

Green Supply Chain Practices and Sustainable Performance: Moderating Role of Total Quality Management Practices in Electronic Industry of Thailand

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Abstract--This study examines and empirically investigates the green supply chain practices and sustainable performance. The study examines the impact of green supply chain practices on sustainability of the performance of electronic industry of Thailand. Green supply chain management impact on environmental, economic and intangible performance of firms. Organizations follow GSCM practices as business strategy to achieve their long-term goals to enhance performance. Data was collected from firms of electronic industry of Thailand with GSCM activities and determine their performance. Data was collected through questionnaire to analyze the relationship between constructs of the study; GSCM entails Green Purchasing, Green Logistics, and Legislation for green environment and sustainable performance. Total quality management practices plays vital role in determine the performance, present study investigated moderating role of TQM practices between GSCM practices and sustainable performance at electronic industry of Thailand.

Keywords: Green Supply Chain Practices, Total Quality Management Practices, Electronic Industry

1. Introduction and Background

Academic literature has discussed supply chain management in various contexts, and green aspect of supply chain coined in literature and gained attention of scholars as environmental concerns became important issue. The interest of scholars in green supply chain has increased recently due to environmental concerns and climate change worldwide. Organizations and governments of various countries have addressed to the issues of climate change and environmental changes around the world due to heavy

industry. Recently, environmental issues and supply chain management has considered as most thriving issue and organizations focused to minimize their impact on environment around the world [1]. Due to increased concern and popularity of environmental issues in industrialized countries there is need to discuss on green supply chain management for sustainable performance of supply chain [2, 3]. Emerging economies have focused on green supply chain including south East Asian countries such as Malaysia, Indonesia, Thailand and China. The researchers have embarked on green supply chain management (GSCM) and its outcomes on quality certified firms in Malaysia [4], further researchers have conducted studies on internal and external factors influential for performance in green supply chain (GSCM) perspective [5].

However, there is lack of research on green supply chain management in South East Asian region an important emerging country Thailand. Current study conducted on Thailand's electronic market.

The coordination and collaboration of various different activities of complex network involved in finished products or services to deliver end user and consumer. The product life cycle of products at each stage influence supply chain environment from raw material procurement to manufacturing and usage, reuse, recycle and disposal of goods [6]. Inclusion of "Green" component in traditional supply chain management by considering "Green Procurement", "Green Manufacturing", "Green Distribution", "Green or reverse Logistics" emerged as

Green Supply Chain Management (GSCM). The focus of GSCM is to eliminate or reduce the waste material including energy, chemical, emission or solid waste throughout supply chain [7]. In various countries such as US, EU and Japan has considered environmental issues and related legislation for manufacturing companies. The emergence of green supply chain helped firms to develop effective integrated strategies for accomplishment of goals and gain market share while adopting innovative solutions by lowering the risks to environment and increase the ecological efficiency [8].

Researchers have separated GSCM into two aspects, one as framework for green supply chain management and performance assessment. Improvement of relationship between supplier and manufacturer is proposed by various researchers, another aspect is to exploration of gaps between proposed framework and present research for supporting managerial decision making. Previously, researchers have been conducted on value chain and logistics management on the behalf of higher education commission Thailand at university level with collaboration of industrial engineering department. These researchers have been conducted to improve the procedure of firms and to achieve the maintenance of green supply chain [9, 10]. The assessment of performance of supply chain determine the efficiency and effectiveness of present system of firm to be compared with proposed system to enhance the value and to uplift the level at desirable performance standards [6, 7, 11].

The present study intends to empirically examine the green supply chain activities to be influential for improving in performance in electronic sector of Thailand.

Electronic industry of Thailand found to be very progressive for contribution in economic growth. Thai electronic industry exports US\$ 29.2 billion to the world since 2008; the 60% of total exports consist of computer parts and accessories. Electronic industry of Thailand has faced barriers in sustainability in their supply chain, the problems have been faced in terms of cost of manufacturing, lack of skills, rapid change in technology, exchange rate and higher competitive market, whereas environmental concerns and legislation by government has increased the problems for electronic industry [9]. Computer and home usage electronic equipment industry has faced challenges in reduction of waste which is related with effectiveness of supply chain of electronic industry of Thailand. The quality plays important role in electronic industry, as lower quality electronic products decreases the life time of equipment as higher rate of waste occurs due to lower level of quality. The lower quality of electronic equipment decreases the performance of supply chain due to short life of electronic equipment and

ultimately damages the sustainability of performance got negatively affected. There are various issues and problems have been identified in Thai electronic industry and increases obstacles in waste management, these issues entails ineffective recycling, incomplete collection of required infrastructure, lack of incentives, insufficient rules and regulations and their enforcement, limited technology and community level which causes reduction in efficiency and effectiveness of supply chain, hence found to be negatively influence the sustainability of performance [9, 12].

The government institutes has collaborated to develop rules and regulations for environmental protection, electrical and electronics institute, federation of Thai industries and pollution control department has suggested to develop strategies for electronics industry to reduce waste management and to improve green supply chain activities to control damage to environment and improvement in performance. The industry has taken these measures seriously and implementation of environmental legislation in electronic industry to increase effective and efficient supply chain to control over waste management and maintain required quality performance [9, 12].

Firms strive to develop strategies to gain sustainable competitive edge and performance. The success of firm largely depends upon transportation and transport becomes more crucial in perishable material, the study conducted on fish distributors stressed on transportation of fresh fish to the distributors [13]. Since 5 years, maintenance cost has increased and fuel consumption cost inclined in ASEAN region, which has become another challenge for quick and cost effective supply chain in Thailand for delivery of goods or providing services. However, green logistics and green supply chain activities have become crucial in ASEAN countries, such as Indonesia has put limit on emissions from the transportation such as usage of trucks used for transportation around the country [14, 15]. The cold storage transportation if increased than the limit of emission can't get entry to Indonesia which can be damaging to perishable commodity. The owners of logistics and transportation companies must fulfill the requirement for "green logistics", to keep low emission producing vehicles for successful and fulfill rules and regulations for environmental issues. Thus, usage and adoption of environmental transport to fulfill green logistic purpose considered as deciding factor in competitiveness and effective supply Green supply chain [14, 16]. The interconnected activities of different parties must be green in nature for manufacturing to delivery of goods to gain cost effectiveness and efficiency in performance [17].

The current study explains sustainable performance of electronic industry of Thailand, the influential factors of green supply chain management including green procurement, green logistics and legislation for green activities with moderating role of total quality management. The current study is one of pioneer in examining the sustainable performance of electronic industry while considering green supply chain factors including procurement, logistics and legislation with moderating role of total quality management.

2. Literature Review

Academic researchers have explained supply chain management in practice and defined supply chain as follows:

“SCM is defined as collaboration and integration of key business processes from purchasing of raw material, manufacturing and distribution to end users along with information that add value for consumers and stakeholders” [18].

The network of supply chain consists of flow of information and product raw material to finished goods, further key supply chain business processes includes functional activities of supply chain. The researchers have explained the relation of supply chain with logistics and literature has explained the marketing channels in supply chain perspectives [18]. The study described SCM framework and elements which are closely interrelated in business practices, the effective supply chain enable firms to gain benefits and advantages over their competitors. The effective supply chain helps to reduce waste management, reduce cost and improve logistics and time, which ultimately helps to improve performance of firms [19, 20].

Since the concern about environment has increased and governments has taken action and developed legislation about emission control and pollution to protect environment, green aspect in supply chain has introduced to reduce waste, cost and negative damaging effects of supply chain activities. In Thailand electronic manufacturers are selected for current research to assess the green supply chain activities including green procurement, logistics and legislation to determine the sustainable performance. Previously, studies have been conducted to assess the green supply chain factors which include green procurement, manufacturing, distribution and reverse logistics in diverse context to meet the environmental aspects. In electronic market perspective computer parts are considered as product to be delivered to consumers. The industry entails various

stakeholders including computer stores, waste collectors; assemble/recycle plants and manufacturing company involved. To fulfill green aspect of supply chain all participants must comply with legislations to reduce hazardous and toxic elements during electronic parts production and usage [9]. The green activities are presented in the figure below.

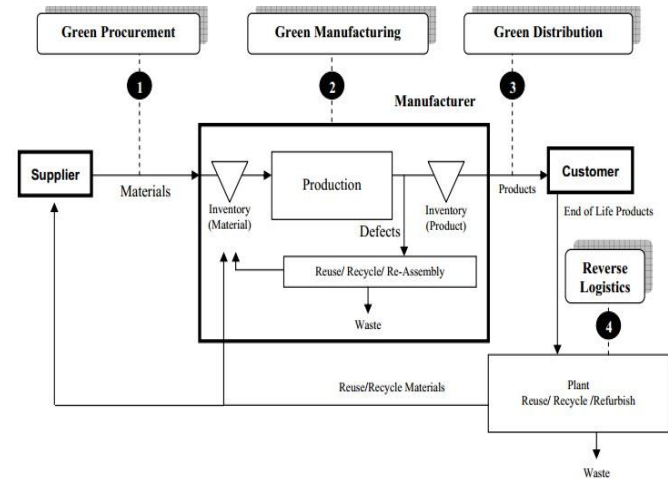


Figure 1: Green supply chain Activities

Previously, researchers have incorporated various theories to define the supply chain activities and effectiveness, these organizational theories includes RBV (resource based view), transaction cost theory, agency theory, institutional and network theory to understanding adoption and initiatives for quality management, manufacturing and supply chain management [5, 20, 21]. Green supply chain management argues to act as green and environmental friendly way to fulfill customer demand and legal requirement. The legislation development and pressure from government agencies for adoption environmental friendly activities for influencing responsible behavior of firms; which found to be helping for meeting the legal requirement and enhance performance [22]. Other researchers found that firms adopt environmental practices due to pressure from external and internal stakeholders and especially non-compliance with rules and regulations. Researchers have claimed that legal obligations enforce firms to adopt green supply chain activities more rapidly and green activities can be implementing throughout supply chain [23].

Green supply chain or environmental activities have been adopted by various firms in developed countries for achievement in competitive position and enhancing performance with limited resources to maintain efficiency. The researchers have found that firms were influenced by external factors in adoption of green activities and supply chain management as described by institutional theory.

These factors or drivers for adoption of green supply chain activities were defined as (i) legislation enforced by government, climate change issues, development of clean mechanism, clean energy bill, and restriction on emission or toxic due to production of electronic components [7, 10]. Another extern driver play role for adoption of green supply chain activities includes requirement of customers which entails sustainable packaging at Wal-Mart, recycle issues, zero carbon store at Tesco, leadership in environmental concerns at Toyota and go green dealership at Ford; influenced firms to adopt green aspect in their business activities and supply chain. The researchers have identified that implementation of green supply chain management mainly influenced by institutional pressures.

Therefore, it is proposed to examine the influence of green supply chain activities on sustainable performance of electronic industry of Thailand.

2.1. Green Supply Chain Management Practices:

Performance of manufacturers remained top priority as several studies have been conducted to examine the performance based on effective supply chain. The adoption of green practices in supply chain has taken place due to pressure by government agencies and regulatory demands which influence financial performance [24, 25]. Several researchers have conducted studies to link and examine the relation between green supply chain management and performance of firms. Few studies have depicted positive relationship between green practices and performance [6], [29], [30]. Contrary, few researchers didn't find relation; they reported not significant relationship between green practices and performance of firms [26, 27]. On the other hand, few researchers have found combination of positive and other relationships [28].

The previous studies and their findings show that there is lack of consensus to determine the impact on performance of green supply chain practices. Various researchers have depicted this conflict and reported in their studies [4, 29]. The conflicting findings of various researchers have increased barriers for firms to implement green supply chain practices to enhance their performance and to gain competitive edge in highly competitive business environment [29]. To address the inconsistent findings and to verify the relationship between green supply chain management practices and performance, current study intendeds to examine the relationship with moderating role of total quality management in electronic industry of Thailand. There are various sources of inconsistency based on previous studies, first includes the type of green SCM

practices and second considers the type of performance measured and outcomes of implementation of GSCM [28-30]. Another conflicting reason has been depicted by researchers the context of examining the relationship between GSCM and performance related outcomes [31]. Researchers have also found that there is lack of unified framework in common to determine the impact of green supply chain practices on performance [32]. On the other hand, various researchers have conducted studies on green aspect of supply chain and defined that it consists of green design, energy efficiency, recycle and reuse material and packaging, environmental friendly logistics and environmental collaboration in supply chain [33]. It has been argued in literature that green practices includes green and cleaner production, number of patents, internal service quality, green design, green procurement and innovation [30].

Green practice also includes sale of excess inventory, scrap quantity, environmental friendly material, environment auditing issues, top management concern and commitment and quality standards at each stage of raw material to end users throughout the supply chain [34]. The studies have examined pro-active and re-active approaches of GSCM, whereas pro-active practices of GSCM includes green procurement practices, eco deigns practices, logistics practices; on the other hand, re-active GSCM has been defined as legislation and regulations for supply chain. The studies have divided eco design stage into product related and packaging related practices. Further, outcomes of effective supply chain is examined as performance of various natures, the studies have categorized green performance measures as environmental performance, economic performance, intangible performance, studies considered low cost business strategy and quality as control variables for explanation of performance due to strategic focus of firms.

2.2. Sustainable Supply Chain Management:

Sustainable performance of firms has become increasingly crucial as competition has increased in recent number of years. It has been under consideration of various researchers in diverse context and stakeholders and advocated as key component of social contract between business and society [35]. The trend of sustainability of supply chain has extended and considered the supply chain of partners to be effective in order to gain long term benefits. The brands around the world focus on their sustainability of their supply chain and avoid the risk of negative possible impacts. The researchers have depicted that focal firms are held accountable for their actions taken for supply chain as they

placed in accordance with global supply chains of their business partners [36, 37].

The studies have found that it has been experienced that loss of market share has been observed and reputational damages by recalling million of plastic toys with toxic paints sourced by Mattel's suppliers [38]. Similarly, it is reported that well-known retailers and their suppliers discharge damaging chemical and water into major rivers of China, which is against established legislation of being green in throughout their supply chain activities and business processes [39]. The government of Brazil charged parent company of Zara for their poor working conditions from one of their suppliers [37]. Nestle, being a leading company had to change their palm oil source due to one of Indonesian supplier found in illegal activities related to environmental issues [40]. As supply chain management practices plays an effective role in connecting all suppliers, manufacturing, distributors and end users to achieve efficiency and long term performance objectives [41]. Supply chain integration focuses on information sharing serves as key to the whole system of supply chain efficiency [42]. Researchers have argued that there are common goals of supply chain management which includes effective communication while removing barriers of communication and achieve common objectives of SCM. Another researcher focused on waste reduction, operational efficiency, and performance of delivering goods, quality management and flexibility in production unit for effective supply chain management to achieve goals [42].

Later, researchers included few other activities such as customer satisfaction, time and cost management, warehousing and relations with suppliers as goals of effective supply chain management in literature [43]. Further, literature has added other influential activities including audit and leadership style and activities. With the passage of time SCM has emerged as crucial and integrated approach to reduce waste, operational excellence, better delivery performance, quality management, flexibility and customer satisfaction, time, cost, warehouse and long term relations with suppliers and retailers for achievement of goals and to gain competitive edge which enhance performance of firms [44, 45].

2.3. Green Procurement and Sustainability Performance:

Inbound or procurement in supply chain has most important and crucial activity and researchers have argued that greening aspect in supply chain produces various benefits for organizations including reduce cost, integrate suppliers, participation in decision making and promote environmental

innovative initiatives [46-48]. Due to increased global concern firms has considered green purchasing strategies as part of their inbound function which plays role in sustainability of environment. The burning issues of waste material to achieve the objective to reduce wastage can be addressed by enforcing green purchase strategies to protect environment, the strategies consider environment friendly source for raw material, minimization of wastage also given importance in determining the effective supply chain. The role of suppliers stated as significantly important factor in achievement of goals of firm, therefore, firms manage their suppliers while focusing on their environmental aspects to ensure raw material and other equipment must be eco-friendly in nature to meet the criteria of being green and to comply with legislation developed in similar regard [49].

“Green Purchasing” has been explored in 1997 by [50] for determination of key factors influential for buying firm's choice of suppliers. The choice of appropriate suppliers found to be as key obstacle to green purchasing initiatives [49]. The studies have investigated the relations between green purchasing and objectives of firms. The framework has been presented to indicate assessment of suppliers that argues that environmental initiatives leads firm towards achievement of competitive position and to reduce risks [51]. The two key components have been depicted by scholars to define green purchasing strategies; these factors include evaluation of suppliers' performance in accordance with environment and assist them to improve their performance. Further, it focuses on evaluative elements such as tools and techniques in assessing behavior of supplier towards environmental friendly activities [52]. Firms encourage suppliers to develop in-house environmental management system to comply with government's legislation and to meet standards. The external quality standard certification helps firm to choose appropriate suppliers as western companies purchase from South East Asian region based suppliers.

Common practice of green supply chain is considered as green purchasing and widely accepted to be influential for positive outcomes. The firms with green supply chain objectives always focus on their suppliers to be green follow green practices to gain their performance related objectives [53]. The firms before getting into purchasing agreement they focus on their green behavior and ensure that suppliers can play role in meeting their objectives to be green. The strategies for deployment of collaborative based activities to initiate training programs, information sharing mechanism related to environmental issues, and joint session for research to be innovative and effective in their supply chain. On the other hand, organizations have options to choose

suppliers with quality standards ISO 14001 awarded suppliers for their commodity which fulfill environmental issues. Researchers have depicted that external pressure including customer's pressure found to be influential for adoption of environmental legislative quality standards [33].

Recycling, reuse and utilizing fewer resources considered as another influential aspect of green purchasing as discussed in literature [2, 54]. Firms also ensure and assist their suppliers in adoption of green supply chain management practices in order to compliance with legislation, which contributes for sustainable performance in highly competitive environment. Firms encourage their suppliers to meet environmental criteria by adopting eco-friendly activities for development of environmental management system [50, 54, 55].

Green purchasing activity focuses on environmental performance of suppliers and monitor for required actions to ensuring environmental quality [49]. Purchasing of raw material is starting point of value chain and success of firm largely depends on effective supply chain while following environmental efforts. Researchers have considered green procurement can impact performance of firms, while reducing wastage by suppliers [16].

The researcher in present research claims that green purchasing can influence financial and non-financial performance of firms, for example reduction of waste material can help to achieve goals by minimizing packaging and by usage of recycle packaging and containers.

On the basis of above discussion following hypothesis have been developed:

H1: *Green purchasing positively influence firms to achieve sustainable performance at electronic industry of Thailand*

2.4. Green Logistics and sustainable performance:

Effective supply chain facilitates consumers by integrated management [17, 56]. The primary step of supply chain is procurement of raw material, production and distribution of existing material for specific products. The initial step of supply chain includes transport charges, storage of raw material, storage management and handling, material management and most importantly exchange process of information [14, 57]. Effective supply chain helps firm to meet demand of consumers and same time minimize the cost of activities taken during whole process of supply chain. Therefore, firms strive to reduce the cost as associated with environmental issues and social life.

The above stated cost reduction objective of supply chain includes impact on climate and environment, environmental pollution, noise pollution and accidents [58]. The concept of environmental safety developed the idea of green logistics with emphasis on reduction the negative impact of logistics on environment and development of sustainable balance between social, economic and environmental concerns. Green logistics is important node in green supply chain and focuses on development of concept of environmental concerns [14]. The concept of green supply chain consists of most important factor green logistics and reverse logistics. By the help of green supply chain concept firms expected to produce lean logistics with environmental friendly logistics in South East Asian region [59]. Green logistics entails the processing of goods and supply to consumers with environmental friendly raw material to be used through whole process to reduce waste and pollution [16]. After product usage at consumer level it might be sent back for repair so it must remain environmentally friendly as recycle purposes. There are various objectives of effective and green supply chain management which includes speedy movement of goods, just in time availability of required services to consumers, social development, establish link between suppliers and customers and reduce barriers in communication and reduce time of decision making. Green logistics helps to reducing damage to environment, green supply chain helps to develop environment purification and fully effective utilization of resources enable firms to reduce waste material [16, 58, 60].

The standards of green logistics include various aspects; usage of low emission distribution vehicles and low transportation, efficiency in transport ability and scheduling; packing and designing of products with environmental friendly commodity [16, 58, 61]. On the basis of above discussion and literature following hypothesis of green logistic has been developed.

H2: *Green logistics positively influence sustainability performance at electronic industry of Thailand*

2.6. Legislation for GSCM and sustainability Performance:

Literature has discusses about development of rules and regulations related to green supply chain management to reduce waste material and to gain efficiency in resource utilization and to become environmental friendly from the first point to the last of development and supply of commodity. Government of various countries have developed regulations for environmental safety, research scholars have noted that due to intervention of government

agencies green regulations and incentives programs have been developed [62,81]. Further, researchers have considered on development of legislation and policies for central substantiating the greening of supply chain and focused on the importance of green supply chain development legislation for effective performance of firms [62].

Researchers have noted that various legislation and regulatory practices have been regularized in diverse ways such as PPW in 2004, WEEE and RoHS in 2003 and EUP in 2005 [5, 63]. Researchers have depicted that legislation for green SCM influence positive performance related outcomes and organizations are making efforts for accelerating greening supply chain in response to stringent rules and regulations. This legislation included proactive address to environmental and social concerns. Hence, there is lack of empirical studies in examining the relationship and influence of legislation for green environment and sustainable performance [5, 64].

Current study intends to examine and investigate empirical relationship between legislation development for greening the SCM and sustainable performance at electronic market of Thailand [79].

Therefore, on the basis of above discussion following hypothesis have been formulated for investigation:

H3: *Legislation development influence sustainable performance at electronic industry of Thailand*

2.5. Total Quality Management as Moderator:

Management philosophies have been developed for achieving customer satisfaction and performance; these philosophies include total quality management practices (TQMP) and supply chain management practices (SCMP) [65, 66]. Classical approaches of quality management focuses on performance based and develop defect and error free products [66-69]. Supply Chain management plays vital role in satisfying customers and reduce delivery time while maintain quality standards at product and services [66, 70]. However, previously SCM was all about concerned with logistics management only [71,82]. Studies have depicted that on time delivery and reduced time for delivery is considered as centered attention of SCM literature [72]. Reducing cost at each stage of supply chain, from raw material handling to delivery of goods and specifically reduced delivery time has been considered as hallmark of performance of supply chain management.

Quick response towards customer requirement and achieve satisfaction of customer with minimum cost has taken as prime concern of effective supply chain strategy at firms [66]. Interestingly, behavioral dimension of TQM has been revealed by scholars' overtime, these dimensions include Resource focus, leadership, focus on customer demand, and HR focus which are also known as soft concept of TQM as important and crucial determinant for assessing performance of firm's SCM and sustainability [73,80]. Research scholars have conducted studies on supply chain and concluded that SCM as integrated system of different activities throughout material and information flow from raw material to finished goods. Supply chain management focuses on timely delivery; on the other hand, there are chances that quality may be reduced as firms focus on reducing time and cost of development of goods and process. Achievement of customer satisfaction act as synergic related and achievement of goals to accomplish overall objectives of firms [66,75,76]. Further, the study depicted positive and significant relation between TQM and sustainable performance of firms. The studies suggested that total quality management directly effect and facilitate implementation of SCM and enhance firms' performance of supply chain and activities.

Moreover, total quality management practices directly influence and improve performance of supply chain through supply chain practices. The study was conducted on managers of automotive industry of Thailand and depicted significant relationship between supply chain management practices, total quality management practice and performance of firms [78].

On the basis of above discussion following hypothesis have been formulated to investigate the moderating role of total quality management between green purchasing, green logistics, legislation and sustainable performance at electronic industry of Thailand.

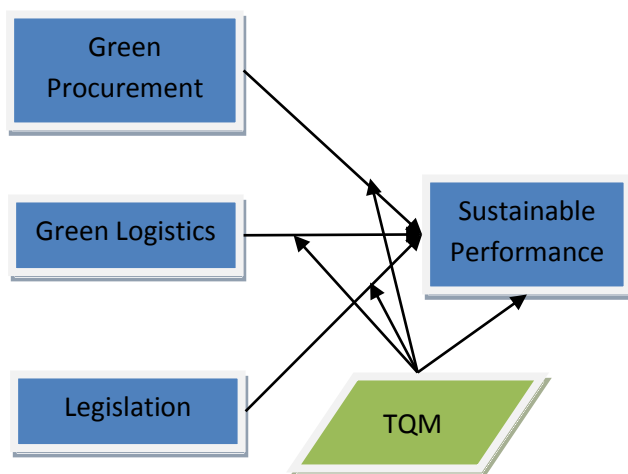
H4: *TQM directly influence the sustainable performance of electronic industry of Thailand*

H5: *TQM moderate relationship between Green purchasing and sustainable performance*

H6: *TQM moderate relationship between Green Logistics and sustainable performance*

H7: *TQM moderate relationship between legislation for greening and sustainable performance of electronic industry of Thailand.*

3.2. Research Framework:



3. Methodology:

Methodology is discussed in current phase of the study, study sample, analysis unit, data collection tool from electronic industry of Thailand, from users and operators have been collected. Questionnaire was developed from adopted scales of variables from previous studies.

3.1. Sampling procedure:

For ensuring that Green supply chain management practices have been adopted and implemented at firm level by respondent organizations, the sample of the study was limited to companies with ISO 14001 certified. The stated ISO relates to the initiatives with Environmental Management System (EMS) in Thai electronic industry. The list of certified companies in electronic industry was available and taken from Thai Industrial Standards Institute (TISI). The list is available at website of the concerned authority. Studies have depicted that acquiring ISO certification leads firms to implement green supply chain activities to gain long-term benefits [29, 34]. Data collection was done through tool of questions based on previous studies and adopted from and used in various studies. The questionnaire was sent to their project management department and specifically Environmental Management Representative (EMR).

The instrument was sent to experts in implementation of GSCM in Thailand. The instrument was sent to 502 listed companies and only 190 valid and useable questionnaire were received with response rate of 38% for assessing the relationship between green supply chain practices and sustainable performance [77].

3.3. Instrument:

The survey questionnaire was adopted from the study of Zailani et al. (2012). The instrument was used by various other researchers to investigate the relationship with different set of variables and dependent variable in environmental impact studies. All the scale of the study was measured on five-point Likert Scale range from 1 as “low” and 5 represents “High”.

Green Purchasing or procurement (GP): The scale was adopted from previous studies of Zhu et al., (2004) [6], and from the study of Zhu, Qinghua, Joseph Sarkis, and Kee-hung Lai (2007) [74]. The scale consists of 04 items. The Cronbach Alpha for the construct was observed as 0.912; which is highly acceptable.

Green Logistics (GL): The scale was adopted from the study of Hutomo et al., (2018) [14]; to measure the utilization of logistics for meeting the environmental issues. Green logistics was measured by three items. The Cronbach alpha for the construct was observed as 0.710; which is acceptable for measuring the empirical relationship.

Legislation related to GSCM (LGSCM): For assessing the legislation which enforce firms to adopt green supply chain practices, the scale to measure this construct was adopted from the study of Zailani et al (2012) [5]; the scale consist of seven items and measured on five point Likert scale, similarly other variables of the study. The Cronbach alpha for the construct was observed as 0.781; which is acceptable for empirical investigation.

Total Quality Management (TQM): The scale to examine the TQM practices at firm was adopted from the study of Basheer et al., (2019); the six items scale was measured against five point Likert scale. The Cronbach alpha for the construct was observed as 0.803; which is acceptable.

Sustainable Performance (SP): For examining the sustainable performance of electronic industry of Thailand, measurement scale was adopted from the study of Hutomo et al., (2018); the scale consist of 4 items and was measured on five point Likert scale; the Cronbach alpha for the construct was observed as 0.836; which is acceptable for empirical investigation and determining the relationship between constructs.

4. Results and Discussion

4.1. Measurement model:

SMART-PLS has been used for analyzing the relationship of study. PLS found to be helping for investigating relationships by usage of measurement model and structural equation modeling (SEM). Cronbach alpha was checked of

measurement scale of all constructs of the study and found satisfactory and acceptable results. The cronbach alpha is given in the table 1 below which shows alpha value higher than 0.6 as cutoff point. Therefore, all measurement scale has strong reliability.

Table 1: Cronbach Alpha (α) Values of all constructs:

S#	Constructs	Items	α	Remarks
1	SP	04	0.836	Acceptable
2	GP	04	0.912	Acceptable
3	GL	03	0.710	Acceptable
4	LGSCM	07	0.781	Acceptable
5	TQM	06	0.803	Acceptable

Composite reliability (CR) helps to determine internal consistency of the scale. The value of CR must be higher than 0.5 to be acceptable. Table 2 shows all CR and AVE values of constructs and indicate strong convergent validity.

Table 2: Composite Reliability and Average variance extracted:

S#	Constructs	CR	AVE
1	SP	0.81	0.84
2	GP	0.86	0.88
3	GL	0.90	0.93
4	LGSCM	0.75	0.77
5	TQM	0.88	0.71

For discriminant validity of measurement model; square root of AEVs is calculated and compared to those values with correlations of each variable. Table 3 shows results of discriminant validity in diagonal and square roots in non-diagonal elements.

Table 3: Discriminant Validity of constructs

Constructs	SP	GP	GL	LGSCM	TQM
SP	0.811				
GP	0.786	0.913			
GL	0.790	0.813	0.891		
LGSCM	0.775	0.875	0.812	0.871	
TQM	0.788	0.891	0.823	0.810	0.719

4.2. Structural Model:

PLS-SEM was used for examining the relationship between constructs and empirical investigation of hypotheses developed in the present study. Current phase of the analysis entails hypothesis testing; direct and indirect effects are examined separately to better understanding relationships between selected constructs.

4.3. Hypothesis Testing:

H1: Direct effect: *Green purchasing positively influence firms to achieve sustainable performance at electronic industry of Thailand*

Results showed that hypothesis one statistically significant positive relationship between Green purchasing and sustainable performance at electronic industry of Thailand; with path coefficient of 0.329 and a t-value 4.120 at 0.01 level of significance. Therefore, H1 found to be statistically supported.

Table 4: Direct effect H1

S#	Hypothesis	Path Cof	T-Value	Remarks
H1	GP→SP	0.329	4.120	Supported

H2: Direct effect: *Green logistics positively influence sustainability performance at electronic industry of Thailand*

Positive and significant relationship has been depicted of hypothesis two as well, the relationship between Green logistics and sustainable performance at electronic firms of Thailand found to be influential and following green logistics to have impact on sustainable performance in highly turbulent and rapidly changing environment. The results in table 5 show the direct effect between construct of hypothesis 2. Path coefficient of relation is observed as 0.325 and t-value is observed as 3.008 and sig level of 0.01. The t-value of relationship found to be higher than the cutoff point 1.96; Therefore H2 supported.

Table 5: Direct effect H2

S#	Hypothesis	Path Cof	T-Value	Remarks
H2	GL→SP	0.325	3.008	Supported

H3: Direct effect: *Legislation development influence sustainable performance at electronic industry of Thailand*

Positive and significant relationship has been depicted of hypothesis three as well, the relationship between development of legislation for adoption of greening supply chain and sustainable performance at electronic firms of Thailand found to be influential and following rules and regulations for greening supply chain to have impact on sustainable performance in highly turbulent and rapidly changing environment. The results in table 6 show the direct effect between construct of hypothesis 3. Path coefficient of relation is observed as 0.311 and t-value is observed as 3.128 and sig level of 0.01. The t-value of relationship found

to be higher than the cutoff point 1.96; Therefore H3 supported.

Table 6: Direct effect H3

S#	Hypothesis	Path Cof	T-Value	Remarks
H3	LGSCM→SP	0.311	3.128	Supported

H4: Direct effect: *TQM directly influence the sustainable performance of electronic industry of Thailand*

The relationship between TQM practices and sustainable performance also found to be influential and significant. The implementation of TQM practices at electronic industry of Thailand influence better performance and sustain it among rapidly changing and competitive environment, where environmental damage has given significant importance. The results in table 7 show the direct effect between construct of hypothesis 4. Path coefficient of relation is observed as 0.303 and t-value is observed as 2.181 and sig level of 0.01. The t-value of relationship found to be higher than the cutoff point 1.96; Therefore H4 is also supported.

Table 7: Direct effect H4:

S#	Hypothesis	Path Cof	T-Value	Remarks
H4	TQM→SP	0.303	2.181	Supported

Moderating Effects:

H5: Moderator TQM: *TQM moderate relationship between Green purchasing and sustainable performance*

In table 8; moderation effect of TQM practices is shown; hypothesis 5; results shows t-value 0.423 found to be lower than cutoff point 1.96; which indicate that TQM practices doesn't moderate statistically significant between the relationship of Green purchasing and sustainable performance at electronic industry of Thailand. Thus, the result shows no credibility and rejected. Therefore, H5 is rejected. The moderating effect of TQM practices on the relationship of GP and SP found β value as ($\beta = 0.021$, $t = 0.423$, $p < 0.05$), hence H3 rejected.

Table 8; Moderation effect:

S#	Hypothesis	β	T-Value	Remarks
H5	GP*TQM→SP	0.022	0.421	Rejected

H6: Moderator TQM practices: *TQM moderate relationship between Green Logistics and sustainable performance*

In table 9; moderation effect of TQM practices at electronic firms of Thailand has shown; hypothesis 6; results shows t-value 4.083 found to be higher than cutoff point 1.96; which indicate that TQM practices moderate statistically significant between green logistics and sustainable performance. Therefore, H6 is accepted. The moderating effect of TQM practices on the relationship between GL & SP found β value as ($\beta = 0.422$, $t = 4.083$, $p < 0.05$), hence H6 accepted on statistical grounds.

Table 9; Moderating Effect:

S#	Hypothesis	β	T-Value	Remarks
H6	GL*TQM→SP	0.422	4.083	Accepted

H7: Moderator TQM practices: *TQM moderate relationship between legislation for greening and sustainable performance of electronic industry of Thailand.*

In table 10; moderation effect of TQM practices at electronic firms of Thailand has shown; hypothesis 7; results shows t-value 1.083 found to be lower than cutoff point 1.96; which indicate that TQM practices doesn't moderate statistically between green legislation and sustainable performance. Therefore, H7 is rejected. The moderating effect of TQM practices on the relationship between LGSCM & SP found β value as ($\beta = 0.422$, $t = 1.083$, $p < 0.05$), hence H7 is rejected on statistical grounds.

Table 10; Moderating Effect:

S#	Hypothesis	β	T-Value	Remarks
H7	LGSCM*TQM→SP	0.422	1.083	Rejected

5. Conclusion:

The study examined the impact of green supply chain management practices on sustainable performance at electronic industry of Thailand. The study considered green procurement, green logistics and legislation for greening supply chain. The impact of GSCM practices were investigated on the sustainable performance of firms in highly competitive environment. The results have shown that positive significant relationship found between green purchasing and sustainable performance, green logistics and legislation also found to be significant and positive relationship with sustainable performance, therefore, hypothesis H1, H2 and H3 are accepted. The moderating role of total quality management also examined between constructs of the study. The direct relationship between TQM practices and sustainable performance hypothesis H4 also accepted on statistical grounds.

The moderating role of TQM practices found to be insignificant and hypothesis 5 was rejected; as results depicted that green purchasing and sustainable performance was not moderated by TQM practices. On the other hand, moderating effect was found between green logistics, legislation for GSCM and sustainable performance, therefore, H6, H7 was accepted on statistical grounds. The results of the study found that firms in electronic industry of Thailand adopt green supply chain practices to enhance and maintain their performance. Conversely, firms may fail to recognize the importance of TQM practices for improvement in procurement to enhance performance at electronic industry of Thailand. There are still developmental issues at Thai manufacturing companies within context of green supply chain management.

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