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A structure equation model of total quality management and innovation capability affecting organisational performance

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Abstract

The relationship between total quality management (TQM) and innovation capability affecting organisational performance was examined. Empirical data were obtained from a survey of 437 automobile and auto parts industries and 462 electrical and electronic industries**.** Structural equation modelling (SEM) is used to analyse structural relationships between measured variables and latent construct variables. Findings suggested that TQM and innovation capability had a positive influence on organisational performance. Analysis of the structural equation model for TQM, innovation capability and organisational performance gave consistent results with empirical information. Results from our research showed that TQM had a positive effect on innovation capability and organisational performance. Findings indicated that criteria related with people management and supplier quality management had a stronger correlation with performance. Accordingly, organisations should provide the necessary quality-related training with rewards for superior quality improvement. Leaders should maintain close communication with suppliers concerning quality considerations and design changes.

Keywords: Total quality management, Innovation capability, Organizational performance, Structure equation model

1. Introduction

Nowadays, most organisations try to improve their products and serverice using various strategies to create competitive business advantage such as total quality management (TQM), green manufacturing and world class manufacturing [1,2]. TQM is an integrated management philosophy aimed at improving the effectiveness of business to customer (B2C) demands [3]. The automobile sector and electronic industry are two of the prime job creators in Thailand, involved in around 12.2% and 7.8% of Thailand's manufacturing Gross Domestic Product (GDP) respectively [4]. Thailand is the 13th largest automobile manufacturer in the world and was the largest automotive market in Southeast Asia in 2016. However, the Thai automobile sector and electronic industry have now realised the importance of quality management due to competition and regulations. Three problems affecting future growth are 1) Middle Income Trap, 2) Inequality Trap and 3) Imbalance Trap [5]. Innovation has become a key issue at various levels for firms, institutions and governments. This has motivated researchers to identify the various driving forces [6]. Innovation is a broad and multi-dimensional concept that refers to all scientific, technological, organisational and commercial activities which lead to the implementation of new technology or improved products or services [7]. The link between innovation and organisational performance has been well established in previous research. Evidence in the academic literature indicates a positive relationship between innovation and organisational performance in the manufacturing industry [8]. The need for quality and innovation in organisations has become vital for business excellence to strengthen their competitive advantage [9,10]. This has driven and motivated many researchers to conduct studies concerning the

relationship between TQM practices and innovation. The existing literature has provided fresh views and various approaches from different perspectives of the TQM practice-innovation relationship.

Many studies exist in the literature which measures the impacts of TQM practices on expected performance outcomes; however, scant empirical research has been carried out to determine the impacts of key TQM practices for implementing improvement and creating new innovation towards sustainability on expected organisational performance outcomes. Therefore, this research aimed to study the causal factors of TQM and innovation capability affecting organisational performance. The causal relationship structure and confirmatory factory analysis of TQM and innovation capability affecting organisational performance were analysed. The study was carried out on companies with ISO9001 or IAIF16949 certificates. Questionnaire surveys were given to quality managers working in 899 automobile and electronic companies in Thailand. Data from the survey were then analysed using a structural equation model software package. The next section describes the literature and hypotheses, followed by the findings, discussion and conclusions.

2. Materials and methods

2.1 Literature review and development of hypotheses

The research hypotheses are proposed based on the literature review and presented as follows.

2.1.1 The relationship between TQM and organisational performance

A literature review of the relationship between TQM and organisational performance found both supportive and consistent research. Most scholars confirmed that the factors of TQM were positively related to organisational performance [3,11-15]. On the other hand, some found no correlation between determining multiple factors [16,17]. All previous studies measured indicators at different times [11,17,18]. This research is an extension of Sirisan and Pianthong (2017) [19] who studied the relationship of TQM and organisational performance measured by three indicators as 1) business results, 2) product quality and 3) innovation performance. All indicators were measured simultaneously.

The relationship between TQM and organisational performance was found to be mainly positive; however, some studies of this relationship found a negative result [17]. The literature review of this relationship determined that no previous research had used three indicators as business results, product quality and innovation performance for simultaneous, empirical measurement. We also found that some research studies addressed the relationship between TQM and organisational performance in product quality and business results directly and studied the relationship between TQM and innovation performance directly [16,17,20]. Therefore, here, we developed hypothesis 1 as follows:

H_1: The critical success factors of TQM have positive direct and indirect influence on organisational performance.

2.1.2 The relationship between TQM and innovation capability

Scant previous literature was found detailing the relationship between TQM and innovation capability as all considered how TQM determines innovation capability indirectly [21-23]. Most results supported a positive relationship. In the manufacturing industry, previous study of this relationship was not very extensive and mostly focused on the roles expected to arise from this relationship to enhance the overall efficiency of the organisation and the ability to create new innovations as indirect measurements [24,25]. Therefore, the literature review of this relationship was considered as a guideline and an important aspect of studying the relationship between total quality management and innovative capabilities that impact on organisational performance. Both direct and indirect relationships were estimated as a single analysis. In this study, three types of innovation capability is an extension of Sirisan and Pianthong (2017) [19] as 1) process innovation capability, 2) product innovation capability and 3) administrative innovation capability. Hence, from all the studies mentioned above we developed a hypothesis of the relationship between TQM and innovation capability as follows:

H_2: The critical success factors of TQM have positive direct influence on innovation capability.

2.1.3 The relationship between innovation capability and organisational performance

A literature review of the relationship between innovation capability and organisational performance in the manufacturing industry found that innovation capability was positively correlated with organisational performance [3,26,27]. However, scant evidence exists of extensive empirical study on the relationship between

innovation capability as three types of process innovation capability, product innovation capability and administrative innovation capability on organisational performance by measuring business results and product quality. The structural relationship between the latent constructs was estimated from a single calculation using an SEM approach. Most previous research supported a positive correlation of the relationship between innovation capability and organisational performance support [28-32]. However, some results were negative and found no statistically significant relationship between the ability of innovation in the form of observable variables as well as a good positive relationship with statistically significant significance [33]. Therefore, the study of this relationship gave both positive and negative results with no significant correlation between the variables. This may indicate the possibility that other more complex factors are interrelated because nowadays, innovation has become an important part of company survival. Long-term innovative capabilities can be considered as a good intermediary that can help to promote an effective relationship between management]34[. If the organisation or business has the ability to innovate, effective processes will result in the development of products that respond to the needs of consumers faster and create competitive advantage in the market [34-37], while maintaining the ability to compete in the market continuously [24]. Thus, we developed a hypothesis of the relationship as follows:

H_3: Innovation capability has positive direct influence on organisational performance.

2.2 Research framework

This research framework is an extension of Sirisan and Pianthong (2017) [19] and developed to simultaneously examine the relationship between the important factors of TQM and innovation capability impacting on organisational performance. The framework is presented in Figure 1.

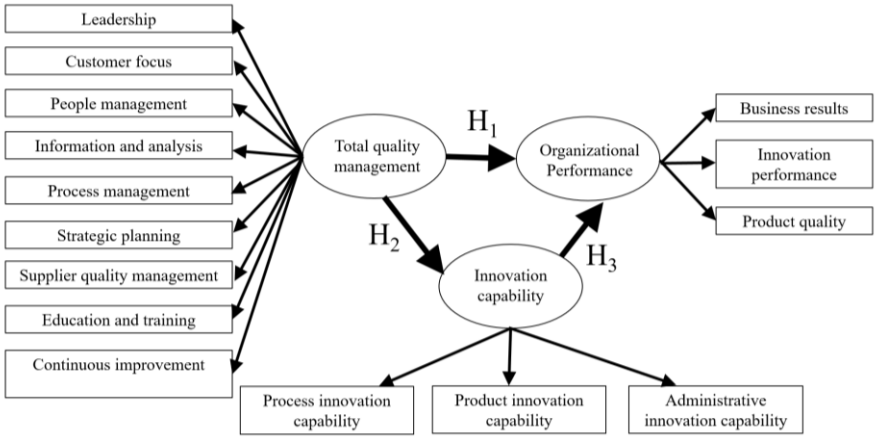

Figure 1 Research framework.

2.3 Methodology

The research methodology is shown in Figure 2.

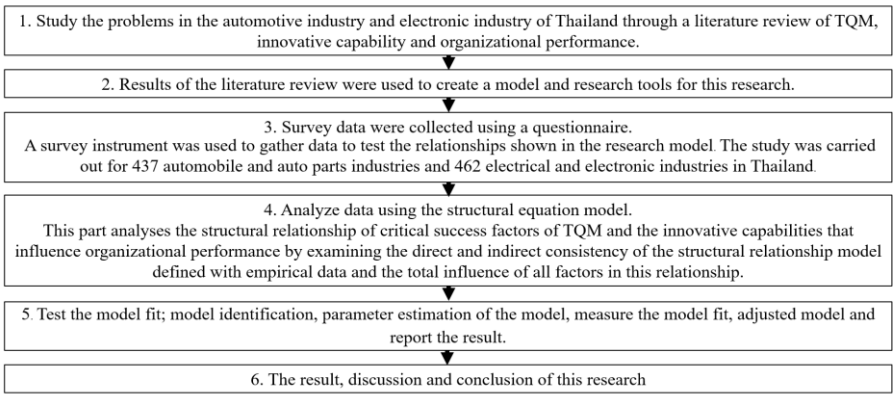

Figure 2 Research methodology.

3. Results

This chapter presents the results as four major parts. The latent construct variables are presented in section 3.1 while general information of the questionnaire is explained in section 3.2 Reliability and validity of the data are examined in section 3.3 with hypothesis testing in section 3.4

3.1 The latent construct variables

The instrument developed in this study consisted of three major parts is an extension of Sarinya and Nalin (2017) [19]. The first part comprised nine critical success factors of TQM as leadership, customer focus, people management, information and analysis, process management, strategic planning, supplier quality management, education and training and continuous improvement. The second part comprised three types of innovation capability as product innovation capability, process innovation capability and administrative innovation capability, while the third part comprised three different measurement indicators of organisational performance as business results, innovation performance and product quality.

3.2 General information of the questionnaire

The instrument used was a seven-point Likert scale representing a range of attitudes from strongly disagree to strongly agree. Empirical data were collected through a random survey of 437 automobile and auto parts industries and 462 electrical and electronic industries**.** Results showed that most respondents were male at 89.8% and aged between 21 and 30 years at 48.7%. Most were heads of department at 69.1% and 83.5% had a bachelor degree. The representative samples consisted of 48.6% from the automobile and auto parts industries and 51.4% from the electrical appliances and electronics industries. The organisations were mostly international (94.4%) with their Head Offices in Asia (83.9%). All had a Certificate of Quality Management as ISO9001, 50.7% were IATF16949 standard, 18.7% used the entire quality management system (TQM) and 90.5% had used quality management for the past 8 years.

3.3 Reliability and validity of the data

Data were first analysed to ensure instrument quality by convergent and discriminant validity. By applying SPSS, confirmatory factory analysis (CFA) was conducted to measure the underlying dimensions associated with 36 items of nine TQM factors. Construct validity was measured using Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of the sampling adequacy of individual variables. KMO overall should be 0.6 or over to perform factor analysis [38]. The results of Bartlett's test of sphericity and KMO revealed that both were significant and suitable for factor analysis (Table 1).

Table 1 KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.871
Bartlett's test of Sphericity	Approx. Chi-Square	3056.382
	df	36
	Sig.	0.000

Bartlett's test of sphericity indicated sufficient correlation between the variables at 3,0 56.382 with significance ($p > 0.000$). Factor loading of all items of each scale exceeded 0.5 [38]. All the factors were loaded at above 0.6 (Table 3); thus, these values constituted evidence of convergent validity. Data analysis demonstrated that measurements possessed an acceptable convergent validity. The composite reliability of the measurements must reach 0.6 or above [39]. Results indicated that all the latent construct variables ranged from 0.73 to 0.911 as reaching or above the standard.

The reliability coefficient was also tested using Cronbach's alpha (α) to measure the reliability for the set of five constructs. According to the Cronbach's alpha test by, the total scales of reliability varied from 0.737 to 0.835 (Table 2) which exceeded the threshold value of 0.7 suggested by Nunnally (1978) [40]. A value of 0.7 or greater indicates a good scale of reliability [41]. The Cronbach's alpha of fifteen factors ranged from 0.737 to 0.835 which indicated that they were all reliable.

Table 2 Factor loading and reliability analysis.

Scale	Item	Factors loading	Cronbach's α	AVE	CR
TQM	Leadership	0.929	0.835	0.630	0.911
	Customer focus	0.945	0.737		
	People management	0.945	0.793		
	Information and analysis	0.895	0.781		
	Process management	0.885	0.759		
	Strategic planning	0.901	0.796		
	Supplier quality management	0.911	0.755		
	Education and training	0.906	0.740		
	Continuous improvement	0.938	0.780		
Innovation capability	Process innovation capability	0.888	0.786	0.602	0.729
	Product innovation capability	0.908	0.748		
	Administrative innovation capability	0.904	0.782		
Organisational performance	Business results	0.907	0.797	0.691	0.731
	Innovation performance	0.890	0.760		
	Product quality	0.900	0.828		

Moreover, convergent and discriminant validities were measured using the average variance extracted. According to Bagozzi et al. (1991) [38], the basic test criterion on each value of average variance extracted should exceed 0.5. The average variances ranged from 0.602 to 0.691 and exceeded the threshold of 0.5 [38], indicating that the study had adequate levels of convergent and discriminant validity (Table 2).

3.4 Hypothesis testing

The SEM model was employed to examine the relationship between the developed constructs. SEM analysis was performed by AMOS 22 version simultaneously and supported goodness-of-fit indices. For the whole model, statistical results showed that Chi-square (χ^2)/df = 3.151, CFI = 0.984, GFI = 0.980, AGFI = 0.945, RMSEA = 0.049 and SRMR = 0.018 (Table 3). Hu and Bentler (1999) [42] mentioned that RMSEA, CFI and GFI are necessary to value the model fit. According to the study, we hypothesised three paths including three hypotheses.

Table 3 Model fit.

Goodness of fit indices	Criteria	Construct	Result
χ^2/degree of freedom	< 5.00 [43]	3.151	pass
CFI (comparative fit index)	≥ 0.95 [44]	0.984	pass
GFI (goodness fit index)	≥ 0.95 [44]	0.980	pass
AGFI (adjusted goodness of fit index)	≥ 0.90 [44]	0.945	pass
RMSEA (root mean square error of approximation)	< 0.05 [44]	0.049	pass
SRMR (standardized root mean square residual)	< 0.05 [44]	0.018	pass

SEM analysis investigated the impact of TQM, innovation capability and organisational performance. Results exhibited that all the paths were significant ($p < 0.01$). The SEM model divulged that TQM directly, indirectly and positively affected organisational performance. In addition, TQM directly and positively affected innovation capability. All paths were significant at $p < 0.01$. The nine factors of TQM both directly and indirectly impacted on the three indicators of organisational performance in the automobile and auto parts industries and electrical and electronic industries. Statistical findings revealed that TQM had a positive effect on innovation capability and organisational performance. TQM also had an indirect influence on organisational performance. Therefore, hypotheses (H_1) and (H_2) were accepted at 0.01 statistical significance. The correlation coefficients among TQM and organisational performance were 0.46, 0.78 and 0.26 ($p < 0.01$). In addition, results showed that innovation capability had a positive direct influence on organisational performance at 0.01 statistical significance with correlation coefficient of 0.44 ($p < 0.01$). Hence hypothesis H_3 was accepted (Table 4).

Table 4 Standard estimation of the main model.

Path	D.E.	I.E.	T.E.
T→N	0.46	-	0.46
T→P	0.78	-	0.78
N→P	0.44	-	0.44
T→N→P	0.78	0.26	0.20

T=Total quality management, N=Innovation capability, P=Organisational performance, D.E.=Direct Effect, I.E.=Indirect Effect, T.E.=Total Effect

4. Discussion

Research findings supported the claim that total quality management in the automobile and auto parts industry and electrical and electronic industry in Thailand had positive effects and strongly impacted on organisational performance. TQM also had indirect influence on organisational performance concurring with Leavengood (2011), Feng et al. (2006) and Prajogo and Sohal (2006) [18,27,45] who found that acceptance and implementation of quality TQM factors led the organisation to improve efficiency. Important factors such as customer focus based on TQM principles enabled the organisation to know the real needs of customers; thus, enabling management to address the needs of clients together with the comparison of competitors to determine future strategy and vision. Implementation of strategic plans of every department within the organisation created a competitive advantage over other companies. Thus, hypothesis H_1 was supported. Total quality management had a strong and significant impact on business results, product quality, and innovation performance. Additionally, factors of TQM in the implementation of the organisation and focus on human resources did not show a direct relationship with the performance of innovation. On the other hand, both factors were positively related to each other when measured indirectly, with the ability to innovate as a passing aid. This study supported the claim that total quality management in the automobile and auto parts industry and electrical and electronic industry in Thailand had positive effects and strongly impacted on innovation capability. From the results of this study, therefore, prioritising the importance of factors is consistent with empirical data. Quality management elements throughout the organisation are important for organisational development resulting in innovative capabilities of an efficient organisation. Yusr (2016); Perdomo-Ortiz et al. (2006); Prajogo and Sohal (2006a); Kim, Kumar, and Kumar (2012) [18,24,25,46] stated that factors of TQM positively correlated with ability. Innovative way with this relationship being implemented or used in different industries. Moreover, quality management throughout the organisation can also help to increase creativity for employees to develop new innovations into the market, leading to continued business expansion. Therefore, considering each aspect according to the priority of the observed variables of quality management throughout the organisation that affect innovation ability, hypothesis H_2 was supported.

Another important result was that innovation capability had a positive direct influence and significant impact on organisational performance. This finding concurred with Camisón and Villar-López (2014) [34] and confirmed that all three innovative capabilities were highly correlated with organisational performance in business results. Results were also consistent with Muhamad, Ebrahim and Hami (2014); Alam et al. (2013); Jiménez-Jiménez and Sanz-Valle (2011) [30-32] who concluded that organisations with effective management innovation capabilities were able to support process and product innovation to develop superior performance than competitors. Effective management innovation also improved production levels, responded to the needs of the market faster and helped to develop production process efficiency to create sustainable competitive advantage. Manual (2005) and Gunday et al. (2011) [33,47] concluded that if an organisation or business has innovative capabilities then good management, ability, innovation and effective processes will result in innovative product capabilities that can develop products in a short time or respond to new products and satisfy are the needs of consumers and competitors. As a result, the organisation can successfully overcome and create competitive advantage in the market. Rajapathirana and Hui (2017); Karabulut (2015); Camisón and Villar-López (2014); Muhamad, Ebrahim and Hami (2014); Alam et al. (2013); Gunday et al. (2011); Jiménez-Jiménez and Sanz-Valle (2011); Martínez-Costa and Martínez-Lorente (2008) [28-34,48] conducted research on the influence of the components of innovation ability on the performance of the organisation. They concluded that the components of innovation ability were intermediate variables and indirectly affected the performance of the organisation. Thus, hypothesis H_3 was supported.

In addition, the analysis of structural equation model and TQM, innovation capability and organizational performance gave consistent result with empirical information. The chi-square (χ^2) value is equal to 135.504 at the degree of freedom of 43, the relative or norm chi-square (χ^2/df) is equal to 3.151, the comparative fit index (CFI) is that of 0.984, the goodness of fit index (GFI) is equal to 0.980, the adjusted goodness of fit index (AGFI) is equal to 0.945, the root mean square error of approximation (RMSEA) is equal to 0.049 and the standardized root mean square residual (SRMR) is equal to 0.018. The results from this research show that TQM have positive effects to the innovation capabilities and organizational performance. TQM also have indirect influence on organizational performance at 0.01 statistically significance. The correlation coefficients among TQM innovation capability and organizational performance are 0.46, 0.78, and 0.26 ($p < 0.01$) respectively. The innovation capability has positive direct influence on organizational performance at 0.01 statistically significance. The correlation coefficients are 0.44 ($p < 0.01$).

5. Conclusion

Research on structure equation model of total quality management and innovation capability affecting organization performance in the automotive industry and automotive parts production and the electrical and electronic industry of Thailand. The objectives of this research are 1) to study the causal factors of total quality

management and innovation capability effecting organizational performance 2) to study the relationship between the important factors of TQM and Innovation capability 3) to analyze the causal relationship structure and confirmatory factory analysis of TQM and innovation capability effecting organizational performance.

The population and the sample group used in this study are corporate executives or managing directors, production managers or QA department managers, planning and development managers and the head of the department. Including 1) 437 automotive and auto parts industries in Thailand, and 2) 462 electrical and electronic industries in Thailand, using Proportion Stratified Sampling method. The questionnaire has been completed and used for data analysis total of 899 sets.

Data analysis and testing of hypothesis of research using statistical program AMOS 22 version. The data obtained from the complete questionnaire to analyze the frequency, percentage, mean, standard deviation and test the hypothesis with the Measurement Model and Structural Equation Model.

The Structural Equation Model from this study found that the total quality management factors have direct and indirect relationships with innovation capability factors to organisational performance. Hence, further study should include other factors for instance; Market orientation, Quality system, Transformational leadership, Sustainability management process of technology in organizational, etc. in order to develop and enhance the success of the organisational performance with high efficiency.

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