
	The government encouraged SMEs to adopt EC during the Covid-19 pandemic	GOV2	
	The government ensured EC transactions were protected during the Covid-19 pandemic	GOV3	
	The government provided various educational programs to train SMEs in EC during the Covid-19 pandemic	GOV4	
	The government provided incentives to ensure affordable Internet services for SMEs during the Covid-19 pandemic	GOV5	

3.3 Data Analysis Technique Partial Least Squares-Structural Equation Modelling (PLS-SEM)

The selection of dependent and independent variables was based on previous research. Consequently, the multivariate analysis examines multiple variables representing individuals, companies, and activities from the survey questionnaire. This analysis aims to validate the model and identify hypothesized relationships supported by theories (Hair et al., 2018). Partial Least Squares-Structural Equation Modelling (PLS-SEM) was employed for this purpose. SEM encompasses a measurement model (the outer model) and a structural model (the inner model). The measurement model evaluates the relationships between variables and their respective items, whereas the structural model assesses the relationship between independent and dependent variables (Hair et al., 2010). Confirmatory factor analysis (CFA) is conducted within the measurement model to evaluate convergent and discriminant validity. Additionally, internal consistency reliability is assessed to ensure that all items are reliable, thereby providing greater confidence in the results. The reliability of individual items is determined through composite reliability and average variance extracted (Fornell & Larcker, 1981).

The structural model is to assess path coefficients and conduct hypothesis testing (t-value), evaluate effect size (f2), and analyse coefficients of determination (R2) and Q2 after ensuring convergent and discriminant validity in the measurement model. Path coefficients indicate the hypothesis's relationships between variables through bootstrapping (Komiak & Benbasat, 2006). This method allows for calculating empirical t-values based on bootstrapping standard errors. An empirical t-value greater than 1.645 at a 5% significance level or greater than 2.33 at a 1% significance level indicates a positive relationship. A value below 1.645 at a 5% significance level suggests a negative relationship (Chin, 1998). In PLS analysis, all tests are typically one-tailed, except for tests involving a mediator, which are considered two-tailed.

Effect size (f2) is a metric employed to gauge the influence of an independent variable on a dependent variable (Cohen, 1988). It quantifies the extent to which an independent construct explains variance in a dependent variable. Cohen's (1988) benchmarks for effect size are 0.02 (small), 0.15 (medium), and 0.35 (large). Another crucial aspect in analysing the structural model is the coefficient of determination (R2), which evaluates the collective impact of independent variables on the dependent variable (Hair et al., 2018). The R2 values indicate the model's predictive accuracy: 0.67 is considered substantial, 0.33 is moderate, and 0.19 is weak (Chin, 1998). Subsequently, the analysis moves to the predictive relevance of the model, assessed through Stone-Geisser's Q^2 prediction (Geisser, 1974). This value is obtained using the blindfolding procedure (Sattler et al., 2010). A Q^2 prediction value greater than zero for reflective items indicates that the exogenous variables have predictive relevance for the endogenous variable (Henseler et al., 2009).

4. Results

4.1 Demographic Analysis

As shown in Table 2, the majority of the respondents fall between 31 to 40-years-old (47.10%), followed by those aged 41 to 50-years-old (31.61%), with the smallest percentage belonging to the age group of 60 years old and above (1.29%). Further, the male respondents constituted the majority at 50.97%. The largest proportion of the respondents holds a degree or professional qualification (42.58%), followed by postgraduate degree holders (15.48%), while a minority has completed only secondary school or lower (6.45%). Among the total of 155 respondents, more than half of them were in the EALP category (54.84%), followed by executives (19.36%) and managers (17.42%). The majority of the respondents (56.77%) stated that their enterprise's sales turnover was below RM300,000, with an additional 26.45% of respondents' firms falling within the sales turnover range of RM300,001 to RM3,000,000. Further, 10.32% reported their enterprise's sales turnover falling within the RM300,000 to RM3,000,000 range. The majority of respondents were running their business with full-time employees numbering between 5-25 (50.97%), while another 32.90% were operating with fewer than five employees. Additionally, 12.26% of the respondents reported having 26-45 full-time employees in their business.

Table 2 *Demographic information*

Demographic	Percentage (%)	Demographic	Frequency (n = 155) Percentage (%)
SMEs location			
Kedah	1.20%	Kelantan	0.60%
Penang	10.3%	Terengganu	1.30%
Perak	8.10%	Johor	20.0%
Selangor	27.1%	Sabah	1.30%
Negeri Sembilan	0.60%	Sarawak	19.2%
Malacca	10.3%		
Age:		**Gender:**	
21-30	11.61%	Female	49.03%
31-40	47.10%	Male	50.97%
41-50	31.61%		
51-60	8.39%		
Above 60	1.29%		
Education:		**Current Position:**	
Secondary or below	6.45%	EALP	54.84%
Certificate/Diploma	8.39%	Executive	19.36%
Degree/Professional Qualification	42.58%	Manager	17.42%
Post Graduate	15.48%	Senior Manager	8.39%
Other	27.10%		
Sales Turnover:		**Full-Time Employees:**	

Less than RM300,000	56.77%	Less than 5	32.90%
RM300,000 - RM3,000,000	10.32%	5 - 25	50.97%
RM300,001 - RM3,000,000	26.45%	26 - 45	12.26%
RM3,000,001 - RM10,000,000	2.58%	46 - 65	2.58%
RM10,000,001 - RM15,000,000	3.23%	66 - 75	1.29%
RM15,000,001 - RM20,000,000	0.65%		

4.2 Analysis of the Measurement

The item loadings and cross-loadings illustrate the correlation of each item with its intended construct (e.g., loading) as well as its correlation with other constructs (e.g., cross-loading). The loading value for the COP (ranging from 0.718 to 0.934); GOV (ranging from 0.743 to 0.916); COMP (ranging from 0.773 to 0.880); PB (ranging from 0.712 to 0.895); TOP (ranging from 0.684 to 0.870) and ECOM (ranging from 0.834 to 0.895) are reliable. Each of these items has a loading digit that surpassed the threshold of 0.5 (Hair et al., 2010). Nevertheless, two items, COP5 and GOV3, were removed due to their lower loading score, which did not meet the threshold of 0.5. Meanwhile, the Average Variance Extracted (AVE) assesses convergent validity, and it should exceed the threshold value of 0.50 (Hair et al., 2010). An average construct value higher than 0.50 explains the variance among the indicators. On average, the variance of the indicators is explained by COP (0.650), GOV (0.701), COMP (0.706), PB (0.626), TOP (0.575), and ECOM (0.732). Further, a Composite Reliability (CR) value exceeding 0.708 signifies both internal consistency and the reliability of individual indicators (Hair et al., 2011). The CR values range from 0.870 to 0.932. The numbers of COP (0.880), GOV (0.903), COMP (0.923), PB (0.893), TOP (0.870), and ECOM (0.932) indicate a high level of reliability in the study. Refer to Table 3.

Table 3 *Measurement model*

Construct & Items	Measure	Loading	AVE	CR
Competitor Pressure (COP)	Reflective		0.650	0.880
COP1		0.822		
COP2		0.718		
COP3		0.934		
COP4		0.733		
Government Support (GOV)	Reflective		0.701	0.903
GOV1		0.916		
GOV2		0.906		
GOV4		0.770		
GOV5		0.743		
EC Complexity (COMP)	Reflective		0.706	0.923
COMP1		0.853		
COMP2		0.880		
COMP3		0.773		
COMP4		0.879		
COMP5		0.813		
Perceived Benefits (PB)	Reflective		0.626	0.893
PB1		0.712		
PB2		0.714		
PB3		0.895		
PB4		0.811		
PB5		0.810		
Top Management Attitude (TOP)	Reflective		0.575	0.870
TOP1		0.684		
TOP2		0.695		
TOP3		0.805		
TOP4		0.720		
TOP5		0.870		

EC Adoption (ECOM)	Reflective		0.732	0.932
ECOM1		0.838		
ECOM2		0.834		
ECOM3		0.895		
ECOM4		0.873		
ECOM5		0.837		

Note: Item COP5 (0.382) and GOV3 (0.250) were removed due to their lower loading score
Note: [a] AVE should be above 0.50 [b]; CR should be above 0.708

The square root of Average Variance Extracted (AVE) values surpass the correlations with other constructs for COP (0.806), GOV (0.856), COMP (0.837), PB (0.841), TOP (0.791), and ECOM (0.758). Refer to Table 4. In accordance with Fornell and Larcker (1981), it is evident that for each construct, the square-root of the AVE exceeds the highest correlation with any other construct. Thus, the criteria are met.

Table 4 *Discriminant validity - Fornell and Larcker*

	1	2	3	4	5	6
1. COP	**0.806**					
2. GOV	-0.117	**0.856**				
3. COMP	-0.010	-0.067	**0.837**			
4. PB	-0.097	0.689	0.002	**0.841**		
5. TOP	-0.078	0.652	0.004	0.696	**0.791**	
6. ECOM	0.011	0.530	-0.054	0.682	0.690	**0.758**

4.3 Analysis of the Structural Model

The path coefficients, standard errors, t-values, and p-values for the structural model were reported utilizing a resample bootstrapping procedure with 5,000 samples (Jr et al., 2011). The findings indicated that H1 (β = 0.344, t-value = 4.312) and H2 (β = 0.464, t-value = 6.222) were supported. While H3 (β = -0.027, t-value = 0.318), H4 (β =-0.046, t-value = 0.720) and H5 (β = -0.071, t-value = 1.021) hypotheses were not supported. Refer to Figure 2 and Table 5 for details.
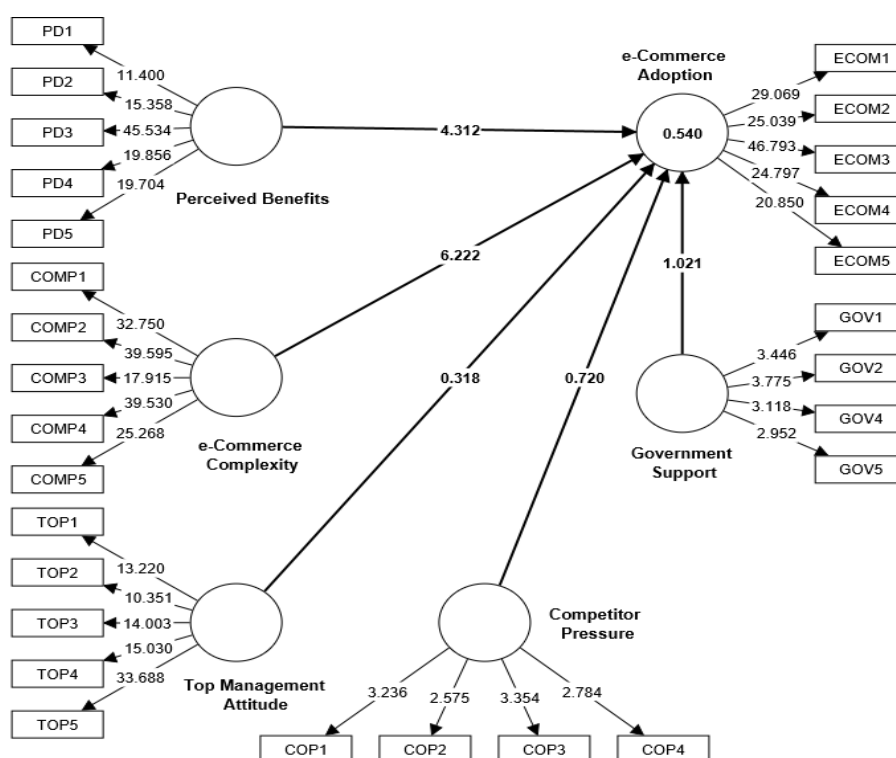

Fig. 2 *Results of t-value and R²*

The effect size (f2) serves as a metric for assessing the relative impact of PB, COMP, TOP, COP, and GOV on ECOM. The effect size (f2) values of 0.02 (indicating a small effect), 0.15 (reflecting a medium effect), and 0.35 (representing a large effect) serve as the benchmarks for interpreting the impact of the DV (Cohen, 1988). PB (f2 = 0.119), TOP (f2 = 0.008), COP (f2 = 0.014), and GOV (f2 = 0.021) show a small effect on ECOM. In contrast, COMP (f2 = 0.214) has a medium effect on ECOM and ECOM (f2 = 0.002). Therefore, ECOM can be achieved with PB, COMP, TOP, COP, and GOV. The R2 value, also known as the coefficient of determination, measures the proportion of variation in the latent components of ECOM that is explained by the IV in the model. In this study, the R2 value for ECOM is 0.540, suggesting that exogenous factors explain approximately 54% of the variation in ECOM. Further, the Confidence Interval Bias Corrected (BCI LL and BCI UL) criteria are met. There is no proof of multicollinearity among the IVs, as all variance inflation factor (VIF) values are less than 3.3. Thus, there are no issues regarding multicollinearity among the constructs in the model (Diamantopoulos & Sigouw, 2006). Refer to Table 5.

Table 5 *Path coefficient for main model*

Hypothesis	Relationship	Std Beta	Std Dev	t-values	p-values	BCI LL	BCI UL	f²	VIF
H1	PB→ECOM	0.344	0.080	**4.312**	P<.001	0.214	0.477	0.119 (small)	2.344
H2	COMP→ECOM	0.464	0.075	**6.222**	P<.001	0.343	0.587	0.214 (medium)	2.311
H3	TOP→ECOM	-0.027	0.086	0.318	0.375	-0170	0.111	0.008 (small)	2.295
H4	COP→ECOM	-0.046	0.064	0.720	0.236	-0.133	0.083	0.014 (small)	1.025
H5	GOV→ECOM	-0.071	0.070	1.021	0.154	-0.152	0.084	0.021 (small)	1.007

Note: We use 95% confidence interval with a bootstrapping of 5,000; p<0.05, t-value greater than 1.645-2.32 (1-tailed); one-tailed p<0.01, t-value greater than 2.33 (one-tailed)
Note: f² = 0.02 (small effect); f² = 0.15(medium effect) and f² = 0.35 (large effect)

The prediction summary was evaluated through the MV and LM prediction summary. The MV prediction summary is shown in Table 6; the RMSE-PLS-LM and MAE-PLS-LM values are primarily negative and less than zero, which are desirable outcomes, indicating a high predictive capability. This is supported by Shmueli et al. (2019). This implies that SME's adoption of EC can be reliably predicted.

Table 6 *PLS-Predict*

MV prediction summary	Q²predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE	RMSE PLS-LM	MAE PLS-LM
ECOM1	0.349	1.018	0.706	1.008	0.716	0.01	-0.01
ECOM2	0.346	1.049	0.754	1.185	0.855	-0.136	-0.101
ECOM3	0.342	1.182	0.903	1.195	0.897	-0.013	0.006
ECOM4	0.405	0.852	0.604	0.936	0.699	-0.084	-0.095
ECOM5	0.365	0.848	0.607	0.907	0.658	-0.059	-0.051

The values for Q^2 Predict are positive, thus suggesting good predictive performance (Shmueli et al., 2019). Refer to Table 7.

Table 7 *Q^2 Predict*

Construct	Q²_predict
ECOM	0.494

5. Discussion, Implications, and Conclusion

5.1 Discussion

In the technological dimension of the TOE model, PB (H1) exhibited an optimistic relationship with EC adoption. The finding aligns with the results of contemporary studies (Grooss, 2024; Hu et al., 2019). SMEs in Malaysia demonstrate a favorable outlook and are eager to support and invest in EC-related activities. In Malaysia, businesses within the SMEs consider EC to be beneficial, enhancing the efficiency of their business operations; this enables them to accomplish tasks swiftly, boost productivity, and improve overall business performance. Despite facing challenges, the majority of Malaysia's SMEs maintain a positive outlook regarding the potential benefits of EC in ensuring the sustainability of their business success. Next, with regards to H2, COMP had an optimistic impact on the adoption of EC. Complex interfaces, constant EC updates, and digital marketing are perceived by SMEs as factors that introduce complexity within an organisation. The finding aligns with Yin (2023), Chong & Olesen (2017), Ali et al. (2015), Zheng et al. (2013) and Hamad et al. (2018). SMEs may need help to select the most suitable service provider for EC (e.g., Lazada, Shoppe, Mudah). Based on the descriptive data, a significant percentage of respondents in this study (54%) are above the age of 40 and have attained a higher level of education, with the highest proportion holding a bachelor's degree; hence, these individuals may not be early adopters of technology and could be influenced by the complexity associated with EC.

In the organisational dimension of the TOE model, it was unexpected that TOP (H3) did not exhibit a statistically significant impact. Respondents indicated that TM (SME owners and decision makers) did not prioritize EC adoption, made limited investment in EC initiatives, and did not perceive EC as beneficial to stakeholders. This suggests that larger enterprises are inclined to integrate technological innovation compared to smaller ones. Building on the findings of Sun et al. (2020) and Zheng et al. (2013), highlights the standing of motivating TM to actively explore new EC and social commerce platforms. TM should demonstrate an enduring commitment to embracing technological innovation by engaging in various support and training initiatives for both themselves and their employees. Giving priority to employee development through training is essential for effective SME management. Such training enables a comprehensive understanding of the functional and technical aspects of the EC. This, in turn, simplifies complex tasks and enhances overall work efficiency. Ultimately, the real potential of technology, particularly EC, can be fully harnessed when TM demonstrates its willingness to overcome the initial adoption costs and associated risks.

In the environmental dimension of the TOE model, the findings for H4 and H5 showed a negative impact on EC adoption. Neither COP nor GOV significantly influenced SMEs' adoption of EC. Specifically, the results of H4 contradict the outcomes of Hasani et al. (2023), Mukherjee et al. (2023), Zhong & Moon (2023), and Porter & Millar (1985). The results of H4 suggest that Malaysian SMEs are not facing substantial competitive pressure. Instead, they acknowledge the tangible economic benefits that EC adoption could offer, indicating that their motivation is driven by potential advantages rather than external competitive pressures. Likewise, the finding of H5 contradicts the results reported by Al-Alawi & Al-Ali (2015) and Rahayu & Day (2015). There is a need for the government to re-evaluate its support for SMEs. In developing countries, the government may need increased funding for technological advancements. Therefore, it is crucial that these resources are distributed in a manner that maximizes the potential economic benefits. In the Malaysian context, the ideal scenario would entail the government identifying SMEs with the greatest potential for economic growth. Therefore, the Malaysian authorities should evaluate existing support programs to ensure that funds are allocated to the most appropriate SMEs. Importantly, government assistance must be extended impartially to all small businesses, irrespective of ethnicity or political affiliations. For instance, it is crucial to guide enterprises in the implementation of secure payment gateways, encryption protocols, and other measures to ensure the protection of customer information and financial transactions (Ji & Singh, 2023). Meanwhile, mobile responsiveness, secure payment gateways, and efficient inventory management systems are integral components that enhance customers' online shopping experiences. In addition, those aiming to penetrate the EC market encounter several challenges, including issues related to scams, counterfeit products, and the preservation of online brand reputation (Mukhtar et al., 2016). In essence, these challenges act as barriers that discourage businesses from embracing EC, despite recognizing its EC for long-term business sustainability. These obstacles are of particular significance as SMEs require additional resources. According to Astuti & Nasution (2014), SMEs encounter substantial and unique challenges when adopting new technology. Nevertheless, many SMEs are trying to adapt to the rapid updates and changes in EC. Therefore, government support remains crucial.

5.2 Implications

The study contributes to the literature concerning technology, operational efficiency, and innovation in EC adoption in line with the TOE model to explore the factors of PB, COMP, TOP, COP, and GOV surrounding EC adoption by SMEs. Most studies in this domain primarily focus on the manufacturing and retailing industries. On

the contrary, this study shifted its focus towards the service and other sectors including agriculture, construction, mining, and quarrying in Malaysia. This study broadens and enriches the current body of literature by introducing novel insights, thereby contributing to the ongoing discourse in this field. The positive impact of PB on SMEs' EC adoption in Malaysia was evident. SMEs are aware of the benefits associated with EC such as expediting tasks, boosting productivity, and improving overall performance. However, TM should prioritize regularly exposing employees to novel technologies whenever updates become available, ideally on a monthly basis.

COMP had an optimistic finding on EC adoption by SMEs. Overall, complex interfaces, frequent EC updates, and digital marketing efforts are sources of operational complexity. Hence, TM must facilitate user-friendly interfaces and provide training for employees in digital marketing, covering areas like live streaming, social media marketing, email campaigns, picture and video editing, and offer constant sustenance to minimize problems associated with technological intricacy. Essentially, digital marketing plays a vital role in enhancing brand visibility and acquiring customers, and fostering overall business growth within the context of EC adoption.

TOP was identified as having a negative impact on EC adoption. Therefore, TM should allocate IT human and financial resources to support initiatives for adopting EC, particularly in the service and other sectors of Malaysian SMEs. This is further linked to COP. While SEMs may not face direct competition pressure from rivals, it remains essential to ensure that the culture and structure of these enterprises support digital marketing, M-commerce, mobile payment, secure payment methods, encryption protocols, and other AI tools. These measures contribute significantly to enhancing the operational effectiveness and efficiency of SMEs. Moreover, it is imperative for technology developers to direct their efforts specifically toward SMEs to accelerate the adoption of EC among these firm owners.

This study solely utilised a quantitative approach, with data collected through an online survey. One of the primary limitations of quantitative research is that it may not yield as detailed information as qualitative research. Therefore, future research can ponder adopting a mixed method to study the TOE framework. Through conducting interviews with 20 or more individuals, including managers, executives, senior managers, and EALP, researchers can make more targeted recommendations for SMEs. For example, exploring how service-oriented enterprises like hairdressers and beauticians can effectively integrate EC into their operations. In this study, questionnaires were distributed to 13 states of Malaysia. However, the researchers were unable to obtain responses from Pahang and Perlis, resulting in data collection from only 11 states of Malaysia. Therefore, future researchers should consider gathering data from all states for a more comprehensive analysis. In addition, future research could focus on the manufacturing sector SMEs with sales turnover not exceeding RM20 million, or having a workforce of not exceeding 75 full-time employees in view that the current study focused on the service and other sectors. In future studies, it could be beneficial to introduce moderators, such as government support or competitor pressure into the context of EC adoption. This would help assess whether government support or competitor pressure strengthens the relationship between the IV and the DV.

6. Conclusion

Internet application has become the cornerstone, leading to a shift from traditional business establishments to virtual market platforms. This study examines the critical constructs surrounding the adoption of EC by SMEs in Malaysia's service and other sectors. The study is supported by the TOE Framework which incorporates PB, COMP, TOP, COP, and GOV, as illustrated in the conceptual framework. Researchers employed purposive sampling to deliberately select SMEs within the service and other sectors based on specific criteria, such as sales turnovers and the number of full-time employees while excluding SMEs in the manufacturing sector; 155 valid responses were collected to address five RQs. This study utilized PLS-SEM techniques to examine both the measurement and structural model in evaluating the hypotheses. The statistical proof indicates an optimistic relationship of PB and COMP on EC adoption among Malaysian SMEs. Conversely, TOP, COP, and GOV exhibit a statistically insignificant and negative relationship with EC adoption. Even in the face of government programs designed to promote technical development and digitisation, other constructs may have a greater impact on EC adoption than the support provided by the government. These constructs may include operational complexity concerns, the quick speed at which technology is advancing, and the requirement for customized solutions that address the unique requirements of various SMEs. Therefore, it is crucial to tackle, in a more comprehensive manner, the various obstacles SMEs experience on their path to digitalization.

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Conflict of Interest

The authors confirm that there are no conflicts of interest related to the publication of this manuscript.

Author Contribution

The authors authorise involvement in the manuscript as follows: ***study design***: Komathi Wasudawan, Chia Hua Sim; ***data collection***: Komathi Wasudawan; ***analysis and interpretation of results***: Komathi Wasudawan, Chia Hua Sim; ***draft manuscript preparation***: Komathi Wasudawan, Chia Hua Sim.

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