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Intention of Smart Manufacturing Technologies Adoption among Manufacturing SMEs in Malaysia

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Abstract

This paper aims to examine four main drivers under the institutional theory and transaction cost theory as antecedents of the intention of SMT adoption among manufacturing SMEs in Malaysia. Only 20% of the SMEs in Malaysia have started to use SMT platforms in their business. Currently, only limited insight on studies of motivation from supplier-customer perspective that drive the intention of SMT adoption among SME manufacturers in Malaysia. This reluctance risks manufacturing SMEs being left behind compared to players in neighbouring countries. This quantitative study of Malaysia manufacturing SMEs uses a non-probability sampling method. The study collected 160 manufacturing SMEs as valid data for analysis using the contact data from Federation of Malaysian Manufacturers (FMM) directory as the sample frame. The result was analysed by using SmartPLS 4.0. The findings of this study indicated that the intention of SMT adoption among manufacturing SMEs in Malaysia were influenced by efficiency and expected competitive advantages but there were no significant influenced by supplier pressure and customer pressure. The theoretical and practical implication was discussed which are believed to offer meaningful insight to small SMEs, academicians and government agencies.

Keywords: Smart Manufacturing Technologies, SMEs, Internal Motive, External Motive

Introduction

The world is currently amidst a technological transformation, one which is very different from those which preceded it due to the sheer pace and breadth of these changes (MITI, 2018). The landscape has changed to transit into a digital ecosystem as convergent digital technologies like Smart Manufacturing Technologies (SMT) continue developing and gaining adoption. SMT with IR 4.0 technology-enabling capabilities has displayed immense potential in modifying the manufacturing of SMEs, specifically by enhancing the productivity, efficiency, and cost, strengthening the organizational, managerial, and production capabilities for improved product quality and monitoring while establishing the innovators and producers of IR 4.0 technologies (Ikumoro and Jawad, 2019).

Previous research explains that advanced digital technologies adoption of smart manufacturing enhanced manufacturing business performance by improving sales, customer and supplier relationship while supporting internal organizational capabilities (Ghobakhloo

and Ching, 2019). Čater *et al.,* 2021 used UTAUT to study the drivers for IR4.0 technologies to investigate the motivational factors and enablers from intention of IR4.0 technologies and its actual use on large export companies in Europe. Abdullah Sani *et al.,* 2021 found that the intention of big data analytics technology produce good result raises the expectation of performance. Marcon *et al.,* 2022 found company that emphasized on socialtechnical perspective contribute to higher level of IR4.0 technologies adoption. Lastly, Liu *et al.,* 2010 found that normative pressure under institutional presssure positively related to Internet-enabled Supply Chain Management system adoption intention. Constradictly, Arnold *et al.,* 2018 found that perceived outside support negatively affects the IR4.0 adoption for German manufacturing companies.

There is lack of SMT impact awareness among manufacturing SMEs from strategic business opportunities perspective (Mittal et al., 2020). Specifically, potential motives as drivers for SMT adoption intention are needed (Liere-Netheler *et al.,* 2018). Büyüközkan and Göçer (2018), and Rahamaddulla *et al* (2021), highlighted that study focused on SMEs' SMT adoption received little attention. Many studies have discussed the different characteristics and technologies associated with SMT. However, little attention has been devoted to study the motivational aspect for the intention of SMT adoption that requires intentional motive for pre-implementation planning and assessment leading to maximize efficient machine utilization (Mahmoud and Grace, 2019). Other study intention of SMT from the economic, environmental, and social bottom lines from a sustainability perspective (Wuest *et al.,* 2022), while Marcon *et al* (2022), studied the changes required from the systemic perspectives. Most previous studies either locally or abroad which investigated adopting a new technology mainly focused on technological and developmental aspects. The literature review for the previous research papers on intention of technology adoption and its development mostly applied the DOI, T-O-E framework, and UTAUT model done either abroad or locally within Malaysia (Uddin *et al.,* 2019; Rozmi *et al.,* 2019; Hizam *et al.,* 2021; Tsai *et al.,* 2013; Jayashree *et al.,* 2022; Ghobakhloo and Ching, 2019; Khin and Kee, 2022). However, the unique characteristic of SMEs caused different adoption process as compared to larger company. There is much to win for those who intend to adopt SMT earlier, with even more to lose for those laggards in SMT adoption (Mahidhar & Davenport, 2018; Bughin, 2018). Although there is literature that provides maturity and readiness models and toolkits for adoption, manufacturing SMEs has been slow in adoption due to the lack of a transition strategy and identification of relevant technologies required to achieve a smart factory. The decision-making models for SMEs are inadequate (Bhatia & Diaz-Elsayed, 2023)

In summary, the connection between the preferences and the antecedents of organizational motivation factors on intention of new technology adoption is less understood (Kupfer *et al.,* 2016). Only limited research has been done to identify the key antecedents influencing SMEs' decision on adoption and implementing SMT (Ghobakhloo and Ching, 2019). Marcon *et al* (2022), suggested the frameworks for Industry 4.0 adoption intention should also consider non technological steps. Thus, this study examines the supplier pressure, customer pressure, efficiency and expected competitive advantages on the intention of SMT adoption among manufacturing SMEs in Malaysia. The present study aims to answer the following objective:

1. To examine the motivational factors influencing the intention of SMT adoption among the manufacturing SMEs in Malaysia.

Smart Manufacturing Technologies (SMT)

Wang *et al* (2016), refer to SMT as the integration of information technology, industrial manufacturing technology, and human capital, enabling autonomous customized flexible production processes. Barroga *et al* (2021), further subcategorize SMT into vertical integration and horizontal integration. Vertical integration of SMT in manufacturing context is sending the data from smart-sensor-attached items on a physical manufacturing floor through network embedded systems for physical process monitoring and controlling (Hofmann and Rüsch, 2017). Horizontal integration of SMT is the integration of the various IT systems used in the different stages of the manufacturing and business planning processes, from materials planning and scheduling, energy and manufacturing information both within a company value chain (e.g., inbound logistics, production, outbound logistics, marketing), and between inter-company value chain networks (Kagermann *et al.,* 2013).

SMT adoption enables companies to meet fluctuating demands by creating agility within their organization and performance levels through short delivery time. Thus, promoting optimized mass production with a high level of intra- and inter-organizational collaboration and shifting to decentralized model allowing fast and effective localized day-to-day operational decision making (Yong *et al.,* 2020). Jung *et al* (2015), report that the ability to respond in real time to the information quickly and effectively is paramount for efficient SMT, as delays in the process may disrupt the subsequent ongoing operations.

SMT for Small Business

Manufacturing SMEs needs SMT for performance efficiency and expected competitive advantages management to facilitate long-term sustainable goals after accessing the influence of the legitimacy pressures. According to Conrad, (n.d), there is varies benefit from SMT. SMT can be deployed to produce smart products by monitoring all product quality aspects besides providing real-time manufacturing data to reduce process variance, eliminate undetected errors, and identify potential issues as early stage. customers are significantly more demanding, looking for zero defects as they have more access to information and more vendor choices through vast internet accessibility. Machine learning allows engineers to extract previous process failure history while using big data analytics translate data with the correct context link to strategy and resources for correct and effective decision-making to minimise scrap and rework cost. The aided digital metrics and operational insights via digital twin can faster assists in identifying the causes of poor quality related to the human, machine, or environmental. The final benefits of higher quality via SMT direct impact to customer satisfaction, brand loyalty upbringing, and reduced product recalls warranty, which consequently improved business performance (Conrad, n.d).

Hypotheses and Model Development

Institutional theory argues that the business environment of business practices may affect a company's adoption intention (Tsai *et al.,* 2013), explaining customers and supplier as external stakeholders of business practices may entrench how and why business strategy change occurs. Initially, transaction cost theory was simply conceptualised to answer why do firms opt to conduct business exchanges internally has evolved to address the rationale for the business existence of any organizational design is its efficiency compared to the set of other alternatives design (Winter, 1991; Roberts and Greenwoods, 1997).

Gulati (1995), and Granovetter (1985), commented that transaction cost focuses fundamentally on the company's current competencies and static efficiency, neglecting the environmental risks exerted by legitimacy pressure under institutional constraints. In reality, organizations face institutional obstructions from various aspect of social expectations and norms, that could be controverting with its' current static efficiency and competencies, as the organization drive the effort for production enhancement (Roberts and Greenwood, 1997; Liu *et al.,* 2010). In practical, transaction cost and institutional perspectives are not necessarily conflicting but serving as complementary elements of a constrained-efficiency framework to understand next organizational design adoption. The constrained-efficiency framework illuminates the adoption of organizational designs by viewing organizations as efficiency seeking under cognitive and institutional constraints, as opposed to efficiency optimizing (Roberts and Greenwood, 1997).

The core objective of SMT adoption are collaboration and integration among stakeholders (Shahzad et al., 2023). Customers and suppliers are important external stakeholders who have direct business dealing that may influenced the decision making of manufacturing SMEs in Malaysia for SMT adoption. The proposed independent variables under institutional theory and transaction cost theory fit aptly in answering the research questions of this study. In summary, manufacturing SMEs are efficiency optimization and adopt the more plausible position to achieve expected competitive advantages subject to cognitive constraints and institutional influences.

Hypotheses Development

Supplier Pressure

Supplier pressure is a normative pressure under institutional theory, as the supplier is a key business partner in any supply chain management. Manufacturing companies strived for greater supply chain collaboration to leverage the internal resources capabilities with the product knowledge from their suppliers within the mean of the current challenging business environment (Cao & Zhang, 2011). SMEs are commonly known to have limited financial resources and skilled workers, especially in technology development and adoption aspects. Supplier pressure has positive direct associated with intention of adoption (Liu *et al.,* 2010). Thus, SMEs rely greatly on their supplier to share the latest product, technology, and market development, particularly if SMEs need to develop their creation and new market penetration. Patterson *et al.,* (2003) argue that companies face supplier pressure in high uncertainty business environment has more intention to adopt high-tech value chain spanning information technologies, which foster a fast and reliable knowledge sharing for production data and schedules. Hence, this study hypothesized that supplier pressure has positive significant influence on intention of SMT adoption for SME manufacturers.

H1: Supplier pressure has positive significant influence on intention to adopt SMT among manufacturing SMEs in Malaysia.

Customer Pressure

Customer pressure describes the burden felt by a company who believe that the customers are exerting pressure to adopt Industry 4.0 technologies (Jayashree *et al.,* 2022). The greater customer pressure an organization will drive intention of the company to adopt SMT to improve its business efficiency. Customer engagement, inspiration, and compulsion are important concerns need to be handled for Industry 4.0 accomplishment apart from

mutual trust and relationship interdependency between a company and its customers (Maduku *et al.,* 2016). Company intent to adopt IT development due to customer demand. Such, fulfilling customers' expectations will trigger the intention of manufacturing SMEs to adopt new technologies like SMT. According to Wang *et al* (2016), found that company adopts to an innovation technology in the business due to customer pressure, mitigated the danger of competitive disadvantages.

Likewise, Yin *et al* (2018), and Nugroho (2017), have linked customer pressure with the transformation towards IR4.0 (Khin & Mui Hung, 2022). As such, the decision to start the SMT process is driven by customers' requirements. This enables companies to respond to quickly changing customer needs caused by the commoditization of many industrial products. Hence, this study hypothesized that supplier pressure and customer pressure have positive significant influence on intention of SMT adoption for SME manufacturers.

H2: Customer pressure has positive significant influence on intention to adopt SMT among manufacturing SMEs in Malaysia.

Efficiency

Generally, SMEs expects better business process efficiency after implementing new technology. According to Yu and Schweisfurth (2020), knowledge information and expected benefits of new technology adoption are the drivers for implementing SMT. The company has more propensity to adopt, implement, and invest in SMT if there is sufficient information on SMT and its benefits are well understood (Barroga *et al.*, 2021). Ristuccia (2019), suggests that adopting IR4.0 leads a company to have more efficient internal resources utilisation, such as improved production output, product cost savings, and real-time data to better reaction to consumer demands (Khin and Mui Hung, 2022). SMT connects all the smart manufacturing systems, starting from customised product design, real-time manufacturing processes with data analytics, stocks and supply chain systems, to link the end customers through cloud computing. Such interlink results in high performance and makes effective supply and demand ecosystems more efficient (Phuyal Sudip *et al.,* 2020). However, the company may face device compatibility concerns in implementing smart manufacturing technologies simply because some outdated communication protocols control the old machinery compared to the new devices, mainly designed under a different, more advanced protocol (Phuyal *et al.,* 2020). Small companies like SMEs are more likely to implement internet technologies which they deem to be lower cost (Wahid and Zulkifli, 2021). Such, this study hypothesised that efficiency positively influence the intention of SMT adoption for manufacturing SMEs in Malaysia.

H3: Efficiency positively influences the intention to adopt SMT among manufacturing SMEs in Malaysia.

Expected Competitive Advantages

SMT also addresses all the risks that can avert the enterprise pertaining to fiscal performance, product quality, working environment, and the business relationship with the stakeholders (suppliers, customers, and employees). The benefits with implementing SMT can be summarized in three aspects such as maximum production efficiency, management proactivity, and smart decision-making (Haricha *et al.,* 2021). Such capabilities undertake as expected competitive advantages, including production cost reduction due to better manufacturing flexibility, shorter production times-to-market, efficient energy management, and environmental impact preservation, ultimately leading to increased production efficiency

(Supekar *et al.,* 2019). SMT integrate vast amounts of manufacturing information to achieve agile, intelligent and self-reconfigurable manufacturing processes in dealing with dynamic demands in the global market (YU *et al.,* 2017). Prevalent advanced technology will help companies outperform their competitors (Wahid and Zulkifli, 2021). However, pursuing wrong initiatives will lead to business-facing difficulties scenario including being bankruptcy (Wahid and Zulkifli, 2021). As such, wrong or poor-fit technology that does not match company performance expectation may lead to the consequent disuse of the new technology. These concerns mostly resulted the company at a competitive disadvantage (Tellis, 2006; Čater *et al.,* 2021). Such, this study hypothesised that expected competitive advantages positively influence the intention of SMT adoption for manufacturing SMEs in Malaysia.

H4: Expected competitive advantages positively influence the intention to adopt SMT among manufacturing SMEs in Malaysia.

Research Framework

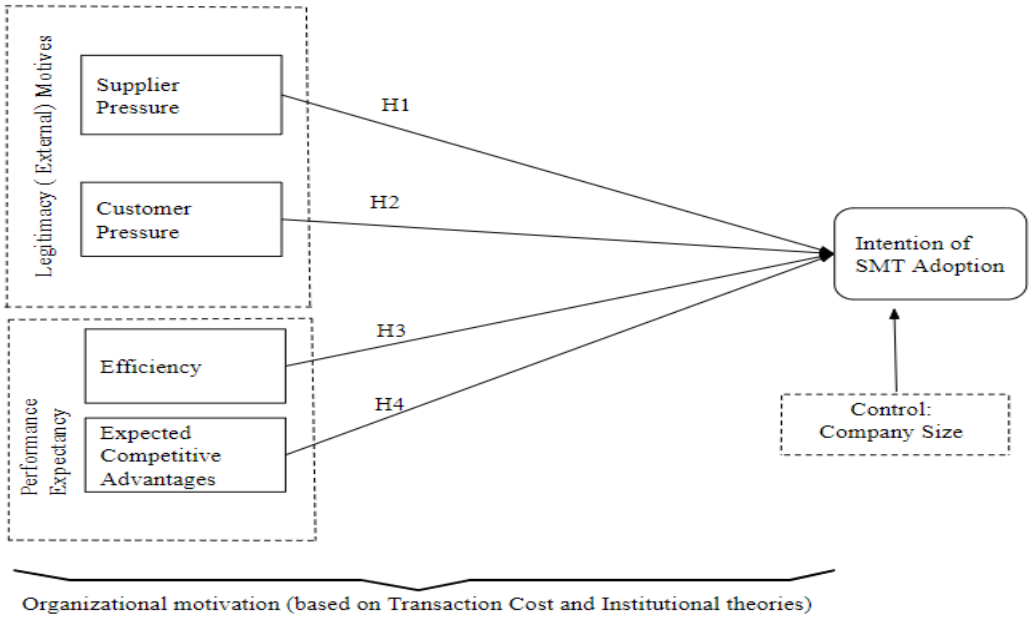

Figure 2: Research Framework

Figure 2 above shows the research framework of this study, aims to examine organisational motivational factors from supplier-customer perspective using two primary exogenous constructs: legitimacy motive as external pressure and performance expectancy as internal motive. Legitimacy is linked to supplier pressure and customer pressure with reference to institutional theory to explain the influence of normative forces toward intention of SMT adoption, while performance expectancy was measured through efficiency and expected competitive advantages under a reflective measurement model. Control variable for this study is company size which limit the data was collected from small and medium size SMEs only. The micro size SMEs (less than RM300,000 sales revenue or less than 5 headcounts) were excluded from this study with the assumption that the intention of SMT adoption requires long-term high investment cost from the company.

Research Methodology

This is a quantitative study at organizational level. This study adopted purposive sampling method. 500 manufacturing SMEs that wide spread over 13 states in Malaysia was selected from the directory provided by Federation of Malaysian Manufacturers (FMM), based on the study criteria which excluded micro-SMEs with less than RM300,000 annual revenue and less than 5 employees, and companies with more than 200 employees and sales revenue more than RM50 million. FMM directory 2022 was selected as it has more comprehensive company information in systematic manner for selection purpose. Questionnaire with 5 point Likert scale was adopted and adapted from Khin and Mui Hung (2022), Čater *et al.,* (2021), and Jayashree *et al*., (2022). A pre-test by focus group consist of academic scholar and industry experts was conducted to check the appropriateness of wordings in the questionnaire, while pilot test was conducted to check operationalization of the survey. Survey form was sent to all targeted respondents via email and follow up by calls. Respondent bias analysis was conducted to check as the data was collected over 8 weeks from February 2023 to April 2023. The data was analyzed using SmartPLS 4.0 for both measurement items analysis and structural path analysis.

Results

A total of 500 manufacturing SMEs that met the definition of SME by SMECorp were selected for this survey. 232 companies responded to the survey which contributed to 46.40% of response rate. 160 data was verified as effective valid responded that met all SMEs criteria which is 32.00% of the total sampling size. Table 2 below indicates the analysis of convergent validity included indicator loading, average variance extracted (AVE), and composite reliability (CR). The factors loading for all the items with indicator loading index more than 0.708 as suggested by Hair et al. (2014). AVE value for all variables was in the range of 0.686 and 0.840 (which is more than the recommended value of 0.50). On the other hand, CR was calculated as 0.853 to 0.936. Thus, CR met the required recommended value of 0.70, as suggested by Hair *et al.,* (2014). Hence, the result demonstrates the existence of convergent validity for this study.

Table 2
Loading Factors for Measurement Items

Construct Measurement Items	Outer Loadings	AVE	CR
Availability of finance (AF)		0.822	0.894
AF1	0.903		
AF2	0.899		
AF3	0.918		
Customer Pressure (CuP)		0.707	0.900
CuP1	0.860		
CuP2	0.848		
CuP3	0.797		
CuP4	0.857		
CuP5	0.841		
Efficiency (E)		0.790	0.911
E1	0.863		
E2	0.901		
E3	0.912		

E4	0.877		
Expected Competitive Advantages (EC)		0.701	0.914
EC1	0.754		
EC2	0.874		
EC3	0.890		
EC4	0.838		
EC5	0.866		
EC6	0.792		
Intention of SMT Adoption (IA)		0.832	0.933
IA1	0.911		
IA2	0.939		
IA3	0.932		
IA4	0.864		
Supplier Pressure (SP)		0.701	0.857
SP1	0.865		
SP2	0.878		
SP3	0.803		
SP4	0.800		

Table 3 below presents the structural model analysis result for the collected data in this study. The one tailed test result with 95% confident level shown that efficiency (β = 0.379, p =0.000), and expected competitive advantages (β =0.231, p= 0.037) have significant influence on the intention of SMT adoption among manufacturing SMEs in Malaysia as both the p value was less than 0.05. Hence, hypothesis H3 and H4 were supported.

Table 3
Result for Structural Model

Relationship	Beta	SE	T-value	Decision	Effect Size
H1: SP-> IA	-0.050	0.504	0.669	Not Supported	No Effect size
H2: CuP -> IA	0.113	0.244	1.166	Not Supported	No Effect size
H3: E -> IA	0.379	0.000*	3.584*	Supported	Small Effect size
H4: EC -> IA	0.231	0.037*	2.088*	Supported	Small Effect size

* Significant at 95% Confident Level, p<0.05, one tailed

The endogenous construct of intention of SMT adoption has the R^2 value of 0.538 (see Table 4 below), which is substantial. This R^2 value mean 53.8% of the variance of the construct intention of SMT adoption among manufacturing SMEs can be explained SP, CuP, E and EC. Table 5 also shows the Stone-Geisser's Q^2 value for this study is 0.422, which is more than 0. Such, the model has good precisely predicted data points for the endogenous construct.

Table 4
R^2 and Q^2

Endogenous Construct	R^2	Q^2
Intention of SMT Adoption	0.538	0.422

Discussion

Measuring the Intention of SMT adoption (IA) among manufacturing SMEs in Malaysia

The mean value of the intention of SMT adoption ranged between 3.775 and 3.863 out of 5 with overall mean of 3.822 and median of 4. This finding indicated an average response slightly more positive than the neutral (3). This finding also indicated that the manufacturing SMEs in Malaysia has lower level of acceptance on the intention of SMT adoption. This result indicated the manufacturing SMEs in Malaysia has the intention to SMT adoption in the business process but they do not fully desire to it due to some concerns over full acceptance. IR4.0 is considered a new concept to the manufacturing SMEs in Malaysia, only 30% of Malaysian manufacturing SMEs have just started the adoption of Industrial 3.0. This low adaptation rate indirectly shows the business entities may have a limited information on the impacts and cost-effectiveness of adopting SMT in their business (Shahzad et al., 2023).

The demographic data showed that 65.63% to 72.50% of the companies that participated in this study were small SMEs that had a 5 to 75 employee headcount and total yearly sales revenue in the range of RM300,000 to RM15 million. Manufacturing SMEs, particularly those that are small, generally do not possess the extra resources – most notably, high skilled human capital with technology competency – required to handle SMT adoption (Stentoft *et al*., 2019). Previous studies also found that SME companies considering adopting of a fast-follow strategy being a primary reason for the low intention of SMT adoption (Mahidhar and Davenport, 2018; Ryfors *et al.,* 2019). Under this fast-following strategy, manufacturing SMEs are waiting for SMT to mature and become more commonly available before adoption. SMEs hindered in adoption due to the lack of a transition strategy and identification of relevant technologies required to achieve a smart factory (Bhatia & Diaz-Elsayed, 2023). The low intention of SMT adoption can be explained by the majority of technology acceptance and process innovation taking placed by a step-by-step, phased approach (Won and Park, 2020). Another concerning matter is cybersecurity faced by most SMEs in Malaysia (Fazlida, 2022).

Supplier Pressure (SP) and Intention of SMT adoption (H1)

The finding of this study indicated a beta of -0.050. Thus, the hypothesized relationship of supplier pressure positively influencing the intention of SMT adoption among manufacturing SMEs in Malaysia (H1) was not supported. This finding is consistent with previous studies that supplier pressure does not exert significant influence on the intention of SMT adoption (Son and Benbasat, 2007; Ghobakhloo and Ching, 2019; Čater *et al.,* 2021; Jayashree *et al.,* 2022; Arnold *et al.,* 2016). The finding of the study can be explained as the respondent demographic profile in this study showed that 71.88% of the respondent companies had been in operation for more than 11 years. Thus, these companies have consistent and stable sources of suppliers in their purchase listing. Moreover, these manufacturing SMEs also established trust and strong commitment from suppliers after many years of business dealing (Bianchi and Abu Saleh, 2020).

On the other hand, SMEs generally have flexibility in the supplier selection process as most SMEs do not use the complicated enterprise resources planning (ERP) system, which has predetermined specific supplier for each material to be used in the production. New cost and technology have negative effects on ERP adoption for SMEs, since there is no adequate gain in return of investment (ROI) (Wang, 2009). The diversity in supplier selection means less

significant pressure from a single supplier in SME decision-making on the supplier selection process. Moreover, the purchase of material base on the letter of authority issued by customers is commonly accepted especially in the case of semiconductors, electronics that contract manufacturers and the medical industry supply. Consequently, the entire transaction can be completed without further questions from the supplier.

Customer Pressure (CP) and Intention of SMT adoption (H2)

In this study, the customer pressure of manufacturing SMEs in Malaysia is hypothesized as positively influencing the intention of SMT adoption in Hypothesis 2. The test result indicated a beta of 0.113 with p value of 0.244 (which is more than 0.05). Thus, the hypothesized relationship of customer pressure positively influencing the intention of SMT adoption among manufacturing SMEs in Malaysia was not supported. This finding can be explained customers prefer to work with manufacturing SMEs, mainly due to the SMEs generally being deemed as more flexible in fulfilling their needs as compared to larger manufacturing companies. This is particularly true when customers require fast response with short lead time in their product support due to unforeseen production surges or delivery push out when their production volume has dropped (Brozović et al., 2023). Hence, customers are less driven by the intention of new technology (SMT) adoption as the reason for their supplier selection

Next, most manufacturing SMEs have shorter and simpler manufacturing flow as compared to large manufacturing companies. Customers are very much cost-sensitive, particularly given the current slow business demand. The adoption of SMT is a long-term high investment commitment. However, such extra commitment from the manufacturing SMEs may not guarantee additional benefit to product quality, based on cost-benefit analysis. Such, demand for new adoption of SMT may potentially force manufacturing SMEs to amortise the new investment cost of SMT into the individual part cost. Third, most manufacturing SMEs have a diverse customer base. Thus, a proportion of sales revenue per customer ratio could be minor when compared to the total yearly SME business revenue. Consequently, losing some customers that are highly demanding of SMT investment may not be immediately detrimental for SMEs.

Efficiency and Intention of SMT adoption (H3)

In this study, the efficiency of manufacturing SMEs in Malaysia is hypothesized as positively influencing the intention of SMT adoption in Hypothesis 3. The test result indicated a beta of 0.379 with p value of 0.000 (less than 0.05). Thus, the hypothesized relationship of efficiency positively influencing the intention of SMT adoption among manufacturing SMEs in Malaysia was supported. The finding of this study can be explained by looking into few potential reasons. First, as stated in the SMECorp 2020/2021 report, manufacturing SMEs need to improve in digitalisation by continuous adoption of modern technologies to capitalise their value-added generation ability which ultimately translates into improved manufacturing productivity in the long run (p. 71). A demographic analysis by Mohamad *et al.,* (2021) showed that many employees and industry owners in Malaysia were aware of the benefit of Industry 4.0 stated in Industry4WRD policy launched by the Malaysian government. Overall efficiency is thus improved as SMT helps SMEs to automate repetitive tasks and gain a higher output as the employee focus on more value-added activities into day-to-day working culture. SMT also

enables access to a feasible method of productivity tracking (Latif and Saari, 2023). Such productivity efficiency tracking awareness increased the intention of SMT adoption.

Second, the outbreak of COVID19 in 2020 has triggered crisis management awareness among SMEs in Malaysia. Employee and physical goods movement was disrupted during the movement control order (MCO). The concept of working from home has been commonly adopted after the MCO, which is inspiring manufacturing SMEs to reconsider improving business process efficiency issue by adopting new technologies like SMT, as SMT allows remote visual monitoring on production activities via visual reality (VR) and augmented reality (AR), real time production information sharing, and monitoring across all executive employees This is a compelling as efficiency eventually translates into significant additional cost savings which improves overall company bottom line profit earning. Thus, the business scenario after MCO stimulated the intention of SMT adoption among manufacturing SMEs in Malaysia. SMEs has expediated the intention of SMT adoption as to make the manufacturing systems agile, adaptive and sustainable after the CoVID19 pandemic (Shahzad et al., 2023).

Expected Competitive Advantages and Intention of SMT adoption (H4)

In this study, the supplier pressure of manufacturing SMEs in Malaysia is hypothesized as positively influencing the intention of SMT adoption in Hypothesis 4. The test result for H4 indicated a beta of 0.231 with p value of 0.037 (which is less than 0.05). Thus, the hypothesized relationship of expected competitive advantages positively influencing the intention of SMT adoption among manufacturing SMEs in Malaysia was supported.

The positive result can be explained as manufacturing SMEs in Malaysia have high intention for SMT adoption as SMEs face challenges from intense market competition. The research by Yoshino (2016) indicated that the ability to adapt to drastic ever-changing market demand, technological evolution, and capacity constraints are the key worries of SMEs regarding knowledge, innovation, and creativity for long term sustainability. Fast and flexible manufacturing adjustments and short product-to-market lead times for order fulfilment as expected competitive advantages attract both new and existing customers. Globalization over the last decades has increased domestic and international market competition while local manufacturing SMEs still have few networks due to a lack of information, know-how, and experience of domestic and international market integration (Yoshino, 2016). In 2021, the Malaysian government launched the Industry4FWD blueprint to advocate IR4.0 awareness among SMEs by providing grants and assistance for readiness assessment (RA). Market pressure, global competitiveness, and the advocation of Industy4FWD by the government lead to the intention of SMT adoption among manufacturing SMEs spurred on by expected competitive advantage creation.

Theoretical Implication

The first theoretical contribution is to conceptualise a proposed theoretical framework that integrated both institutional theory and transaction cost theory to examine four drivers based on two primary exogenous constructs around the intention of SMT adoption for manufacturing SMEs in the Malaysian context. The first exogenous construct on institutional theory, measured by supplier pressure and customer pressure, acting as external pressure did not significantly influence intention of SMT adoption. In contrast, the second exogenous construct, performance expectancy, acts as an internal motive, measured by efficiency and

expected competitive advantage under the transaction cost theory was found to significantly influence the intention to adopt SMT among manufacturing SMEs.

Practical Implication

The main practical implications of the finding of this study are that the intention of SMT adoption among manufacturing SMEs in Malaysia appears to be driven mainly by performance expectancy, and it is not influenced by normative legitimacy. The finding of this study allows manufacturing SMEs to know that efficiency and expected competitive advantages are the key decision factors on adopting SMT in their manufacturing floor. Manufacturing SMEs should focus on operations streamlining and production cost reduction to create expected competitive advantages. Manufacturing SMEs may not consider suppliers and customers as important stakeholders in the decision-making process of the intention of SMT adoption, because the finding of this study demonstrates that both supplier pressure and customer pressure do not significantly influence SME intention on SMT adoption. Consequently, the government and its agencies should focus on stimulus programs for productivity enhancement to stimulate the intention of SMT adoption as a business strategy in creating expected competitive advantages for the new market and new product penetration.

Future Recommendation

Future research may consider conducting a longitudinal study to determine whether the intention toward SMT adoption decision changes as organizations evolve over time. This is particularly significant to check how availability of finance affects the intention of SMT adoption as financial conditions change over time. Future research may also consider to include the level of digitalization of respondent companies as part of demographic data.

Conclusion

SMTs focus on the digital interconnectivity of manufacturing elements facilitates sustainable resource utilisation efficiently while promoting expected competitive advantage in manufacturing capabilities of SMEs. However, the acceptance level of SMT adoption among manufacturing SMEs in Malaysia is low. This study aims to examine the organizational motivational aspect on the intention of SMT adoption among manufacturing SMEs in Malaysia, using quantitative research methodology with non-probability sampling method. A total of 160 respondents were collected from among manufacturing SMEs in Malaysia.

The finding of this study indicated that intention of SMT adoption among manufacturing SMEs in Malaysia is driven by internal motive, measured as efficiency and expected competitive advantages. This finding indicated that manufacturing SMEs in Malaysia are looking at productivity improvement in their manufacturing process in order to achieve expected competitive advantages in their industry. Productivity improvement is important as manufacturing SMEs often operate in highly competitive markets whereby efficiency can be a key differentiator.

Supplier pressure and customer pressure in this study does not exert statistically significant influence on the intention of SMT adoption among manufacturing SMEs in Malaysia. This possibly due to customers primarily care about buying price and reasonable quality while manufacturing SMEs have a wide dispersion in their customer base. Flexibility in supplier

selection actually given manufacturing SMEs a wider option, which further reduces supplier pressure on the intention of SMT adoption among manufacturing SMEs.

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