Journal of Engineering and Applied Sciences 11 (8): 1727-1734, 2016
ISSN: 1816-949X

The Effect of Supply Chain Technology Adoption: An Empirical Study of Textile and Apparel Industry in Malaysia

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Abstract: In today's dynamic business environment, the competition is no longer between firms but between supply chains to gain competitive advantages. The global sector, especially the textile and apparel industry are essentially known for its supply chain dependency. The delicate nature of its business leads to emphasis on the smooth movement of upstream and downstream supply chain. The nature of this industry, however, result in huge dynamic flow of physical, information and financial. The dynamic management of these flows requires adoption of supply chain technology. Even though, technology is widely implemented and studied in many industries by researchers, the adoption of supply chain technology in Malaysian textile and apparel industry is still limited. There is relatively a handful academic study conducted on recent developments in Malaysian textile and apparel industry and supply chain technology adoption indicate a major gap in supply chain studies. Considering the importance given to Third Industrial Master Plan by the government Malaysia, it is necessary to understand the power of supply chain technology adoptions. This study aims to investigate supply chain technology adoption by textile and apparel companies in Malaysia. The result highlighted the supply chain agility perceived by textile and apparel companies from supply chain technologies. This study could be used as a precursor for further detailed studies on this issue.

Key words: Supply chain technology, supply chain agility, textile and apparel industry, Malaysia, firms

INTRODUCTION

Malaysia is one of the competing countries globally. Malaysia economy was rank 24th in the global competitiveness index in 2013. Besides, Malaysia is one of the fastest growing economies in the world. Malaysia economy was declared as the 34th largest economy in the world's Gross Domestic Product (GDP) worth US $305 billion, in 2012. Malaysian manufacturing industries and service sectors contribute to its economy rapid growth. The Textile and Apparel (T&A) industry is one of the fastest growing industries in Malaysia. Besides, the industry has been recognized by the Third Industrial Master Plan (IMP3) for further advancement and it has the highest forecast of annual growth of export which is 7.80% per annum. Moreover, Department of Statistics Malaysia reported that T&A industry has contributed 1.70% to the growth of GDP in the manufacturing sector in 2012. This shows the industry's potential to be researched primarily because of its contribution to Malaysia's GDP.

Issues of the study: T&A industry support both upstream and downstream of the supply chain. This industry is highly fragmented with Small and Medium size Enterprises (SMEs) (Ma and Zhang, 2009). As per Federal of Malaysian Manufacturer (FMM), Malaysian T&A industry is made up of small, medium and large enterprises. Hong Kong T&A supply chain is faced the similar situation as described by Hunter and Valention (1995) and Lam and Postle (2006) Therefore, the developed and developing countries such as Malaysia had placed specific attention on the development of SMEs (Mizar, 2013), since it has contributed to the country in terms of resource utilizations, employment opportunities and economy development. In general, the T&A industry faced several problems in its operation. One of the most critical issues faced by T&A companies worldwide is related to supply chain agility.

Supply Chain Technology Adoption (SCTA) is one solution to all above stated issues (Chen *et al*., 2007). Its deals with the application of transforms raw data into information and knowledge that aiding practitioners to well-organizing and improving the business operations (Singh, 2003). Easy traceability and multi-usage ability has led to SCTA inclusion into textile and apparel supply chain operations. This has led to extensive studies on SCTA in these areas. The complexity, volatile and

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dynamic of T&A supply chains has made the studies of SCTA more challenges (Tarokh and Soroor, 2006; Soroor *et al*., 2009). The situation of Malaysian T&A industry is not different. This leads to a query on SCTA in Malaysian T&A industry. What kinds of Supply Chain Technology (SCT) adopted by the Malaysian T&A company? What is the effect of SCTA in Malaysian T&A company? This study aims to understand the SCTA and the effect to supply chain agility of T&A company in Malaysia.

Textile and apparel supply chain: Regardless in developed or developing countries, textile and apparel are one of the important requirements for human being in the world. It provides necessary protection to individuals. The necessity made textile and apparel industry become stronger and potential to be developed. This industry has added value to each single movement along the supply chain starting from the initial supplier of raw materials to the delivery of finished goods to end customer (Khurana *et al*., 2008). The potential of the industry to be developed has led the industry to be researchable. This is supported by the IMP3, where textile and apparel industry has been recognized to extend further and gives the contribution at a higher level of GDP. This industry possesses the highest forecast of annual growth of export and lowest investment share which is 7.80% growth per annum and 2.10% share as illustrated in Fig. 1. In fact, the exports of T&A grew by 15.9% in 2011 from RM9.32-10.81billions. In addition, Department of Statistics Malaysia reported that T&A has contributed 1.70% to the growth of GDP on manufacturing sector in 2012. This shows the industry's potential to be researched primarily because of its contribution to Malaysia's GDP Fig. 1.

Generally, supply chain consists of upstream and downstream process flows. Similarly, T&A supply chain business also classified into two main sectors. The upstream sectors consist of vendors that producing and performing fiber, yarn, fabric and wet processing activities. While, the downstream sectors consist of manufacturers who producing apparel, textile products, home textiles and clothing accessories for wholesaler or retailer and customer to purchase. The development broadens the coverage areas of this industry which involving spinning, knitting, weaving, dyeing, printing, silk screening and embroidery making. Most of the Malaysian made T&A are exported to Canada, United Stated, Turkey and Europe while major imported from China, Taiwan and Japan (Seong, 2007). Indian T&A exporters are facing strong competition and challenges

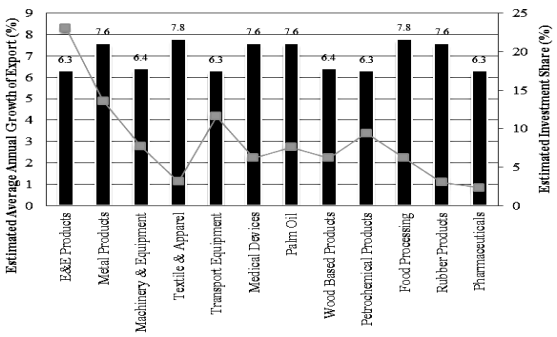

Fig. 1: Comparison between estimated percentage of exports average annual growth and investment share among twelve selected industries

from low wage countries such as Indonesia, Cambodia, China, Bangladesh and Vietnam. One of the developing countries, Malaysia is facing the same problem that faces by India. However, Malaysia managed to sustain the operation even with the economic slowdown in 2009 (Musa, 2010). This is because Malaysian T&A industry has achieved a certain international standard on its quality, reliability and prompt delivery as well as fashionable Islamic apparel's producer. In detail, Malaysian T&A companies has produced a number of world known brands such as Brooks Brothers, Ralph, Kohl's, Calvin Klein, Alain Delon, Gucci, Polo, Lauren, Adidas, Nike, Yves St Laurent, Walt Disney, Reebok, Puma, GAP, Oshkosh, Burberry, Ashworth, etc.

Today's T&A marketplace is characterized by dynamic competition and short life cycles, tremendous product variety (Sen, 2008), high volatility (Ma and Zhang, 2009), low predictability (Lam and Postle, 2006), high impulse purchasing (Christopher *et al*., 2004), unclear market boundaries, non-linear direction (Beske, 2012) and colossal number of product codes (Ma and Zhang, 2009). In information perspective, the Malaysian T&A industry is no longer a chain but a value net. This is because this industry formed by SMEs. As per FMM, Malaysian T&A industry is made up of 1% is micro enterprise, 30% are small enterprises, 44% are medium enterprises and 25% are large enterprises as illustrated in as following. Chin *et al*. (2012) found that large companies are well recognized the benefits of Supply Chain Management (SCM) but SMEs in Malaysia are insufficient knowledge on remarkable changes and potential benefits of SCM in Fig. 2.

Supply chain technology adoption: Although, SCT is universally accepted but there is no common definition of SCT (Kamaruddin and Udin, 2009). Therefore, there are a number of definitions used to define SCT by several

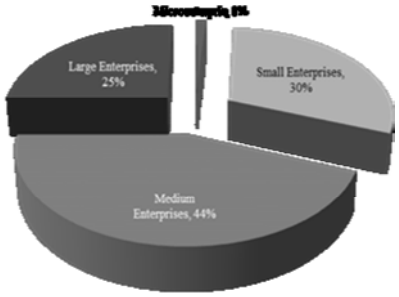

Fig. 2: Sized of textile and apparel companies in Malaysia

researchers in their study (Singh 2003; Kamaruddin and Udin, 2009; He and Chen, 2008; Blankley, 2008.) generally defined SCT as an Information Technology (IT) specifically used to manage or support elements or components of the supply chain. Singh (2003) defined SCT as an application to transform original data into information and knowledge that can efficient and effective the business activities. Kamaruddin and Udin (2009) defined SCT as "a technology or a system that use to coordinating and integrating information flow electronically throughout the supply chain to generate effectiveness and efficiency of business processes".

New technologies and innovations are constantly changing and improving the way of doing thing and approach problems. Today, the applications of IT touch human live every second. It has aided processes, institutions and industries around rethought and redesigned. In the current decade, SCT is plays an essential role in SCM. Based on the global information technology report, Malaysia is on top of the networked readiness index which ranked 29th among 144 countries around the world. Generally, this means that IT usage in Malaysia can be considered as high if compare to other selected countries in the list. IT intelligently provides connection between people, processes, data and things. It is clear that SCT offers higher benefits such as offering new ways to create value by better and more efficiently organizing the use of physical, information, financial and human resources (Hassan *et al.*, 2013). As highlighted in the global information technology report, this study believes that SCT would demonstrate a positive impact on short and long term performance. This study also believes the next wave of new SCTA will further advance the growth effects of the SCM. Despite the facts that SCTs are becoming increasingly universal, the queries of implementation, adoption or usage remain essential.

Supply chain agility: In recent years, the attention and focused of researchers and practitioners have been growing to supply chain agility, since the products and services are driven and defined by customers (Ping and Debin, 2010; Gligor *et al*., 2013). Agility can be defined as the flexibility and adaptability to react quickly and rapid shifts in supply and demand changing (Hult *et al*., 2007). There are differences between agile and lean. Agile is characterized as flexibility, low in prediction, market sensitive and able to works in rapidly varying demand with high product variety while lean experts in huge production but low product variety and needed predictable environments (Christopher, 2000). In the early 1990's, agile manufacturing was proposed and implemented to meet customers' rapidly varying demand through flexibility and reconfigurability (Gligor and Holcomb, 2012). Flexibility is "a manufacturing systems' ability to adjust to suit customers' preferences" while reconfigurability is "the ability to adjust to meet changing demands" (Luo *et al*., 2001).

The study of Jin, Wang and Palaniappan (Jin and Wang, 2005) revealed that agility can be achieved through the integration of all available resources in the supply chain including technology, people and organization. Meanwhile, supplier partnership is crucial importance to achieve the agile response in rapidly varying market demand. The study of Tallon and Pinsonneault (2011) which includes 241 firms from Top Computer Executives Directory 2002 justified that agility as part to improve their performance. Therefore, agility is becoming one of the main characteristics in contemporary and modern SCM (Jiang *et al*., 2008). Aligned with the market demand, several technologies have emerged for firms to manage their supply chain more agile but most of them are in development stages. However, universal users in the supply system expected that all the information be readily available whenever and wherever it is needed (Jiang *et al*., 2008).

Supply chain technology adoption and supply chain agility: The adoption of SCT offer organization abundant benefits. Several researchers found that SCTA is led to operational benefits (Hamid and Anuar, 2008), reduce costs, improved reliability (Burn and Ash, 2005), reduce inventory cost, improved flexibility (Bingham *et al*., 2003; Porter, 2001; Hwang and Min, 2015), enhanced agility (Hwang and Min, 2015; Vickery *et al*., 2010; Bagheri *et al*., 2013a, b, 2014) increase responsiveness (Bingham *et al*., 2003) providing management support, improve customer service, reducing operational costs, gaining competitive advantages (El Sawy *et al*., 1999; Premkumar *et al*., 1997; Dolci and Macada, 2014; Chan *et al*., 2012) minimizing bullwhip effect, reducing inventories, maximizing efficiency of activities, higher

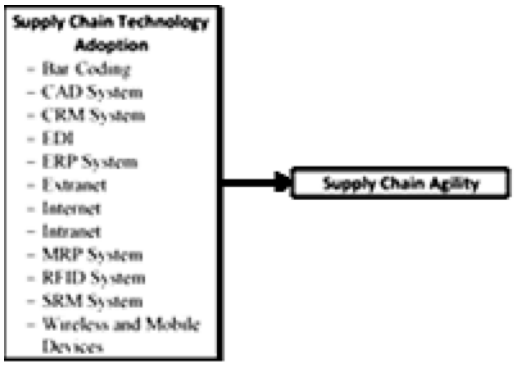

Fig. 3: Research model

quality (Burn and Ash, 2005; Cao *et al*., 2013), lowering cycle times (Hamid and Anuar, 2008; Vickery *et al*., 2010; Cao *et al*., 2013), better transaction efficiency (Hamid and Anuar, 2008; Efendi *et al*., 2012) and greater market transparency (Efendi *et al*., 2012). The adoption of B2B is led to performance improvement through lower administrative and purchasing costs (Efendi *et al*., 2012) while the adoption of the Internet and mobile technology is led to enhance agility in the supply chain (Samdantsoodol *et al*., 2013), responsiveness and flexibility (Sukwadi *et al*., 2013). It is clear that SCT investments revolutionize supply chain performance (Collins *et al*., 2010; Ranganathan *et al*., 2004). However, these advantages and benefits can be elusive (Edmondson *et al*., 2001). Different applications can lead to the different outcomes, even the use of similar technologies (De Sanctis and Poole, 1994). This means that the company must be capable to adopt the right SCT in the right time and on the right place that completely matches the operation needs for the company.

Research model and hypotheses: Research model of the study is presented in to illustrate the relationships of the variables that undertaken in this study. Based on the aforementioned discussion, it is hypothesized that SCTA has a positive relationship with supply chain agility. This leads to the hypothesis of this study as follows Fig. 3.

- H_1: SCTA is positively influence to supply chain agility

MATERIALS AND METHODS

This study employed quantitative research method in testing objective theories (Creswell, 2013). Survey questionnaire was the instrument of this study. Respondents were asked to answer closed-ended questions. The items used to measure the variables of this study were presented in . This study consisted of 18 items used to measure supply chain technology adoption and supply chain agility, where six items and 12 items respectively. The samples of 201 organizations of this study were drawn by using simple random sampling techniques from the total population of 423 organizations in the directory provided by Federation of Malaysian Manufacturers (FMM) and Malaysian External Trade Development Corporation (MATRADE) (Matrade Directory, 2013; Krejcie and Morgan, 1970; Kervin, 1992; Saunders, 1997). While, the unit of data analysis for this study is organization. A total of 201 survey questionnaires were sent through email and mailed to the samples. The data was collected through the proper followed of data collection procedure advised by Whitley (1985), Mentzer and Kahn (1995) and Grant *et al*. (2005). This was led to the good response rate which is about 60.20%. This means that 125 survey questionnaires were returned, four were discarded due to the incomplete response and 121 usable responses were used for the data analysis of this study.

RESULTS AND DISCUSSION

The total of 121 usable responses were used for the Analysis Through Partial Least Square Structural Equation Modeling (PLS-SEM) analytical technique with the aid of the application of SmartPLS. In PLS-SEM, the assessment is comprised of two elements which is measurement model and structural model (Hair *et al*., 2014). The assessment of the measurement model is to test the reliability and the validity of the outer model. Therefore, convergent validity and discriminant validity are performed (Fig. 4).

As Hair *et al*. (2010) recommended, the adopted threshold value of factor loading is 0.50 and above. The value of Composite Reliability (CR) above 0.70 is considered acceptable and the Value of Average Variance Extracted (AVE) above 0.50 is considered appropriate (Fornell and Larcker, 1981). shows that all the factor loadings ranged from 0.520-0.922 which exceeding the threshold value of 0.50 (Hair *et al*., 2012). In addition, composite reliability and the AVE statistics for every construct are considered good and accepted, since all composite reliability and AVE is above 0.70 and 0.50, respectively. The results of convergent validity revealed that all the constructs used are capable to measure the actual concepts of the study in Table 1.

Supply chain agility

"During the last three years, our company achieved significant improvement in":

- Adaption to product volume changes
- Solve unexpected problems

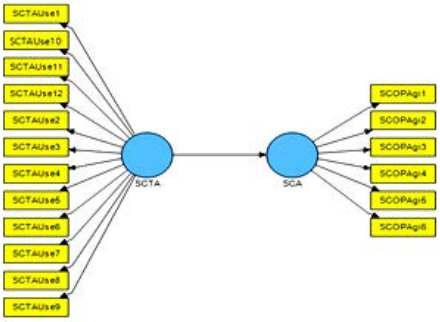

Fig. 4: Full model

Table 1: Convergent validity

Construct/Item indicator	Loading	AVE	CR
Supply chain agility			
SCA1	0.875	0.748	0.947
SCA2	0.922		
SCA3	0.825		
SCA4	0.869		
SCA5	0.811		
SCA6	0.883		
Supply chain technology adoption			
SCTA2	0.816	0.528	0.916
SCTA3	0.803		
SCTA4	0.732		
SCTA5	0.669		
SCTA6	0.595		
SCTA7	0.597		
SCTA8	0.520		
SCTA10	0.684		
SCTA11	0.846		
SCTA12	0.904		

AVE = Average Variance Extracted; CR = Composite Reliability; Loadings>0.50; AVE>0.50; Composite reliability>0.70; SCTA1 and SCTA9 were deleted due to low loadings

- Resources reallocation to support demand changes
- Customization level
- Speed of respond to demand changes
- Expedite shipments
- Supply chain technology adoption
- "Our company has adopted…"
- Bar-Coding Technology
- Computer-Aided Design Systems (CAD)
- Customer Relationship Management Systems (CRM)
- Electronic Data Interchange (EDI)
- Enterprise Resource Planning Systems (ERP)
- Extranet
- Internet
- Intranet
- Material Requirements Planning Systems (MRP)
- Radio Frequency Identification Systems (RFID)
- Supplier Relationship Management Systems (SRM)
- Wireless or Mobile Devices

Table 2: Discriminant validity

Constructs	SCA	SCTA
SCA	0.865	-
SCTA	0.393	0.726

Table 3: Results of hypothesis testing

	Full model				
Hypothesis	Relationship	β	ES	t-value	Decision
H_1	SCTA_SCA	0.393	0.122	3.207	Supported

Table 4: Construct cross validated redundancy

Total	SSO	SSE	1-SSE/SSO(Q^2)	Remark
SCA	162.000	156.868	0.032	Significance

Significance at $Q^2>0$

Table 5: GoF and geometric means

Variables	Communality	Composite reliability	R^2
SCA	0.748	0.947	0.154
SCTA	0.528	0.916	
Geomeans	0.628		0.154

R^2*Communality = 0.097; GoF 0.408; GoF values 0.1 above = small; 0.25 above = medium; 0.36 above = large

Besides, the assessment of discriminant validity was also undertaken to ascertain the external consistency of the model. Fornell and Larcker (1981) noted that discriminant validity was confirmed when the square root of each constructs higher than its highest correlation with any other construct. presented the result of discriminant validity with the value of square root of AVE of each construct in which SCA = 0.865 and SCTA = 0.726. The results further revealed that the measures of all the variable represent the true measures of their individual variables (Table 2).

The assessment of the structural model is begun after the completion of the measurement model examinations. It is to examine the assumption of regression and correlation of variables. fully explained the path coefficients, beta, standard error, t-value and hypothesis result. In this study, the t-value was calculated using 5000 re-sampling iterations in repetitive bootstrapping (Hair *et al*., 2014). The results explained that the hypothesis was supported with the significance level of 1% (Table 3 and 4).

Besides, this study further test for predictive relevance of the model and represented by Q^2 as shows in This study calculates the Q^2 through blindfolding and the result get from cross validated redundancy determines the ability of the model to predict the endogenous variable (Hair *et al*., 2014). The value of $Q^2 = 0.032$ indicates that the model has predictive relevance Table 5 and Fig. 5.

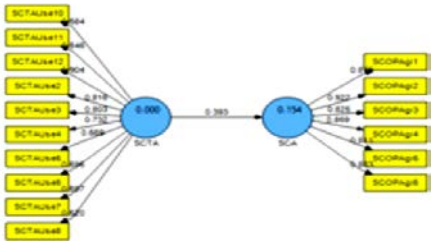

Fig. 5: Holistic effect

CONCLUSION

This study further test for the holistic effect of SCTA on SCA as shown in . The R^2 value 0.154 indicates that SCTA capable of influencing 15.4% of the changes in SCA. This study was conducted to understand the supply chain technology by textile and apparel companies in Malaysia. The total of 121 responses received from the survey of this study has been analyzed through PLS-SEM analytical technique with the aid of SmartPLS application. The results revealed that supply chain technology adoption able to give the contribution in improving supply chain agility in Malaysian textile and apparel industry. The result of this study hinges to a large extent on the ability of the industry to operate more efficiently and effectively in the global competitive market environment. Therefore, Malaysia's textile and apparel companies should pay more attention to adopt proper supply chain technologies to achieve more competitive advantages and greater agility in their supply chain. However, the findings of this study further revealed that there is not enough statistical evidence to support the supply chain technology of bar coding and MRP systems in influencing supply chain agility in textile and apparel industry in Malaysia. Thus, more research on this topic needs to be undertaken to provide stronger justification.

ACKNOWLEDGEMENTS

The researchers would like to extend the appreciation to Universiti Utara Malaysia (UUM) who has provided the academic development opportunities and postgraduate academic supports. Besides, our gratitude also goes to the Ministry of Higher Education Malaysia who has provided the generous financial support through the Fundamental Research Grant Scheme (FRGS).

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