Determinants of B2B Adoption Intention: The Context of MRO Procurement Value for High-tech Industry in Thailand

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Abstract

This study is intended to investigate the interactive relationship between the factors affecting the behavior of B2B adoption intention in the context of MRO procurement value. A conceptual model is developed and tested using quantitative data from high-tech manufacturing organizations in Thailand. Findings reveal that B2B adoption intention is significantly influenced by perceived B2B integration value. Among the set of MRO procurement value, the supply network value, manufacturing value, and market information value positively influenced perceived B2B integration value. On the other hand, relationship value shows no significant influence on the perceived B2B integration value. The mediating role of cost in the correlation between perceived B2B integration value and B2B adoption intention is also tested, but no support is found. The findings of the study are further analyzed to suggest appropriate MRO procurement strategies for Thailand's high-tech manufacturing organizations. Discussion and implications are also addressed.

Keywords: *MRO, Maintenance Repair and Operation, MRO Procurement, Value of Procurement, MRO B2B, B2B Adoption Intention*

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1. Introduction

The recent rise of the fourth industrial revolution, Industry 4.0, and the convergence of the Industrial Internet of Things and Smart Manufacturing have made the transformation of the manufacturing industries (Liu, 2017). While industrial equipment empowers the manufacturing sectors, they affect a company's survival and development to a large extent. The parts and supplies to maintain, repair, and operate the machines and equipment in the manufacturing process, so-called MRO, are now playing a vital role in the manufacturing sector for operation performance enhancement (Schuh, Jussen & Harland, 2018; Hadjikhani & LaPlaca, 2013; Hertwig, 2012).

According to the market survey done by Industry 4.0 Industrial Research Center, the MRO purchase amount is less than 20% of the total purchase; however, companies invest nearly 80% of its resources in MRO procurement. This reveals that manufacturing sectors recognize the needs for maintenance, repair and operation of manufacturing systems, and the significance of MRO procurement for manufacturing (Yang, 2017). Uncertainty is the most challenging aspect of MRO procurement, in which structured material and supplies requirement and planning may not be available. Hence, to improve the MRO procurement dilemma, it is necessary to understand the current operation mode and seek new opportunities for MRO procurement from the new supply chain model. On the other hand, it is necessary to examine the strategic value of MRO Procurement to the organization from a strategic perspective.

First of all, the procurement market of MRO supplies in Thailand's high-tech industry is limited to the traditional model. One way is to purchase through the wholesalers and another way is to purchase through the small and medium-sized trading firms nearby the company. However, such traditional procurement models have various drawbacks, namely time consumed, inconsistent prices and quality, a necessity to maintain high level of inventory, a high level of post-purchase costs, etc. As Thailand's MRO supplies market is relatively fragmented and has not yet formed a scale, MRO supplier management is rather ineffective. In addition, in view of the lack of planning for MRO supplies demand, the high-tech industry has also sought to develop a tracking system to emphasize proactive maintenance. It is expected to solve the existing MRO problems with digital operations and systematic maintenance. These developments reflect the problems in MRO procurement process and management. Hence, how to improve the efficiency of the supply chain and reduce the manufacturing cost has become a vital concern for companies and there arises the MRO B2B industry (Yang, 2017). B2B e-commerce is an efficient and comprehensive integrated service platform that integrate logistics, financial, and information flow. B2B e-commerce integrates the rationale of supply chain management, connecting the company's partners, suppliers, distributors, retailers

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and even end customers together. By unifying the planning and data in the chain, there comes the dynamic alliance ad coordination and realizes the linkage of logistics, financial and information flow (Yang, 2017). In the information economy era, e-commerce platform effectively connects the product supply and demand, simplifies the MRO procurement process, strengthens the communications between companies, reduces information asymmetry, reduces total procurement costs, improve procurement efficiencies and eventually realizes the bottom line to the manufacturing sectors (Srai & Lorentz, 2019; Schuh, Jussen & Harland, 2018; Nurmilaakso & Kauremaa, 2012).

The research findings and suggestions provide domain researchers, high-tech practitioners, B2B consultants and agents with the main determinants linking to the MRO B2B adoption intention. Thereby provides an insight into the advancement opportunities for the MRO procurement management in the high-tech industry in Thailand.

2. Objectives

As the Thai economy transforms from traditional to high-value industries, to gain a competitive advantage, investment in technology and innovations, and upgrading its MRO procurement strategies for effective industrial equipment maintenance become inevitable. This study takes Thailand's high-tech industry as the research object, analyzes the relationship between MRO procurement value and B2B adoption intention, and considers Cost as the mediating role. The intended objectives include:

(1) To propose and verify the relationship between B2B adoption intention and supply network value, manufacturing value, relationship value, and market information value in the context of MRO procurement.
(2) To analyze the mediating role of cost in the relationship between perceived B2B integration value and B2B adoption intention.
(3) To propose appropriate MRO procurement strategies for Thailand's high-tech manufacturing organizations.

3. Literature Review
3.1 MRO B2B

Traditional MRO procurement approach is to search as many offers as possible from various suppliers and select the vendor that is most cost-effective. Such a procurement approach requires a plenty of manpower and time for sourcing, but even so, the quality of purchased items cannot be guaranteed. On the other hand, MRO B2B electronic commerce platform effectively utilizes big data, integrates relevant supply and demand information, locates many qualified suppliers in an instance, shortens the transaction time, and eventually reduces the manpower and time in the procurement process. While MRO B2B assist enterprises to reduce the overall procurement cost and increase procurement efficiency, enterprises can release the resources of professional procurement and supply management from routine repetitive tasks and focus on tasks that are more value-added to the company.

3.2 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) adopted from the Theory of Reasoned Action (TRA) in 1985 to predict an individual's intention to engage in a behavior. The TRA was intended to explain all behaviors over which people have the ability to exert self-control. The key component to this model is behavioral intentions, which are influenced by the attitude about the likelihood of the expected outcome of that behavior, and the subjective evaluation of the risks and benefits of that outcome, in which perceived value for potential determinants is considered to link to the attitude. Ajzen (1985) adopted the TRA to include the Perceived Behavior Control as the third factor to influence behavioral intentions. The TPB stated that behavioral achievement depends on both motivation (intention) and ability (behavioral control). The TPB has been employed successfully to predict and explain a wide range of behaviors and intentions. The TPB was used to develop the conceptual model in the present research.

3.3 Consumption Value Theory

Customer perceived value is an individual's subjective evaluation. The theory of customer perceived value from a customer's perspective while its trade-off definition has its roots in economic theory (Kohtamäki & Rajala, 2016). Perceived value is the consumer's overall assessment of the utility of a product or service based on the perception of getting, giving, benefiting, and sacrificing. In other words, customer perceived value is basically a chain-based value creation which combines the consumer's overall assessment of the utility of a product or service after weighing on the perceived benefit and the cost paid for the product or service (Makkonen & Sundqvist-Andberg, 2017).

The consumption value theory (CVT) introduced by Sheth et al. (1991) indicates that factors influencing consumer behavior can be investigated on the basis of consumption values. Consumer choice behavior is affected by five consumption values: functional value, social value, conditional value, emotional value, and epistemic value. When choosing a product or a service, consumers may be affected by only a single value; however, they may be influenced by two or more or even five values in most cases. This model is founded on three basic assumptions: (a) Consumer choice is a function of multiple consumption values. Consumer's decision is affected by any or multiple or all of the five consumption values. (b) The consumption values make differential contributions. Different consumption values lead to different choice behaviors in any given choice situation. (c) The five consumption values are independent and irreplaceable. The concept of CVT is used to develop potential determinants that are associated with the perceived B2B integration value.

3.4 Perceived B2B integration value and Cost

As economic globalization continues, both business competition and demand uncertainty intensify. Businesses need effective supply chain system to beat competitors and dominate the market. However, MRO purchasing is characterized by variety, a small number of one-time purchases, frequent purchasing, and high demand for professional services. These properties impede a business' effective supply chain management. Nevertheless, MRO supplies play a crucial role in the operation of manufacturing industries. By strengthening MRO purchasing management, a manufacturing organization tend to operate its production process properly, and therefore able to reduce daily maintenance and repair costs, and most importantly, prevent major losses from production equipment downtime. As the Internet and information technology advancement has prompted the development of new business-to-business and smart purchasing platforms, MRO purchasing management must be kept in pace with these developments to facilitate a sound MRO strategic purchasing practice, particularly realizing a supply chain management model that contributes not only a single value but also value to the organization as a whole. From an organization's perspective, the value of supply chain integration includes supply network value, manufacturing value, relationship value, and market information value. Hence, the perceived B2B integration value is a key factor influencing the intention to adopt B2B applications.

Cost is one of the factors that influence the adoption of innovative technologies (Lee, Choi & Koo, 2018). The Department of Commerce of the Ministry of Economic Affairs in Taiwan has consigned the Institute of Information Industry to conduct the E-Commerce Overall Measuring Indicator Survey as part of the Internet Business Application Project. The survey results showed that 32% of the businesses in Taiwan remained reluctant to introduce e-commerce (EC) applications primarily because of cost and online transaction security considerations. Business operators maintained that the most significant outcome of EC application was the reduction of business-related costs and procurement costs. Regardless, several medium-sized enterprises still decided against implementing B2B EC application for cost considerations (Department of Commerce, Ministry of Economic Affairs, 2000). The ultimate goal of a business organization is maximizing its economic benefits. The decision to adopt information technology is closely related to benefits to obtain against the cost to be paid (Chulkov, 2017). On the basis of concept of customer value-chain of Makkonen & Sundqvist-Andberg (2017) and Sheth et al.'s proposition that consumer choice behavior may be influenced by only a single consumption value but in most cases influenced by two or more values, to study the interactive relationship between the factors affecting the behavior of B2B adoption intention, it is hypothesized that:

H1: Perceived B2B integration value significantly influences B2B adoption intention.
H2: Cost mediates the relationship between perceived B2B integration value and B2B adoption intention.

3.5 Supply Network Value

In a supply chain, supply network value serves to promote the information flow and information sharing of information to forge a strong tie between manufacturing industries and consumers so that authentic data and information on consumer demands can be transferred to upstream suppliers timely. Upstream suppliers prepare material for production and deliver output product according to market demand, thus increasing the possibility of transforming a mass production model to mass customization production model. Such transformation ensures a reduction of inventory and unwanted loss as well as fulfill consumers' personalized needs. In a traditional supply chain relationship, information source draws on a horizontal indirect transfer process, in which information is transferred to neighboring members of each level whose partnership is built on mutual trust and respect. The technology advancement of the Internet of Thing (IoT) allows for the correct and immediate integration of supply chain information to promote close coordination and cooperation between members of the supply chain. With the direct information flow obtained from connected supply chain members, supply chain members are able to increase their productivity, curb costs, shorten lead-time, enhance quality, and strengthen customer relationships (Story et al., 2017).

The value-creating potential of a B2B platform draws on the extent by which the participants are motivated and willing to repeat transactions and to which extent the participants have incentives to maintain and improve their links and relations. This phenomenon is the so-called networking. With repeated transactions, the volume increases, and with interactive relationships the willingness to buy and sell increases, ultimately creating values through a lasting network (Gharib, Philpott & Duan, 2017). The trust and increased links between the buyers and sellers of an internet marketplace can enhance the network values when dealing with the strategic value of B2B internet marketplaces (Liu et al., 2018). Moreover, trust is gained through the diverse elements and transparent information of a transaction process, which in turn strengthens the communication channel. Therefore, it is hypothesized that:
H3: Supply network value significantly influences perceived B2B integration value.

3.6 Manufacturing Value

Industry 4.0 emphasizes on value-creation process instead of pure manufacturing, implying a regression to the nature of manufacturing industries. Changes in global consumer behavior have resulted in a shorter product life cycle. Hence, manufacturers shall identify means to satisfy diverse customer demands. To maintain the competitive edge in the market, companies shall improve production efficiency and enhance capabilities to respond to the fast-changing market. Manufacturing servitization and product-based services are the key paths for the upgrading and transformation of manufacturing industries.

From a manufacturing perspective, sales, purchase, and production are linked chain of activities, which involved in a dynamic process of material input and product output. From a logistics perspective, procurement is the first stage of the product output process and hence plays a key role in the production process, product pricing, and the ultimate business profitability. Therefore, procurement management is imperative in a business' operation (Hou & Peng, 2016). While cost, quality, delivery, and innovation could all be the competitive advantages of a business, an effective manufacturing process is fundamental to the actualization of these competitive advantages.

In general, the objectives of procurement include (1) providing the needed supplies for business operation; (2) controlling procurement costs; (3) sustaining product quality; (4) maintaining optimal inventories, and (5) creating competitive edge for the business. These goals are also applicable to MRO purchasing, which is performing as a service role to coordinate and support the operations of a company. Industry 4.0 smart factory represents a leap forward from more traditional automation to fully connected operations and production systems. While production capacity increase with the more automated process, there increase the complexity of the production systems. Consequently, maintenance of this connected production systems becomes critical to the production performance i.e. quantity and quality.

MRO B2B platform, integrating the Internet and information technologies, serves as a tool for MRO procurement. The B2B application realizes the seamless integration of procurement processes i.e.

sourcing, price benchmarking, price negotiation and order follow-up, resulted in procurement efficiency improvement, procurement cost reduction and increased transparency of the procurement process. By means of MRO B2B, procurement personnel could instantly communicate and engage in transactions with numerous suppliers from around the world and free themselves from routine tasks and in turn devote more efforts to strategic operations, thereby facilitating a more flexible business operation. Based on the aforementioned literature, it is hypothesized that:

H4: Manufacturing value significantly influences perceived B2B integration value.

      H4-1: Price value significantly influences perceived B2B integration value.

      H4-2: Quality value significantly influences perceived B2B integration value.

      H4-3: Maintenance value significantly influences perceived B2B integration value.

      H4-4: Repair value significantly influences perceived B2B integration value.

      H4-5: Operation value significantly influences perceived B2B integration value.

3.7 Relationship Value

Traditional supply chain management focuses on the restructuring of internal processes, placing emphasis on the coordination between sales and production related departments as well as the short-term benefits for individual members of the supply chain. However, the rigorous development of Internet technologies has expedited the process of economic globalization, driving supply chain members to cooperate with each other for the sake of market value (Murphy & Sashi, 2018). If a company cannot maintain a positive cooperative relationship with its existing suppliers, then these suppliers could easily turn to partner with its competitors.

The relationships in a supply chain can be a simple trading relationship; however, it can also be a complex one with interdependent relations. A positive supplier relationship empowers a company to have more control over cost, to better allocate the restricted resources, to upgrade its services capabilities, and eventually to increase top-line revenue. In an increasingly complex business environment, companies realize that long-term relationships can facilitate the entire supply chain performance (Kaufmann, Czinkota & Zakrzewski, 2015). The objective of supply chain management is maintaining closed and long-term relationships among members to gain the competitive advantages of the entire supply chain (Kaufmann, Czinkota & Zakrzewski, 2015). These advantages include reduction of transaction costs, development costs, quality costs, and after-sales service costs through effective communication. The establishment of supplier relationships ensures the quick acquisition of key supplies, equipment, and technologies, greatly reduces the latent risks and uncertainties in the supply chain, enhances product quality, shortens delivery lead time, and ultimately improves customer satisfaction. Moreover, knowledge disclosure and transmission in buyer-supplier relationship strengthen a company's ability to launch new products into the market quicker than its competitors do.

Over the past few decades, the B2B market is witnessing an apparent trend toward closed relationships with fewer selected suppliers (Ulaga & Eggert, 2006). Manufacturers reduce their supplier base to a group of key suppliers with whom they wish to maintain true relationships, not mere transactions, in search of operation efficiency, risk sharing, and value creation (Barry & Terry, 2008). Establishing enduring relationships can help suppliers and buyers to create higher value that can be mutually beneficial (Murphy & Sashi, 2018). Companies can build long-range, closely cooperative, and goal-oriented strategic networks in which network members can gain a competitive advantage by lowering transaction costs (Lee, H., Choi & Koo, 2018). The e-commerce can increase information transparency and therefore a cooperative relationship can reduce information asymmetry, thereby improving a company's ability to avert uncertainties (Schubert & Legner, 2011). Based on the aforementioned literature, it is hypothesized that:

H5: Relationship value significantly influences perceived B2B integration value.

3.8 Market Information Value

As supply chains become more complicated, companies face unprecedented pressure from competitions and require an efficient tool to exploit and maximize the value of data. Data analysis is probably the most crucial catalyst for procurement operations in an Industry 4.0 context. Advanced artificial intelligence technologies and algorithms can be integrated and processed to analyze extremely large

volumes of data from heterogeneous sources. Results of data analysis can provide extensive insights regarding suppliers, markets, and customers. These results can also be employed to forecast market trends and monitor production systems. Data analysis help business operators to make wise decisions and even make autonomous purchase decisions (Hsu, 2017). E-Commerce procurement provides a powerful collaborative network that helps companies to identify more qualified suppliers and simultaneously actualize intelligent analysis for predicting supplier capability and reliability. Based on a business roadmap, upcoming supply chain demand can be predicted, thereby realizing a strategic procurement supply chain management practice (Deloitte, 2017).

MRO procurement is characterized by a long-tail distribution, in which categories and specifications expand while usage quantity or purchased amount decreases, thus highlighting the difficulty of MRO purchasing management. In recent years, the development of information systems has provided effective system tools to facilitate the management of complex items in MRO purchasing. However, the MRO B2B operators nowadays establish quality control standards and enforce rigorous supplier evaluation mechanisms to screen for a large pool of top-notch suppliers and build sets of big data on diverse products. This approach definitely fulfills the needs of MRO buyer who constantly seek for market information to improve the procurement efficiency. Based on the aforementioned literature, it is hypothesized that:

H6: Market information value significantly influences perceived B2B integration value.

4. Method

Based on the research motivation, research objectives, literature review, and hypotheses formed in this study, the relationships between the value of MRO Procurement and B2B adoption intention were investigated. Figure 1 illustrates the research framework. The independent variable was MRO procurement value, which comprises of supply network value, manufacturing value, relationship value, and market information value. The dependent variable was "perceived B2B integration value", which was also the independent variable when "B2B adoption intention" is the dependent variable. Finally, this study adopted cost as the mediating variable of "perceived B2B integration value" and "B2B adoption intention."
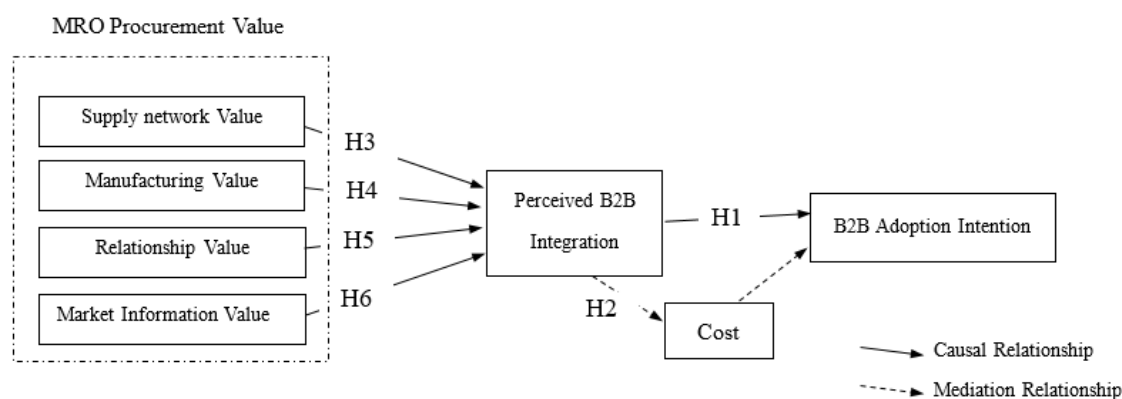
Figure 1 Conceptual Model of MRO Procurement Value and B2B Adoption Intention

This study adopted an online structured questionnaire approach to collect samples. There were 216 questionnaires distributed to corporate members in high-tech manufacturing companies in Thailand. In total, 163 questionnaires were returned. After invalid questionnaires were excluded (e.g., incomplete questionnaires, questionnaires in which a single answer was selected for all questions, or questionnaires with inconsistent responses to reverse-worded questions and general questions under the same dimension), 128 valid questionnaires were collected for a valid retrieval rate of 78.53%.

Data analysis was performed in several stages. First, to ensure an unbiased and accurate result, a preliminary data analysis in SPSS was conducted. Subsequently, to assess the newly developed measures, an exploratory factor (EFA) in SPSS was performed.

The reliability of each construct was assessed by examining the Cronbach's α value and Corrected Item-Total Correlation. Table 1 shows all constructs' value of Cronbach's α were in between 0.843 to 0.968 and Corrected Item-Total Correlation were in between 0.684 to 0.984. The measures showed none of the constructs had reliability issues as the value of Cronbach's α and Corrected Item-Total Correlation were all above the acceptable threshold 0.7 and 0.5 respectively (Chen, 2005).

An EFA in SPSS was conducted using principal component factor analysis with a Promax rotation to validate the scales of all constructs. At the first attempt, EFA was conducted with all constructs; however, no appropriate factors could be extracted. The EFA was then conducted for independent variables and dependent variables separately. The final results of the EFA are shown in Table 2 and Table 3. Seven factors were extracted for independent variables with factor loadings in between 0.622 to 0.908, which were above the threshold of 0.5 (Chen, 2005). The Repair Value and Maintenance Value were combined as one factor and therefore renamed as Preservative Maintenance Value. This indicates that the participants perceived the repair and maintenance value as similar values.

Table 1 Reliability test result

Construct	Item	Corrected Item-Total Correlation	Cronbach's α If Item Deleted	Mean	Variance	Cronbach's α Value
B2B Adoption Intention (AI)	AI1	0.793	0.893			
	AI2	0.886	0.811	11.367	3.777	0.906
	AI3	0.778	0.895			
Perceived B2B Integration Value (PIV)	PIV1	0.867	0.874			
	PIV2	0.851	0.883	15.219	5.668	0.918
	PIV3	0.822	0.889			
	PIV4	0.725	0.927			
Cost (PC)	PC1	0.761	0.905			
	PC2	0.755	0.908	14.555	5.745	0.915
	PC3	0.837	0.879			
	PC4	0.875	0.866			
Supply Network Value (NV)	NV1	0.759	0.853			
	NV2	0.783	0.844	15.523	4.015	0.887
	NV3	0.765	0.851			
	NV4	0.714	0.873			
Manufacturing - Price Value (MVP)	MVP1	0.738	0.758			
	MVP2	0.684	0.813	11.766	2.827	0.843
	MVP3	0.713	0.777			
Manufacturing - Quality Value (MVQ)	MVQ1	0.729	0.889			
	MVQ2	0.844	0.788	11.078	3.931	0.889
	MVQ3	0.784	0.843			
Manufacturing - Maintenance Value (MVM)	MVM1	0.901	0.973			
	MVM2	0.97	0.922	11.008	4.373	0.967
	MVM3	0.919	0.959			
Manufacturing - Repair Value (MVR)	MVR1	0.944	0.944			
	MVR2	0.935	0.95	11	4.157	0.968
	MVR3	0.916	0.964			
Manufacturing - Operation Value (MVO)	MVO1	0.893	0.944			
	MVO2	0.928	0.918	11.422	3.112	0.955
	MVO3	0.896	0.942			
Relationship Value (RV)	RV1	0.923	0.93			
	RV2	0.926	0.925	10.82	4.212	0.957
	RV3	0.984	0.958			
Market Information Value (MIV)	MIV1	0.784	0.826			
	MIV2	0.699	0.863	15.367	4.927	0.878
	MIV3	0.764	0.838			
	MIV4	0.724	0.85			

Table 2 Exploratory factor analysis result (Independent Variables)

Scales	Factor						
	Preservative maintenance value	Market information value	Relationship value	Supply network value	Manufacturing - quality value	Manufacturing - operation value	Manufacturing - price value
MVR-2	**0.908**	0.127	0.168	0.175	0.09	0.052	0.096
MVM-2	**0.906**	0.163	0.145	0.146	0.17	0.154	0.063
MVR-1	**0.903**	0.15	0.145	0.06	0.11	0.179	0.18
MVR-3	**0.881**	0.133	0.085	0.191	0.095	0.171	0.145
MVM-3	**0.88**	0.154	0.09	0.134	0.185	0.26	0.124
MVM-1	**0.855**	0.161	0.113	0.195	0.142	0.081	0.07
MIV-2(Adj)	0.147	**0.847**	0.048	0.06	0.097	0.113	0.114
MIV-1	0.167	**0.799**	0.122	0.254	0.177	0.069	0.156
MIV-3	0.171	**0.72**	0.177	0.336	0.03	0.122	0.226
MIV-4	0.236	**0.692**	0.257	0.18	0.034	0.343	0.087
RV-1	0.169	0.127	**0.889**	0.173	0.199	0.08	0.14
RV-2	0.155	0.141	**0.88**	0.188	0.213	0.106	0.151
RV-3	0.167	0.164	**0.863**	0.15	0.203	0.13	0.107
NV-1	0.164	0.196	0.108	**0.838**	0.116	0.105	0.2
NV-2	0.292	0.333	0.167	**0.728**	0.185	0.078	0.157
NV-3	0.208	0.204	0.222	**0.661**	0.266	0.279	0.128
NV-4	0.223	0.178	0.339	**0.622**	0.194	0.267	0.106
MVQ-2	0.122	0.091	0.293	0.206	**0.795**	0.188	0.262
MVQ-3	0.29	0.099	0.238	0.215	**0.759**	0.222	0.147
MVQ-1	0.297	0.205	0.302	0.206	**0.672**	0.033	0.243
MVO-2	0.432	0.254	0.166	0.264	0.206	**0.698**	0.235
MVO-1	0.395	0.253	0.135	0.32	0.276	**0.675**	0.175
MVO-3	0.385	0.317	0.22	0.237	0.184	**0.67**	0.248
MVP-2	0.11	0.198	0.202	0.185	0.301	0.216	**0.709**
MVP-3	0.259	0.189	0.274	0.2	0.178	0.254	**0.694**
MVP-1	0.288	0.44	0.064	0.26	0.252	0.01	**0.659**
kaiser-meyer-olkin value (KMO）: 0.904; Bartlett's sphericity test : 3781.020; Significance : 0.000							

For dependent variables, the factor loading for PIV-3 was below the threshold of 0.5 (Chen, 2005), indicating it did not accurately measure its relevant constructs, and therefore was eliminated from the scale. After reanalyzed the scales, three factors were extracted for dependent variables with corrected factor loadings in between 0.685 to 0.889, which were above the threshold of 0.5 (Chen, 2005).

Further, the convergent validity was accessed by examining the composite reliability (CR) and the average variance extracted (AVE). The measures showed acceptable convergent validity as all items CR were in between 0.722 to 0.958, which were above the threshold of 0.6 (Fornell & Larcker, 1981), All of the constructs had an AVE in between 0.464 to 0.790. AVE result of Quality Value and Price Value is below the threshold of 0.5 (Fornell & Larcker, 1981), but the minor difference (0.036 and 0.027) is considered acceptable in this exploratory study. The final results are shown in Table 4.

Finally, the discriminant validity of the factors was assessed by comparing the inter-constructed correlation with the square root of AVE. Hair et al. (1998) suggested that the acceptable discriminant validity is determined when the inter-constructed correlation is smaller than the square root of AVE. The discriminant validity test result is summarized in Table 4, which indicates adequate validity. The multiple regression model was adopted to derive the results of hypothesis tests.

Table 3 Exploratory factor analysis result (Dependent Variables)

Scales	Factor		
	Cost	**B2B Adoption Intention**	**Perceived B2B Integration Value**
PC-4	**0.87**	0.301	0.19
PC-3	**0.855**	0.235	0.226
PC-2	**0.8**	0.098	0.372
PC-1	**0.747**	0.385	0.219
AI-1	0.224	**0.889**	0.198
AI-2	0.305	**0.832**	0.334
AI-3	0.289	**0.696**	0.476
PIV-4(Adj)	0.228	0.209	**0.852**
PIV-2	0.362	0.426	**0.737**
PIV-1	0.366	0.486	**0.685**

kaiser-meyer-olkin value（KMO）: 0.902; Bartlett's sphericity test :1114.908; Significance : 0.000

Table 4 Convergent validity and discriminant validity test result

	Factor	CR	AVE	1	2	3	4	5	6	7			
Independent Variables	(1)Preservative Maintenance Value	0.958	0.79	**0.889**									
	(2)Market Information Value	0.85	0.588	0.453	**0.767**								
	(3)Relationship Value	0.909	0.77	0.39	0.404	**0.877**							
	(4)Supply Network Value	0.807	0.514	0.5	0.586	0.511	**0.717**						
	(5)Quality Value	0.787	0.553	0.478	0.399	0.563	0.569	**0.744**					
	(6)Operation Value	0.722	0.464	0.608	0.535	0.506	0.608	0.558	**0.681**				
	(7)Quality Value	0.729	0.473	0.469	0.572	0.465	0.575	0.603	0.557	**0.688**	1	2	3
Dependent Variables	(1)Cost	0.891	0.671						0.819				
	(2)B2B Adoption Intention	0.85	0.656						0.603	**0.81**			
	(3)Perceived B2B integration value	0.804	0.579						0.685	0.642	**0.761**		

5. Results and Discussion

First, the effect of perceived B2B integration value on adoption intention was analyzed. Multiple regression analysis was performed on a model of adoption intention as the dependent variable and perceived B2B integration value as the independent variable. The result showed that perceived B2B integration value (β = 0.747, p<0.01, H1) positively and significantly influenced adoption intention, indicating that H1 was supported.

Next, the first-level hypotheses (i.e., the effects of the four antecedents on perceived B2B integration value) were tested. Multiple regression analysis was performed on a model of perceived B2B integration value as the dependent variable and the four MRO procurement values (supply network value, manufacturing value, relationship value, and market information n) as the independent variables. The result showed that, supply network value (β = 0.282, p<0.01, H3) positively and significantly influenced perceived B2B integration value, suggesting that H3 was supported. Manufacturing value (β =0.253, p<0.01, H4) positively and significantly influenced perceived B2B integration value and, therefore, H4 was supported. Relationship value (β =0.026, p=0.749, H5) did not significantly influence perceived B2B integration value, indicating that H5 was not supported. Market information value (β =0.249, p<0.01, H6) positively and significantly influenced perceived B2B integration value; hence, H6 was supported. Table 5 shows the analysis results. Overall, the supply network value, manufacturing value, and market information value positively influenced perceived B2B integration value. The effect of the supply network value was the strongest.

Table 4 Hypotheses test results (first level)

Hypotheses	Casual Path	Standardized coefficients (β)	t	p-value	Test Result
H1	Perceived B2B integration value → Adoption intention	0.747	12.597***	0.000	Support
H3	Supply network value → Perceived B2B integration value	0.282	2.849***	0.005	Support
H4	Manufacturing value→ Perceived B2B integration value	0.253	2.409**	0.018	Support
H5	Relationship value→ Perceived B2B integration value	0.026	0.321	0.749	Not support
H6	Market information value→ Perceived B2B integration value	0.249	2.891***	0.005	Support

**p<0.05; ***p<0.01

Subsequently, the second-level hypotheses were tested (i.e., the effects of the four subfactors of manufacturing value on perceived B2B integration value). Multiple regression analysis was performed on a model of perceived B2B integration value as the dependent variable and the four subfactors (price value, quality value, preservative maintenance value, and operation value) as the independent variables. The two sub-variables, maintenance value, and repair value, were combined into a single variable named as preservative maintenance value and expressed as H4-3. The result showed that price value (β = 0.422, p<0.01, H4-1) positively and significantly influenced perceived B2B integration value; hence, H4-1 was supported. Quality value (β=0.069, p= 0.479, H4-2) and maintenance and repair value (β =0.063, p=0.498, H4-3, H4-4) did not significantly influence perceived B2B integration value, suggesting that H4-2, H4-3, and H4-4 were not supported. Operation value (β =0.197, p<0.1, H4-5) positively and significantly influenced perceived B2B integration value; hence, H4-5 was supported. Table 6 shows the analysis results. Overall, price value as part of the manufacturing value exhibited the strongest influence.

Table 5 Hypotheses test result (second level)

Hypotheses	Casual Path	Standardized coefficients (β)	t	p-value	Test Result
H4-1	Price value→ Perceived B2B integration value	0.422	4.19***	0.000	Support
H4-2	Quality value → Perceived B2B integration value	0.069	0.71	0.479	Not support
H4-3	Preservative value → Perceived B2B integration value	0.063	0.68	0.498	Not support
H4-5	Operation value → Perceived B2B integration value	0.197	1.831*	0.07	Support

*p<0.1; **p<0.05; ***p<0.01

Finally, the mediating relationship was analyzed. As recommended by Baron and Kenny (1986), the following four steps must be met to investigate the presence or absence of a mediating effect: First, perceived B2B integration value and adoption intention must exhibit a significant relationship; second, perceived B2B integration value and cost must exhibit a significant relationship; third, cost and adoption intention must exhibit a significant relationship; and fourth, perceived B2B integration value and cost must have a significant relationship with adoption intention. This study followed the four steps, and the results are organized in Table 7.

Table 6 Mediating effect analysis result

Analysis Step	Hypotheses	Casual Path	Standardized coefficients (β)	t	p-value	Test Result
Step 1		Perceived B2B integration value → Adoption intention	0.747	12.597***	0.000	Support
Step 2		Perceived B2B integration value → Cost	0.664	9.959***	0.000	Support
Step 3		Cost → Adoption intention	0.617	9.795***	0.000	Support
Step 4	H2	Perceived B2B integration value + cost→ Adoption intention	0.603	7.813***	0.000	Not support

*** $p<0.01$

In the first step of the mediation analysis, the adoption intention was the dependent variable and perceived B2B integration value was the independent variable. The empirical results showed that perceived B2B integration value (β =0.747, p<0.01) was significantly related to adoption intention and, hence, Step 1 was met. In the second step of the mediation analysis, the cost was the dependent variable and perceived B2B integration value was the independent variable. The empirical results showed that perceived B2B integration value (β =0.664, p<0.01) was significantly related to cost and, hence, Step 2 was met. In the third step of the mediation analysis, the adoption intention was the dependent variable and cost was the independent variable. The empirical results showed that cost (β =0.617, p<0.01) was significantly related to adoption intention and, hence, Step 3 was met. In the final step of the mediation analysis, the adoption intention was the dependent variable, and the independent variables perceived B2B integration value and cost were simultaneously introduced into the regression equation. The empirical results showed that perceived B2B integration value (β =0.603, p<0.01) and cost (β =0.217, p<0.01) were significantly related to adoption intention and, hence, Step 4 was met. The coefficient changes and level of significance were examined following the four steps for testing mediation. The results revealed significant relationships. Although in terms of coefficients, perceived B2B integration value was reduced from β =0.747 (p<0.01) to β =0.603 (p<0.01), a strong significance was observed between the two variables. Therefore, cost does not exhibit mediating effect and H2 was not supported.

This study found that perceived B2B integration value positively and significantly influenced adoption intention, indicating that companies are aware that B2B e-commerce platforms can bring about diverse values for the company, thereby motivating companies to manage their MRO purchasing on a B2B e-commerce platform. Specifically, the primary factors of consideration were the supply network value, market information value, manufacturing price value, and manufacturing operation value. The finding deepens the understanding of the consumption value theory introduced by Sheth et al. (1991) that consumer choice behavior is affected by any or multiple or all consumption values.

As the supply markets for MRO non-productive materials of high-tech industries in Thailand are relatively scattered and limited in scale, the procurement activity in the industry is still confined to the traditional multi-point procurement method in which companies purchase supplies from their local wholesalers and neighboring traders. Consequently, a considerable amount of time and resources is dedicated to sourcing and managing suppliers to meet the manufacturing requirements. Nevertheless, a B2B platform can effectively utilize information technologies to integrate and match relevant supply-demand information and resources and provide a large number of qualified suppliers and products for benchmarking. Therefore, companies recognize the supply network value and market information value of an e-commerce platform. A B2B platform simplifies the supplier-searching process, shortens transaction time for both parties, and prevents wasting of human resources. Subsequently, sourcing cost is lowered and the transparency of product prices and reputations is increased. In other words, a B2B platform provides values in terms of manufacturing price and market information. The finding is consistent with previous studies following Deloitte (2017) that E-Commerce procurement stipulates a powerful collaborative network that enables companies to identify more qualified suppliers.

On the other hand, the results of this study revealed that relationship value did not significantly influence adoption intention, indicating that companies cannot establish mutual trust and cooperative relationships with suppliers through the use of B2B e-commerce platform for business purchases. The reason behind may be the business risks of authenticity and integrity of trading partners on the B2B platform. In reality, when a company considers a supplier as a good one, it tends to carry on a long-term relationship. When a company has a stable and good relationship with offline suppliers, there seems no motivation for companies to maintain a long-term relationship with B2B platform suppliers. Even if a new supplier relationship is established on the B2B platform, it could develop into a strong relationship without having to come back to the B2B platform for business transactions. This phenomenon matches with the aforementioned result that the factors driving companies to adopt a B2B e-commerce platform are the supply network value and the market information value.

The study revealed that quality value did not significantly influence perceived B2B integration value, indicating that companies are not able to obtain adequate quality-related information about the products in search or effectively manage for consistent product quality over the times. The cause might be the nature of the MRO supplies which is feathered with non-standardization. When goods are not standardized, it is rather difficult for companies to judge the product quality and post-sales service quality over the limited information on the web. In addition, the supply relationship established on the platform is a weak relationship, which is not established on the basis of trust and corporation. While it is difficult for a buyer to touch and experience the goods with an online virtual store, it limits B2B platform suppliers to convey quality-related messages to buyers, especially in the case of non-standardized goods like MRO supplies.

The study also revealed that repair value and maintenance value did not significantly influence perceived B2B integration value, indicating that companies are not able to enhance their equipment repair and maintenance management. This is probably due to the fact that equipment repair and maintenance is mainly related to the post-sales services rather than the parts itself, especially when the repair and maintenance services are technically oriented. In such cases, companies may rather consider the full-service plan offered by original suppliers of the machine or equipment. Besides, different field applications may require more involvement and consultancy from suppliers. While the B2B platform suppliers in most of the cases do not extend their service to post-sales supports, companies consider B2B platforms not helpful for equipment repair and maintenance.

The results of this study showed that there is no mediating effect of cost on the relationship between perceived B2B integration value and B2B adoption intention. This indicates that respondents believe that B2B implementation, adoption, and operation costs are trivial to affect their perceived B2B integration value of B2B and thus to affect their intention to use B2B platforms. This is probably because the large-scale development of the industrial Internet of Things has lowered the B2B adoption cost, and probably B2B procurement has a lower cost than the traditional multi-point procurement especially in the case of MRO procurement, which is featured with small volume, wide variety, and uncertainty. In sum, with the use of B2B platform, companies are able to improve its overall procurement efficiency for the sake of supply network & market information provided by the platform, and thus tend to neglect the B2B cost. The finding sharpens the understanding of Makkonen & Sundqvist-Andberg (2017) that customer perceived value is a combination of overall assessment of a product or service's perceived benefit against the cost paid.

6. Conclusion

This study contributed to propose and verify the relationships between MRO procurement value and the intention to use an e-commerce platform for MRO industrial supplies. Based on the past studies on the development of supply chain management, this study defined and inferred the value of MRO procurement and analyzed the mediating role of cost in between B2B adoption and value of MRO procurement. By collecting samples of corporate members in Thailand's high-tech industry, the results were able to provide an insight into the strategic development for MRO procurement in Thailand's high-tech industry.

The results of the research provide valuable practical guidelines for electronic commerce development. First, electronic commerce cannot provide all the key values in the perspective of supply chain management. Businesses shall reconsider to integrate the online resources with offline supports to take the best out of e-commerce. Second, the study revealed that relationship value is difficult to be realized in the electronics marketplace as the electronics consumption value tend to fulfill the basic product need while the emotional interactions and trusted corporative relationships is difficult to be maintained. Third, based on the result of the study, e-commerce is not suitable for all procurement of industrial supplies, especially in practical MRO procurement, it comes across a wide range of products. It is concluded that e-commerce is more suitable for handling products that are of high market recognition and brand recognition, and products that are standardized and lower in price, and products that are not post-sales service prompted. Based on the aforementioned practical implications, the study proposes below suggestions for MRO procurement in Thailand's high-tech industry:

1. MRO procurement management shall classify the products according to product attributes i.e. easiness of product identification, product standardization level, product unit price, after-sales service requirement, etc. and define the suitable procurement model i.e. traditional procurement approach or e-commerce approach.
2. To leverage the MRO procurement efficiency, businesses shall make use of the prominent value of MRO B2B: supply network value and market information value.

Based on the aforementioned practical implications, the study also proposes below suggestions for MRO B2B platform developer and B2B platform supplier:

1. Pure virtual e-commerce without physical product experiences and service support, B2B platform growth is questionable. Online and offline integration may be the solution to take more out of B2B.
2. B2B platform developer shall enforce strict B2B supplier selection mechanisms, periodic product authenticity review, and post-sales supplier evaluation system for B2B supplier and product quality management enhancement.

The research targets of this study were corporate members of high-tech industries. The results of this study could not be applied to other industries for categorical inference. While the results of validity and reliability tests delivered sufficient confidence; however, developing measures for the constructs with a larger sample is desirable. The research samples were limited in size; the researchers were unable to contact and select the samples that meet the expectation of this study in a larger context. Therefore, some of the empirical analysis results were not as expected. Future studies with an interest in the development of MRO procurement in the high-tech industry can take a more rigorous approach to collect samples. Furthermore, future studies could reconsider the hypotheses that were not supported in this study to conduct further empirical analyses. Finally, the focus of this study was confined to high-tech industries in Thailand. In the future, the scope of this research can be extended to include cross-national and cross-regional comparisons. In other words, future studies could incorporate high-tech industries from different countries and regions as research targets and conduct empirical research on their effects on cross-cultural differences, market economies of scale, and supply chain systems.

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