THAMMASAT REVIEW
PRINT ISSN: 0859-5747 ONLINE ISSN: 2630-0303
Volume 23 No 1 (January-June) 2020 [Page 40-69]

Industry Policies, Logistics 4.0 and Competitiveness Development of Manufacturers in Thailand's Eastern Economic Corridor

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Received 21 November 2019; Received in revised form 12 May 2020
Accepted 13 May 2020; Available online 9 June 2020

Abstract

A qualitative study is employed to explore factors encouraging manufacturers in Thailand's Eastern Economic Corridor to enhance their competitiveness by means of logistics 4.0. There are four research issues needed to be addressed in this study: (1) What is the logistics situation of manufacturers in the Eastern Economic Corridor (EEC) areas; (2) What are the roles of technology changes and transfers in adoption of technology-related logistics system for competitiveness; (3) What are the impact of government policies on manufacturers and its logistics system; and (4) What extent should the government support logistics 4.0 and competitiveness of manufacturers within the EEC area.

Data were collected by means of in-depth interview from thirty-five participants at top and middle management levels in firms across EEC regions. Content analysis was employed to analyze data. The findings show that the government's policies have significant impacts on manufacturers within the EEC area, especially the policies that bridge technology transferring gaps (i.e., funding for human development and logistics consultants to assist of individual organizations on some specific issues). In contrast, the incentives given to new investors in the EEC area discourages competitive advantage of existing manufacturers within the areas. The adoption of information technology in the organization is widely found in most of the organizations; however, there are limitations regarding logistics automations and funding to upgrade the advanced equipment for competitive development.

Keywords

Logistics, Logistics 4.0, Industry 4.0, Eastern Economic Corridor, Manufacturer

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Introduction

Industry 4.0 is a revolutionary industrial policy to advance national industrial technology and the information technology for manufacturing and logistics systems (Chuan, 2018). Thailand 4.0 is part of the industry 4.0 policy that aims to unlock the income inequity gap challenged by past economic models (known as Thailand 1.0, 2.0 and 3.0 which were focusing on agriculture, light industry and advanced industry). The policy is also aimed to alleviate the middle-income gap challenges and for Thailand to become a first world nation by 2032 in innovation, technology and creativity, social well-being, rising human value, and protecting the environment (Jones & Pimdee, 2017).

The Eastern Economic Corridor (EEC) is a mechanism of Thailand 4.0. It is planned to be a new economic growth hub in the Eastern regions. The area covers 13,000 square kilometers across three provinces namely Chachoengsao, Chonburi and Rayong (Office of the Eastern Development Zone Policy Committee, 2018). It is heavily invested (approximately Baht 1.5 trillion) to accelerate the area's readiness to support all aspects of trade, investment, and regional transportation as well as act as a strategic gateway to Asia (GSB, 2018; Royal Thai Embassy, 2015). The EEC project is moving forwards, however, a number of studies have claimed that manufacturers in the region are yet to develop to match the 'Industry 4.0' concept and are still debating on its readiness, particularly in the areas of logistics 4.0 where its costs as percent of GDP (13.6 percent) is lagging behind advanced economic nations (NESDC, 2018).

The Twelfth National Economic and Social Development policy plays an important role in the EEC indirectly by means of the Logistics Development Plan III (2017-2021), which encourages Thailand's logistics system to be more competitive, adding value into the manufacturers' supply chain, developing logistics facilities and infrastructure, and improving logistics resources (Logistics Development Division, 2017). Logistics 4.0 is encouraged as a part of the 'value driver 7D' under the Logistics Development Plan III (2017-2021) and Thailand 4.0 scheme (NESDB, 2018).

Interestingly, the policy to support the Logistics' innovation for manufacturers in the EEC region is in place; however, the reflection on the logistics 4.0 of manufacturers within the regions are yet to be disclosed. Thus, this study aims to explore factors encouraging manufacturers within the Easter Economic Corridor in developing their competitiveness under the logistics 4.0 scheme.

Theoretical foundation

Scope of logistics

Logistics management is a part of supply chain management, which encourages manufacturers to reduce costs, improves customer services, and enhances flexibility by time and place that encompass demand forecasting and planning, inventory management, warehouse management, purchasing and procurement, packaging, order processing, customer service and support, transportation and reverse logistics. Logistics system includes product flows, information flow and monetary flow (Thapa, 2014; Wong & Karia, 2009).

Logistics is important to manufacturers as it is a part of the supply chain, which can encourage or discourage competitive advantage among manufacturers within and across borders (Hazen & Byrd, 2012). Cost leadership and customer responsiveness, for instance, require effective management of a warehouse, fleet, procurement and customer management functions. The failure to deliver a product at the expected service (as the demand for high-individualized products and services) and at the common price point may cause a competitive disadvantage against competitors (Hazen & Byrd, 2012).

The Resource-based view theory (RBV)

Basically, there are three elements of a firm's competitiveness, which are the firm's strategy, process, capabilities and resources (Persson & Virum 2001; Wong & Karia, 2010). Resources are a fundamental element for the other basic elements, and contribute to a firm's competitive position against competitors (Penrose 1959; Porter 1985). Barney (1991), who agreed on Penrose (1959), has added that there are two basic assumptions for RBV theory, which are (1) resources and capacities are different, but interchangeable and distributed among firms and related firms (i.e., suppliers); (2) resources are distributed imperfectly. For the manufacturing firms, competitive resources can be developed in-house and receive from the stakeholders such as machine sellers, consultant or even the suppliers (Barney, 1991).

Competitive resources or capabilities have to be valuable and rare. This means they must be useful to strengthen and minimize impacts from threats in the competitive environment. Where the term rare (inimitable and non-substitutable) is there are uncommonly found resources within the industry. With those key components of competitive resources, competitors may need to spend time to imitate using significant expenses (Wong & Karia, 2010).

Rubin (1973) claimed that the resources itself cannot be competitive resources until it is processed. Thus, the firm should have to process raw resources to make it more useful and contribute for competitive advantage. Resources or multiple types of resources could be the key ingredients to process the raw resources, however, the capabilities to process raw resources are different among organizations. A process of structuring, bundling and

leveraging resources for competitive advantage development is a resource management strategy which allows the organization to process raw resources. Dynamic capability or a firm's capability to build, integrate and adjust internal and external capabilities in responding to changing environment (Priem & Bulter, 2001).

Government policies and organisation competitiveness

How can the government help an organisation develop their competencies? Hirschman (1958) and Krugman (1993) claimed that government policies help organisation competitiveness by means of temporary industry protection, subsidization and coordinated government-induced investment. Obvious examples have been demonstrated in South Korea and Taiwan, where active government policies support local firms to compete with international ones (Wade, 1990). The United States also employed the temporary industrial production act in the 19th Century (Chang, 1994).

The government policies and organisation competitiveness found in the 'industrial policy' literature usually links to the organisation strategic management and business performance at national, regional and corporate levels (Porter 1990, Kogut, 1991). The key for competitive advantage development of the firms in a nation under a state policy is fundamentally driven by the imperfect distribution of valuable and rare resources. Thus, industrial policy needs to consider how to encourage and support less developed industry sector to become more competitive in the global markets (Peteraf, 1993).

One more challenge today for the industrial policy makers is to promote the dynamic advantages (as mentioned in the RBV theory in section 2.2) by creating an ecosystem of technological and human capability to explore new how-to or technology for more competitive advantage in the imperfect global markets.

The Eastern Economic Corridor scheme, Thailand's Industry 4.0 and Logistics 4.0 are government policies that are expected by Thailand's government to boost the economy and enhance sustainable competitiveness of national firms and corporation in the challenging change in World economic orders by means of infrastructure investment and partial subsidization on capability enhancement.

Technology change

Organisations these days have to adapt themselves to new technologies, which particularly change the organisations. Specifically, the change in technology causes changes in organisation's social sub-system and culture (Well, 2000; Monhanty and Yadav, 1996). In addition, they impact workers and the longevity of the organisation.

Technologies mentioned in the literature have transformed the nature of human interaction and have modified working structure in systematic ways. Indirectly, they have influenced the skill development in technology users and forced organizational changes by

means of restructuring (i.e., business process re-engineering or total quality management) (Avgerou, 2000). Interestingly, the changes are mainly conducted by IT consultants and vendors, who have technical skills for planning and managing such changes and also have experience in technology related project development (Avgerou, 2000). However, there are a number of criticisms regarding the role of technology vendors and technology consultants on broadening the technology gaps and lessening organisation competitiveness. The criticism issues are interoperability of system and data, hard selling of their template solution with little consideration of their clients' human capabilities, operational and business requirements, highly required customization, switching costs, and importantly, a lack of consideration of their clients' business (Gardner & Ash, 2003). These issues lead to high operating costs, lack of training, workflow disruption and low return on investment (Gardner & Ash, 2003).

In order to develop organizational competitiveness by means of technology, there are a number of barriers to consider, specifically related to human capabilities, equipment costs, quality and quantity of infrastructure, nature of industry, language barriers, national or industrial policy, IT vendors, working process, attitude of employees at different levels, support from top management, technical know-how, technology change and technology investment (Steward & Mohamed, 2002).

Technology transfer

Technology transfer occurs when the application of knowledge is transferred from the developer to the receiver (Gibson, 1999). The process of technology transfer is a transfer of knowledge in the levels that recipients are fully understand and capable to use, replace and possible re-sell the technology (UNEP, 2001).

There are three methods of technology transfer at the industry level. They are purchase techniques (i.e., purchase license), transfer techniques (i.e., technology transfer from the purchase of a machine, technical manual and on-the-job training), and in-house development (Hong, 1994). The factors contributing to the success of technology transfers at the industry level are human resources, information, contractual capital and technical resources such as equipment.

Table 1 Element of Technology transfer

Element	Method of transfer	Mechanism
Human resources	Technology exchange and dispatch	Know-how and administrative training
Information	Patent, technological books or materials	Design, development, marketing and administrative skills development
Resources	Trade of machine, equipment, research materials and production materials	Methods of development, experiment and production
Capital	Joint venture and industrial cooperation	Share of ownership and complying with the contract
Technology absorption capacity	Rules and procedures, database, training, master apprenticeship, peer talk and teamwork	Organisation-wide communication, influence in technology transfer and adoption of technology
Culture	Training, policy and employ foreign management	

Source: Compiled from Hong (1994); Hussain (1998); and Lin, Tan and Chang (2002)

Proposed Research model

A new technology-driven business growth model is widely adopted among advanced economic countries (Roper, 1997). Thailand, as one of the upper-middle income economies, aims to become an advanced economy in 2035 (Jones & Pimdee, 2017) by initiating and adopting the Industry 4.0 policy as the flagship policy for new technology-driven economic growth model of the nation. The main flagship policy is known as Thailand 4.0. The policy has an aim to be a fruitful source of economic stimulation by restructuring manufacturing structure, to provide resources and infrastructure, and to serve the changing customer demand and coping with competitive disadvantage of Thailand's manufacturing sector in the next 20 years (Maesincee, 2017).

Technologies drive changes in product and service demand. A country with inflexible policies will lead to a 'lagging behind' group of countries that are the least

competitive in the new world trading platforms – the digital platform (Adolf & Girish, 2009). Thus, adoption of information, manufacturing, and logistics technologies are essential.

A number of initiatives, investments and policies have been made and exercised. However, a successful model at the corporate level is yet to be explored; especially in terms of business competitiveness. Organization characteristics are critical to absorb the resources given by the government policies and change in technology, which is measured by organization capabilities to utilize technology for business competitiveness (Benjamin & Terry, 2012).

Logistics 4.0 as a part of the competitive driver at business levels needed to disclose its readiness, the impacts of the policies on their performance, and the model for technology adoption for Logistics 4.0 at the business levels. The research framework is proposed in Figure 1 below,

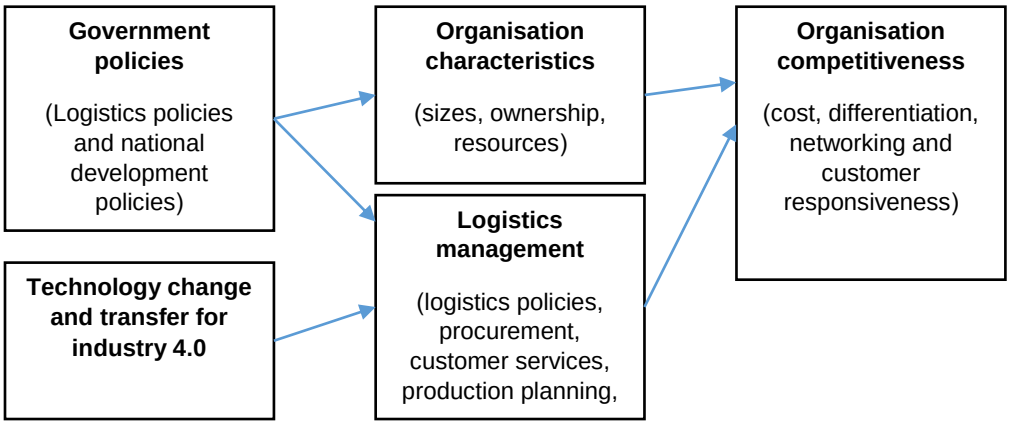

Figure 1 Research framework

Research design

Due to the fact that the research question and objectives are explorative by nature qualitive research was employed in this study. Semi-structured interview questions were used to collect information from thirty-five participants at the top and middle management levels, those who were working in factories at different sizes and industries within the Eastern Economic Corridor areas. Snowball sampling was applied in this study, as qualified informants were fairly limited.

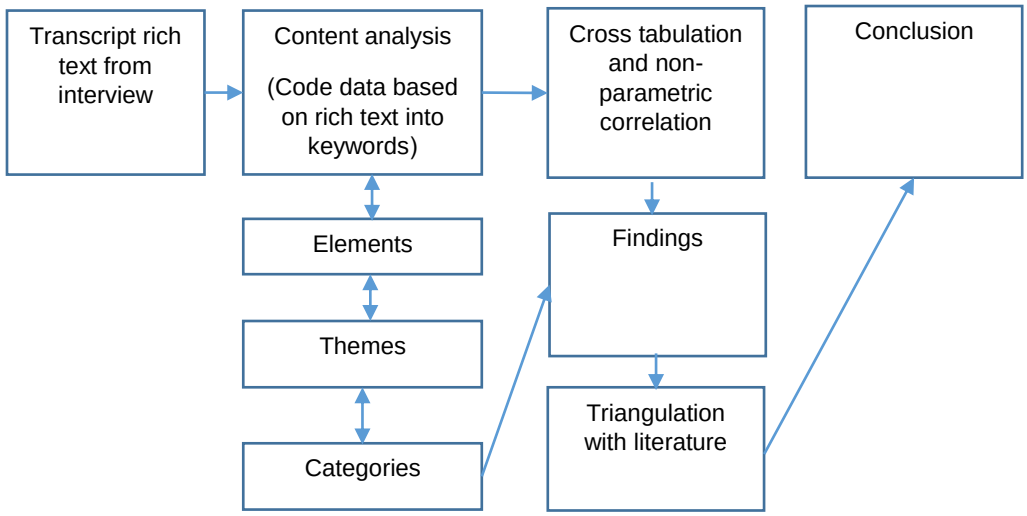

Figure 2 Content analysis approach

Content analysis was employed to analyze the data in order to develop answers the research objectives. A preliminary review of the gathered data was undertaken to clarify the research phenomenon. In this phase a sense of the information was gained from reading the transcripts, and the meaning of the research context could be identified (Creswell, 2003). In the second stage, rich text was reduced into certain phrases, words, or themes which had emerged from the raw data (Patton 1990; Strauss & Corbin 1990). Data-reduction techniques—the process of identifying, simplifying, selecting, focusing, and transforming data into manageable information—were then applied (Cavana, Delahaye, and Sekeran, 2001). The data were reduced by using a coding process. Data in this process were grouped and categorized based on the replication of keywords or elements from the rich text (Creswell, 2003). Categories, themes, sub-themes, and elements were used to describe information about the phenomenon being studied. The findings presented multiple perspectives of participants (Creswell, 2003).

In the third stage, the frequency of categories, themes, sub-themes, and elements were tabulated for each participant and, in that way, represented numerically. Representing the data in such a form allows the researcher to perform very modest statistical operations that could be used to supplement the qualitative descriptions.

Lastly, the outcomes were triangulated with the literature search in order to specify, describe, and represent outcomes and to ascertain whether they were confirmed or disconfirmed (Miles & Huberman 1994). Outcomes of the triangulation were used for conclusions

Respondent profiles

Information was gathered from the top and middle management levels, from manufacturing firms in the Eastern Economic Corridor area, thirteen manufacturing firms were located in Chonburi province, eight from Rayong province and nine from Chachoengsao province.

Table 2 Profile of respondents

Province	Size	Participants	Industry
Chachoengsao	Small (7 firms), middle (3 firms) and large (3 firms)	Top-level managers (10 participants) and middle-level managers (4 participants)	Dairy, Food processing, furniture, automotive, electricity and chemicals
Chonburi	Small (1 firms), and large (7 firms)	Top-level managers (7 participants) and middle-level managers (4 participants)	Construction, paper & material, furniture, food processing, footwear, and automotive
Rayong	Small (3 firms), middle (3 firms) and large (2 firms)	Top-level managers (7 participants) and middle-level managers (3 participants)	Packaging, electricity transportation, food, construction, and automotive

Results

The inductive research approach produced six issues; (1) Impact of EEC in firms' competitiveness; (2) Logistics 4.0 in organizations; (3) Competitive advantage development; (4) Limitations to develop competitive advantage and adoption of logistics 4.0; (5) government support requirements; and (6) the existing support from the government.

Impact of EEC in firms' competitiveness

In general, EEC has perceived no differences in any firm as it is much emphasize on high-tech industries (which is rarely found and competing with existing firms in the EEC areas), the government provides more benefit to new foreign investors (but not to the existing firms) and claimed to face higher land price.

> *I have found no benefit to me (as an existing firm) …except that we have better transportation infrastructure…tax privileges will benefit to the new investor, but not for us. (Chonburi, medium-size, no.3)*

A number of benefits could be the higher accessibility to international markets and other factories that could be suppliers or customers. A few perceived no impact of EEC policies and implementation to them.

> *…the new investor shall be out new supplier…positively, they will help us access foreign market… (Rayong, large-size, no.1)*

In order to take full benefits of the EEC project to them, the firms recommend that the EEC should (1) develop human resources within the regions; (2) improve transportation infrastructure; and (3) leverage information technology for corporate benefits.

1. Human resources

Regarding human resources within the EEC region, the wage is forced to increase continuously. Thus, human skill development is necessary and technology transfer are required to improve overall human productivity.

> *…we are willing to rise wage to our employees. The policies provide some fund for skills development through consultants and improve productivity… (Chonburi, large-size, no.1)*

2. Improve transportation infrastructure

Transportation infrastructure needs to be improved. Road work and traffic mismanagement always hold up the traffic within the regions and to the seaport; expansion of the seaport is required; and multi-mode transportation should be more effective as some government-controlled transportation organizations are not competitive.

> *Road works and traffic control in Rayong is poorly managed. There is only one road to the seaports, which make the traffic bad…we need more roads…in addition, train is not an option for us and it never be reliable… (Rayong, large-size, no.2)*

Many interviewees claimed that they did not benefit from the transportation infrastructure improvement from the EEC initiatives as the plan mostly contributed to Chonburi province, not Rayong.

3. Leverage information technology for corporate benefits

The integration of information for transportation providers, sea line information and delivering status, business profile and the government information (i.e., custom information, forms and inspection) should be integrated for leveraging of information system benefits.

> *…we have invested in information technology to improve our document process…the government has our information but never be integrated with us…besides, they keep changing forms so we need to hire technician to adjust our system to fit them (Rayong, middle-size, no.1)*

Logistics 4.0 in organizations

Participants define the terms logistics 4.0 as (1) information system, (2) machine and equipment, and (3) automation.

1. Information system

All participants claimed to have an information system to support their operations. However, there are four adoption levels of an information system based on size and international presence. The information system adopted by small firms are mostly generic systems (i.e., accounting information system for business management). Larger firms adopt specialized systems but it may not be an integrated system such as warehouse management system. Enterprise resources planning software (ERP) is used within those small and large firms but limited to some modules (the larger the size the more likely to adopt the more integrative module).

> *…we have an accounting system for management… (Chachoengsao, small-size, no.1 and Rayong, meddle-size, no.3)*

> *We have integrated out information system with our regional office…ERP is running… (Rayong, large-size, no.1)*

Organizations with an international presence have an interconnection of the system among firms, specifically with international customers, international data centers and their mother or subsidiary companies.

Thirty percent of the participating organizations had an information development and improvement plan, such as the development of a database system. Others planned to develop and improve the specialized information system for functional operation productivity, enterprise resources planning (more integrative) and a slight number of them referred to the marketing information system (i.e., customer service system).

2. Machine and equipment

Investing in machines and equipment are another means of logistics 4.0 for participating organisations. A number of small and large organizations are investing in the higher performance machines and equipment as parts of the competitive operations.

A quarter of participants claimed that they have planned to purchase and adopt specialized equipment and machines for operations.

> *There are a number of bottom necks in our production process, especially in packing process. We are planning to replace them with machines (Chonburi, small-size, no.1 and Rayong, middle-size, no.3)*

A small number of participants claimed to have little technology transfer from the technology sellers, so they have to depend on them in any system configuration or modification, expansion or new installation. Those dependent are costly to the firm.

3. Automation

Twenty percent of participating organizations claimed to use and are interested in logistics and business automation. A few were using the automated system for operations and were capable to build the automation system for their own operations.

> *…the manual process shall be replaced (many processes have been replaced) into automated systems such as material handling within the warehouse… (Rayong, large-size, no.1)*

> *…I graduated mechatronic engineering a few years ago…I have cooperating with the school I graduated to develop a warehouse automation and now testing in my own plant and my friends' factory next door (Chonburi, small-size, no.3)*

Competitive advantage development

The participating firms were working to significantly develop their competitiveness, which are (1) cost leadership; (2) business networking; (3) bargaining power over customer; (4) customer responsiveness; and (5) credibility.

1. Cost leadership

Cost reduction was found by most of the participating firms, and aligns with the term productivity for a lean operation. A number of logistics, supply chain management process and manufacturing process are revisited regularly for cost reduction purpose.

> *…it is hard for us to push costs to our customers, so we have revisited our working process (and hire) consultant to help us improves process productivity and reduce operating costs and time… (Rayong, large-size, no.1)*

> *We never waste anything in the factory. A plant manager reported me about process error. But we cannot control everything as most of the process are working manually … (Chachoengsao, middle-size, no.1)*

2. Business networking

Business networks were critical for most of the firms participating in this study. They were primarily developing their business networks through outsiders' services on non-

core operations, relationship with customers were closely tied with parent and subsidiary companies within and across countries.

> *…long-term relationship with supplier is our policies…as we invested time with them, they seem to help us and provide additional benefit… (Rayong, large-size, no.1)*

3. Bargaining power over customers

Bargaining power over customers were developed by means of specialized knowledge or capacity; develop high switching costs to customers such as integrated information system for logistics operations and build up capacity or size for oligopoly or monopoly in the market.

> *We have system linked up with our customer, so they can retrieve information from us to lower the system complication for them… (Chonburi, large-size, no.1)*

4. Customer responsiveness

Customer responsiveness becomes one of the competitive advantages to the firms by means of its capability to be more flexible on product and process that meet customers' requirement. In addition, capability to offer a variety of services and options is also critical for customer responsive. A number of participants mentioned that they could configure their systems to meet different requirements and were located in a proximate location to customers for faster response.

> *As we are small, we can make custom arrangement with customers…we have no choice but try to adjust our process to meet their requirements…. sometimes we have to store their orders for more than four months as they have lesser product turnover (Rayong, small-size, no.2)*

5. Credibility

Firm credibility was gained from a long-term presence in the market, quality of product or services, consistently and strong customer commitment. These attributes helped to establish a solid brand name for the surveyed firms.

Limitations of competitive advantage development and adoption of logistics 4.0

There were three critical limitations that discouraged the firms that participating in the study to develop their competitiveness over their competitors and to adopt logistics 4.0. Those limitations were (1) resource management capacity (human and information management); (2) internal capacity; and (3) government policies.

1. Resource management

There are two basic resources consisting of people and information that have impact on the firms across different sizes and geographical locations to develop their competitiveness and adoption of the logistics 4.0.

1.1. Human resources

Small size firms encounter a number of challenges such as seasonal shortage of laborers (i.e., the rice harvesting season), low skill workers, shortage of specialized skill personnel, working load balancing and skill training costs. Middle-size firms have slightly different problems as they encounter labor shortage for operational tasks, as well as, no career development plan for their workers. Large-size firms claim to have some difficulties related to higher labor cost due to the minimum wage policy, difficulties to have a solid production plan as many workers quit their job without any formal resignation, and the firm is yet to have a proper career development plan for their workers.

> *Thai workers are difficult to find. Foreign workers change their job based on their wage. Sometimes they move to a factory next door because of additional 10-baht wage… (Chonburi, large-size, no.1)*

1.2. Information

Information is one of the key resources for planning that a number of firms across various sizes have focused. Small-size firms claim to have no record of various operation activities, such as error in demand forecasting, logistics costs, and information quality (from human error and gathered unanalytical data). Medium- and large-size firms had some difficulties migrating information from the existing system to the ERP system. Most of the problems were information quality, insufficient information from working activities and inaccessibility to a qualified ERP consultants to help develop the system for their organization.

> *…implementing ERP is not an easy. It is expensive and need cooperation…otherwise, we have poor data quality (Chonburi, large-size, no.1)*

2. Internal capacity

There were eight limitations from their internal capacity that discouraged the participating firms from developing their competitiveness over competitors and adopting logistics 4.0. Those internal capacity issues were (1) Marketing, (2) Production planning, (3) Procurement, (4) Production, (5) Packaging, (6) Warehousing, (7) inventory management, and (8) transportation.

2.1. Marketing

Small-sized firms had a limited marketing capacity, particularly related to the demand variation and they were incapable of placing their products in modern trading, as couldn't afford placement costs. In addition, they had limited bargaining power over modern traders who set many costly conditions to small size firms such as delivery time, long credit terms and they took no responsibility for goods placement in the channel.

> *…I no longer place my product in form of the modern trading, as you need to manage your product on their shelf yourself…you have to manage your transport to deal with their loading time…painfully, you need to give them long credit terms… (Chonburi, small-size, no.6)*

For middle-sized firms, a number of them did not have marketing units and were likely to set the price below the costs in the pitching process. Thus, it was difficult for middle-size firms to acquire a new market.

Many large-size firms had some difficulties to control sales and customer service teams on the standard of their service levels to customers.

2.2. Production planning

Small firms are only capable of daily planning, unlike the middle- and large-size firms that are capable of weekly, monthly and yearly plans. Middle size firms face machine load balancing issues that cause some variation of production planning. The large firms claim to have some variation from overtaking of their production schedule due to prioritization of sale demand.

> *…We cannot plan for years or months, as there is too high in variation to forecast. Basically, we have a daily and weekly plan…our customers are working in the daily basis, not in contractual agreement (Chachoengsao, small-size, no.5)*

2.3. Procurement

Small-size firms encounter difficulties accessing skilled and experienced procurement personnel. Middle-size firms experience a shortage of raw materials due to their lack of a supplier database (foreign supplier) and cannot control quality of raw material due to their incapability to assess technical specification (so thus they only inspect the external element of raw materials such as packaging damage and levels of moisture). The large-size firms experienced bargaining power problems over global suppliers.

> *…they (the procurement team) are inexperienced and slow in browsing for more suppliers…when we receive the product, they only do physical observation, not the technical inspection…so far, it is ok (Rayong, middle-size, no.3)*

2.4. Production

Quality was a common production problem for all the surveyed firms. However, the small-size firms claim to have productivity problems; specifically, problems related to a unstandardized production process, human error and poor-quality control (basically using physical observation).

> *I know we can do better, but we don't have time to handle the improvement issues as everyone have to work… (Chonburi, small-size, no.6)*

The middle-size firms claimed to have limited machines for certain parts of their production process (they depend on laborers in these processes) and their machines appeared to have a high error rate.

2.5. Packaging

The only packaging issue found in the study was firms being overly dependent on humans for packing, even though a number of packaging machines are in place.

> *We cannot have a fully-automated as the packaging process need human to work on. We are still thinking about the most productive approach … (Chonburi, large-size, no.4)*

2.6. Warehousing

The warehousing issues for small firms included uncompleted and unorganized warehouses, and there were limited warehousing policies such as storage points. A number of middle size firms had no warehousing policies and unorganized warehouses which was similar to the smaller firms.

> *…Our warehouse is half complete as our production and storage requirements are still ok in current condition… (Chachoengsao, large-size, no.6)*

A number of larger firms experienced warehousing problems from imported materials which caused a long lead time during the holiday period, and they had high inventory handling costs.

2.7. Inventory management

The findings show that most of the firms, regardless of their size, encountered slow inventory movement. For smaller firms, inventory problems were caused by a lack of inventory management knowledge (i.e., ABC inventory management or re-order point), unenforceable FIFO policies, inability to locate goods store area, and some raw material needs to be kept for a certain period of time before use (i.e., rice). For middle-size firms, they have limited space for inventory because some of the storage space needed to be allocated for several types of molds.

> *…dealing with dynamic industry (car parts manufacturing), we need to have different types and sizes of mold to ensure our delivering capacity…. we need to keep those molds for more than 10 years to ensure that the existing model (car) have molds for spare part manufacturing…so we have a pile of mole in the warehouse (Rayong, medium-size, no.1)*

The larger firms were confronted with an unpredictable demand, which lead to inventory management difficulties.

2.8. Transportation capacity

The findings show a number of small firms experienced high transportation costs, a limited capacity to transport in an extended geographical area, the inability to secure transport vehicles during public holidays, unqualified drivers, and a lack of qualified personnel. Larger firms shared some of the same problems with smaller firms such as experiencing unqualified drivers and a lack of delivery personnel. In addition, larger firms experienced delay on goods uploads on truck, goods arrangement, and goods safety on the carrying trucks.

The middle-size firms claimed to have a problem with the 'police fine' due to the fact that their delivery type of vehicle was unlawful to deliver their products at certain weights.

> *We serve different sizes of customers and many are small. So they order us in few units. So it is hard for us to load the product into the proper transport. Thus, it is ok to pay fine on the way … (Chachoengsao, meddle-size, no. 7)*

3. Impact of government policies and capacity

A number of government policies have discouraged competitiveness among the surveyed firms. These policies included the rice mortgage scheme, minimum wage, working immigration policy, inter-regional raw material transfer control laws, first car subsidy program, government subsidy program on basic goods via authorized retail stores, fuel subsidy program, town planning and building control acts.

Small firms suffered badly from a number of policies that have significant impacts to the business operations, such as the rice mortgage scheme, minimum wage, working immigration policy, inter-regional raw material transfer control laws. Those policies caused less cost advantage, broken distribution networks, limited market development and a labor shortage. Medium- and large-size firms were also affected by the minimum wage, working immigration policy, first car subsidy program and town planning and building control acts that limited factory expansion, leading to a labor shortage, high production costs and variability of demand.

> *There are policies such as first car subsidy program that makes us suffer till now. It is not wise to use the policies that destroy the system (Rayong, medium-size, no.2)*

The government support requirements

Government support was found to be crucial for competitive enhancement of the EEC organizations, especially for the existing ones with lesser incentive than the newcomers (the EEC incentive such as the tax exemption). Thus, the government policies to support organizations in the EEC areas needs to be reviewed and reconsidered.

There are a number of policies needed to support the existing firms in the EEC areas. These include (1) sources of logistics technology, (2) intellectual property, (3) international trade dispute and international policy, (4) revisit laws relevant to business operations within the region, (5) enhancing transportation infrastructure, (6) basic infrastructure in the sub-EEC region, (7) labor quality, (8) political red tape in the government organizations, (9) funding and loans, (10) consultant, and (11) marketing channels.

1. Sources of logistics technology

A number of participants claimed to face some difficulties in accessing logistics technologies so thus they have requested for conferences or a logistics technology tradeshow to share technology sources in Thailand.

> *…it is used to have a logistics conference in Thailand, but I cannot remember when. It is useful to explore new technology, which might help us to improve our existing system (Rayong, large-size, no.2)*

2. Intellectual property

Intellectually property within the EEC regions consists of two primary issues, the accessibility of government funded intellectual property and the right to exercise government funded intellectual property. These issues arise from the mismanagement of government funds on innovative product development with intellectual property protection (the matching fund that ties the technology research from the university to with private firms.

> *the joint between government and private entities blocs us to access the technologies. One of our technologies that we have developed with the government is ok for a while, but we want to sell to others, but the government obligation stopped us… (Rayong, middle-size, no.3)*

The fund is distributed, but lacks long-term consideration. So, there are several dispute on the technology rights between researcher and the committed private firms. Those disputes leads to the inaccessibility of the technologies and inability to use those technologies as many parties claims on the technology protection rights.

3. International trade dispute and international policy

International trade dispute and International policies have critical issues for the participating factories as most of them experienced a non-tariff barrier from the destination countries. Alternatively, some countries seem to change their trading policies frequently without prior notification. Thus, the exported goods from EEC need to be reverted back to their origin. In addition, the local protection from foreign firms is less likely to be protected. Unlawful business practice within the EEC regions conducted by foreigners is widely seen and thus distorted their competitiveness.

Anti-trust law should be enforced in order to protect local industries, larger economic counties help subsidize their products and gaining advantages over local products (i.e., steel). Currently, currency exchange is another issue to be considered.

> *…some country like China has changed their import policies all the time. We cannot keep up and sometimes our products cannot get through their customs as they just changed the policy. We need to get our products back and resend the products to our customer…it is costly. Thai authority needs to handle this situation. Don't let us hurt (Rayong, middle-size, no.3)*

4. Revisiting laws relevant to the business operation within the region

Laws and regulations that are relevant to the business practices in the EEC region, such as migration law, industrial zoning, investment promotion incentives, and product control should be reviewed for flexibility and practically complied.

> *If the government want to promote the EEC areas, a number of laws, such as immigration laws need to be revised as we cannot afford any workers if the immigration law is strict and it is costly to us… (Chonburi, large-size, no.6)*

A number of laws that depend on official personal judgements lead to corruption and need to be revised (e.g., machine capacity licenses).

5. Enhancing transportation infrastructure

The major issue of the transportation infrastructure in the regions was the quality of transportation infrastructure and management. The quality of the roads was substandard. Thus, accidents could happen anytime and cause traffic delays. Traffic was also an issue as there were only a few roads that lead to the seaport. Thus, the traffic always caused delays.

> *…the ship is always departing at 4 p.m. and sometimes we missed the ship as the traffic and custom are not well managed and organized… (Rayong, large, no.1)*

6. Basic infrastructure in the sub-EEC region

Basic infrastructure of the sub-EEC region was problematic in the business operations in the region. The basic infrastructure that is necessary for the operations were electricity, water and internet. Only a few firms experienced this but found them costly (as they needed to develop their own ponds, pay for electricity blackout prevention systems and needed to subscribe to expensive and unconventional internet services).

> *…we need to install electricity system and water system for ourselves as the factory location is not in the service area. Can you believe that? (Chonburi, large-size, no.3)*

7. Labor quality

Labor quality was an issue that was raised during the study. The findings show that there is a limited number of professionals in logistics, due to the limited number of education institutions in Thailand that offer logistics courses for the past two decades. The skilled workers in logistics are not widely available.

> *…every logistics professional here are not graduated in logistics as this profession is new to Thailand. So, we need more qualified logistics professionals in the area (Rayong, large-size, no.1)*

Most firms arranged training programs for their employees by means of training incentives and on the job training, particularly for logistics operations and information skills. Company visit and logistics automation trainings are needed for advanced logistics operations.

8. Political red tape in the government organizations

A significant number of the organizations that participating in this study viewed the redundancy of the government organizations' working process which delayed and indirectly causes additional expenses to the firms.

Logistics organisations or the government, specifically the Thai Railway Authority, needs to be more active on integrated logistics operations for firms in the EEC.

> *…we depend on road transportation as the railway system is not well organized and the service is poorly delivered (Rayong, large-size, no.2)*

Law enforcement for the local and international rules breakers is required, particularly for the illegal migrants in the EEC region.

Lastly, the participating organizations claimed that they are not able to access government information regarding the logistics assistant news from the government

organizations. The government should link government information (e-government) to the firms, such as logistics provider databases and chemical suppliers.

9. Funding and loans

Government funds, such as low interest loans or subsidies are necessary to the firms. There are several types of funding for the firms such as loans for business cash flow, investment for machine and equipment, information systems for business and logistics management, and lastly subsidies for the annual information system subscription fees (i.e., ERP application) and consultants).

> *…low interest fund to machine investment, information technology subscription is necessary for us to improve our production and logistics systems… (Chonburi, large-size, no.3)*

10. Logistics and technology Consultants

Consultants play an important role for the improvement of logistics systems of a firm. The participating firms viewed consultants as the sources of technology transfer, operational and strategic assistants, and solution providers. The areas of the consultant needed are the technical consultants on identifying needs in technical requirement, investment and solutions on logistics and manufacturing operations, operational and customer data analysis, and marketing planning.

> *We cannot find expertise at reasonable price. It is best to have 5-7 FTE (full-time equivalent) consultant to work with us. So our employees can learn from them (Rayong, middle-size, no.7)*

11. Marketing channels

Marketing assistance is necessary for the firms as many of them (i.e., small and middle-size firms) have limited opportunity to access the market due to limited financial resources and networks. The government business matching programs and marketing subsidies for exporters are necessary for participating firms.

> *We are busy manufacturing…depending on our sales to help us grow but the market is costly to reach. The program such as business matching and export subsidies are necessary to us (Rayong, small-size, no.2)*

The existing aids

There are five types of government aids that support firms on the adoption of logistics 4.0 and competitiveness development. Those financial aids included (1) investment incentives (under the Board of Investment Scheme) (2) financial aids (3) innovation funds (4) training aids (5) marketing supports and (6) consultants

1. Investment incentives

A number of large-size firms and some medium-size firms received investment incentives, which allowed corporate income tax exemption and value added tax exemption from the Board of Investment (BOI). There was no incentive provided for the small size firms.

> *...we are in the fifth year of investment incentive. It helps us a lot in competition. However, it may be difficult after the incentive ended… (Rayong, large-size, no.2)*

2. Financial aid

The government financial aid for the firms participating in this study included loans with low interest rate, loans for machines and equipment investment or factory expansion. Interestingly, only the small-size firms claimed to have received benefits from this kind of government aid.

> *…machine is not cheap. so we need low interest rate to handle it. Working capital fund is needed if possible (Chonburi, small-size, no.1)*

3. Innovation fund

Innovation fund is a type of financial aid but in the form of joint corporation between the firms and various universities, with an intention to match technologies with the corporate's demand. A certain number of small- and medium size firms received this type of fund.

> *…you know what…I found a machine to cut our product under government scheme – joint cooperation with private firm – but I cannot use or get that machine due to some joint development obligation…sad. I will try to apply for an innovation fund and develop it in-house… (Chachoengsao, small-size, no.4)*

4. Training aids

Training aids from the government are in the form of a training programs arranged by third parties and e-learning resources developed by government agencies such as the Industry Promotion Department. Small- and medium-size firms participating in the training programs, while the large-size firms were more likely to engage with the e-learning system.

> *…we don't really encourage our employees to attend any outside training. It is best that government provides some training resources in the company…. (Chachoengsao, middle-size, no.1)*

5. Marketing support

Marketing support is conducted through government agencies, primarily to match local firms with foreign customers by means of a local and international exhibition. Another approach is to allow firms to use the government trading brands to increase their credibility. A

quarter of the small-size firms took advantage of business matching, but medium-size firms employed the government trading brand.

> *…I was busy traveling oversea with a government agency as they are helping us to meet foreign buyers. It is such a nice program. I am about to export our snack to Russia next months… (Rayong, small-size, no.1)*

6. Consultants

Consultants are funded by the government. The findings show that all small firms take advantage of this fund by asking for the consultants to help them on develop an operation plan and assist with technical problems. Medium size firms used this fund for solve technical problems, develop in new markets and improve their operational productivity. Large-size firms also benefited from this fund by employing consultants for internal process analysis, improving operational productivity and dealing with the production waste or energy management.

> *Subsidized consultants from the government program is very useful for us, as we can save time and costs on the warehouse for operation… (Rayong, medium-size, no.3)*

Discussion and Implications

Referring to the findings, there are various factors contributing to competitiveness development of the participating firms within the Eastern Economic Corridor areas; those competitiveness developments includes cost leadership, business networking, bargaining power over customer, higher customer responsiveness and credibility. The contribution factors comprise government policies, technology change and transfer, efficiency government agencies, organisation characteristics (sizes, available resources and internal capacity), logistics management for industry 4.0. The relationship of the factors is displayed in Figure 3.

Government policies and firms' competitiveness

Government policies have positive and negative impacts to organisations of different sizes and in different regions. Government assistance includes investment incentives, such as income and corporate tax incentives (not applicable to most firms that participating in the study), financial aid for machine and equipment investments, innovation funds, training aids through government agencies and third-party training agencies, financial subsidies for corporate consultation; and marketing opportunity support such as business matching and government endorsement (allow the firm to use government's endorsement brand such as Thailand's best). These forms of assistance encourage competitiveness development of the firms within the Eastern Economic Corridor area. In contrast, a number of government

policies and agencies discourage competencies. The discouraging policies includes the rice mortgage scheme, rising minimum wage policy, unstandardized immigration policy, inter-regions raw material transfer law, first car subsidy program, town planning and building control act. These policies, schemes, regulations and laws lead to a cost disadvantage, high variation of demand planning, limited trading opportunity and broken distribution networks.

Government policies, technology change, technology transfer and logistics 4.0 capabilities

Industry 4.0 policies encourage organizations to invest in technologies to improve the efficiency of their logistics systems, especially those programs and consultants sponsored by government agencies such as the logistics promotion department. Apart from the programs sponsored by the government, technology transfer from suppliers during new machine installation (when a supplier will assist and transfer machine operating knowledge) are also found in the business practice. Private funding for technical and process improvement consultants have also contributed to various forms of technology absorption such as on-the-job training and in-house process design and equipment development, such as material handling automation.

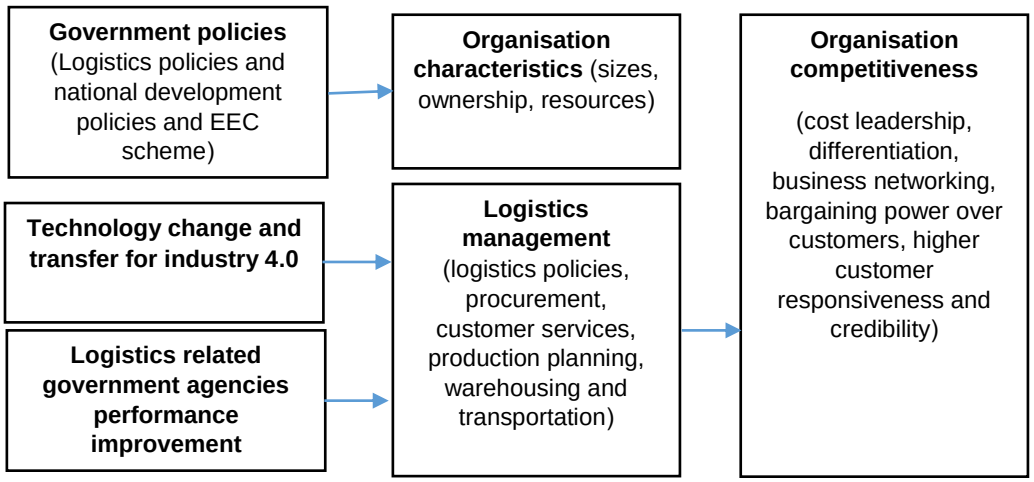

Figure 3 relationship diagram of the competitive development factors of the manufacturing firms within the Eastern Economic Corridor area.

Logistic-related government agencies and logistics management

Efficiency of logistics-related government agencies, such as the railway authority of Thailand and custom department; have significant impacts to mode of transportation planning decisions. The railway authority of Thailand, for instance, discourages firms' competitive advantage by providing an unreliable service and may cause unpredictable delays in product

delivering process. Thus, the firms need to pay for monitoring system and have some expenses on poor customer services. The custom department is another example of a department that has a poorly developed documentation process and utilize an impractical procedure for product inspection and exportation. Their bureaucratic process causes delays in transportation and create longer lead times.

Organization characteristics, logistics management and organization competitiveness

Organisation characteristics, specifically the human, information and financial resources are key obstacles to the development of organisation competitiveness in the logistics and industry 4.0 era. A shortage of skilled workers and specialists; poor FTE load balance; and discouragement of skill development (regardless of any organisation size) lead to an overdependence of consultants, suppliers, and external funds to overcome the organisation-specific problems in the logistics and production areas. Poor development of information resources leads to poor resource planning and this stops the organisation from adopting an information-integrated logistics system. It should be noted that financial resources limit the development of information systems in the small firms in a certain context such as software subscription, modification, availability and information quality. The last three issues are commonly found in the medium- and large-size firms (i.e., no records in various activities, human error, inaccurate logistics costs and non-useful information for analysis). These issues lead to inaccuracy of demand forecasting and operational planning. Thus, they need consultants or suppliers to assist in various aspects.

Internal capacity is divided into demand-side capacity and supply-side capacity. The demand-side capacity, specifically on the marketing and customer services, has different impacts on the firms at various sizes. Small firms are incompetent to place their products in the form of modern trading (be more dependent or use direct sell but less accessible channels), due to several restrictions for product placement, such as long financial credit, cost on product responsibility (product ownership is not transferable to modern traders but still to the firms), placement fees and fixed delivery times. For the middle-size firms, they are struggling to pitch sell at reasonable margin. Large firms find it difficult to standardize their service standard.

In regard to supply-side capacity, there are some issues of information management capacity, human problems (skill shortage, labor shortage, logistics management knowledge, and the lack of technical know-how), technical problems related to logistics and the production design process (i.e., process design, poor quality control, insufficient machine and equipment, availability of machines and equipment in the market), a long lead time for imported materials due to international logistics issues, enforcement of the logistics policies, such as FIFO and warehouse space management for molds or slow movement materials.

Organisation competitiveness

Cost leadership, business networking, bargaining power over customers, higher customer responsiveness and credibility are part of business strategies of the firms that participating in this study. Thus, they are looking for assistance from the government. The existing support is appreciated. However, they are asking for solid programs to help them achieve those competitive strategies. The most requested support includes sources of logistics technologies, rights to access government funded intellectual properties and rights, revisited laws relevant to business operations within the region, enhancing transportation infrastructure, revisited areas with limited basilisks infrastructure and improve quality of basic infrastructure, enhance labor quality (either produce more logistics professional or more flexible on layout migration, reduce bureaucracy of logistic-related government agencies, provide loans for technology development, working capital and machine replacement, subsiding technical and management consultants, and assistance on marketing channel development.

Recommendations

There are six practices to recommend for academic purposes. Firstly, government policies to support competitiveness are critical, specifically using direct and indirect support. For direct support, the resources enhancement and assistance should include human development, funds for consultants to assist the factory on their logistics system, funds for cash flow management, funds for information system development and improvement, and equipment investment. The indirect support should include improvement of transportation infrastructure and fairness in the investment scheme to existing factories within the Eastern Economic Corridor area.

Secondly, government agencies whose work is associated with the Eastern Economic Corridor's supply chain system should adapt themselves to assist firms within the areas, for example, to provide a reliable transportation mode that helps reduce overall multi-model transportation costs. In addition, the international relations department should assist factories by informing them of international import policies.

Third, technology transfer via technology procurement, in-house development and assistance from consultants or technology sellers are critical to the firms. A contractual agreement on technology transfer is needed to ensure cost competitive in the longer terms.

Forth, the resource development plan of the participating firms should be rigid, particularly on the human resources development (from general logistics officers to specialized logistics specialists). Information resources should be emphasized and structured. The analysis of information shall lead to a decision to invest the information

systems, production equipment, machines and automation systems. Financial resources are also critical for those improvements.

Fifth, mid-size firms have limited competitiveness against small and large organizations. In comparison to smaller firms, the mid-size firms have less emphasis on products and process innovation, utilization of information technology, training, and having more pressure on costs than smaller firms. Cost burden, international trade risks and being less competitive to larger local and international firms might limit their growth. Networking strategy, differentiation strategy and bargain over customers are related to competitiveness enhancement.

Sixth, small firms have resource constraints such as skilled personnel and financial resources for machine and quality endorsement investments, unproductive management (lack of logistics knowledge and they are unable to identify and approach for logistic capacity enhancement), and marketing capability. Those limitations limit their growth.

Seventh, EEC policies encourage and discourage firms to develop their competitiveness. Positively, they promote infrastructure development, skill development and assist factors to hire consultants to transfer knowledge or improve their logistic and production capability. In addition, the policy is also improving the supply chain system at both the demand and supply side. Negatively, they discourage competitiveness of the existing firms as new investors receive government incentives which are no longer available to existing firms. However, the generalization of the findings may be limited and should be considered.

Lastly, the study employs qualitative research; in order to explore the contributing factors to competitiveness and their relationships, but the level of importance and significance of their relationships were not statistically proven. Thus, a further quantitative study is required to confirm and disconfirm factors and their relationship found in the study.

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